On Farm Research Approach in PRECISION AGRICULTURE

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SUMMARY

- Background
- Precision Agriculture Concepts Leveling
- On farm research approach
- LSU Digital Agriculture Innitiative
- 2018 Season

Background

- **Family**

  Mother´s family were soybean, corn and cotton farmers since 1940`s

- **BSc – Agronomy 1999 (University of Sao Paulo)**
- **MSc – Agronomy 2001 (University of Sao Paulo/UIDAHO)**
- **PhD – Agronomy 2011 (University of Nebraska – Lincoln)**

- **Researcher Scientist in Precision Ag with the EMBRAPA (2002 – 2017)**
- **(16 years working with farmers)**

- Undergraduate Internship with Precision Agriculture Team (Backpack Differential GPS; SStoolbox; Excel) (USP)
- Master Degree - Mapping weed spatial variability and Soil Fertility with hyperspectral remote sensing
- Active Crop Canopy Sensors for N fertilization (Studying water influence on N recommendations and combination of optical, thermal and ultrasonic sensors to optimize the variable rate N applications.

Precision Agriculture – Concepts

- Agricultural management posture that considers the **spatial variability** of yield limiting factors to improve the use of resources while avoiding environmental impacts.

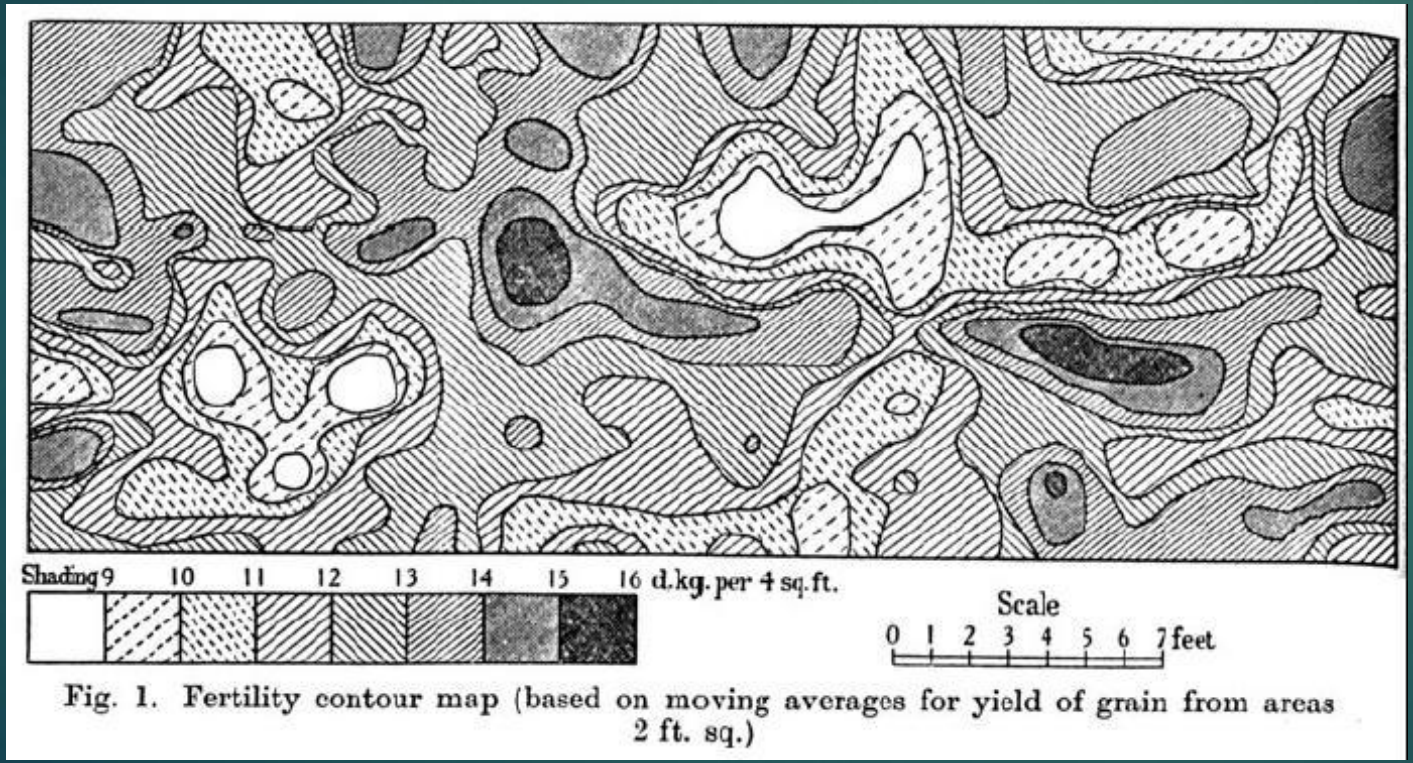


Fig. 1. Fertility contour map (based on moving averages for yield of grain from areas 2 ft. sq.)

Fairfield Smith (1938)

An empirical law describing heterogeneity in the yields of agricultural crops

The Journal of Agricultural Science, 28: 1-23

Tools and Skills to accomplish Precision Ag

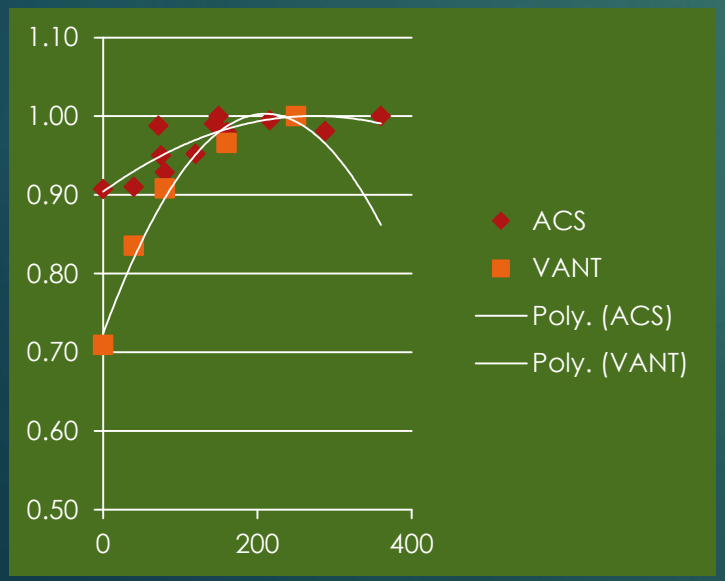
- **Agronomy**
- Remote Sensing
- Geostatistics
- QGIS
- R
- Phyton
- APSIM
- Computers
- Students
- FARMERS

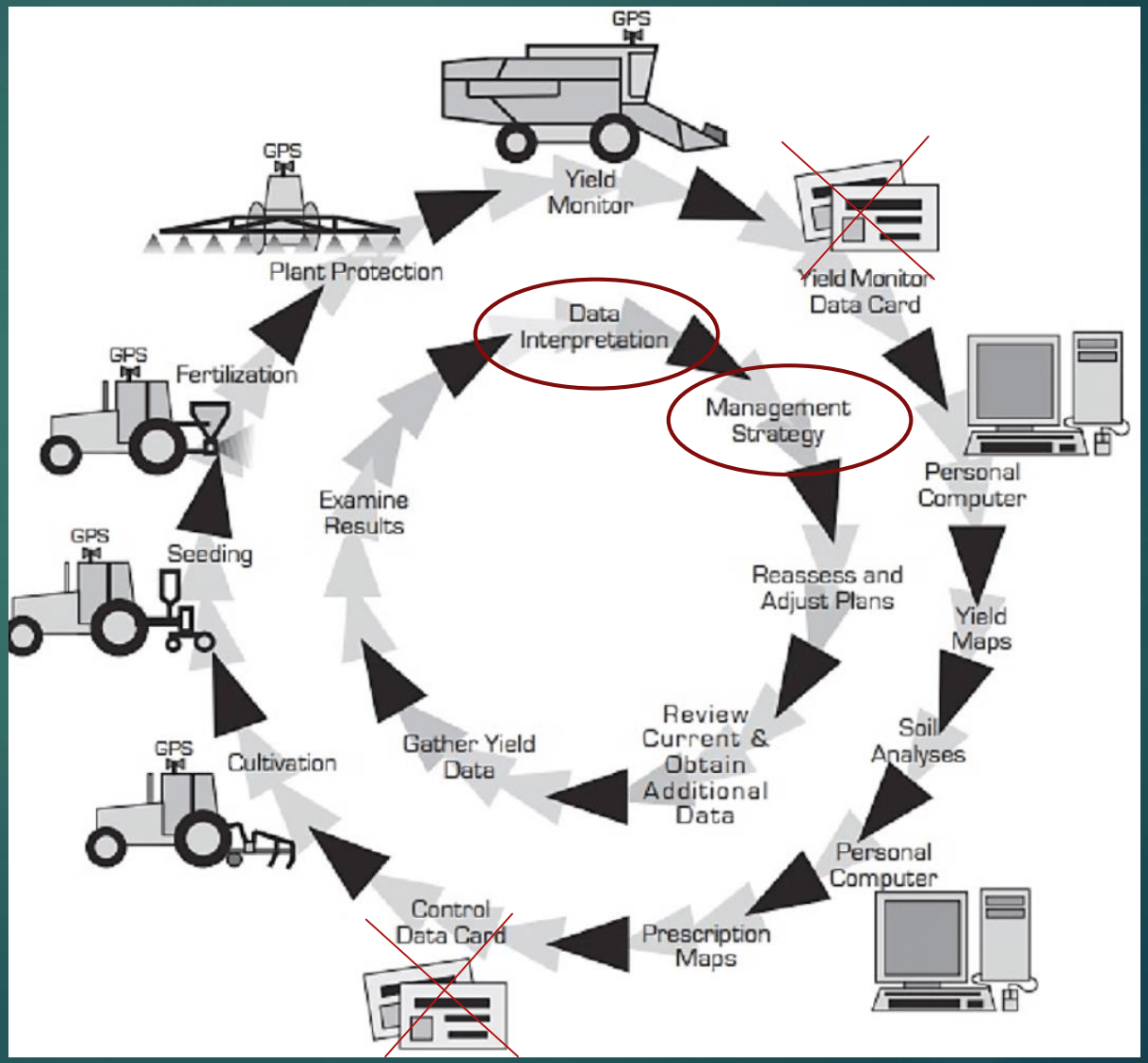
Agronomic Knowledge x Farm machinery
Drones
Sensors
Auto Steering
GNSS

Agronomist x Ag Engineer

90% of the Professionals

Precision Ag Old Cycle



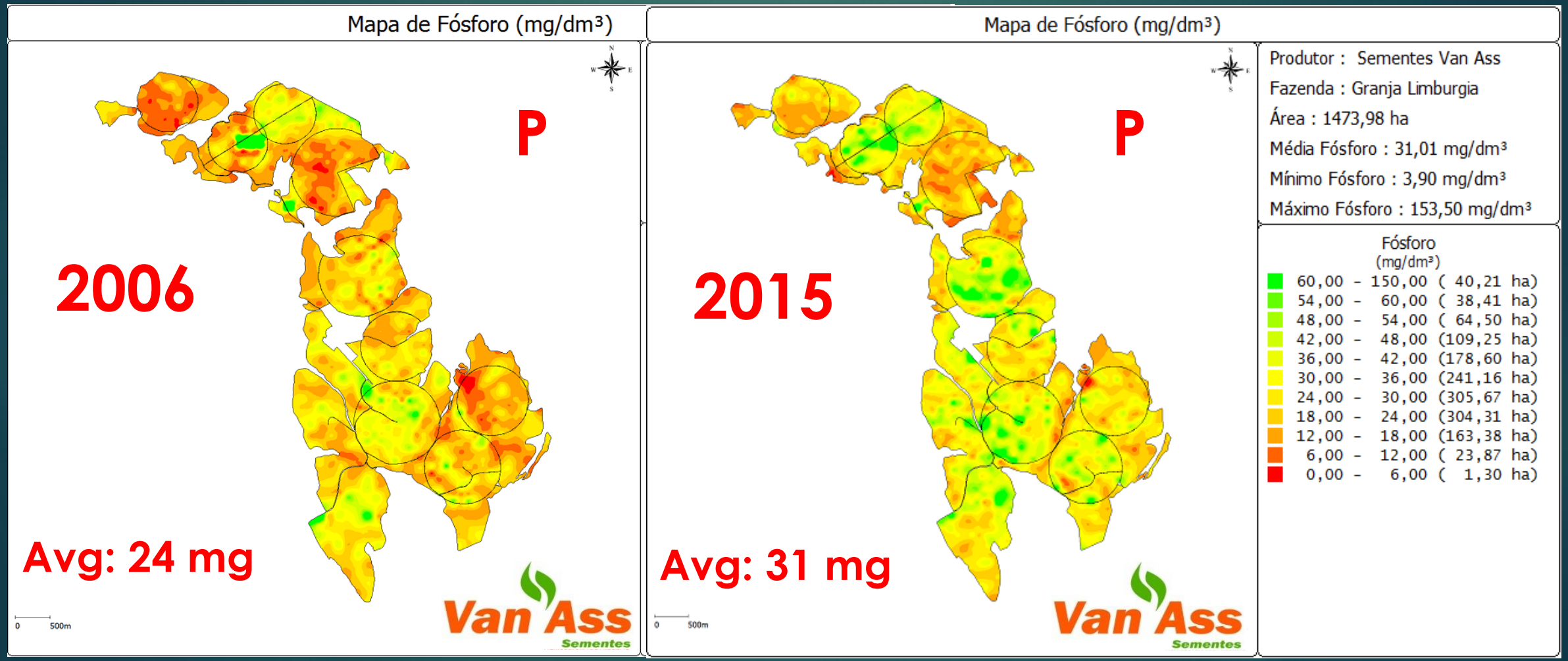


What Do We Need?

- Transform "pretty maps" to good historical numerical data base to generate agronomic knowledge that can drive crop management decisions in long term
- BIG DATA : Input trash – you will have a Big trash
- Model spatial variability of stable characteristics (EC, SOM, texture, elevation)
- Give to farmers/2nd generation technical knowledge and applications that can be used to adopt precision ag unbiased management practices (Cloud computing GIS and a benchmark database)

Precision Ag is a Long Term Work

Generally there is no correlation between soil fertility and yield

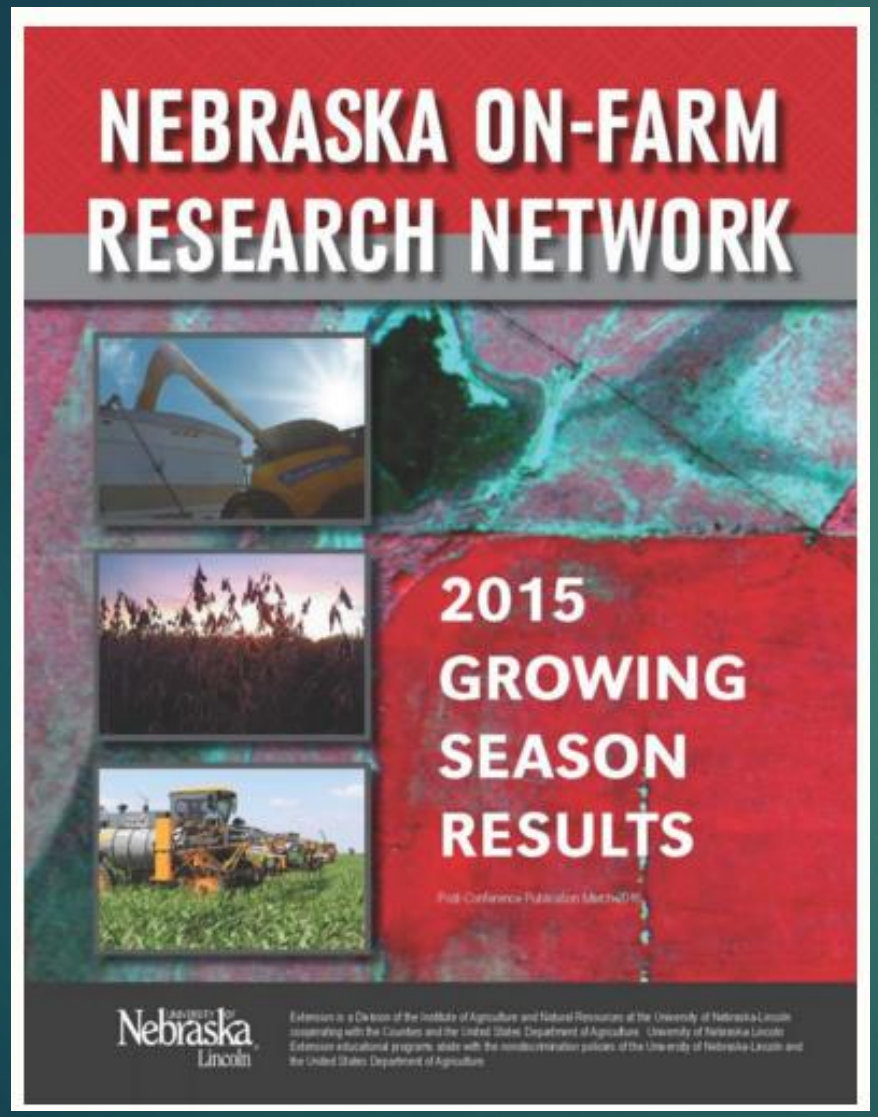


Small Plots x On farm

Require – Flags, labor intensive, alleys

Nowadays – RTK GPS and automation, but still susceptible to spatial variability of soil, landscape, etc.

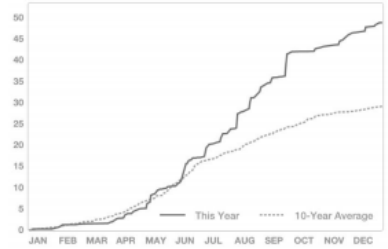
Nebraska



Project SENSE (Sensor-based In-season N Management)

Study ID: 210037201501
County: Colfax
Soil Type: Lawet silt loam;
Planting Date: 5/5/15
Harvest Date: 11/1/15
Population: 32,000
Row Spacing (in.)
Hybrid: GO7B39 3111A
Reps: 6
Previous Crop: Corn
Tillage: Minimum Till
Herbicides: ***Pre:*** LexarEZ ***Post:*** HalexGT
Seed Treatment: Avicta Complete Corn (A500)
Foliar Insecticides: ForceCS at planting
Foliar Fungicides: QuiltXL

Irrigation: Pivot, Total: unknown
Rainfall (in.):



Introduction: This study compares crop canopy sensor based in-season N application to the grower's standard N management.

Grower Nitrogen Treatment: The grower initial N rate was 75 lbs N/acre applied at planting. A side-dress rate of 123 lbs N/acre was applied on 6/22/15. Total grower N application was 198 lbs N/acre.

Project SENSE Nitrogen Treatment: For the SENSE treatment strips, 75 lbs N/acre were applied at planting. Crop canopy sensing and application occurred on 7/10/15 at the V12 growth stage. Across all project SENSE treatments, the average N rate applied in-season was 72 lbs N/acre with a minimum rate of 30 lbs N/acre, and maximum rate of 227 lbs N/acre.

Results: Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Inc., Cary, NC). Mean separation was performed with Fisher's LSD.

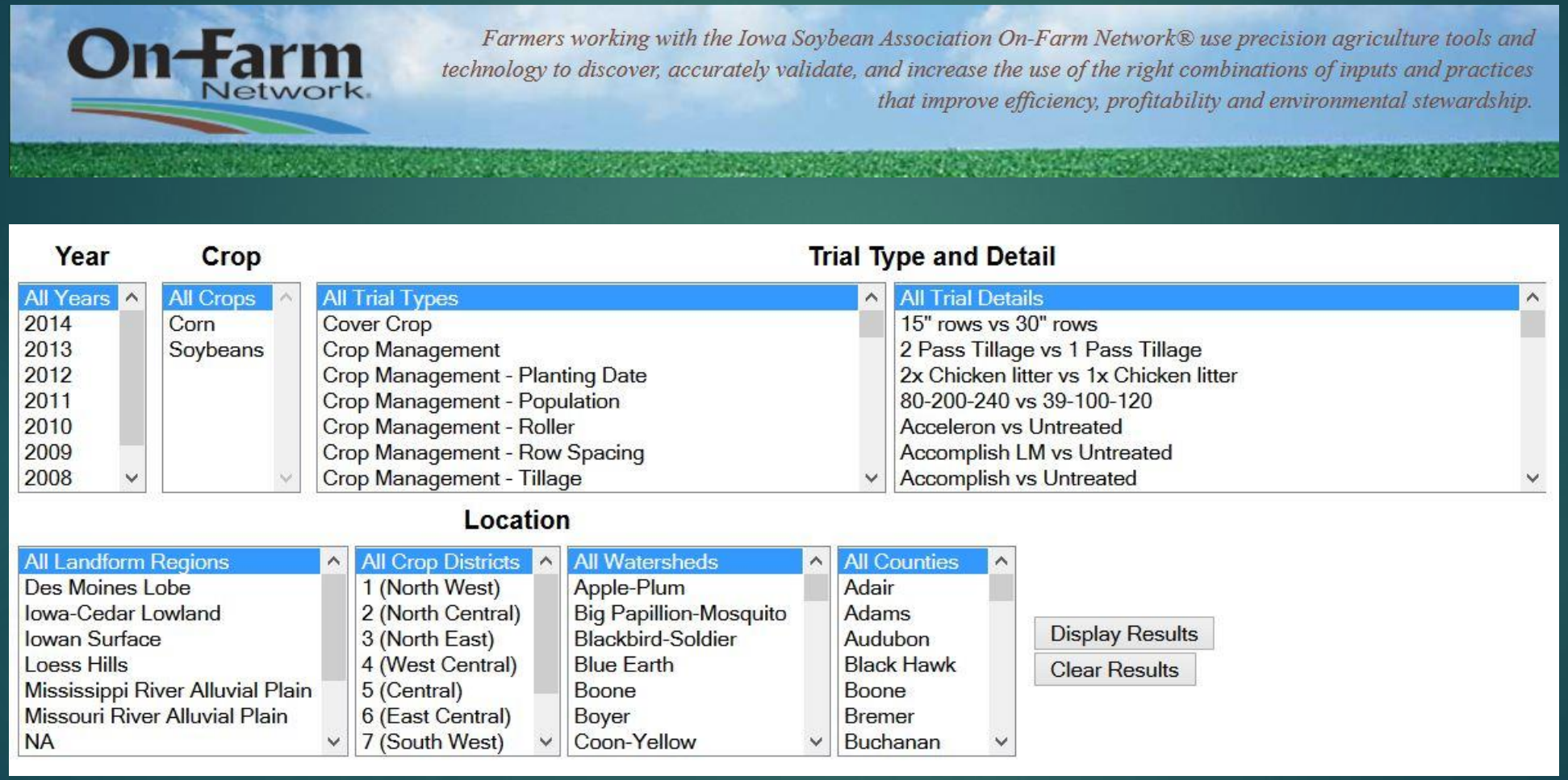
	Total N rate (lb/ac)	Yield (bu/ac)†	Partial Factor Productivity of N (lb grain/lb N)	lbs N/ bu grain	Marginal Net Return‡
Grower N Management	198	207 A*	58 B	0.96 A	$626.85
Project SENSE N Management	147	201 B	76 A	0.74 B	$638.10
P-Value	N/A	0.0031	0.0007	<.0001	N/A

†Yield data from cleaned yield monitor data. Bushels per acre corrected to 15.5% moisture.
*Values with the same letter are not significantly different at a 95% confidence level.
‡Marginal net return based on $3.65/bu corn and $0.65/lb N fertilizer. Cost of applicator and equipment is not included in this calculation.

Summary: At this site, the Project SENSE N application was 51 lb/acre lower than the grower's N application. Yield was significantly lower for the Project SENSE treatment (6 bu/ac). Partial Factor Productivity of N was higher for the Project SENSE N treatment. Marginal net return looking at grain and N prices was favorable for the SENSE treatment this year because N savings outweighed the loss in yield.

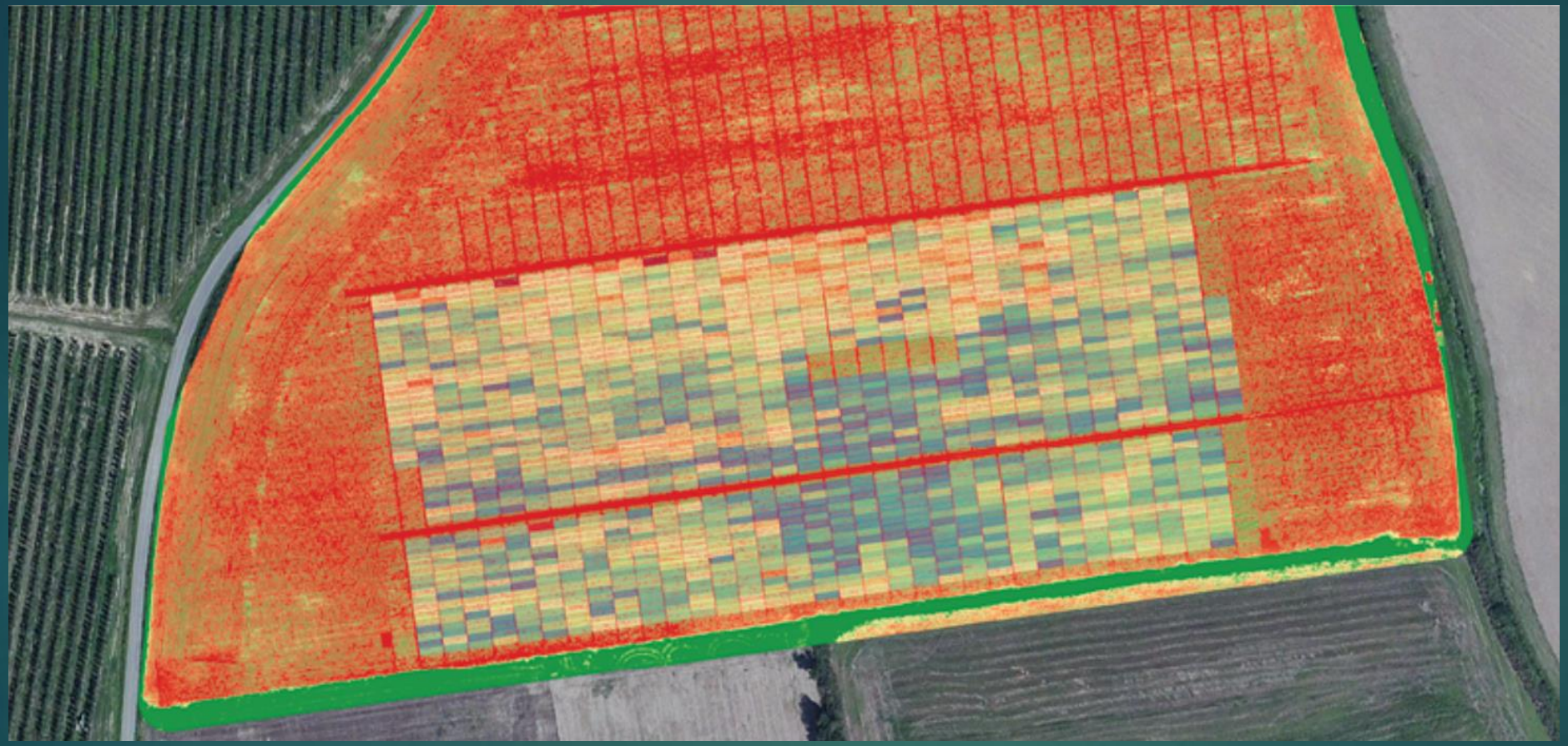
https://cropwatch.unl.edu/on-farm-research

IOWA



https://www.iasoybeans.com/onlinedb/

On Farm Research

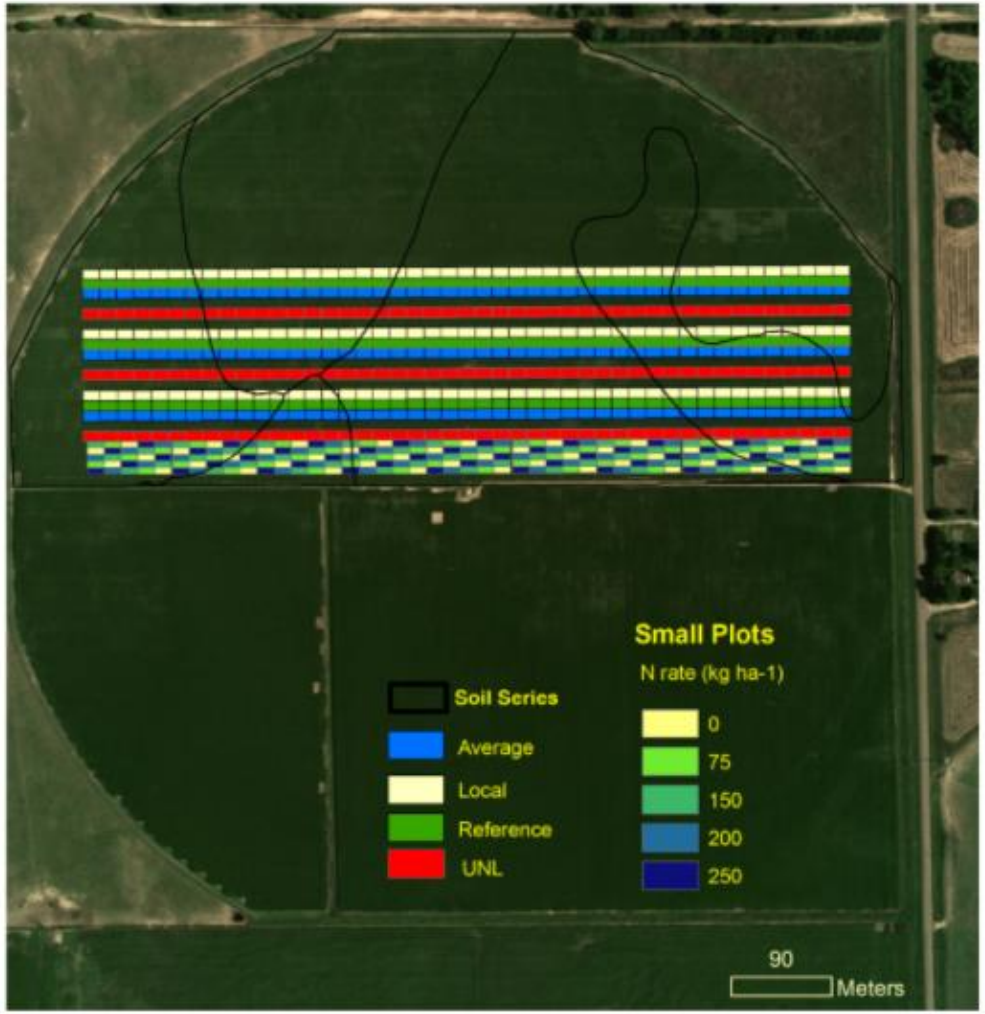


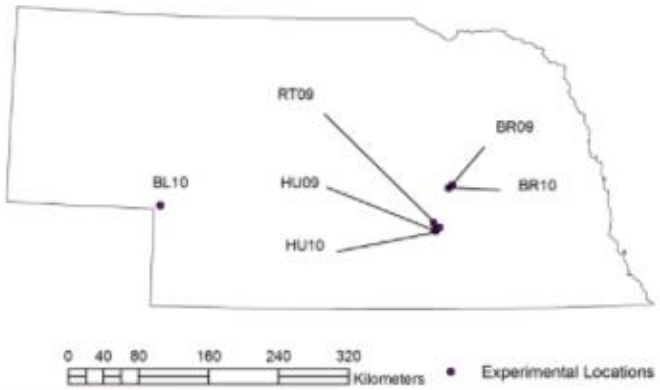
No Flags
No alleys
No Labor
Headache for farmers

Precise GPS
Sensors
Machineries

Drone imagery – Project Precidrones (www.doriane.com)

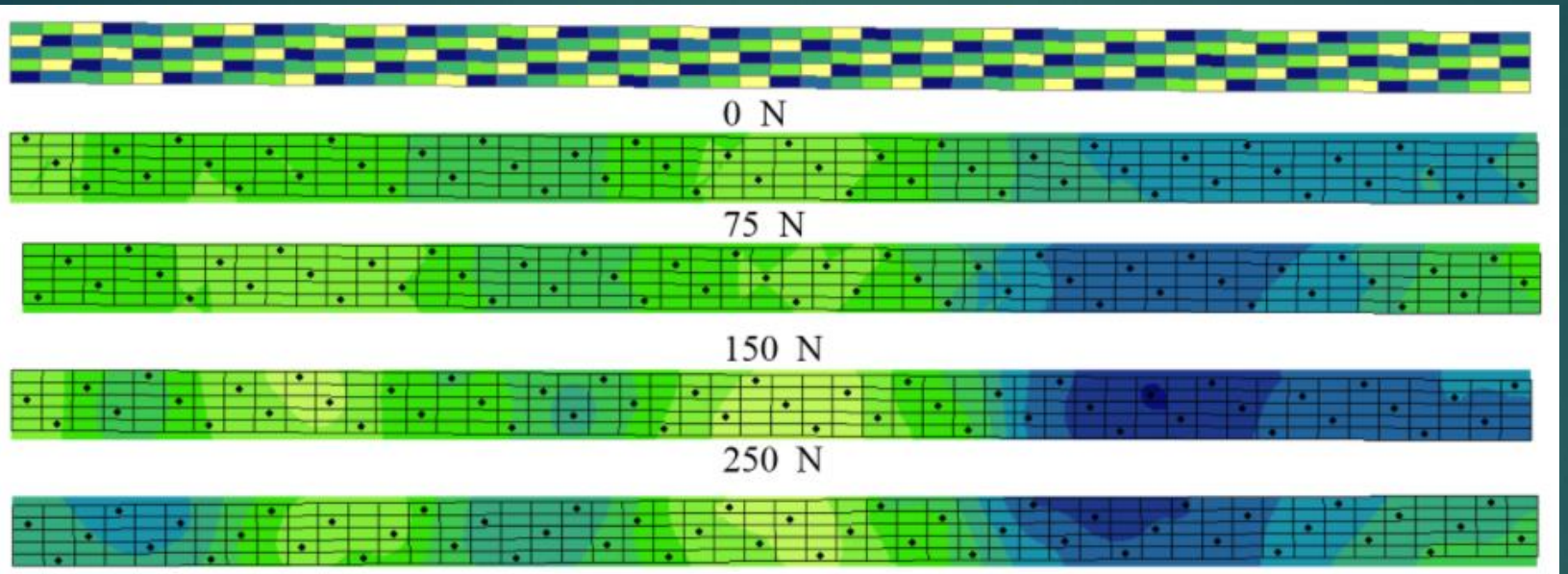
On Farm Research

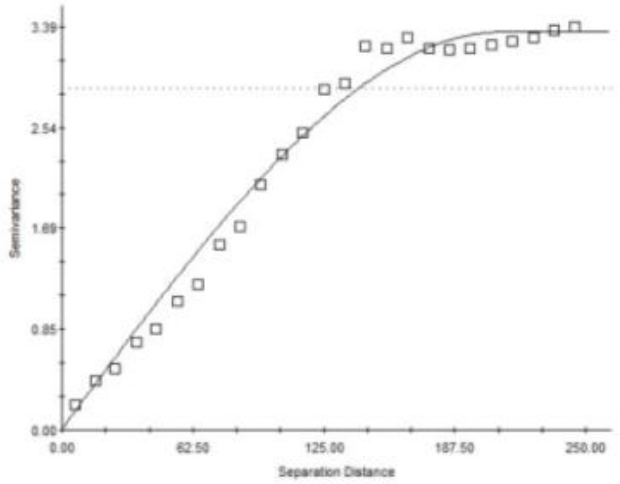




Source: Shiratsuchi, 2011

On Farm Design – considering Spatial Variability

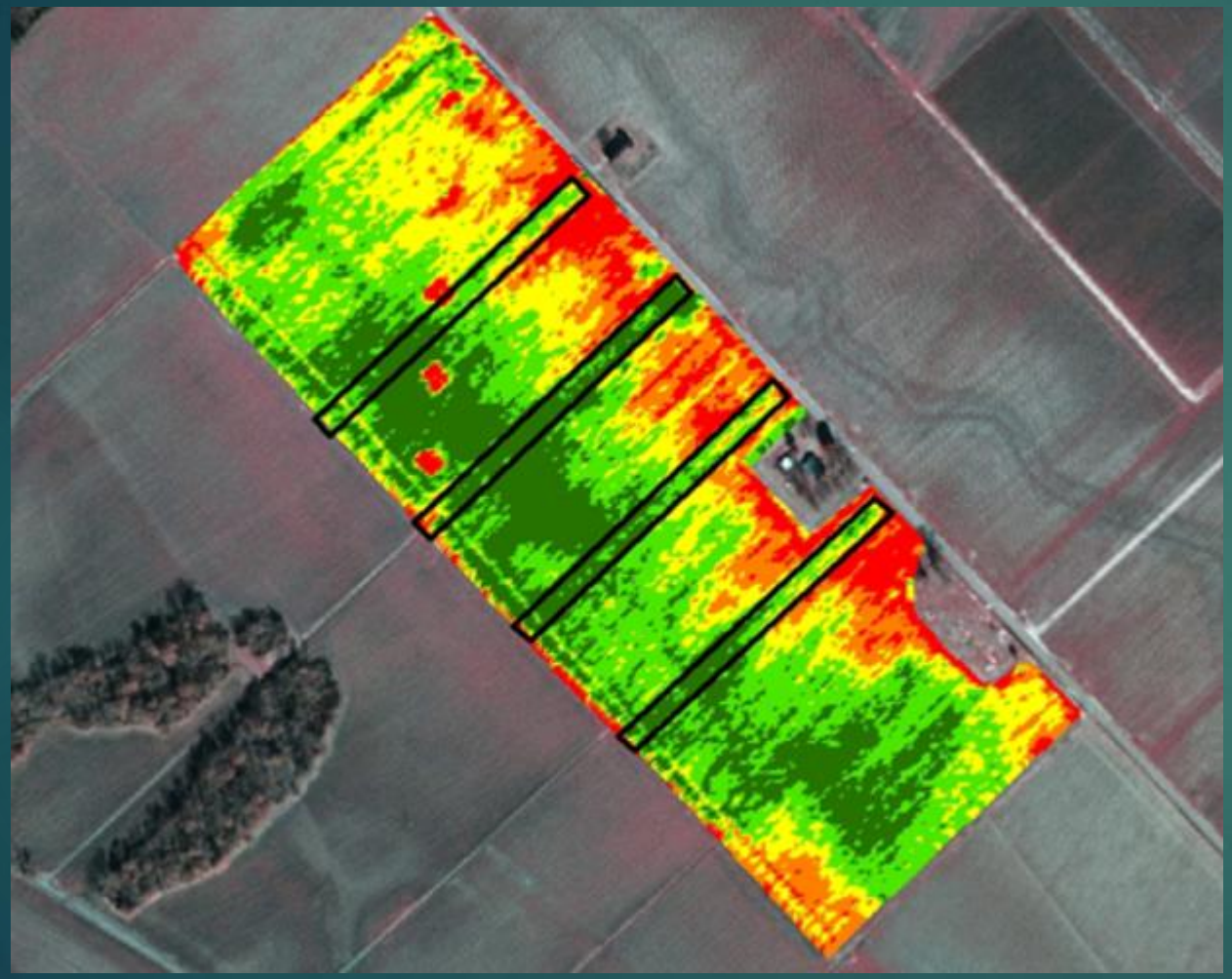




In each field was calculated one semivariogram to adjust the best model for kriging interpolation for surface response variables (SI and Yield) at different N rates

Source: Shiratsuchi, 2011

LSU - Verification Strips – Barbosa and Burns



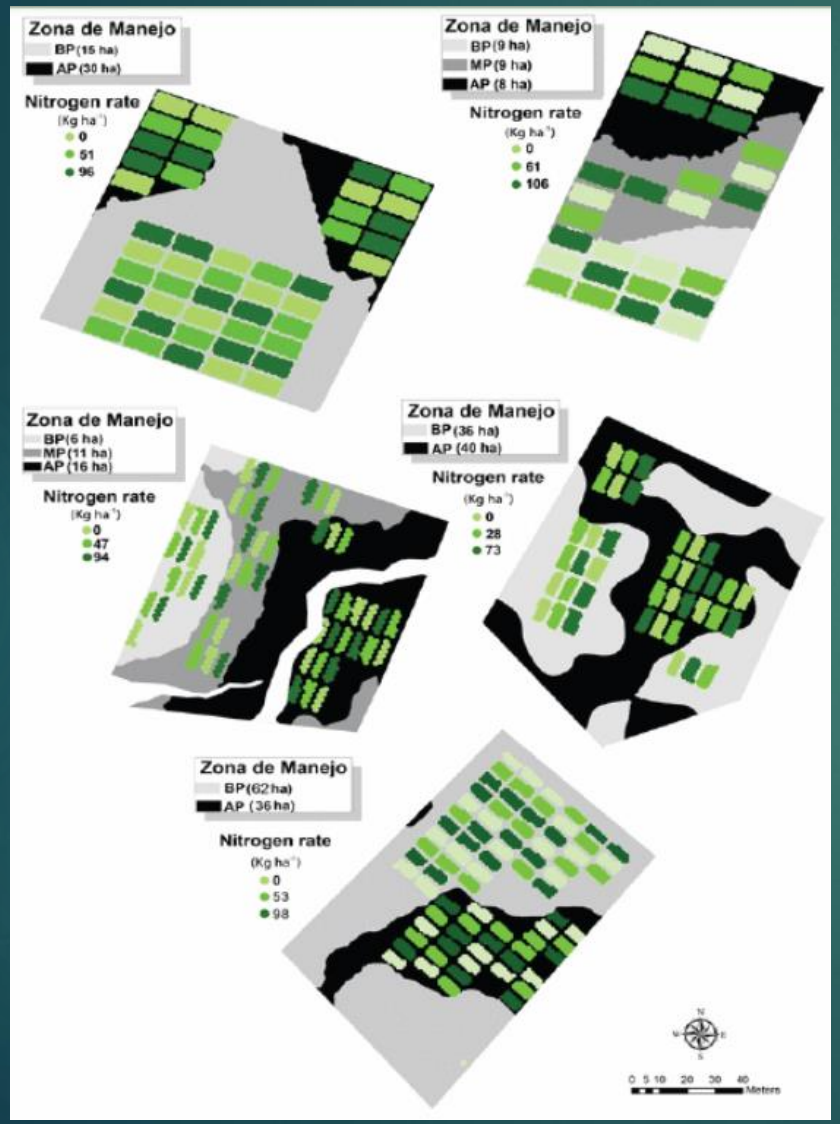
Keep it simple
On Farmers Field

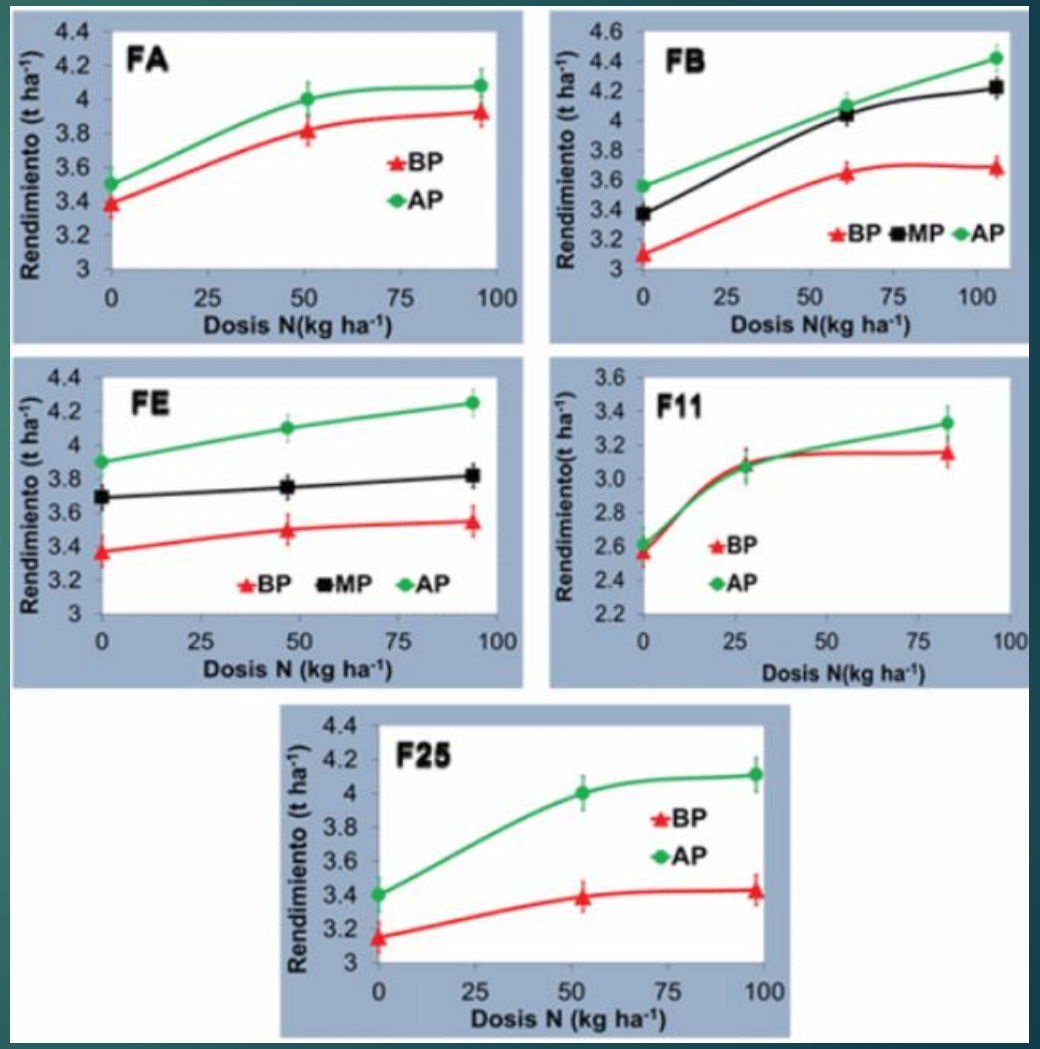
- 20 lb N / acre
Farmer Standard
+ 20 lb N / acre

Variable Rate Equipments

http://www.lsuagcenter.com/portals/our_offices/departments/biological-ag-engineering/research/precisionagriculture/verification-strips

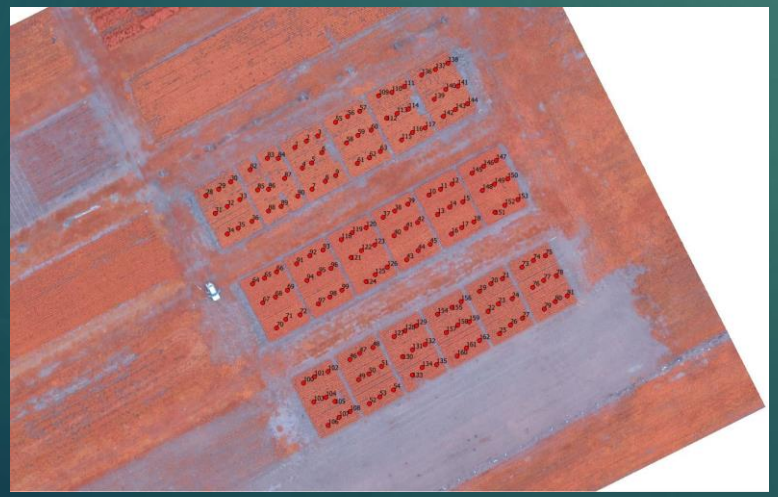
On Farm Research Outputs

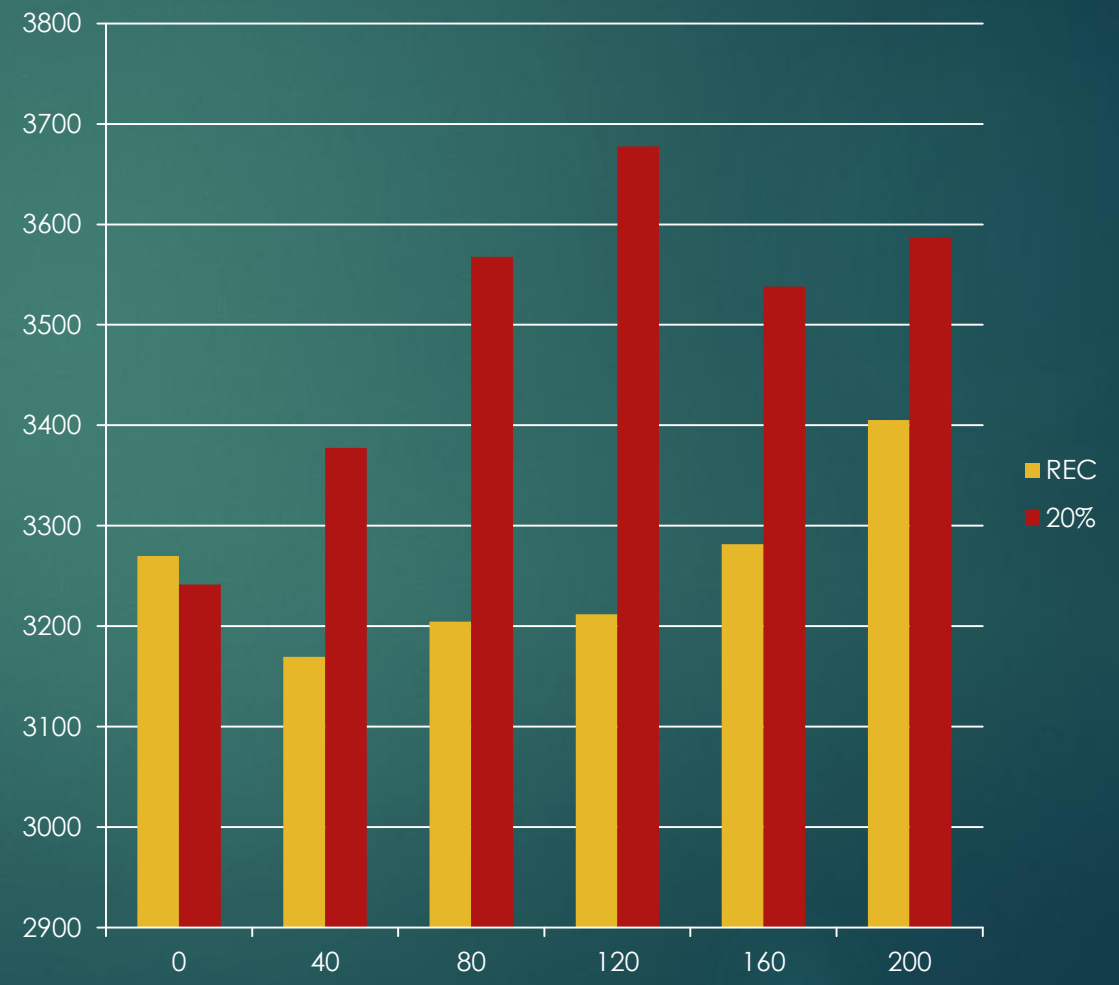




Source: INTA – Argentina – Nahuel Peralta

Nitrogen in Soybeans
Is not a recomendation in Brazil but...
eBee Drone - NIR



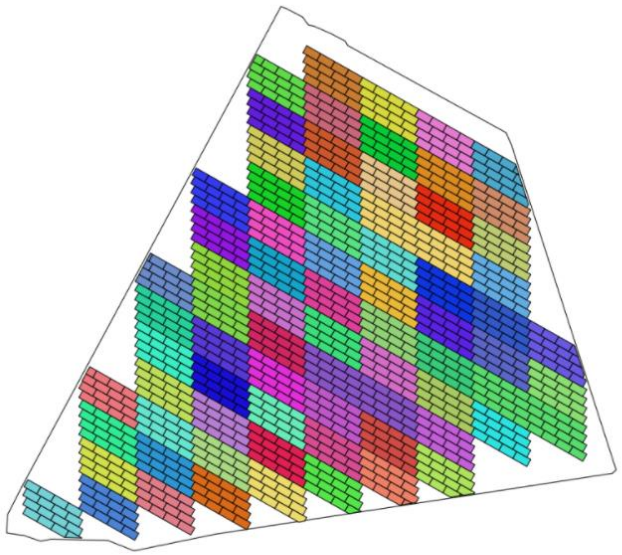


Source: Shiratsuchi, 2015

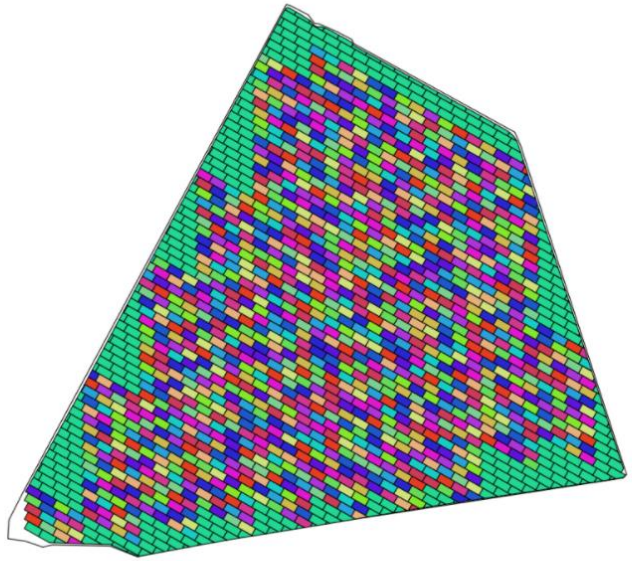
On Farm Research

Field SA01 – Bedin´s Farm (847 acres)

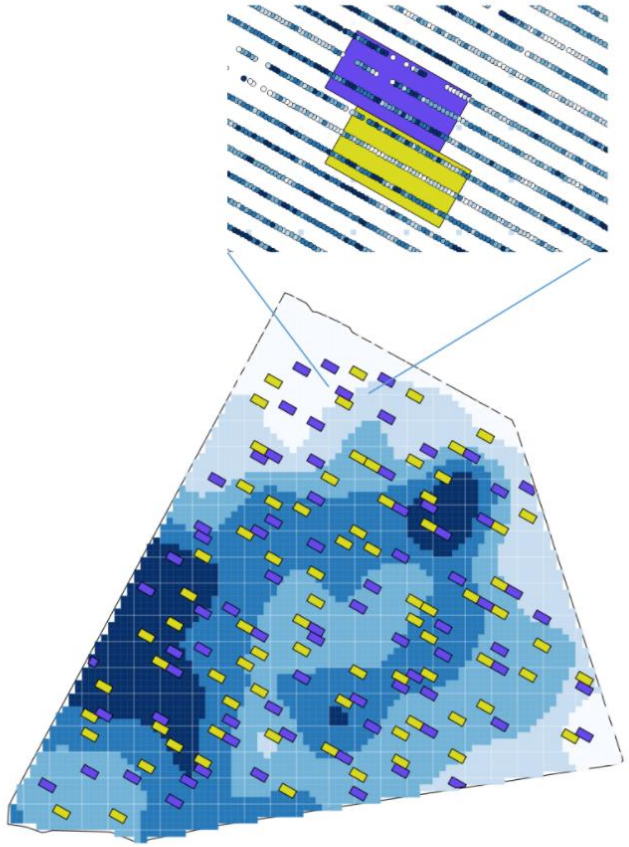
On farm experiment
4 N rates (0, 45, 90, 180 kgN/ha)
4 Plant populations (45, 50, 55, 60,000 seeds/ha)



Blocks (77)



16 treatments in each block

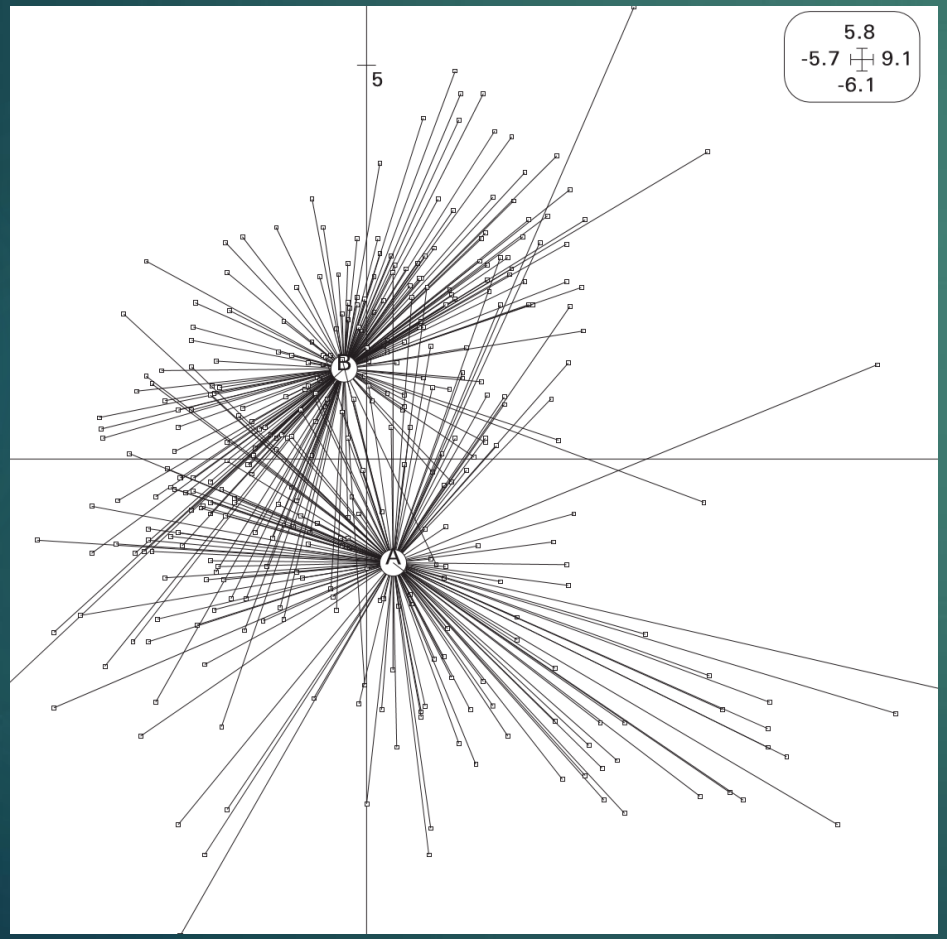


Farmer vs Treatment X

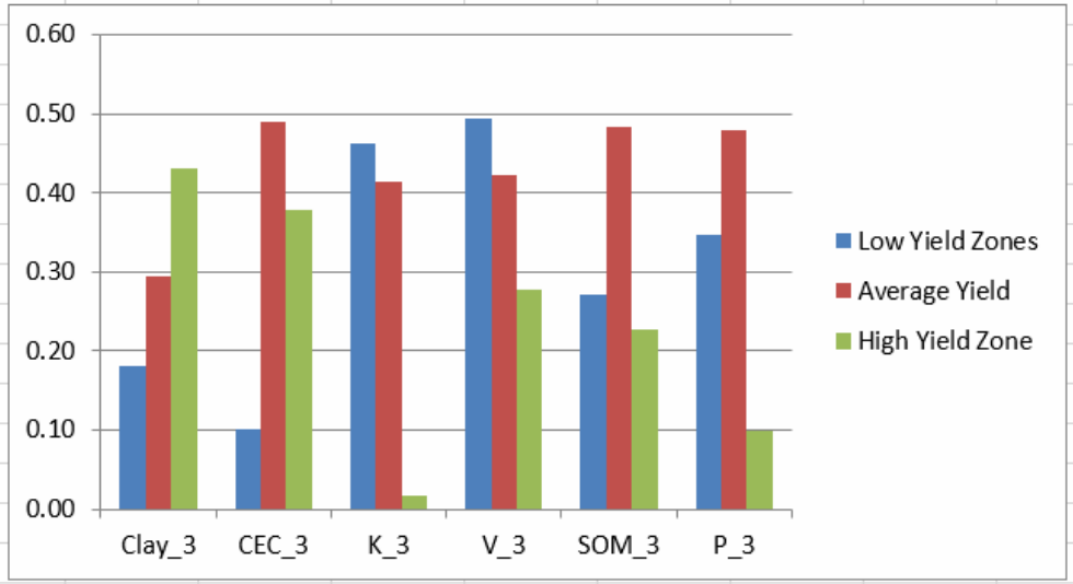
Source: Shiratsuchi, 2017

Example of multivariate statistics in Soil Fertility Management

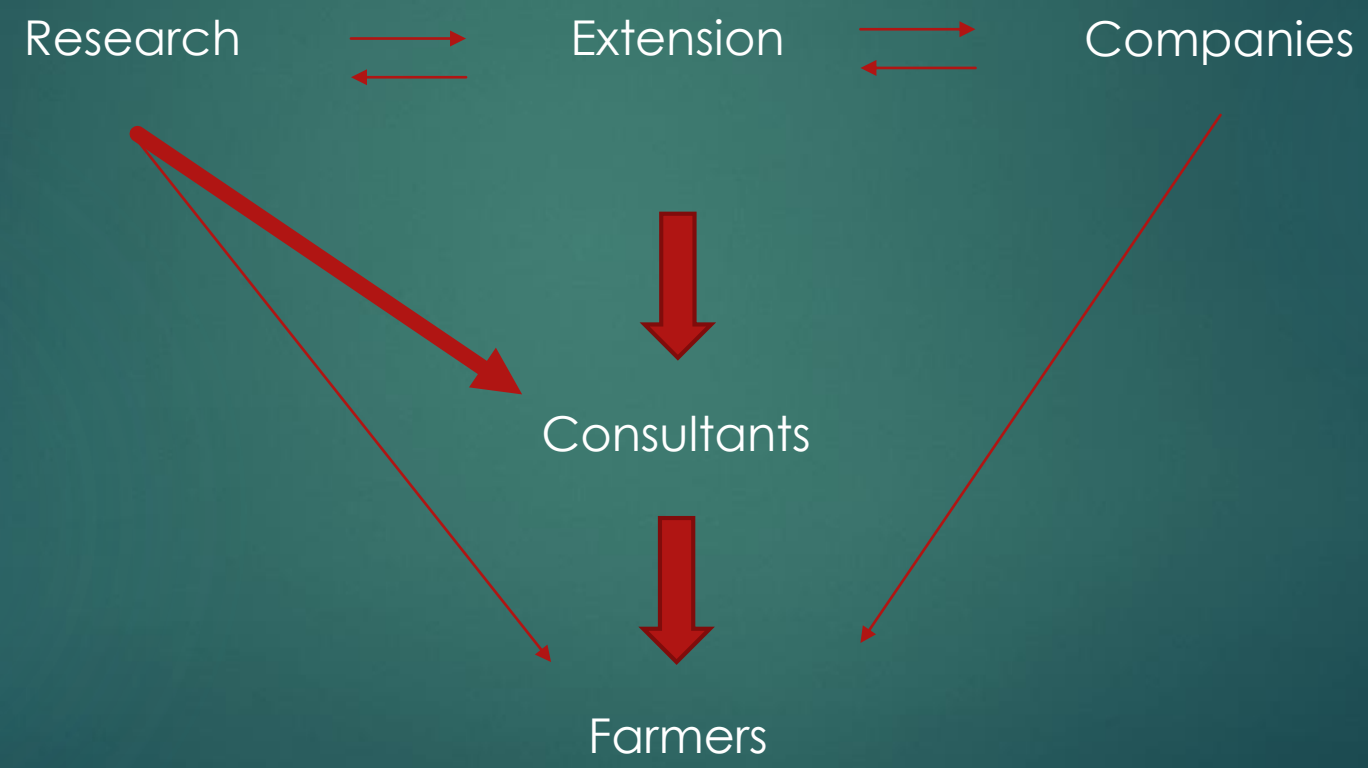
1) Georreferenced database organization with standard methods to develop Big Data Applications and refinate multivariate data analysis (PCA, Path Analysis,...)
2) Decision Support Systems using Cloud Computing



	Clay_3	CEC_3	K_3	V_3	SOM_3	P_3
low	0.18	0.10	0.46	0.49	0.27	0.35
average	0.29	0.49	0.41	0.42	0.48	0.48
high	0.43	0.38	0.02	0.28	0.23	0.10
INDEX	0.91	0.97	0.89	1.19	0.98	0.92
Pearson	-0.15	-0.07	-0.10	0.15	-0.06	-0.08



Arrangements



ON FARM RESEARCH NETWORK – Brazilian Example

Research and Development Coordination

Embrapa — Empresa Brasileira de Pesquisa Agropecuária
Ministério da Agricultura, Pecuária e Abastecimento

Luciano Shiratsuchi

IMAmt — INSTITUTO MATO-GROSSENSE DO ALGODÃO

Márcio Souza

Operational Coordination

SOLOPLANTA

Gabriel Alves

MONAGRI — Agricultura de Precisão & Consultoria Agronômica

Maurício Nicocelli

Reference Fields

Grupo Scheffer — Excelência em Agribusiness

Luciano Brawers

182,000 acres
67,000 acres (Cotton)

TERRA SANTA

Rodrigo Trevisan

407,000 ha
68,000 acres (Cotton)

Petrovina Sementes

Pedro Oliveira Mokfa

45,000 acres
12,000 acres (Cotton)

SLC Agrícola

Ronei Sana

987,000 acres
217,000 acres (Cotton)

Thank you!!

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