

Using Technology to Improve Nutrient Management and Water Quality



Terry Wyciskalla
CPAg, CCA-IL, 4R NMS
Wyciskalla Consulting, LLC

Soybean Summit
February 5, 2019
Springfield, Illinois



ILLINOIS
NUTRIENT LOSS
REDUCTION STRATEGY

2025 Interim Goal:

Reduce Nitrate 15%

Reduce Phosphorus 25%

2035 Final Goal:

Reduce Nitrate 45%

Reduce Phosphorus 45%

Everyone Needs to Make Some Changes or



Illinois NLRs Practices

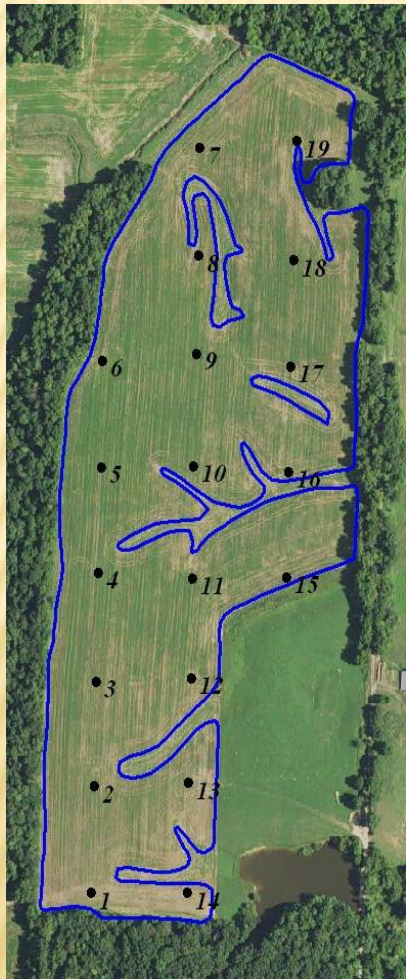
In-field N management In-field cropping management Edge-of-field

	Reducing N application rate to MRTN	Shifting N application timing (move fall to spring)	Use of N Inhibitor	Cover crops	Perennial energy crops	Woodchip Bioreactors	Constructed Wetlands
Percent N reduction	10%	15-20%	10%	30%	90%	25%	40%
Millions of lbs of N removed per year	2.3*	26	4.3	84	25*	25*	49*

* Applied on only a portion of tile-drained acres



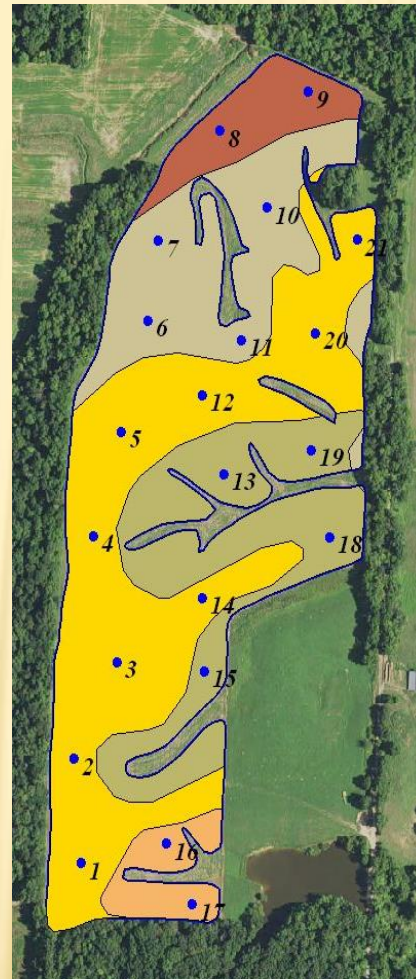
Approaches to Soil Sampling



**Standard Grid,
Software Driven**



**Standard Grid,
Software Driven,
With Soil Types**



**Modified Grid,
With Soil Types**



**Zone Management,
With Soil Types**

Soil Sampling Equipment



Grain P and K: summary to date

Nutrient	No. of samples	Average value	Range		Book value	% change BV to 75th%	Iowa State numbers
			25th	-75th%			
-----lb P/K (oxide) per bushel-----							
Corn P	2,140	0.34	0.31	-0.37	0.43	-14	0.32
Corn K	2,140	0.23	0.22	-0.24	0.28	-15	0.22
Soy P	2,181	0.70	0.66	-0.75	0.85	-12	0.72
Soy K	2,181	1.11	1.06	-1.17	1.30	-10	1.20
Wheat P	625	0.42	0.36	-0.47	0.60	-22	0.55
Wheat K	625	0.26	0.23	-0.28	0.30	-8	0.27



Maintenance P and K for Corn

Corn Yield (bu/acre)	lbs/acre DAP to Apply	lbs/acre Potash to Apply
120	112 (97)	56 (48)
140	131 (113)	65 (56)
160	150 (129)	75 (64)
180	168 (145)	84 (72)
200	187 (161)	93 (80)

Assumes 0.43 lbs/bu P₂O₅ and 0.28 lbs/bu K₂O

Assumes 0.37 lbs/bu P₂O₅ and 0.24 lbs/bu K₂O

(15-25 lbs/ac decrease P)
(8-13 lbs/ac decrease K)



Adapted from the Illinois Agronomy Handbook

Maintenance P and K for Soybean

Soybean Yield (bu/acre)	lbs/acre DAP to Apply	lbs/acre Potash to Apply
30	55 (49)	65 (59)
40	74 (65)	87 (78)
50	92 (82)	108 (98)
60	111 (98)	130 (117)
70	129 (114)	152 (137)

Assumes 0.85 lbs/bu P₂O₅ and 1.30 lbs/bu K₂O

Assumes 0.75 lbs/bu P₂O₅ and 1.17 lbs/bu K₂O

(6-15 lbs/ac decrease P)

(6-15 lbs/ac decrease K)



Adapted from the Illinois Agronomy Handbook

Maintenance P and K for Wheat

Wheat Yield (bu/acre)	lbs/acre DAP to Apply	lbs/acre Potash to Apply
60	117 (61)	30 (28)
70	137 (72)	35 (33)
80	157 (82)	40 (37)
90	176 (92)	45 (42)
100	197 (102)	50 (47)

Assumes 0.90 lbs/bu P₂O₅ and 0.30 lbs/bu K₂O

Assumes 0.47 lbs/bu P₂O₅ and 0.28 lbs/bu K₂O

(55-95 lbs/ac decrease P)
(2-3 lbs/ac decrease K)

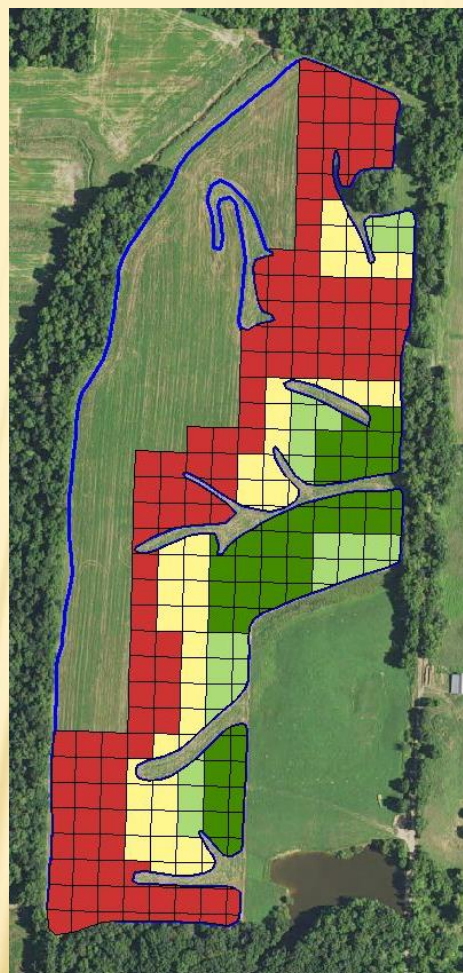


Adapted from the Illinois Agronomy Handbook

Variable Rate Lime and Fertilizer



**Variable Rate,
Limestone**



**Variable Rate,
DAP**



**Variable Rate,
Potash**

Potassium Deficiency and Technology



Irregular Spreader Application



Irregular Manure Application

Sulfur is a Secondary Nutrient

**But is it our next
Macronutrient?**

Decreased Atmospheric S Deposition

Figure 4. 1990 Annual Wet Sulphate Deposition

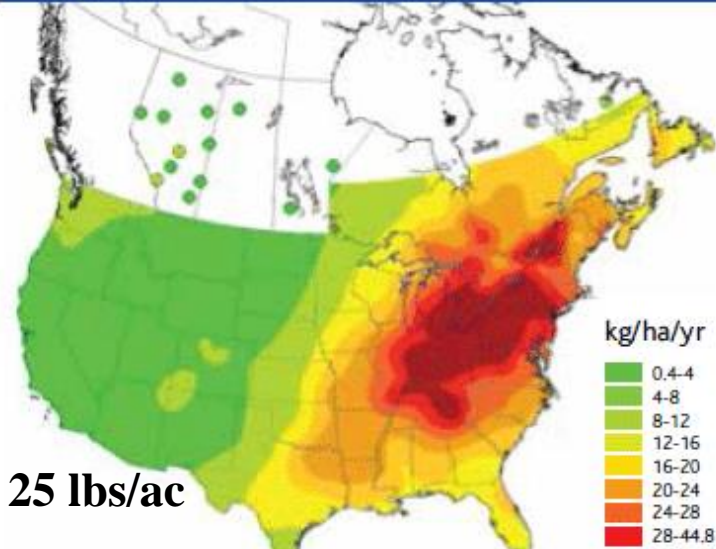


Figure 5. 2000 Annual Wet Sulphate Deposition

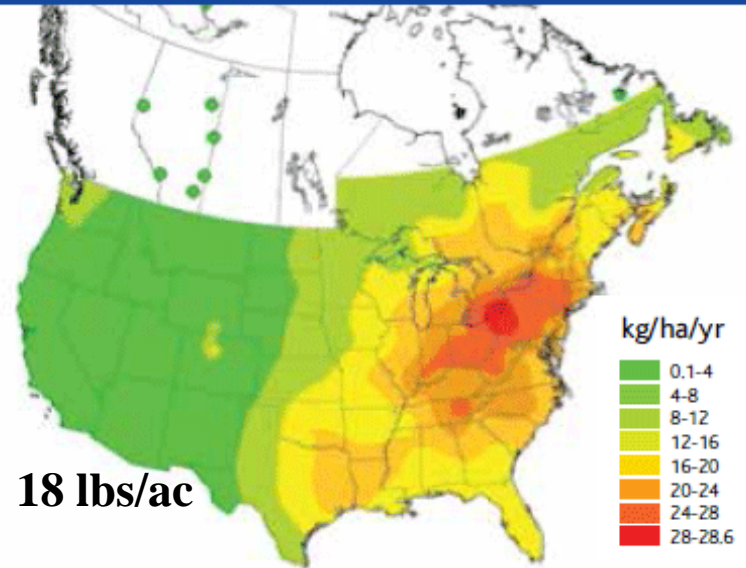
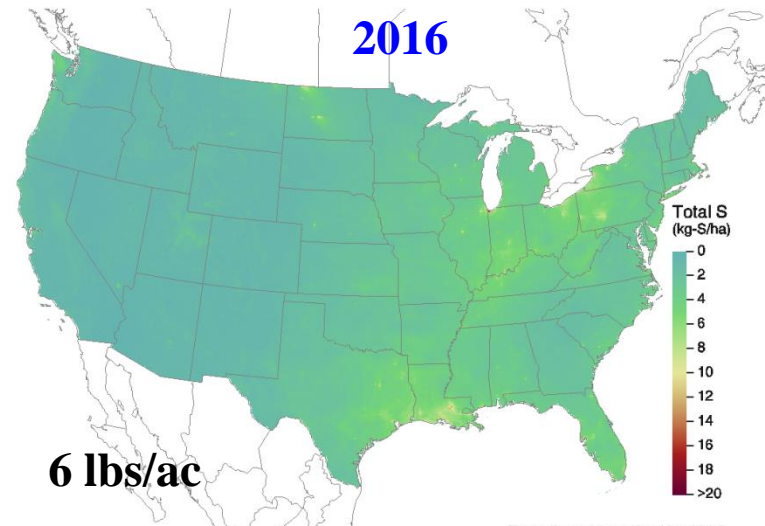
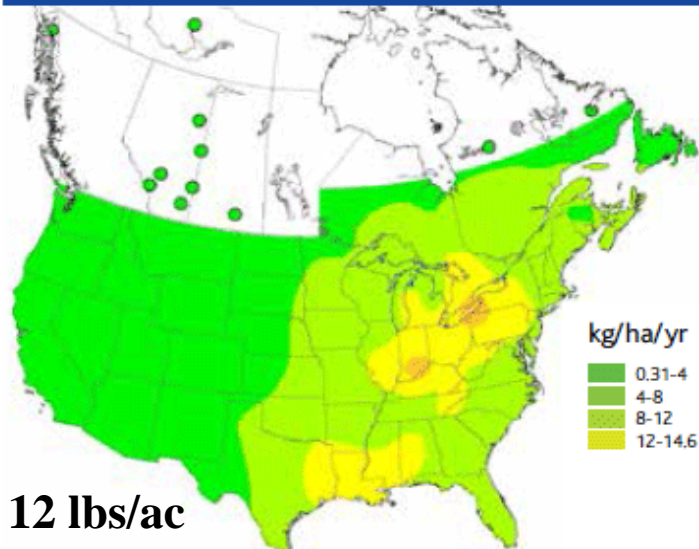


Figure 6. 2012 Annual Wet Sulphate Deposition

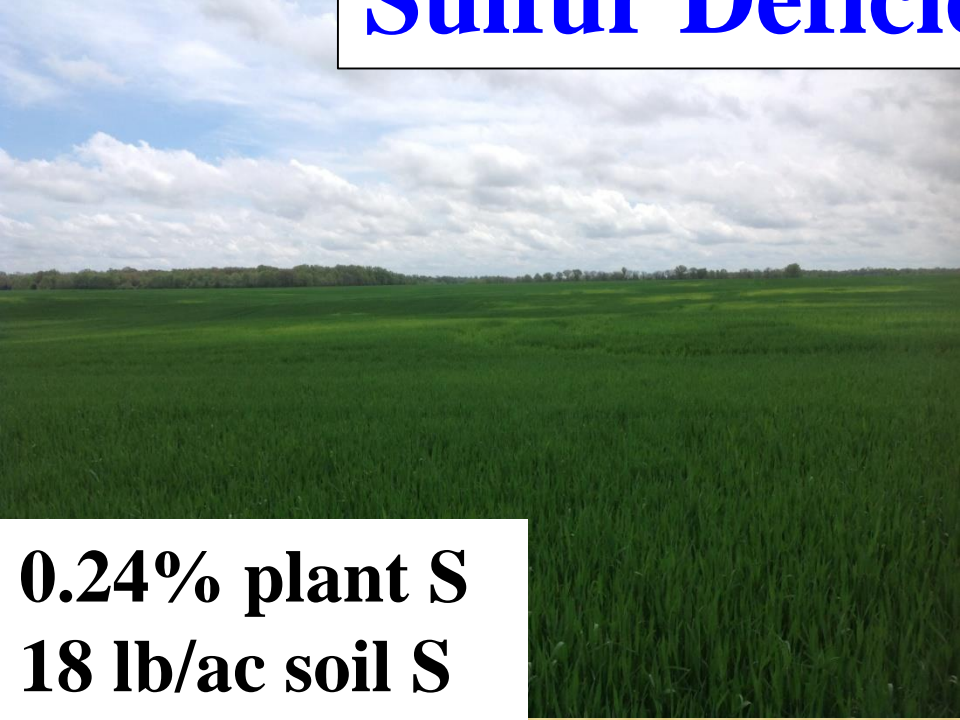


Source: CASTNET/CMAQ/NADP

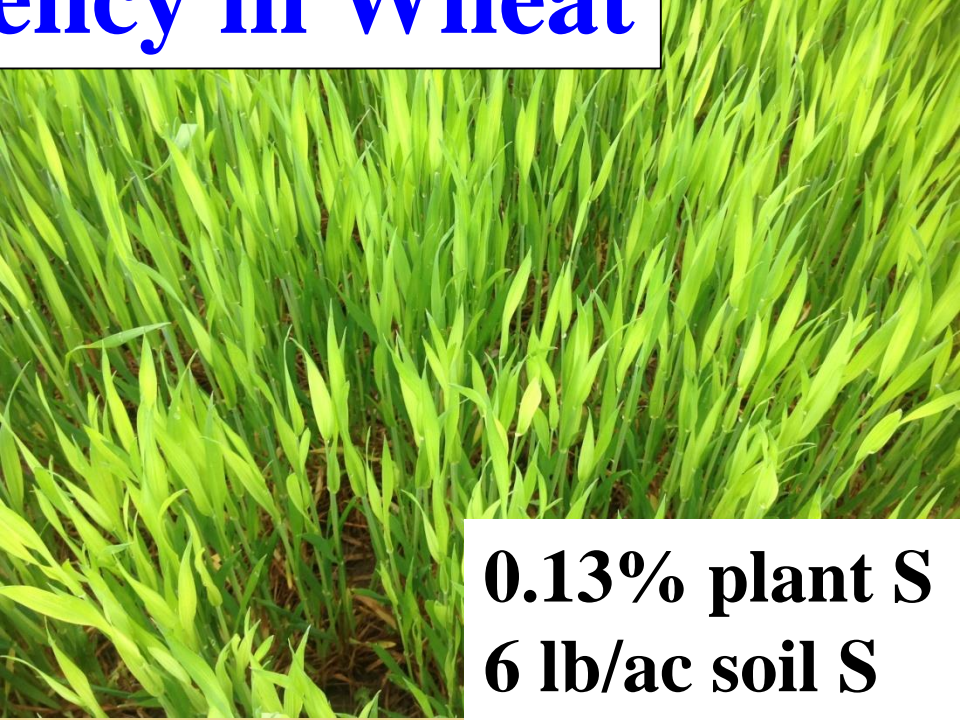
Total deposition of sulfur 2016
USEPA 03/06/18



Sulfur Deficiency in Wheat



0.24% plant S
18 lb/ac soil S



0.13% plant S
6 lb/ac soil S

Disclaimer:

**Products and Technologies mentioned
does not imply an endorsement by
Wyciskalla Consulting, LLC**

**Crop and Soil Sensors
Remote Sensing and Drones
Planter Data
and APPS**

Later-Season N Management



Crop Reflectance Sensors for N Management



Soil Sensors



THE SOIL

THE SENSORS

THE SOLUTIONS

MORE...



MSP3

U-Series

iScan

MSP

OpticMapper

V3150

V3100

Q2800

Q1000

P4000

EC Data

Source: <http://www.veristech.com/>

Soil Sensors



THE SOIL

THE SENSORS

THE SOLUTIONS

MORE...



MSP3

U-Series

iScan

MSP

OpticMapper

V3150

V3100

Q2800

Q1000

P4000

EC Data

Source: <http://www.veristech.com/>

Soil Sensors



THE SOIL

THE SENSORS

THE SOLUTIONS

MORE...



MSP3

U-Series

iScan

MSP

OpticMapper

V3150

V3100

Q2800

Q1000

P4000

EC, OM, pH Data

Source: <http://www.veristech.com/>

Soil Sensors - Software



The screenshot displays the Veris FieldFusion software interface. At the top left is the Veris technologies logo. The navigation menu includes 'THE SOIL', 'THE SENSORS', 'THE SOLUTIONS', and 'MORE...'. The 'THE SOLUTIONS' menu is expanded to show 'FieldFusion™', 'Seed', 'Nutrients', 'Amendments', 'Weeds, Insects, Disease', and 'Water'. A 'LOGIN' button is located in the bottom right corner. The main content area features an aerial view of a farm field with a color-coded map overlay, where different colors represent various soil sensor data points.

Source: <http://www.veristech.com/>

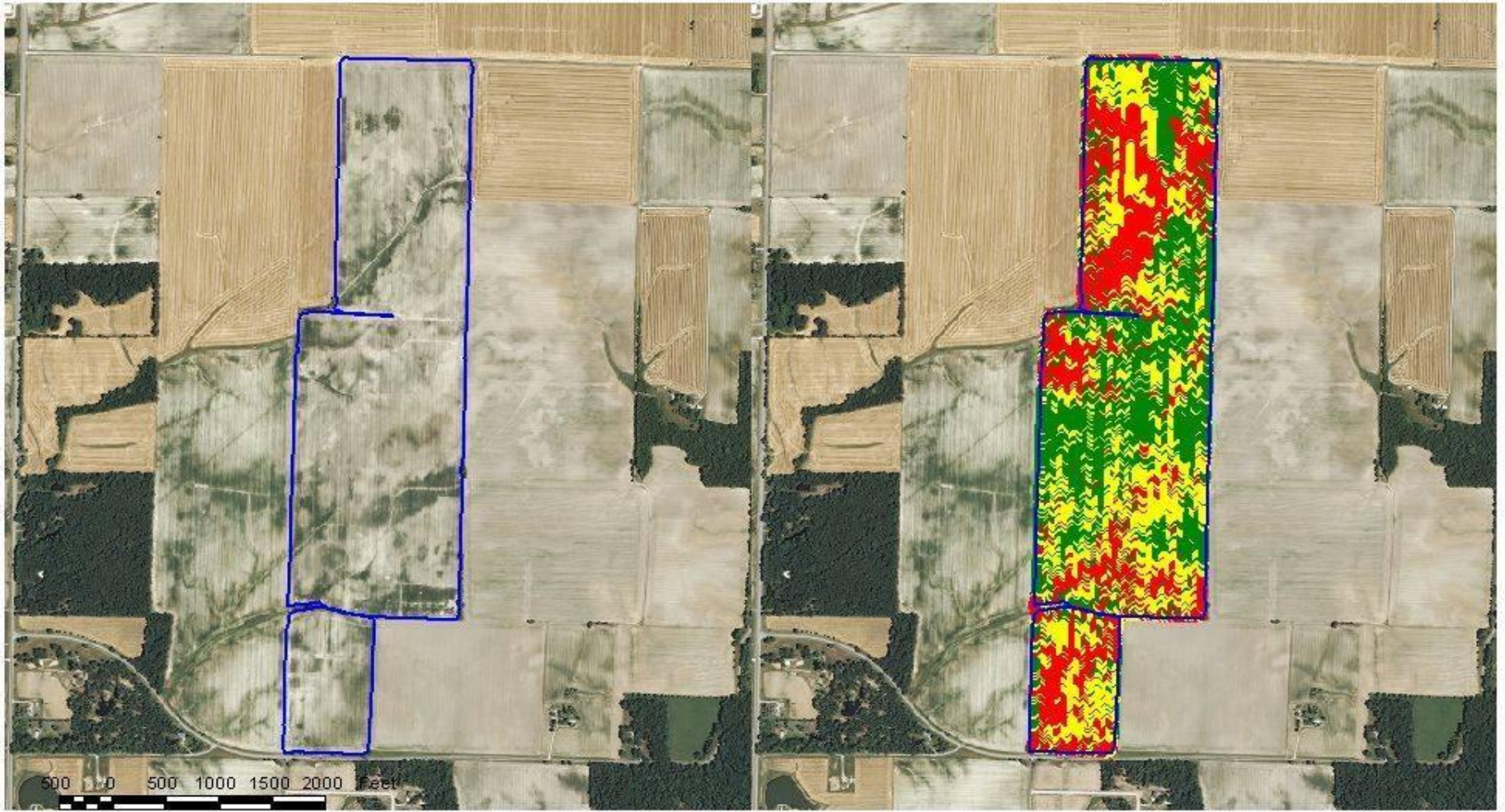


**Side View of the Veris Quad 1000
Soil Conductivity Sensor**

**Rear View of the Veris Quad 1000
Soil Conductivity Sensor**



Long Field; 12 (198.78 ac.)



□ (198.8ac) Field Boundary

□ (198.8ac) Field Boundary
Copy of Veris 063014
● ≤26
● 26 - 41
● 41 - 500



Gypsum (High EC Equation Gypsum (lbs))

- 0000 - 0 (0.0 ac.)
- 0000 - 0000 (198.78 ac.)
- 0000 - 0000 (198.78 ac.)
- 0000 - 0000 (198.78 ac.)
- 0000 - 0000 (198.78 ac.)

Equation Used: High EC Equation Gypsum (lbs)

Date: Aug 10, 2014
 Field Name: Long Field; 12
 Farm Name: Habbe Farms
 Client Name: RH Habbe
 Location: Jefferson Co., Perry Co., Washington Co., Illinois, U.S.
 Section 6, T3 S, R2 W
 Section 7, T3 S, R2 W
 Total Acres: 198.78
 Field Boundary Start Location:
 Latitude: 38.29878146
 Longitude: -89.37004663

Application Estimates:

Product:	Gypsum
Min. Rate:	1000.0 Lbs/Ac.
Max. Rate:	6000.0 Lbs/Ac.
Avg. Rate:	2251.4 Lbs/Ac.
Total Gypsum:	224.12 Tons
Product Price per ton:	\$7.00
Product Cost:	\$1568.84
Number of Acres to be Applied:	198.78 Acres
Per Acre Application Charge:	\$5.00
Anticipated Application Charge:	\$993.90
Total Cost:	\$2562.74
Cost per Applied Acre:	\$12.89
Total Acre Cost:	\$12.89

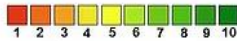
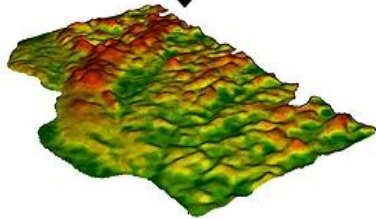


Variable Rate Prescription Map for By-Product Gypsum Application

SWAT MAPS

SOIL, WATER AND TOPOGRAPHY MAPS

What are SWAT MAPS?



SWAT Zone Map

LEARN MORE

View the Price Lists

For Farmers

For Consultants

For Retailers

What is a SWAT BOX?

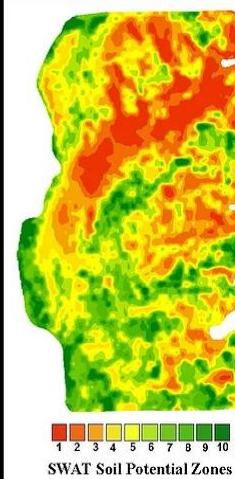
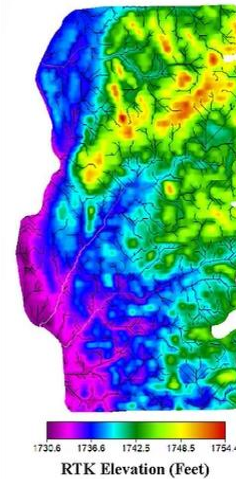
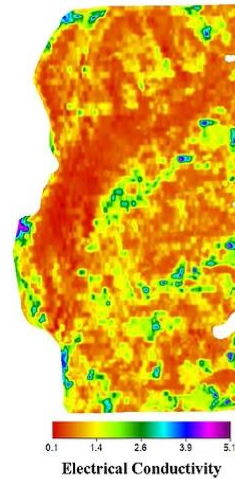


LEARN MORE

SOIL ELECTRICAL
CONDUCTIVITY
+
WATER FLOW
+
TOPOGRAPHY LAYERS
=

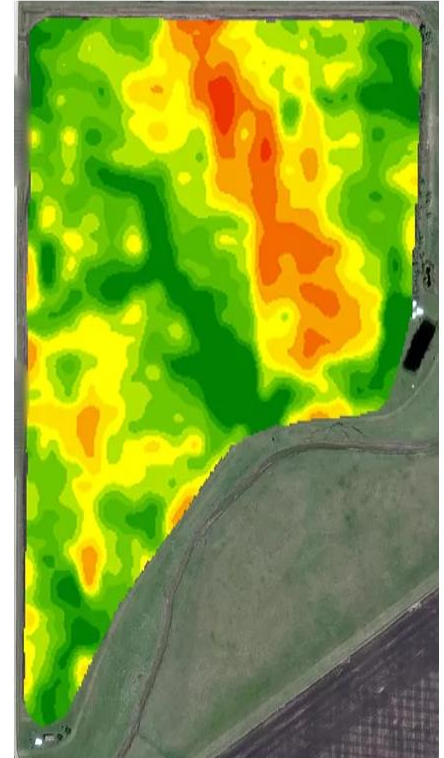
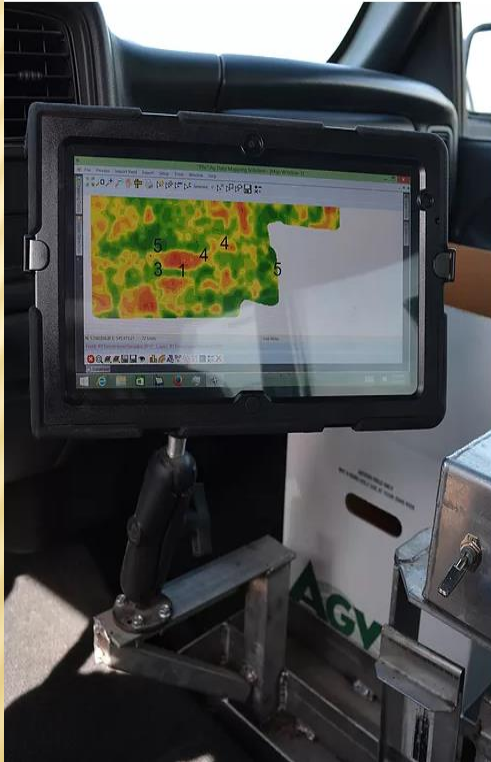
SWAT MAPS

Soil, Water And Topography MAPS



SWAT MAPS

SOIL, WATER AND TOPOGRAPHY MAPS



SWAT MAPS

SOIL, WATER AND TOPOGRAPHY MAPS



Source: <https://www.swatmaps.com/>

SWAT MAPS

SOIL, WATER AND TOPOGRAPHY MAPS



Source: <https://www.swatmaps.com/>

SWAT MAPS

SOIL, WATER AND TOPOGRAPHY MAPS



Source: <https://www.swatmaps.com/>

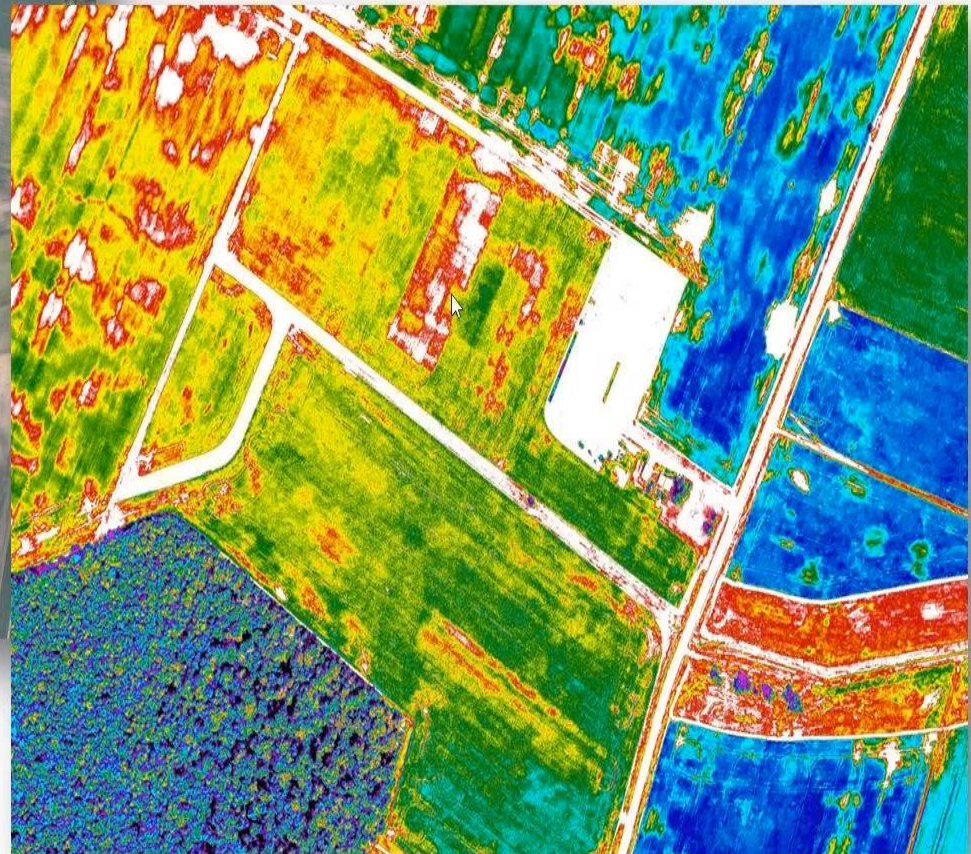


Remote Sensing Imagery



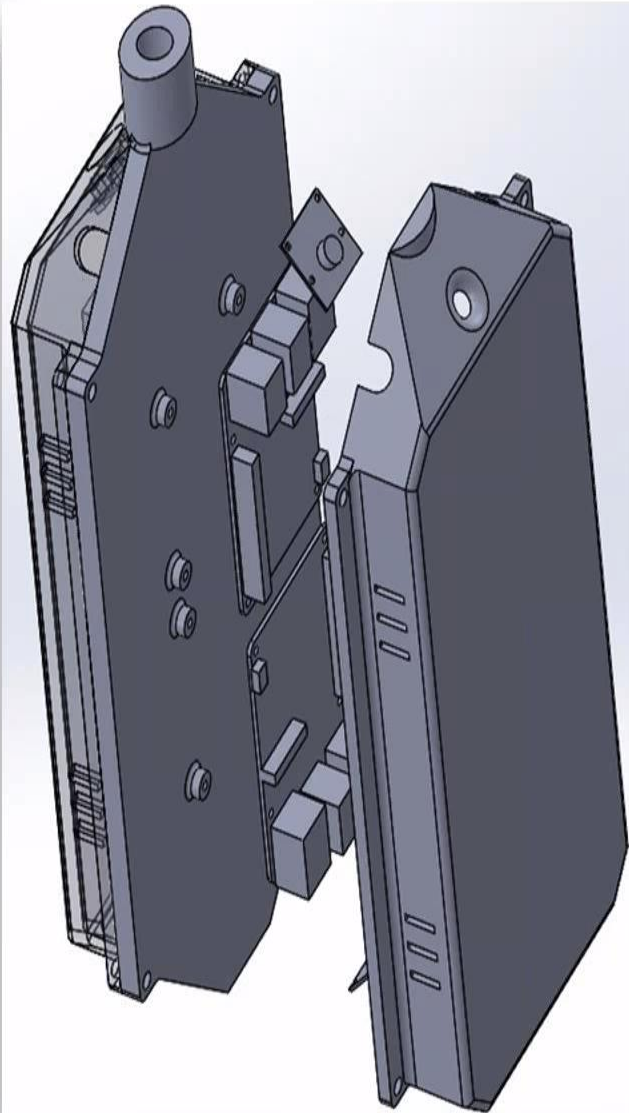
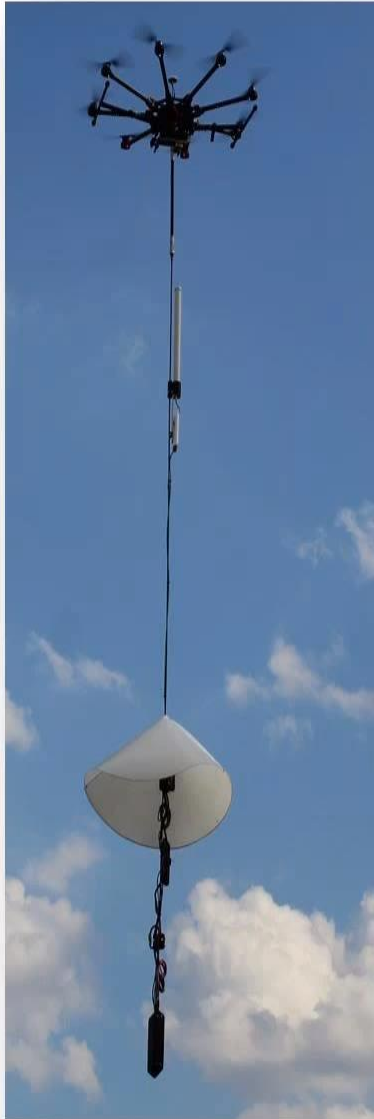
RGB Image

Red Edge Image



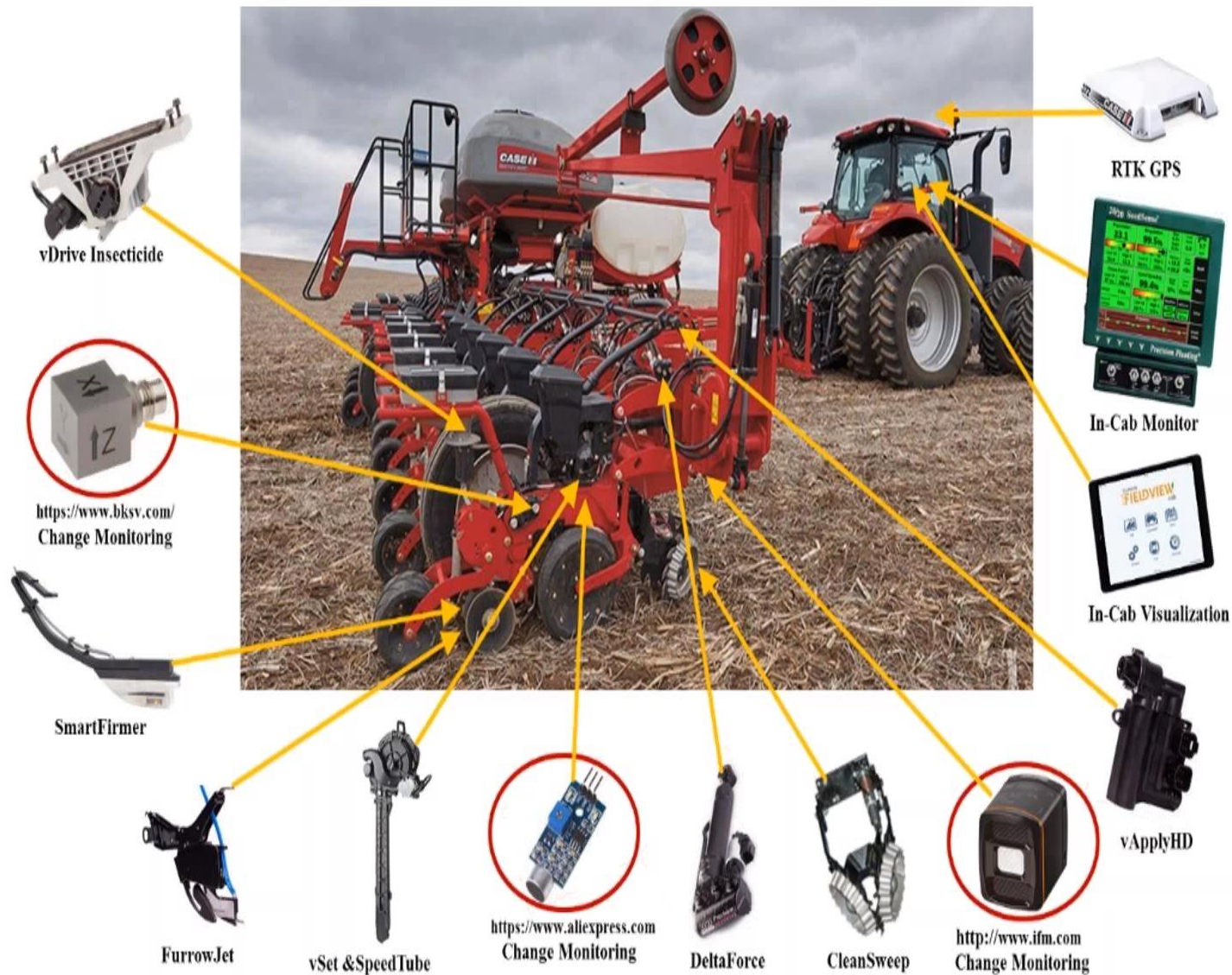
Wavelength between Red and NIR

Within Canopy Crop Stress Sensing





IoT and Sensors in Agriculture



Downforce Control



20|20

DeltaForce



Get Downforce Correct On Every Foot
Of Every Row



20|20

SeederForce



Automated Seeder DownForce Control



20|20

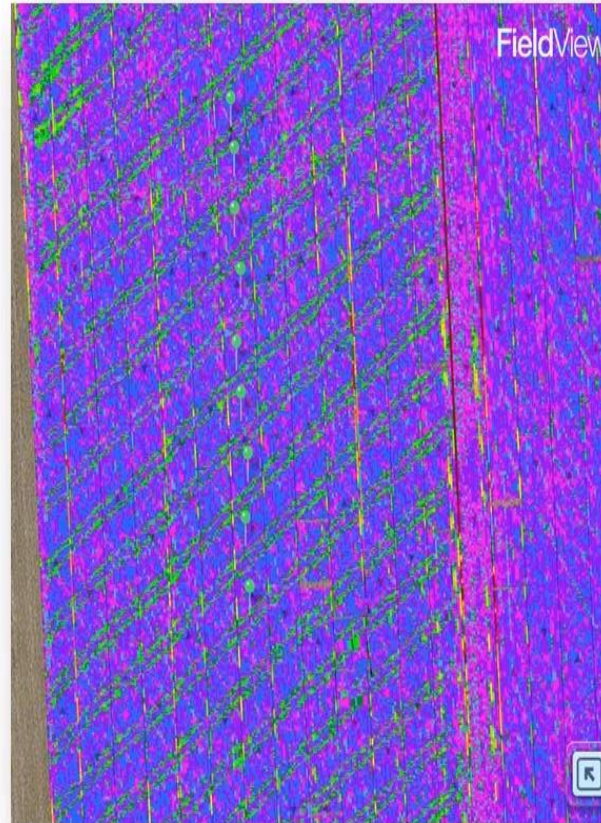
AirForce



Planter Wide Automated DownForce
Control



- As-Applied Files (.shp)
 - Spraying [0.3 MB/ac]
 - NH₃ application [4.3 MB/ac]
 - Planting [5.5 MB/ac]
- Yield Data [4.3 MB/ac]
- Prescription Files [0.01 MB/ac]
- Soil/Fertility Data [0.6 MB/ac]
- **Total [0.5 KB/plant (corn)]**
- If 35,000 plants/acre (corn)
 - 17.5 MB/acre
 - 42.7 GB for 2,500 acres

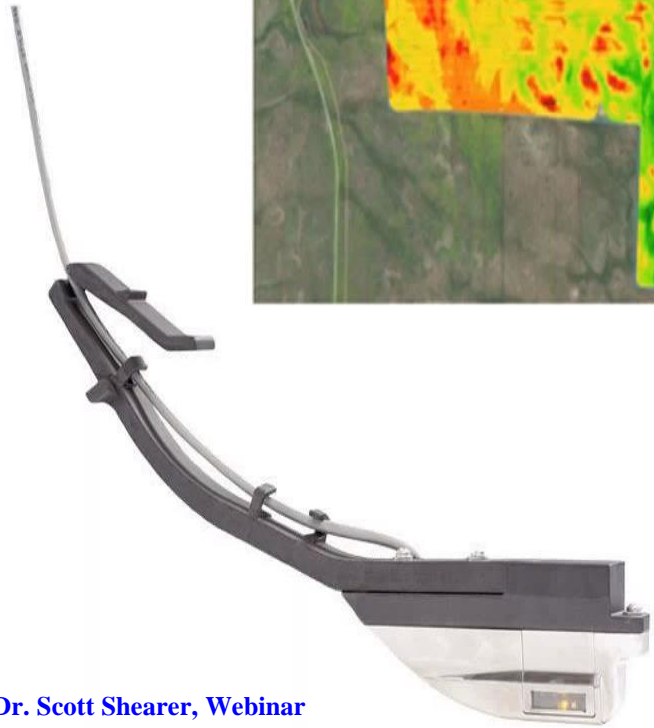
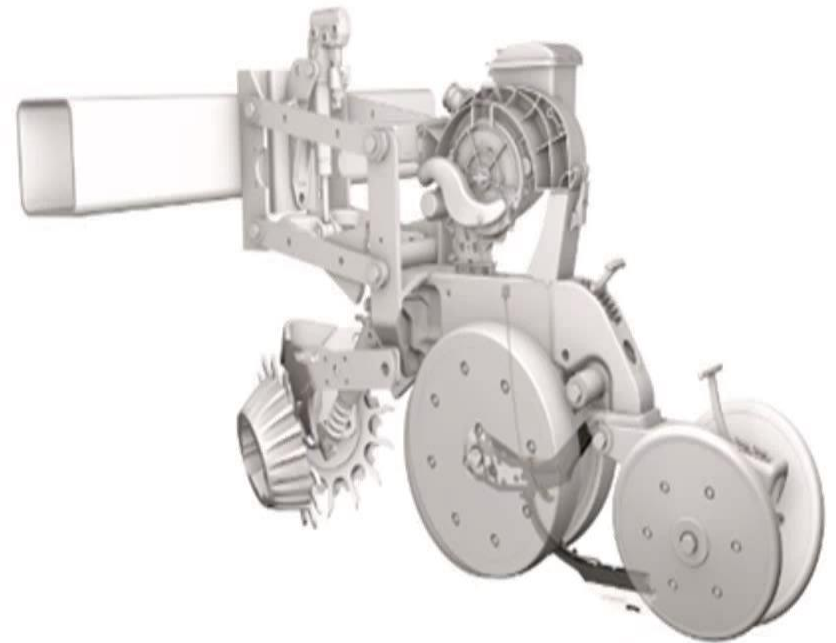
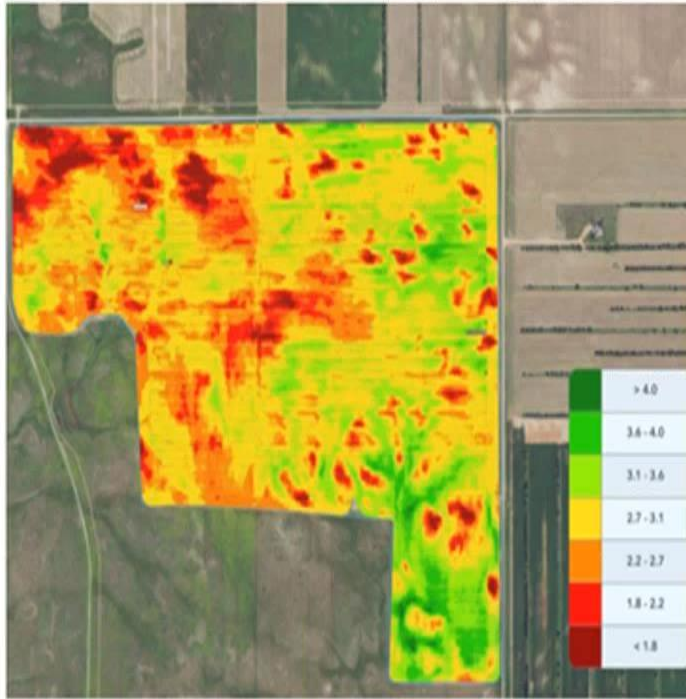


Applied Downforce



Seed Singulation

Precision Planting SmartFirmer



(Source: <http://www.precisionplanting.com>)

Liquid Control/Delivery

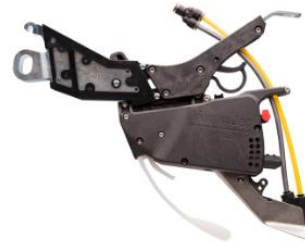


20|20

vApplyHD



Accurate Liquid Control Made Simple



FurrowJet



Optimum Starter Placement



Conceal



Planter Nitrogen Placement Without the Headaches

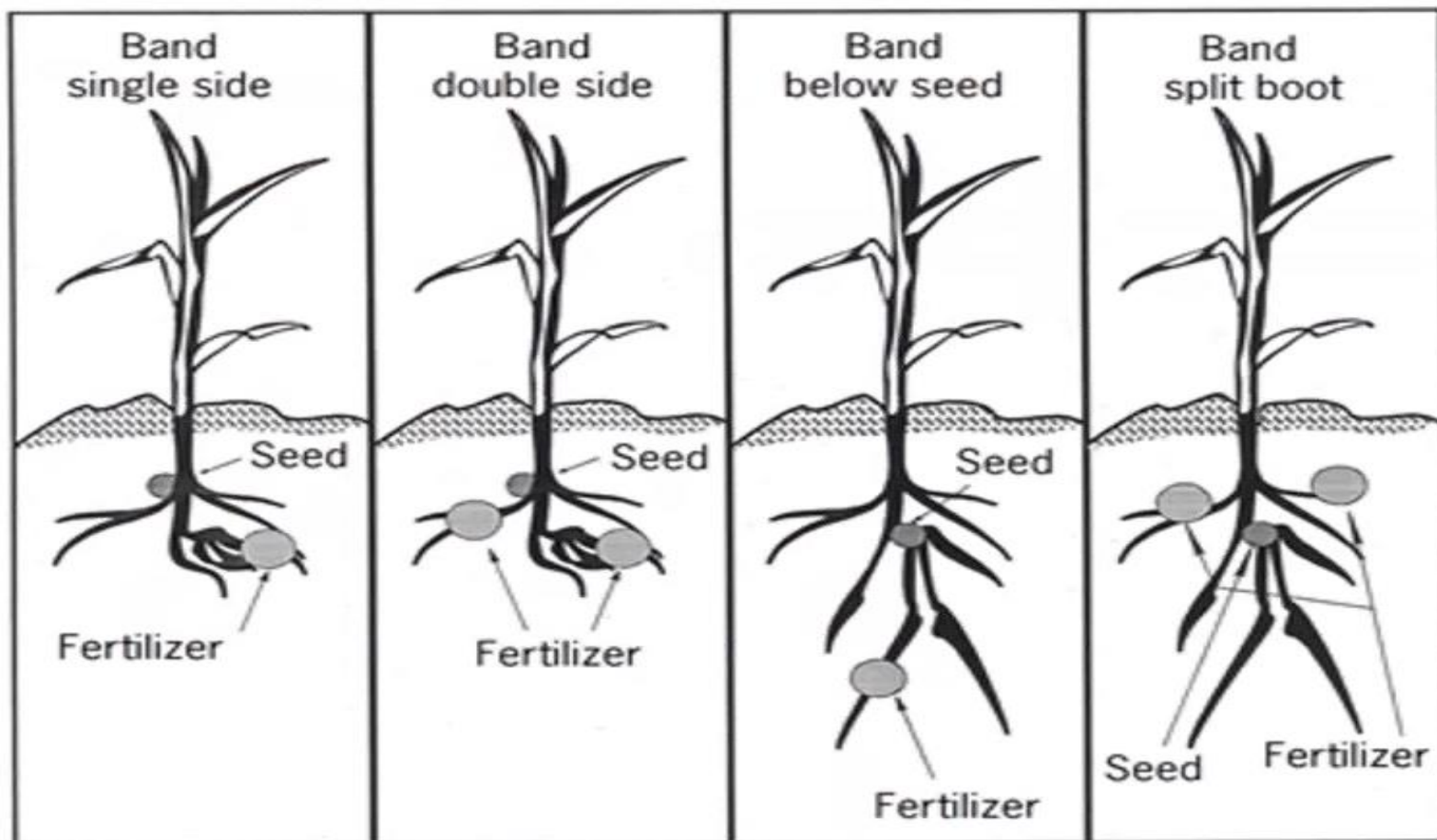


Figure 2. Methods of banding fertilizers. Note that corn plants are used in this example.

(Source: Mahler, R.L. 2001. *Fertilizer Placement*, CIS 757, Idaho State University, <http://www.cals.uidaho.edu>)



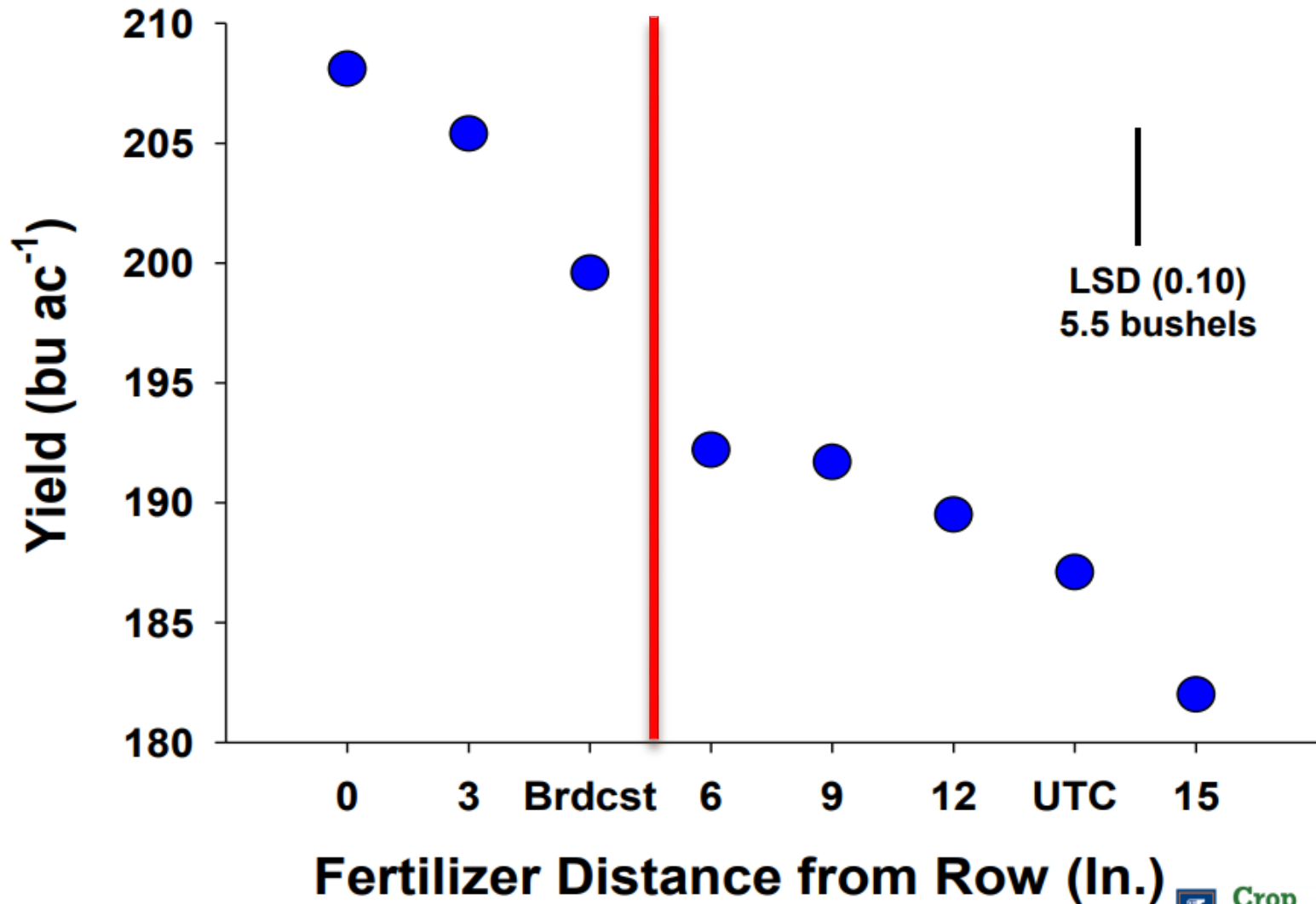
Photo credit: @ColePestorius
Via Twitter

Research has found that corn acquires the majority (63%) of its in-season N from within 7" of the plant base¹

With ~80% of the corn roots within a 8" radius of the plant, N applied in the row middle would require <20% of roots to uptake the majority of the applied N

Hodgen, P. J., R. B. Ferguson, J. F. Shanahan, and J. S. Schepers. "Uptake of Point Source Depleted N Fertilizer by Neighboring Corn Plants." *Agronomy Journal* 101.1 (2009): 99. Web.

Corn Yield Response to Fertilizer Placement

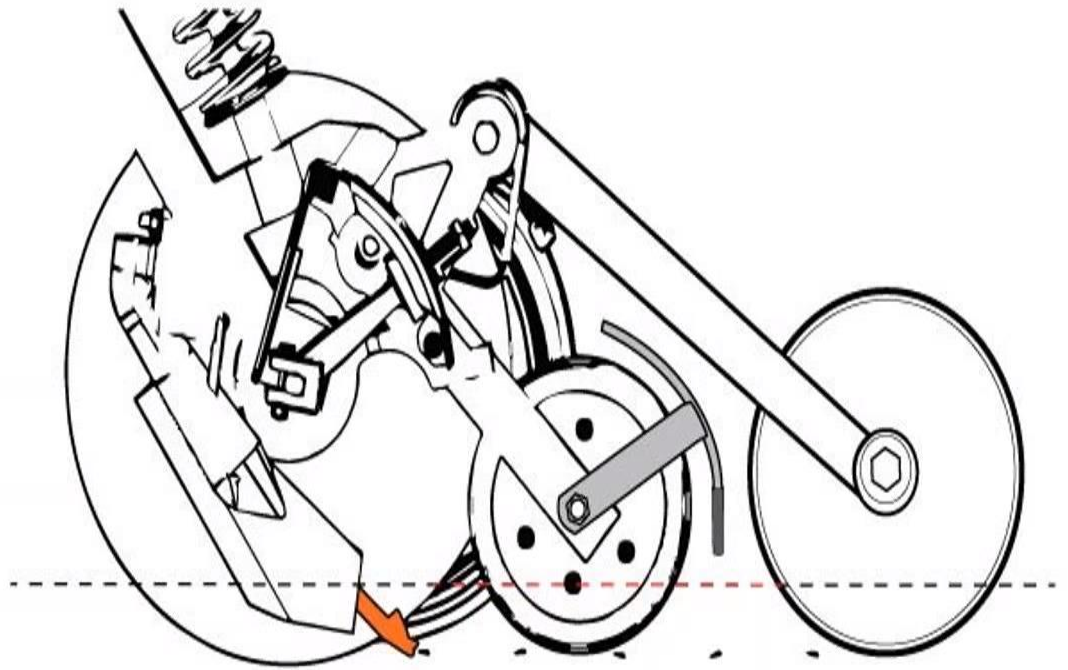


Champaign, IL 2014

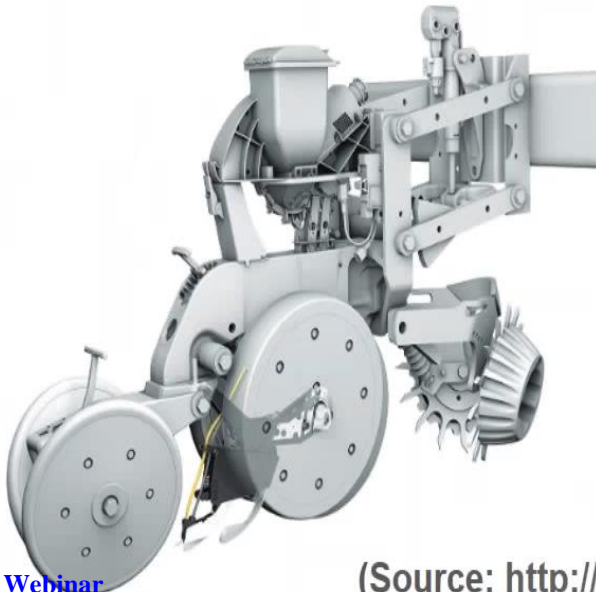
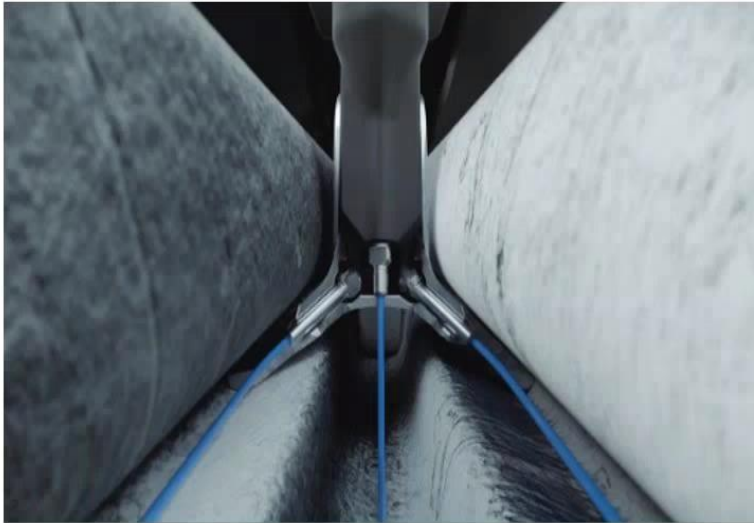




Schaffert Rebounder w/ Y-Not Split It



Precision Planting FurrowJet



(Source: <http://www.precisionplanting.com>)

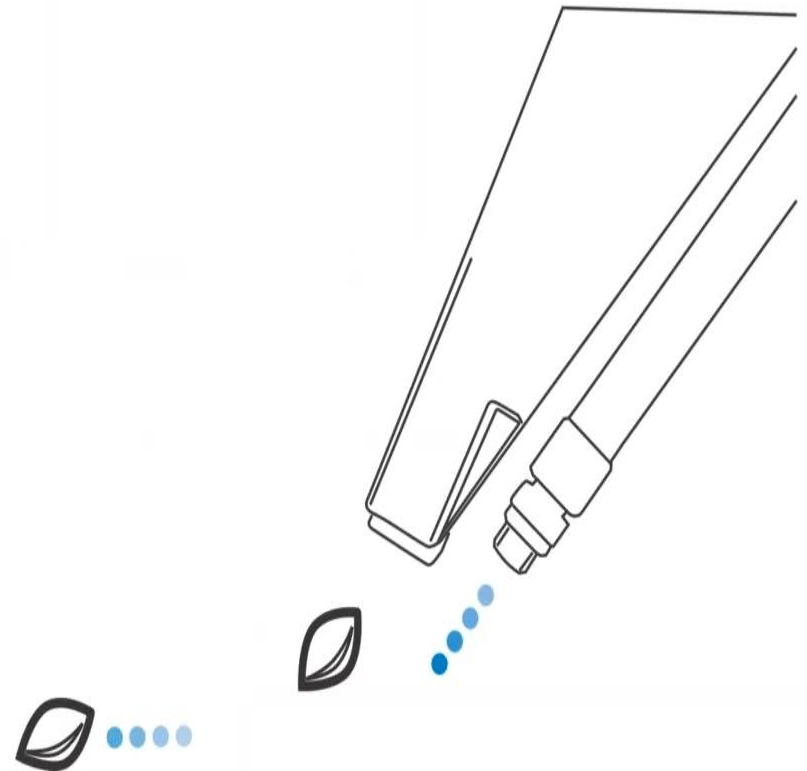


Schaffert G2 and Dual Side Placement



(Source: <https://www.schaffert.com>)

Capstan Ag Seed-Squirter





Strip-Till Systems



MonTag GEN II/AgSynergy RAZER

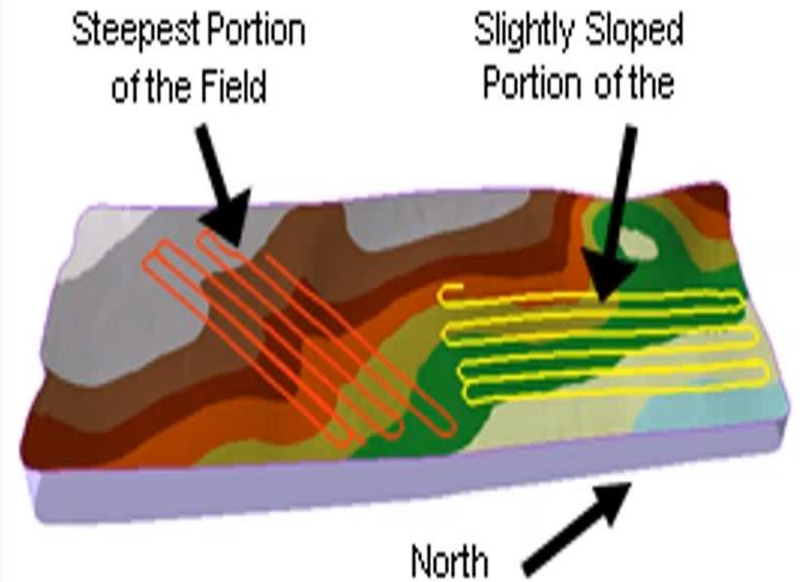


Orthman 1tRIPr XD





Implement Following Error





Hudson Farms ProTRACKER



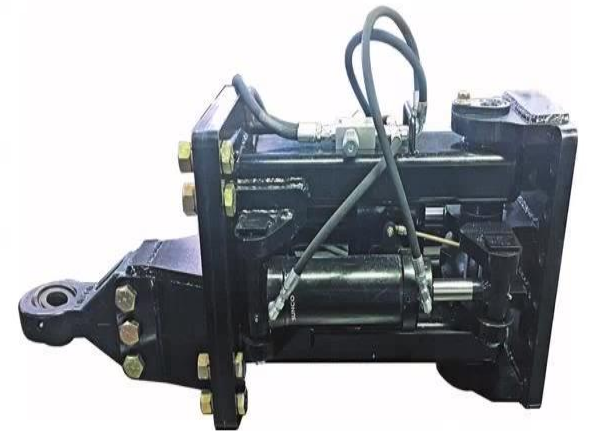
(Source: <https://www.hudsonfarms.com/protrakker>)



SUNCO Implement Guidance



(Source: <https://suncofarmequipment.com>)





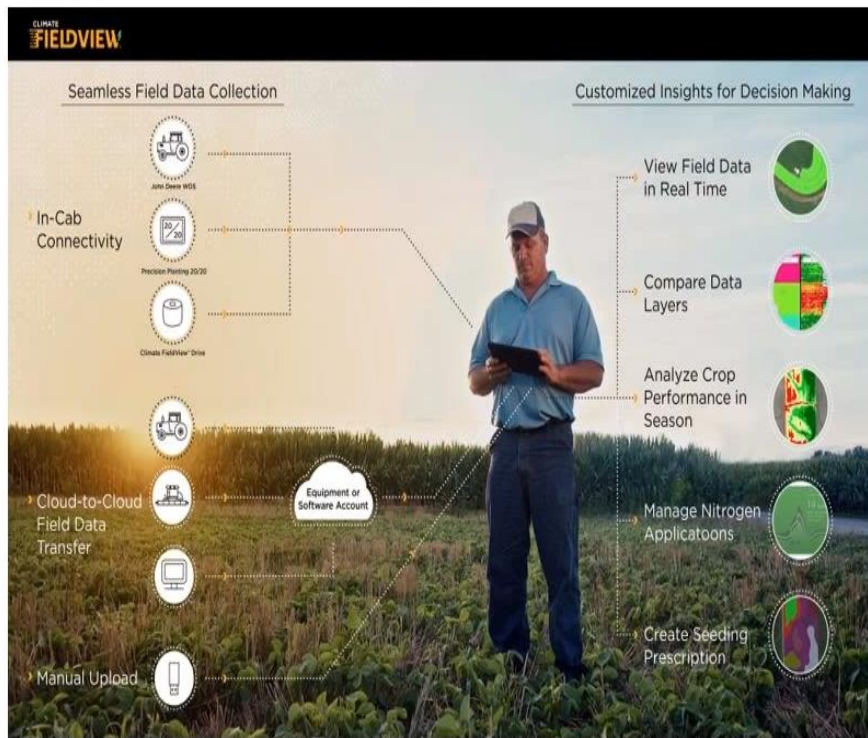
Laforge DynaTrac Hitch



(Source: <https://www.precisionfarmingdealer.com>)

Smart Phones, iPads, and APPS

CLIMATE FIELDVIEW™



Smart Phones, iPads, and APPS

The central diagram features the Encirca logo at its core, surrounded by five interconnected icons representing the app's key areas:

- AGRONOMY**: Represented by a green leaf icon.
- WEATHER**: Represented by a green icon with a sun, cloud, and raindrops.
- ANALYTICS**: Represented by a green icon with a white line graph.
- CUSTOMIZED**: Represented by an orange icon with two stylized human figures.
- SOILS**: Represented by a brown icon with a soil cross-section.

Surrounding the diagram are three images of the app in use:

- Smartphone**: A hand holding a smartphone displaying a map of a field with various data overlays and a weather forecast for the next few days.
- iPad**: An iPad displaying a detailed field map with color-coded zones and a sidebar menu.
- Desktop**: A computer monitor displaying a complex dashboard with multiple data points, charts, and tables, including a 'Field ID' section and a 'Prescription' table.

Smart Phones, iPads, and APPS



Hi, Greg

summary

land

soil

crop

applications

settings

logout

adapt-N FIELD RECOMMENDATION YYYY-MM-DD Go

Recommendation for 06/22/2015

40 / 66 / 105 / 3,520

lbs N/acre (min/avg/max/total)

Grower FIPS 19 - Iowa Export Recommendation

Farm FIPS 047 - Crawford

Field Denison

Acres 54

FIELD CONFIGURATION

Planting Date 05/01/2015

Maturity Class Grains: 107 day corn

Previous Crop Grain Corn

Tillage Method No-Till

Rainfall Since Planting 9.4*

Estimated Growth Stage V8

	min	avg	max
Organic Matter (%)	2.00	2.33	2.70
Harvest Population	30,000	30,000	30,000
Yield Target (bu/acre)	180	191	220

Google






Map data ©2015 Google Imagery ©2015, DigitalGlobe, USDA Farm Service Agency | Terms of Use | Report a map error

Recommendation in lbs N/acre

- 0 - 14 (0.00 acres)
- 15 - 29 (0.00 acres)
- 30 - 44 (9.00 acres)
- 45 - 59 (13.00 acres)
- 60 - 74 (9.00 acres)
- 75 - 89 (17.00 acres)
- 90 - 104 (0.00 acres)
- 105+ (6.00 acres)

APPS


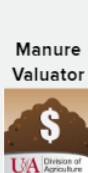



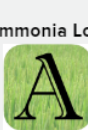





Nutrient Information and Calculators

App	Details
Fertilizer Removal by Crop 	Available from: <i>Ag PhD</i> Operating system: Android / iOS Description: A guide to discovering the vital nutrient amounts critical to attaining optimum yield for the selected crop. Save result and use for later reference. Cost: Free Account needed? No
Ag PhD Deficiencies 	Available from: <i>Ag PhD</i> Operating system: Android / iOS Description: A guide to identifying fertility issues in the field. Content includes a complete list of photos and descriptions of the nutrient deficiencies in a variety of crops. Cost: Free Account needed? No
HumaGro 	Available from: <i>Bio Huma Netics Inc.</i> Operating system: Android Description: Calculate nutrition products and application rates based on lab analysis and info sheets. View fact sheets to allow for easy calculations, and save calculations for later and access product technical documents. Cost: Free Account needed? No
Fertilizer Blend Calculator 	Available from: <i>Wilde Brothers Farms Ltd.</i> Operating system: iOS Description: A calculator to determine the proper fertilizer blend weights and costs as well as various weights and volumes of net elements in the blend. Cost: \$4.99 Account needed? Yes
Yara CheckIT 	Available from: <i>Yara International ASA</i> Operating system: iOS Description: Quickly identify possible nutrient deficiencies. CheckIT has been designed to operate in rural locations with low signal strength. Cost: Free Account needed? Yes
Crop Nutrient Removal Calculator 	Available from: <i>International Plant Nutrition Institute</i> Operating system: iOS Description: Estimate crop nutrient removal for a variety of crops. Cost: Free Account needed? No

Farm Calculators 	Available from: <i>Dr. Vishwanath Koti</i> Operating system: Android Description: Calculate fertilizers (NPK), pesticides, fungicides, herbicides, plant population, seed rate, and seed blending to ensure optimal yields. Cost: Free Account needed? No
NPK Credits – Manure & Legume Nutrient Credit Calculator 	Available from: <i>University of Wisconsin Nutrient and Pest Management Program</i> Operating system: Android / iOS Description: Calculate the plant-available nitrogen (N), phosphorus (P ₂ O ₅), potassium (K ₂ O), and sulfur (S) nutrient credits of manure from various livestock species that are applied to cropland fields. One can also calculate the N credit available to crops that follow forage legumes in the rotation. Cost: Free Account needed? No
Corn N Rate Calculator 	Available from: <i>University of Wisconsin Nutrient and Pest Management Program</i> Operating system: Android / iOS Description: Assists producers in selecting a nitrogen (N) rate that improves profitability when nitrogen and corn prices fluctuate. Cost: Free Account needed? No
N Price Calculator 	Available from: <i>University of Wisconsin Nutrient and Pest Management Program</i> Operating system: Android / iOS Description: Converts the price of individual nitrogen fertilizer sources from price per ton to price per pound of N. Cost: Free Account needed? No
Fertilizer Calculator n2f 	Available from: <i>ICAR CCARI</i> Operating system: Android Description: Calculate nutrient-to-fertilizer values completely offline. Cost: Free Account needed? No
Fertilizer Mixing Calculators 	Available from: <i>FKmicro.com</i> Operating system: Android Description: Access fertilizer facts instantly on Android. Reduce cost with our mobile app to get knowledge like a fertilizer manufacturer on your hand phone, easy to use, make sense, everyone can use. Cost: Free Account needed? No

Source: <https://ohioline.osu.edu/factsheet/fabe-55202>





APPS

 <p>Blend Calculator</p>	<p>Available from: <i>Travis Redpath</i> Operating system: Android Description: Calculates the fertilizer blend and the total application rate needed to apply the required amount of nitrogen, phosphate, potash, and sulphate. The products can be changed to whatever ratios you want to use. Cost: Free Account needed? No</p>	 <p>Manure Valuator</p>	<p>Available from: <i>University of Arkansas</i> Operating system: Android / iOS Description: Helps producers calculate the dollar and nutritive value of manure and allow them to share results via email. Users have access to a bulk cost calculator to determine cost per pound of nitrogen, phosphorus, and potassium from inorganic fertilizers and a database consisting of nutritive value of 18 different sources of manure, which allows user input for custom values for wet and dry manures. Cost: Free Account needed? No</p>
 <p>GreenSeeker Data Logger</p>	<p>Available from: <i>Oklahoma State University</i> Operating system: Android Description: Supports data collecting of NDVI data with a Trimble GreenSeeker handheld crop sensor. *Requires GreenSeeker handheld sensor for data collection. Cost: Free Account needed? No</p>	 <p>Cow Poop Analyzer</p>	<p>Available from: <i>Texas A&M AgriLife Extension Service</i> Operating system: Android / iOS Description: Cow poop photographs are compared with stock photos to determine the approximate crude protein and digestibility of forage/food. Cost: Free Account needed? No</p>
 <p>SoluDrip (Just in Time Crop Nutrition)</p>	<p>Available from: <i>Vital Fertilizers</i> Operating system: Android / iOS Description: Find the exact amount of nutrition for the crop at whichever stage of its life it's at. *Primarily used for vegetable production. Cost: Free Account needed? No</p>	 <p>Ammonia Loss</p>	<p>Available from: <i>Oklahoma State University</i> Operating system: iOS Description: Accurate estimates of ammonia volatilization losses from surface applications of urea in agriculture. Estimates are in percent of the total N rate applied. Cost: Free Account needed? No</p>
 <p>MRTN/Nitrogen Application Calculator</p>	<p>Available from: <i>University of Illinois</i> Operating system: iOS Description: The Maximum Return To Nitrogen (MRTN) calculations combine the agronomics of nitrogen rate research and the realities of economic fluctuations to provide a customized nitrogen rate. Cost: Free Account needed? No</p>	 <p>GreenSeeker N Rate Calc</p>	<p>Available from: <i>Oklahoma State University</i> Operating system: iOS Description: This application hosts sensor-based nitrogen recommendation algorithms which have been developed by researchers in each respective region. The calculations are based upon NDVI values retrieved from the GreenSeeker Sensor. The GreenSeeker is an active light sensor. It would be expected the NDVI from other active sensors would be similar, but potentially not exactly the same. Cost: Free Account needed? No</p>
 <p>Fertilizer Cost Calculator</p>	<p>Available from: <i>Jeffrey Abbott</i> Operating system: Android / iOS Description: Estimates the value of nitrogen per unit of phosphorus source, along with the cost per unit of P₂O₅ with or without the nitrogen value. All calculations based on entered cost per bulk. Cost: Free Account needed? No</p>	 <p>Return on Nitrogen Investment</p>	<p>Available from: <i>Oklahoma State University</i> Operating system: iOS Description: This app is designed as a tool in determining economic nitrogen (N) rates. This calculator determines the return on investment (ROI) of N fertilizer for multiple crops under two different scenarios. The first scenario is that yield fertilized for is not realized. The other scenario is if the producer underfertilizes for the environment. Cost: Free Account needed? No</p>
 <p>Potato Potassium Calculator</p>	<p>Available from: <i>Great Salt Lake Minerals</i> Operating system: Android Description: Potato Uptake Calculator can be used to estimate how much potassium your potatoes remove from the ground and how much you need to apply to replenish the loss. Cost: Free Account needed? No</p>		





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APPS

Equipment Setup






App	Details
 <p>ApplyPlus</p>	<p>Available from: John Deere Operating system: Android / iOS Description: Provides the ability to optimize machine set-up and maintenance procedures. Currently for 4 Series JD sprayers. Cost: Free Account needed? Yes</p>
 <p>AgLogic Mobile</p>	<p>Available from: John Deere Operating system: Android / iOS Description: A complete logistics solution for custom application that syncs with the AgLogic web application. *Requires license to activate account. Cost: Free Account needed? Yes</p>
 <p>Rauch Fertilizer Chart</p>	<p>Available from: RAUCH Landmaschinenfabrik GmbH Operating system: Android / iOS Description: Provides spreading charts for current and older RAUCH fertilizer spreaders. Cost: Free Account needed? Yes</p>
 <p>New Leader Mobile</p>	<p>Available from: New Leader Operating system: Android / iOS Description: Assists users and dealers in conducting a conveyor or catch calibration and determines calibrated CFR or Constant Number. Determines initial settings based off product characteristics. Cost: Free Account needed? Yes</p>

Nozzle and Orifice Selection




App	Details
 <p>TeeJet SpraySelect</p>	<p>Available from: TeeJet Technologies Operating system: Android Description: Enter speed, spacing and target rate, select the drop size category; a list of tips that will work is generated. Cost: Free Account needed? Yes</p>
 <p>Spray It</p>	<p>Available from: Pentair Flow Technologies LLC Operating system: Android / iOS Description: Select the chemical company and name of the chemical applying, a nozzle to use based on the application information on the label will be recommended. Growers can also input application rate, speed, and nozzle spacing and a nozzle size for that specific application will be recommended. Cost: Free Account needed? No</p>
 <p>Kuhn-Nozzle Configurator</p>	<p>Available from: KUHN Operating system: Android Description: Select the correct sprayer nozzle for specific application requirements, such as working speed, flow rate, etc. Cost: Free Account needed? No</p>
 <p>Spray Tips Guide</p>	<p>Available from: Ag PhD Operating system: Android / iOS Description: A guide to select the proper nozzle for the equipment being used. Select nozzle by chemical company or name of the chemical being applied and receive suggestions based on the label application information. Change the application rate, speed, and nozzle spacing for more precise suggestions. Cost: Free Account needed? No</p>

APPS

Soil Sampling

App	Details
 <p>AgWorld Sampling</p>	<p>Available from: <i>AgWorld</i> Operating system: iOS Description: Agworld soil collectors can easily view, complete, and submit sampling jobs assigned to them. *Note: This app requires a precision enabled Agworld account. Cost: Free Account needed? Yes</p>
 <p>Ag PhD Soils</p>	<p>Available from: <i>Ag PhD</i> Operating system: Android / iOS Description: Fast and accurate soil test tool. Lab results come in 5–7 days, aerial imagery of your field, test as much as you want, and pay as you test. Generate variable rate prescriptions, download recommendations and controller files. *Pay to have soil tests sent to Midwest Laboratories. Cost: Free Account needed? No</p>
 <p>360 Soilscan</p>	<p>Available from: <i>360 Yield Center</i> Operating system: iOS Description: A portable soil lab that provides soil nitrate and pH analysis to enable more accurate and timely nutrient management. Cost: Free Account needed? Yes</p>
 <p>SIRRUS</p>	<p>Available from: <i>SST Software Inc.</i> Operating system: iOS Description: Manage the soil on your fields efficiently and with precision. SIRRUS for iPad has what is needed for intensive soil sampling services so you can make informed fertility decisions. Upgrade to Premium to edit recommendations in the field and to make treatment adjustments. Cost: Free Account needed? Yes</p>
 <p>Soil Test Pro</p>	<p>Available from: <i>TapLogic, LLC</i> Operating system: Android / iOS Description: Use Soil Test Pro to order soil sampling supplies, pull precision soil samples, choose a lab from our recommended list, and ship your samples. Cost: Free Account needed? Yes</p>

Field Data Management

App	Details
 <p>Ohio State PLOTS</p>	<p>Available from: <i>OCV, LLC</i> Operating system: Android / iOS Description: Create replicated on-farm trials to compare hybrids, fertilizer rates, stand counts, and more. Provides statistical comparisons and summary reports. Cost: Free Account needed? No</p>
 <p>FieldView</p>	<p>Available from: <i>The Climate Corporation</i> Operating system: Android / iOS Description: Connected suite of digital ag tools. Tracks rainfall, field health, nitrogen status, yield analysis, and recent activities. Includes delivery of weather information. Paid subscription required to access some functionality. Cost: Free Account needed? No</p>
 <p>FieldView Cab</p>	<p>Available from: <i>The Climate Corporation – US</i> Operating system: Android / iOS Description: Digital tool for visualizing planter and harvest field data while supporting field scouting, imagery, and soil data layers. Cost: Free Account needed? No</p>

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Closing Thoughts

- 1. Try not to get overwhelmed by all of the technology that is available.**
- 2. Conduct soil testing to identify your needs. Row/Seed Placement will change how you sample.**
- 3. Moving a portion of the crop nutrient needs via precision placement below the soil surface can help to start improving water quality.**
- 4. This does not imply reducing fertilization rates. We still have to maximize productivity (grain and residue).**

“The Soil is the Mother of Mankind and it will furnish him life and the material basis for happiness and comfort if he does not make too strong demands upon it.”

James Thorpe, 1936. Purdue Univ.



**Wyciskalla
Consulting**

**Soil Sampling &
Precision Ag Mgt**

618-314-0578

wycon@charter.net



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