Variable-Rate N Fertilization of Wheat and Corn in Virginia

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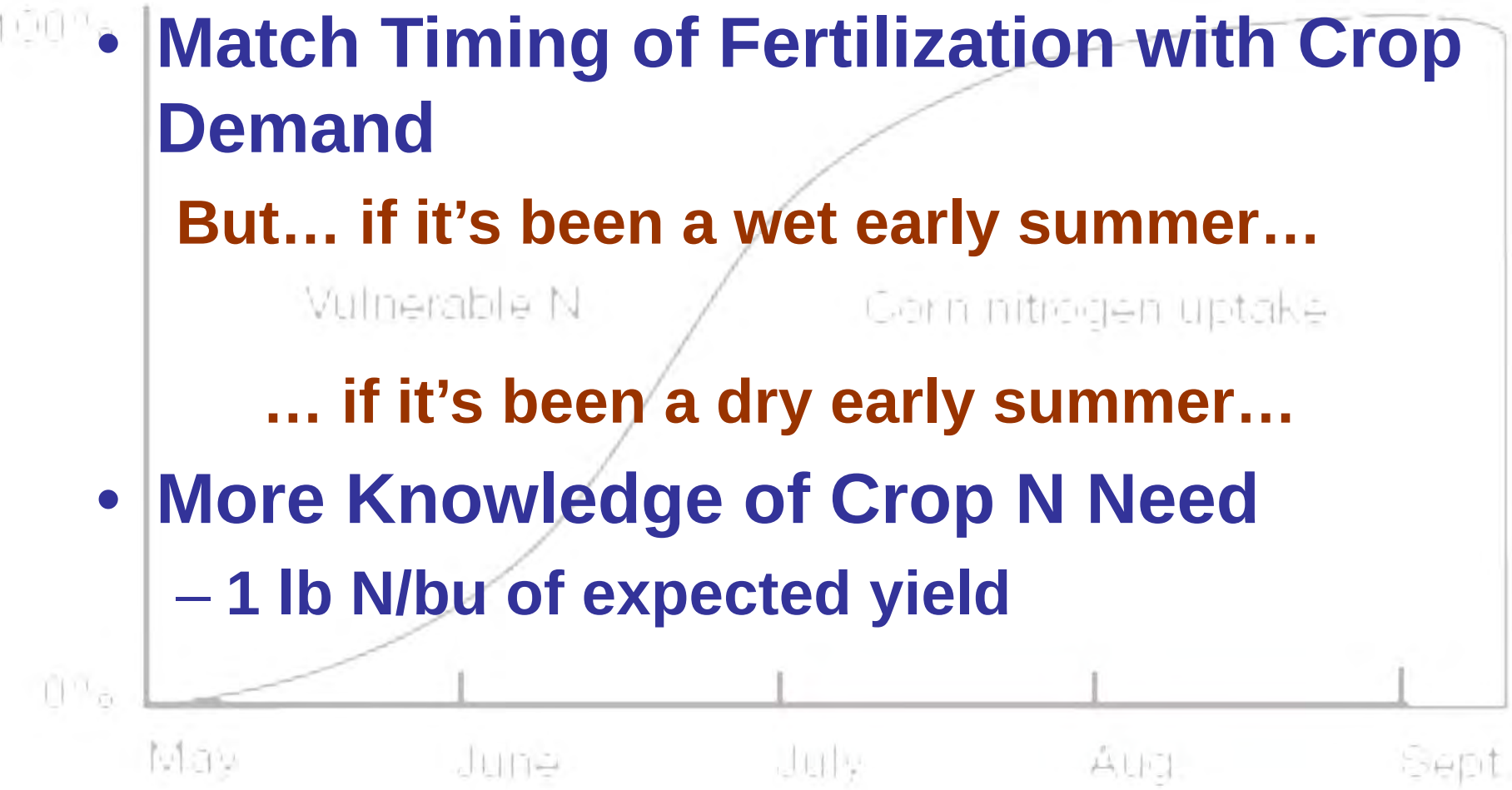
INCREASING N FERTILIZER EFFICIENCY

- **Match Timing of Fertilization with Crop Demand**

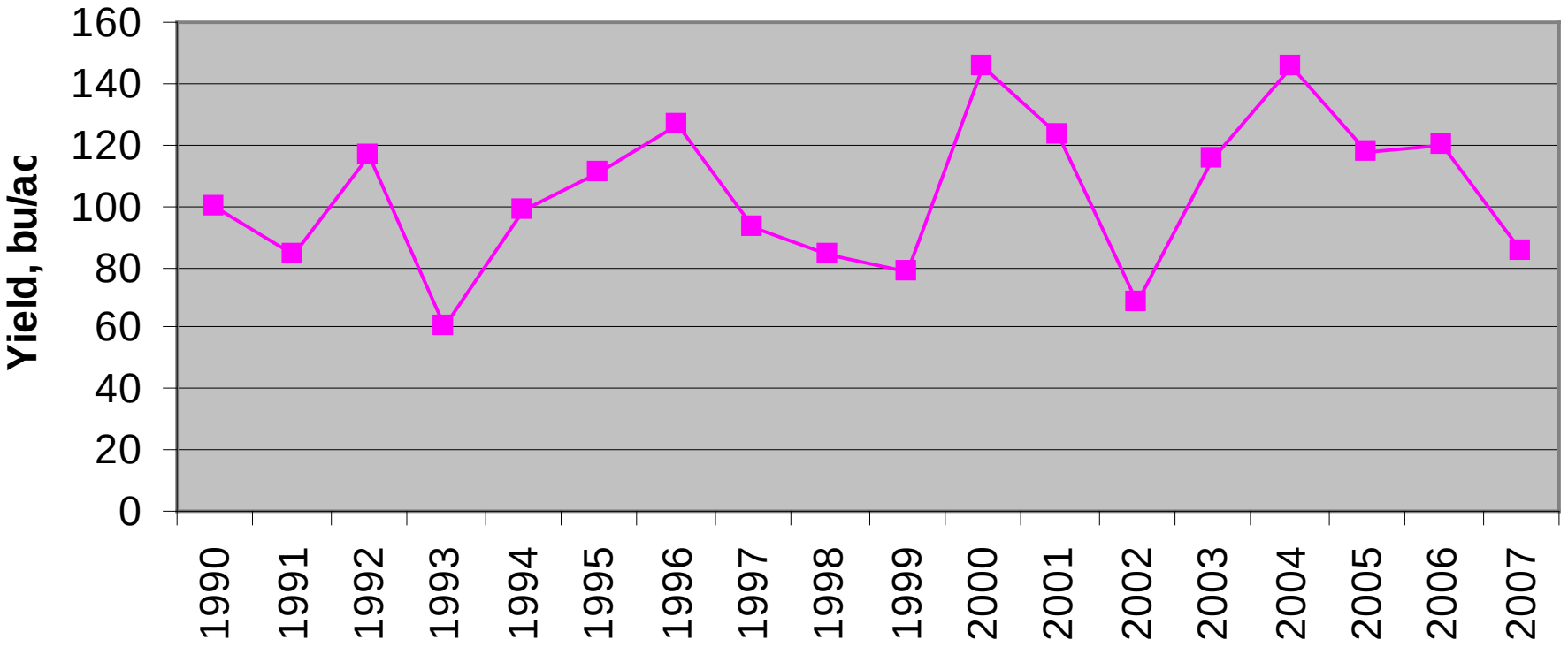
  But… if it's been a wet early summer…

  … if it's been a dry early summer…

- **More Knowledge of Crop N Need**
  - **1 lb N/bu of expected yield**



TEMPORAL VARIABILITY



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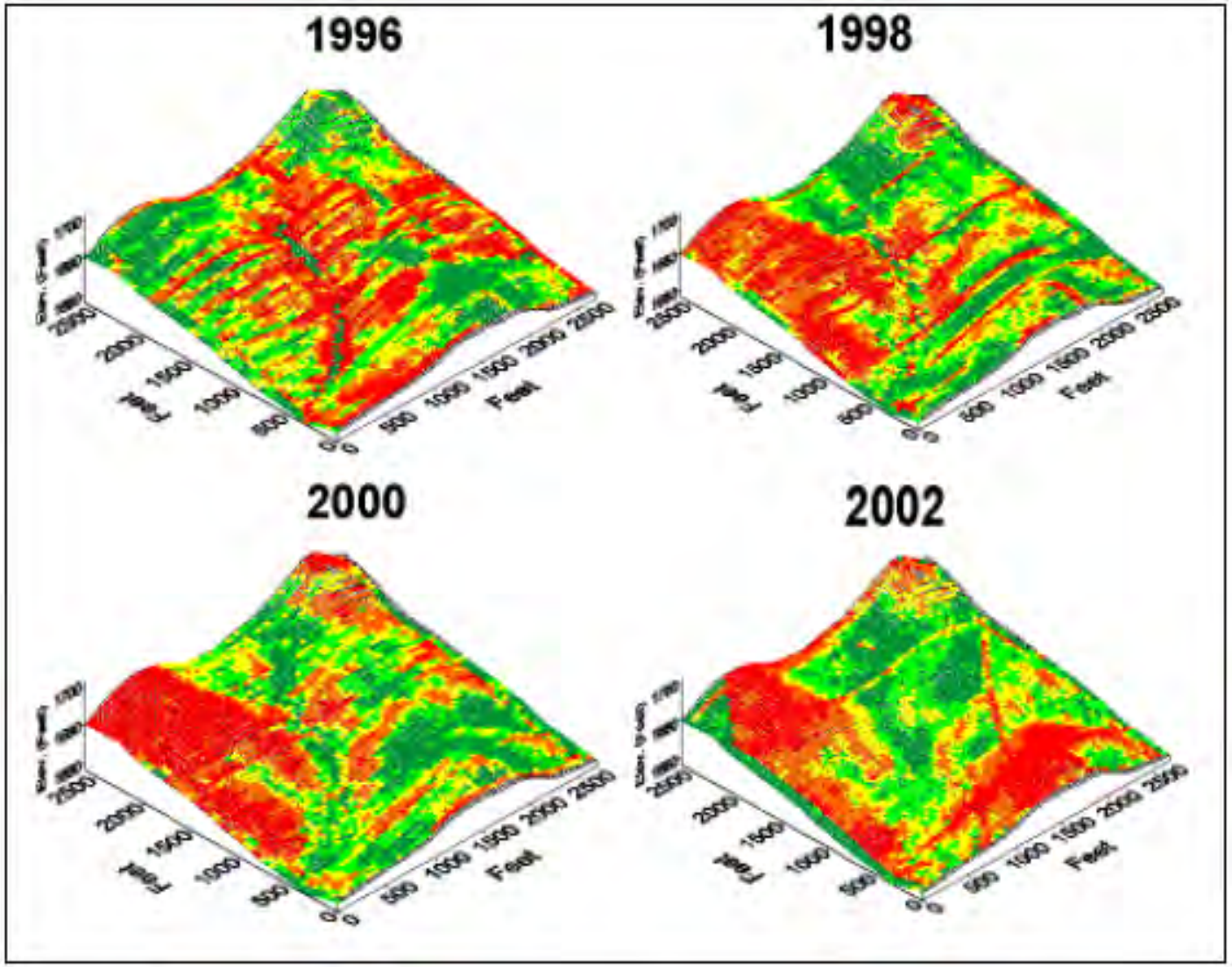
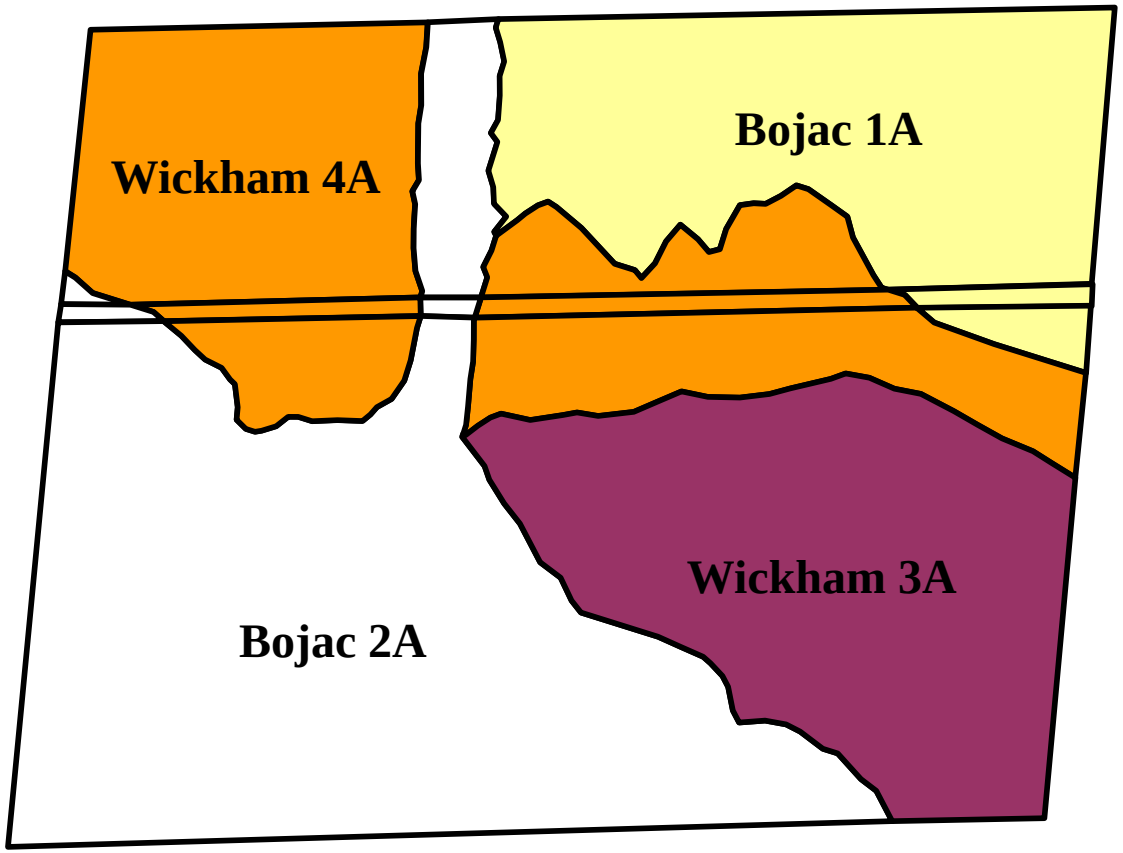


SPATIAL VARIABILITY

- 60 acre field in Caroline County

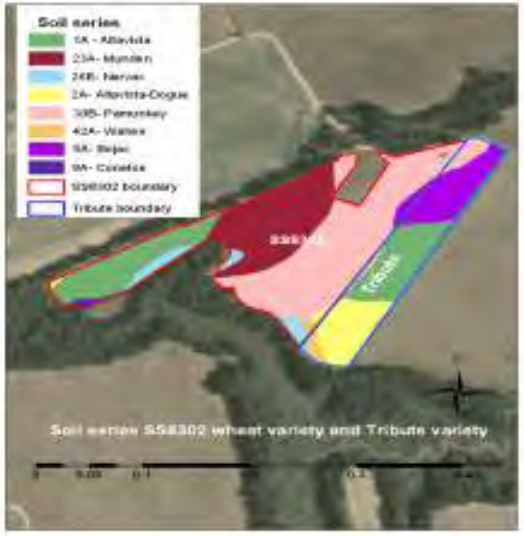
- Wheat yields: 44 to 80 bu/acre

- Corn yields: 85 to 178 bu/acre



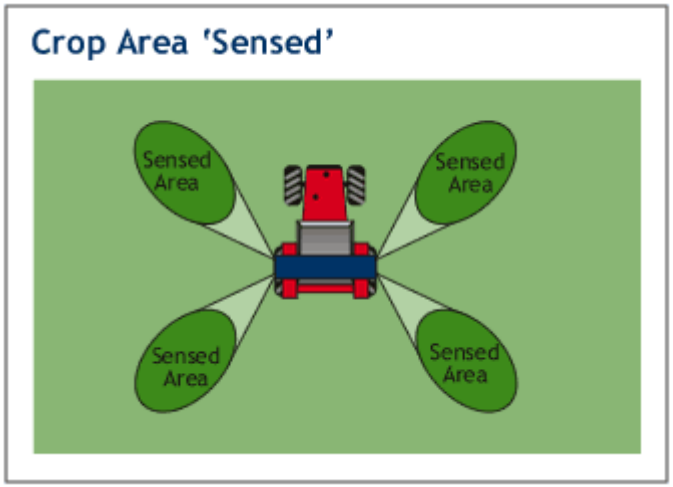
ADDRESSING THIS VARIABILITY

- Temporal
  - Shoot from the hip
  - PSNT
  - Tissue tests
  - Chlorophyll meter
  - Precision Ag Technologies
- Spatial
  - Soil map
  - Yield/History map



In-Season Remote Sensing

- Satellite
- Aerial photography
- Ground-based Sensing

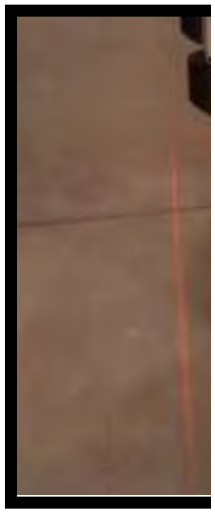


SPRA-COU

Questions…. Answers

- Do Optimum N rates Vary From One Year to the Next in the Same Field?
- Can We Measure and Address this Variability?
- Can N Rates be Adjusted based on Early-Mid Season Measurements?
- Can the Responsiveness to N be Predicted?

OPTICAL SENSORS



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equency of 60

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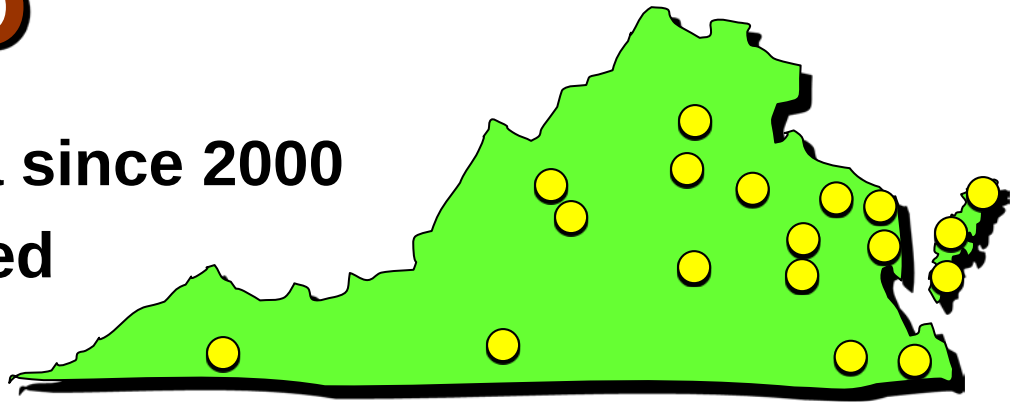
calculated every

BACKGROUND

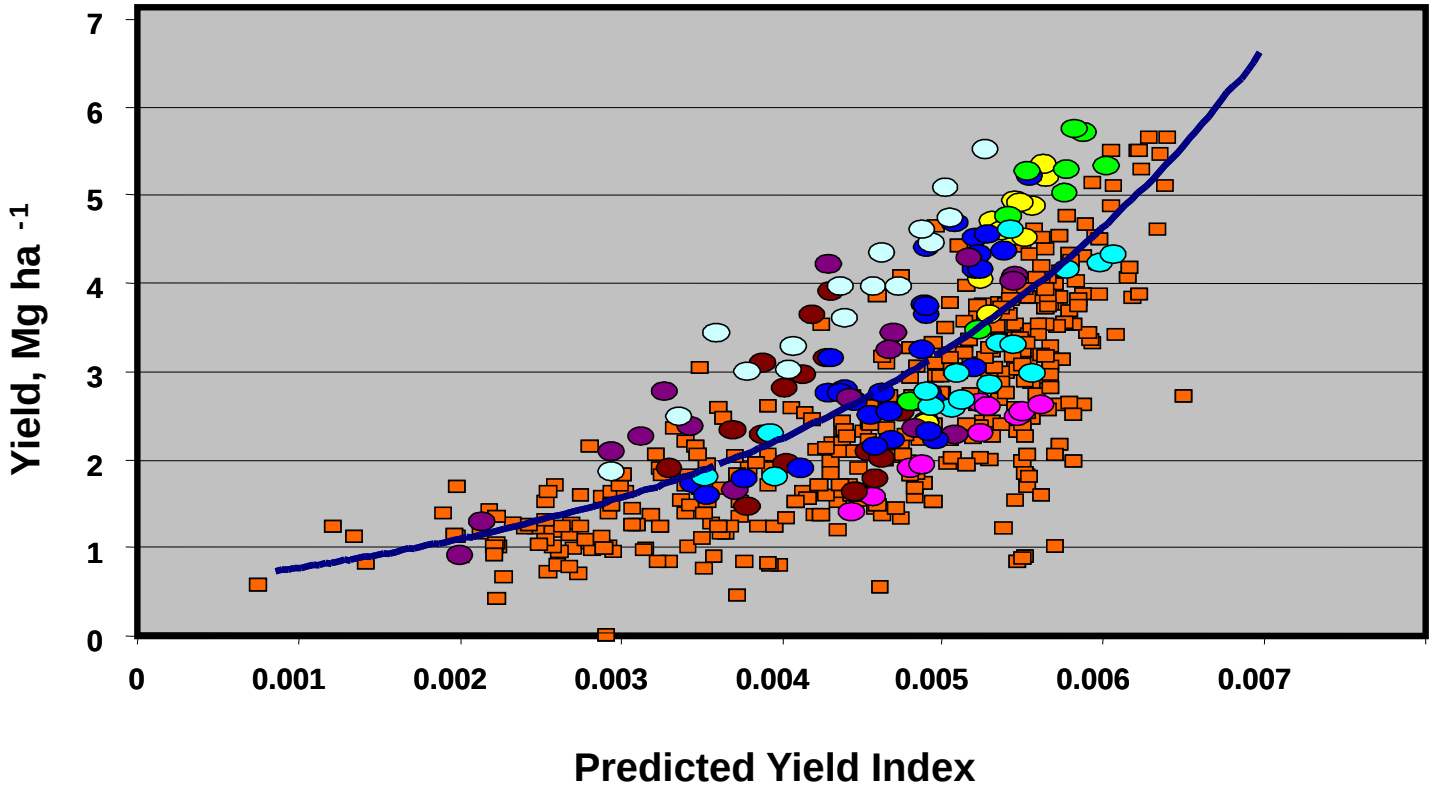


- ~60 sites across Virginia since 2000
- Irrigated and non-irrigated
- Conventional and no till
- Various rotations, hybrids, varieties, and soil types

- Wide range of preplant, starter, and in-season N rates (including VR)
- Collected spectral measurements and an assortment of plant physical and chemical characteristics at various growth stages
- Determine grain yield

VIRGINIA APPROACH

- **Generated calibration models for wheat and corn grown in the Mid-Atlantic**



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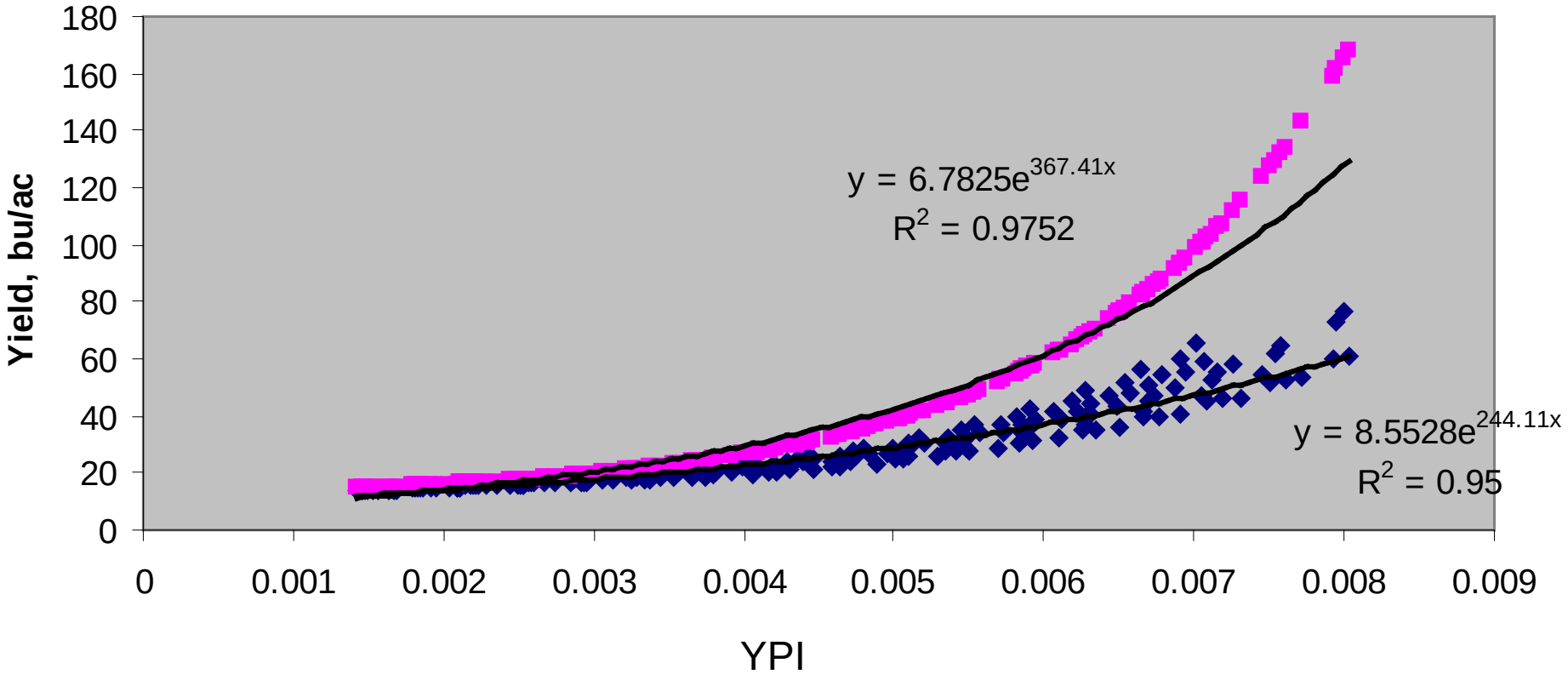
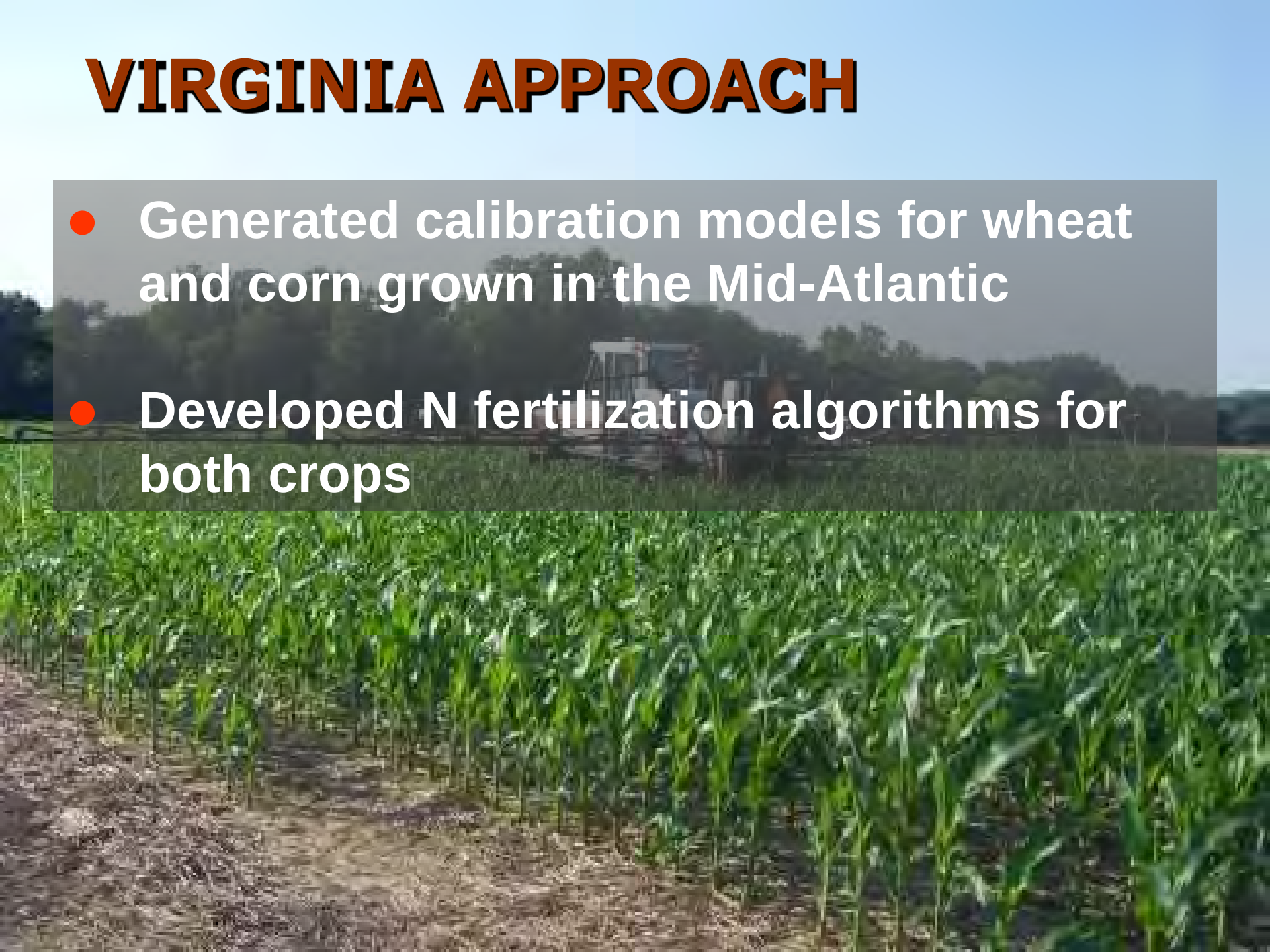


VIRGINIA APPROACH

- Generated calibration models for wheat and corn grown in the Mid-Atlantic
- Developed N fertilization algorithms for both crops

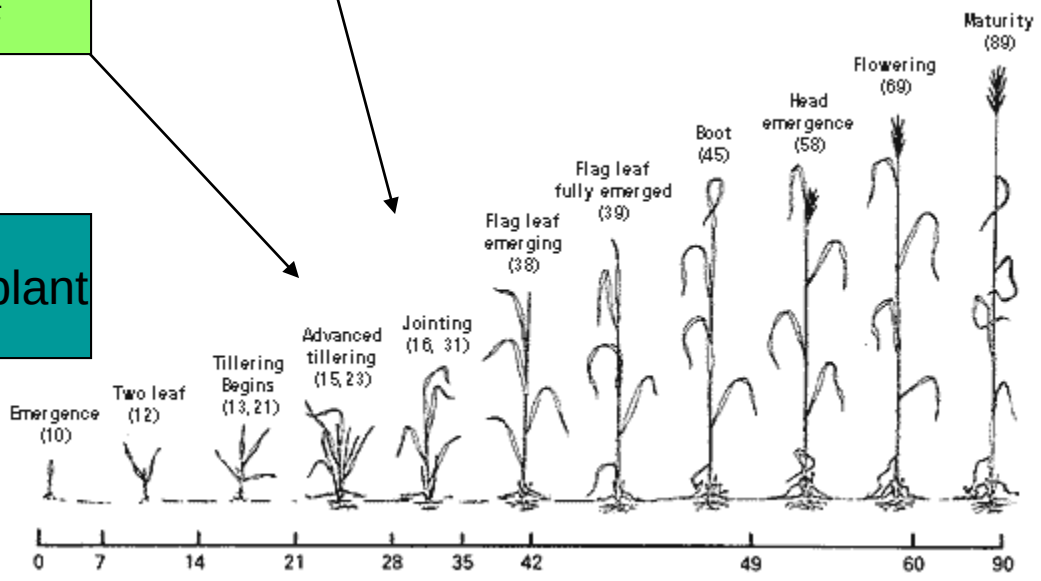


In-season N management

1st topdress based on estimated tiller #

2nd topdress based on Tissue N concentration

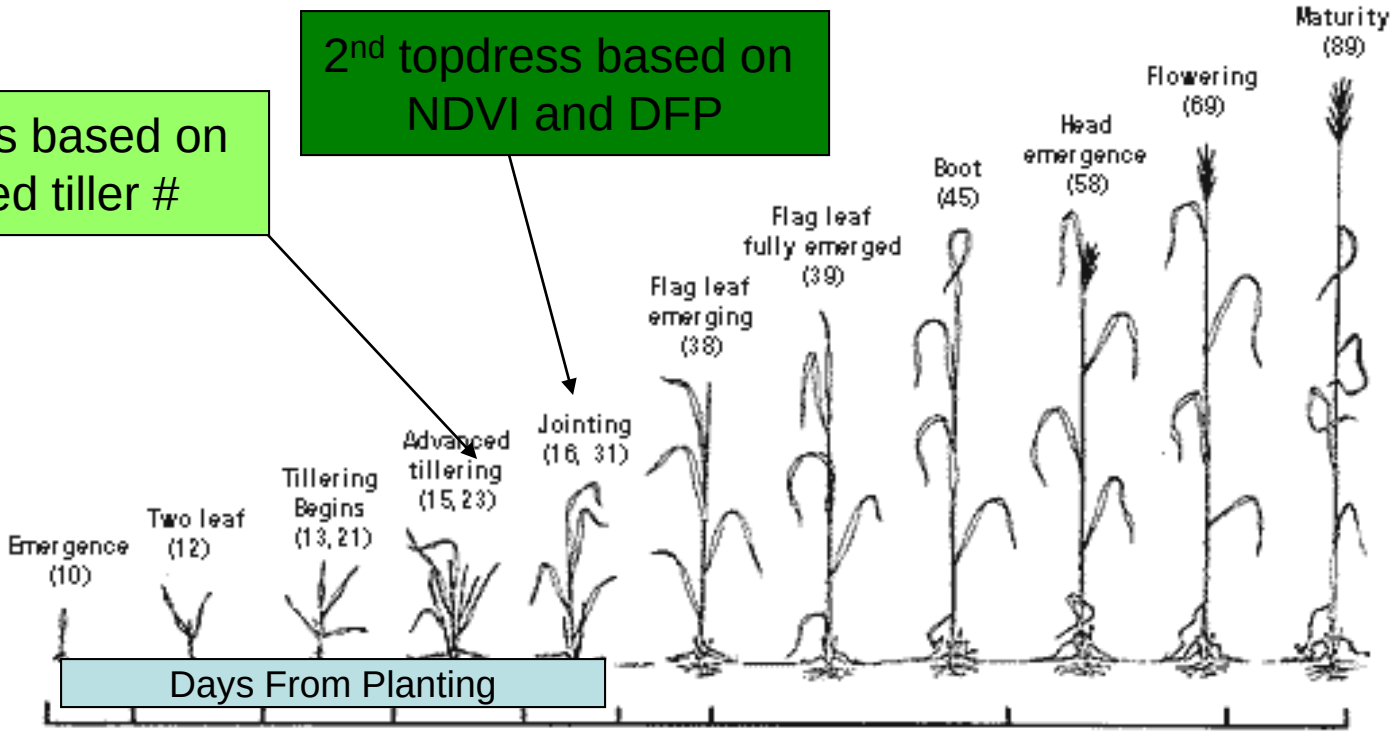
30 to 40 lb N/ac preplant



In-season N timing

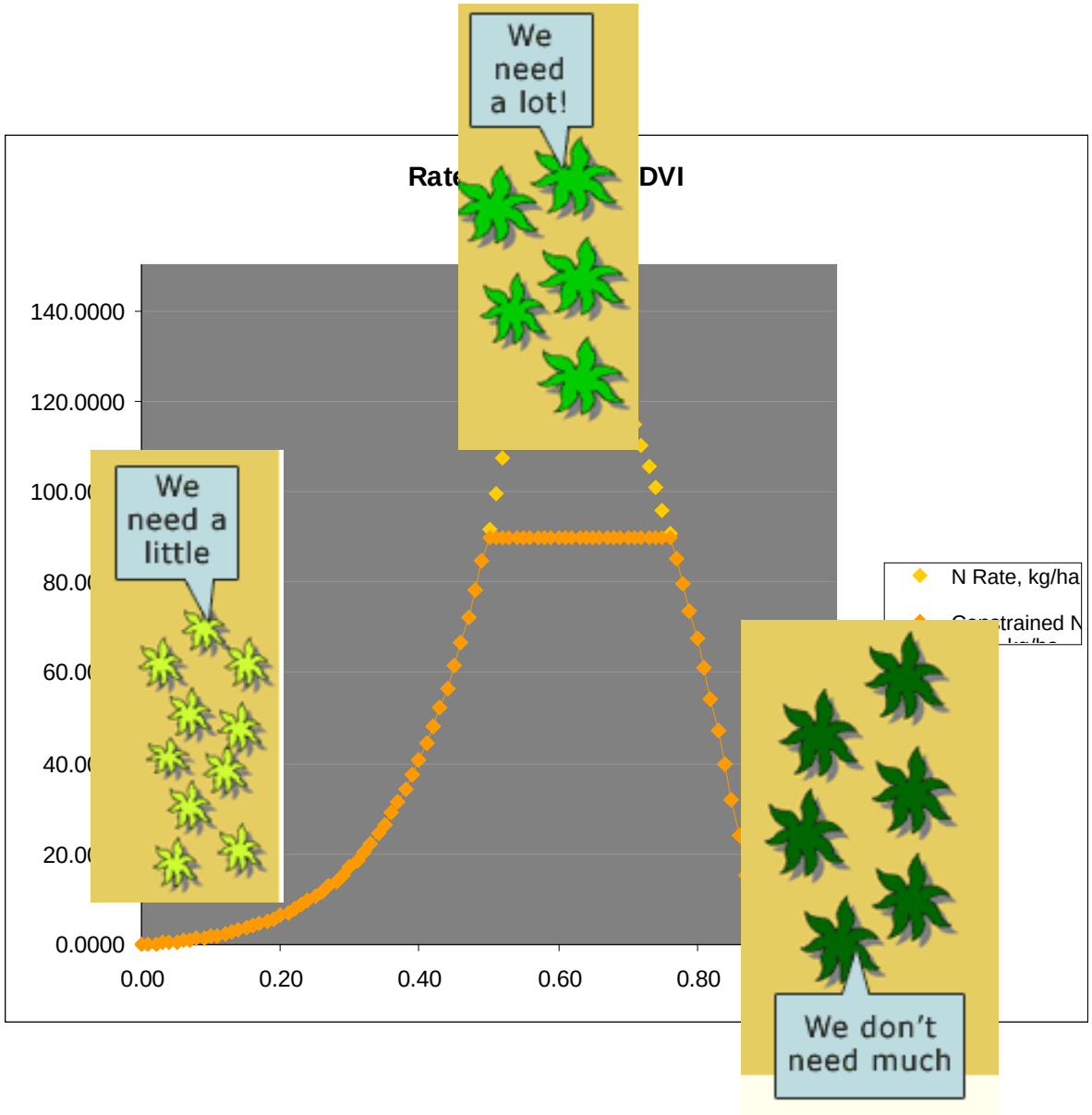
1st topdress based on estimated tiller #

2nd topdress based on NDVI and DFP



Zadoks stage, in parenthesis

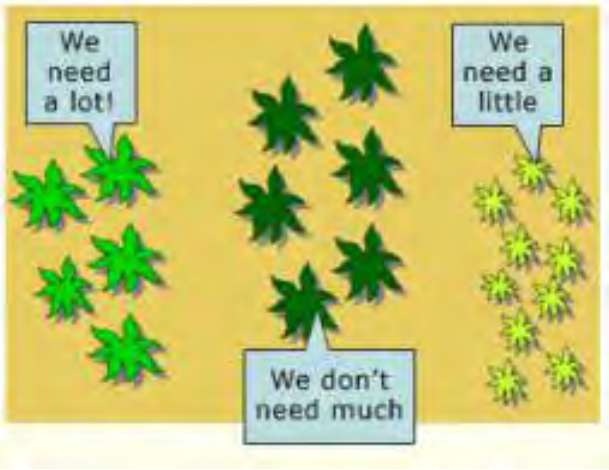
Wheat N Rate Algorithm



What's Needed

- Reference Strips
  - Difference between:
    - High N reference (best possible with more than adequate N)
    - Low N reference (0 N applied)

  And
  - Area currently in sensor's view.

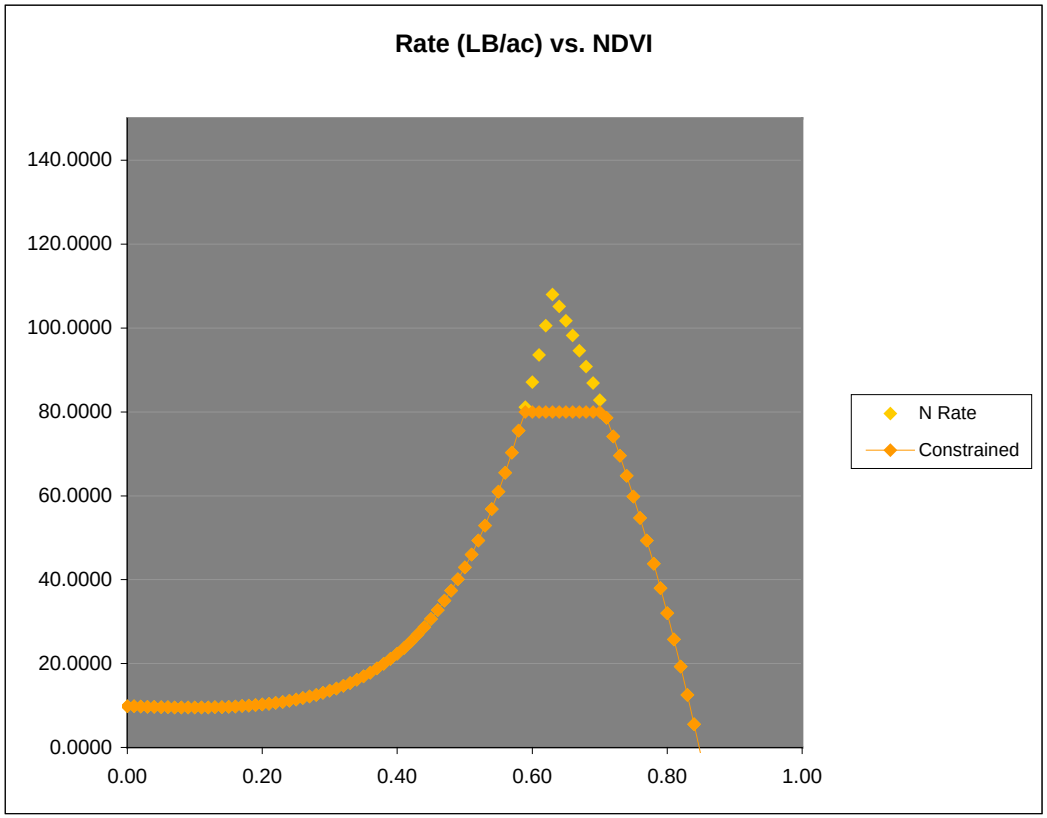


VIRGINIA APPROACH - Wheat

TARGET NDVI	LOW REFERENCE	HIGH REFERENCE	GS 25 N	DAP	MAX YIELD	MAX N	NUE	N RATE
0.60	0.50	0.80	50	150	85	80	50	80
			lbs/N	dap	bushels	max constra	%	lb/ac

87.1361 **N fertilizer required**
23.5681 **N required for additional grain**
46.0133 **Bushel/A expected yield increase due to fertilizer**

coefficients	Define these units	SI units ?
ka	0.74076	
kb	577.66	
kc	1000	
kd		
NUE	50%	
CONVERSION	0.0149	

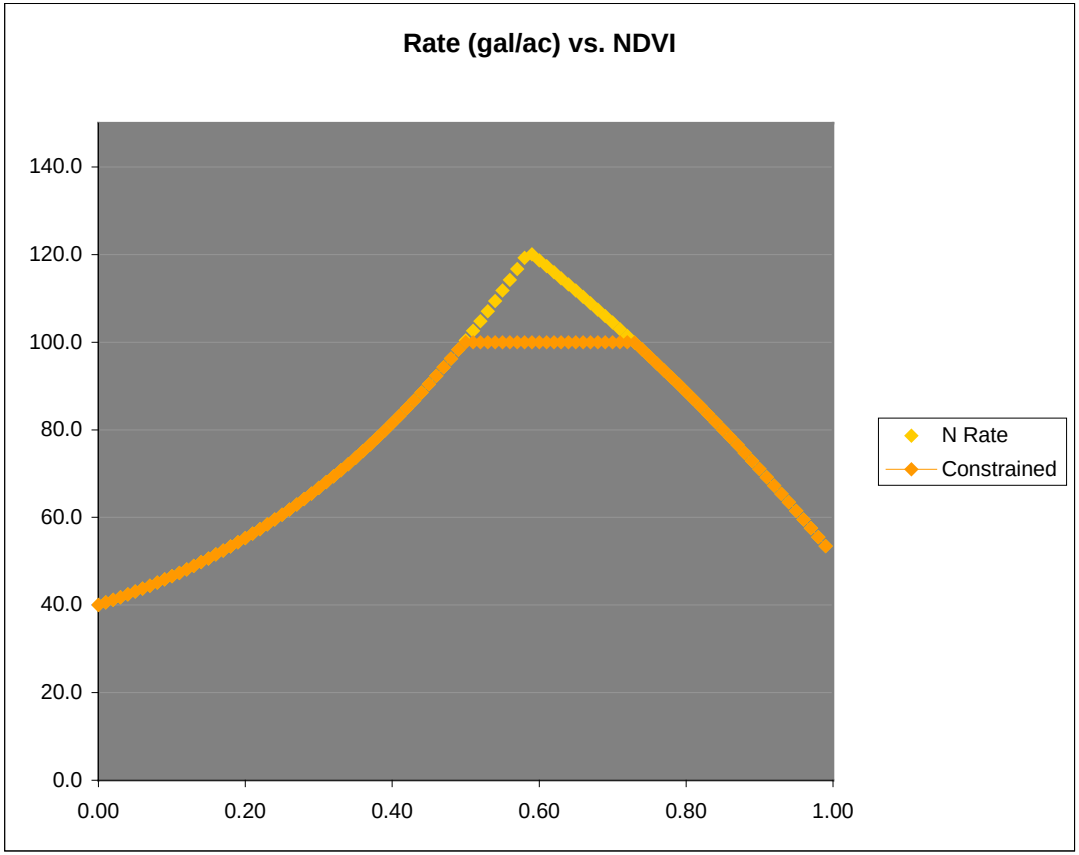


VIRGINIA APPROACH - Corn

NDVI	Low_Ref	Hi_Ref	N_preplant	DFP	MAX YIELD	MAX N	N RATE
0.82	0.50	0.90	60	63	175	100	85
			lbs/N	dap	bushels	max constr	gal/acre
							kg/ha

85.27

coefficients	Define these units	SI units ?
ka	56.479	
kb	67.626	
kc	56	
kd		
NUE	60%	
Pn	0.0125	



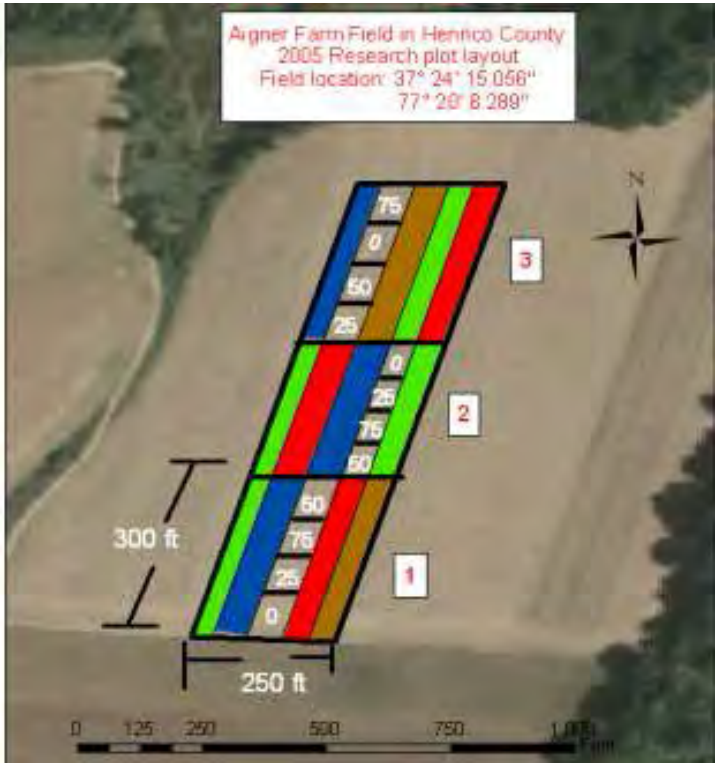
VIRGINIA APPROACH

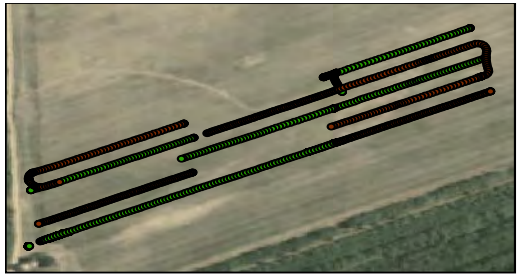
- Generated calibration models for wheat and corn grown in the Mid-Atlantic
- Developed N fertilization algorithms for both crops
- Validated these rate equations for performance

EXPERIMENTAL PROCEDURES

- Diverse locs; RCBD; 3-8 reps
- Plot size: 60 by 250 to 500 ft
- In-season N:
  - 4-5 Fixed Rates
  - 1 Standard Rate
  - 1 Variable Rate
- Grain Yield

- Spra Coupe 220 w/ 60 ft boom and GreenSeeker RT200
- Raven 440 flow rate controller





Average: Single N rate determine using Greenseeker® (VA algorithm)

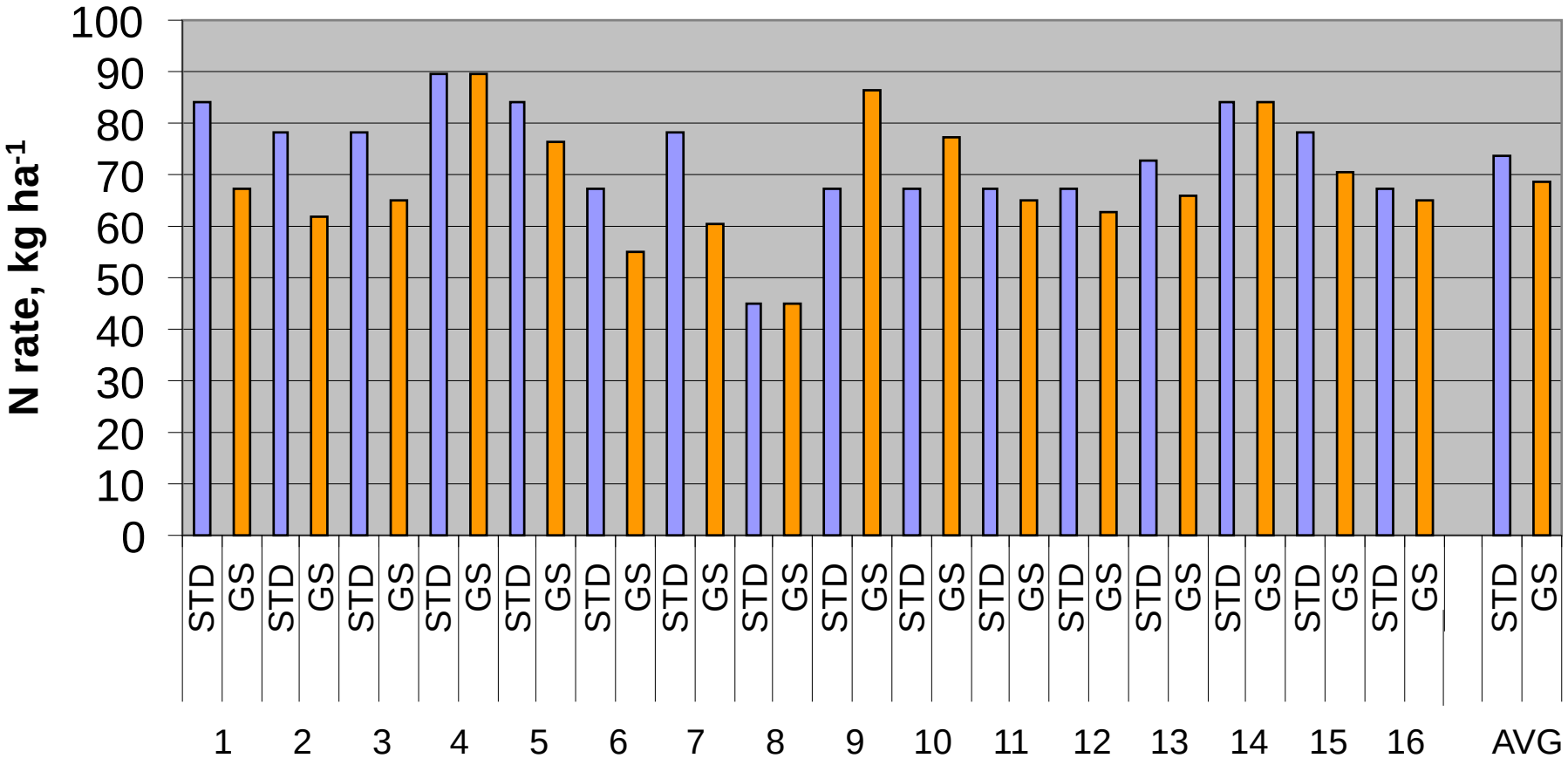
Variable: Variable Nitrogen rate determined using Greenseeker® Virginia Algorithm

Standard: Nitrogen rate determined based on GS 30 tissue test (Standard Virginia recommendation system)

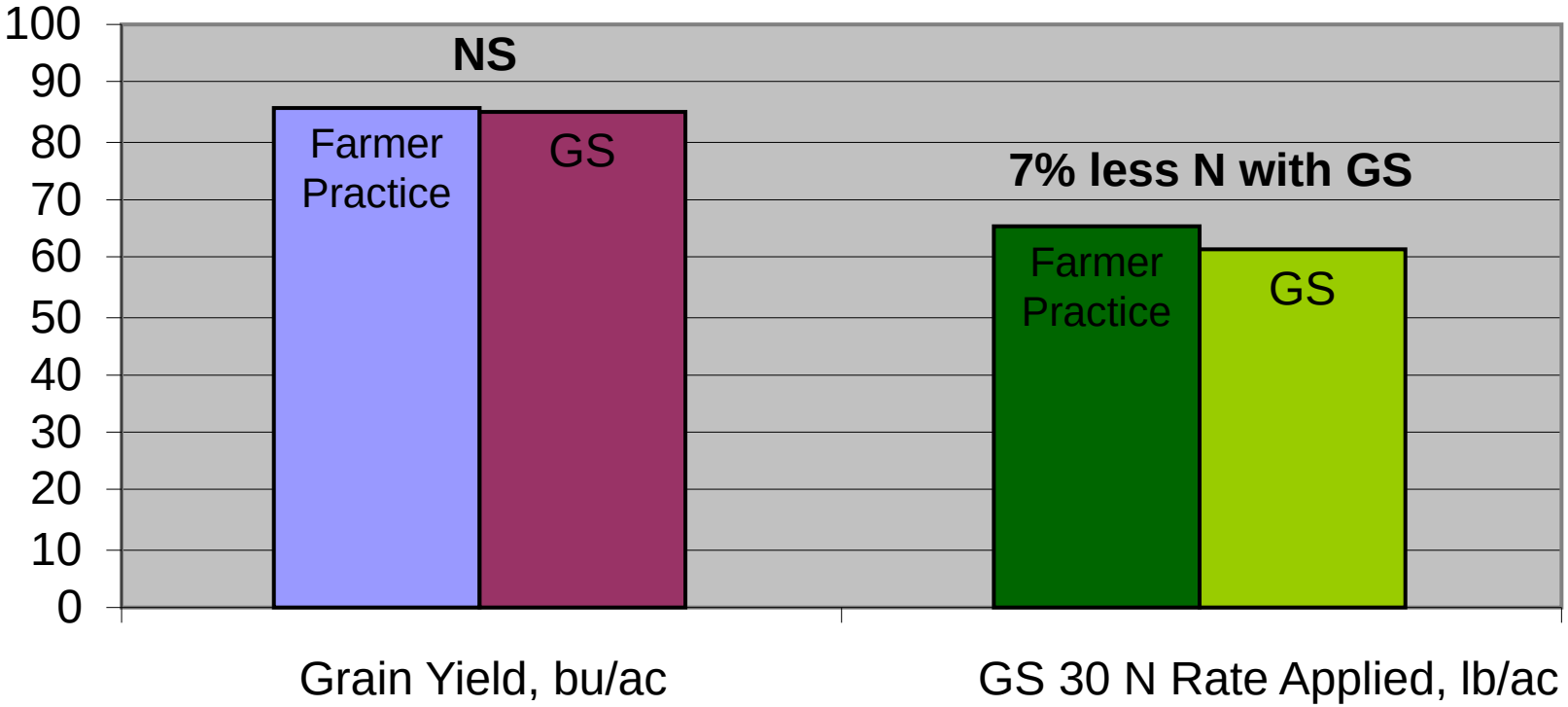
Greenseeker ® : Variable N rates determined using default Greenseeker ® wheat algorithm

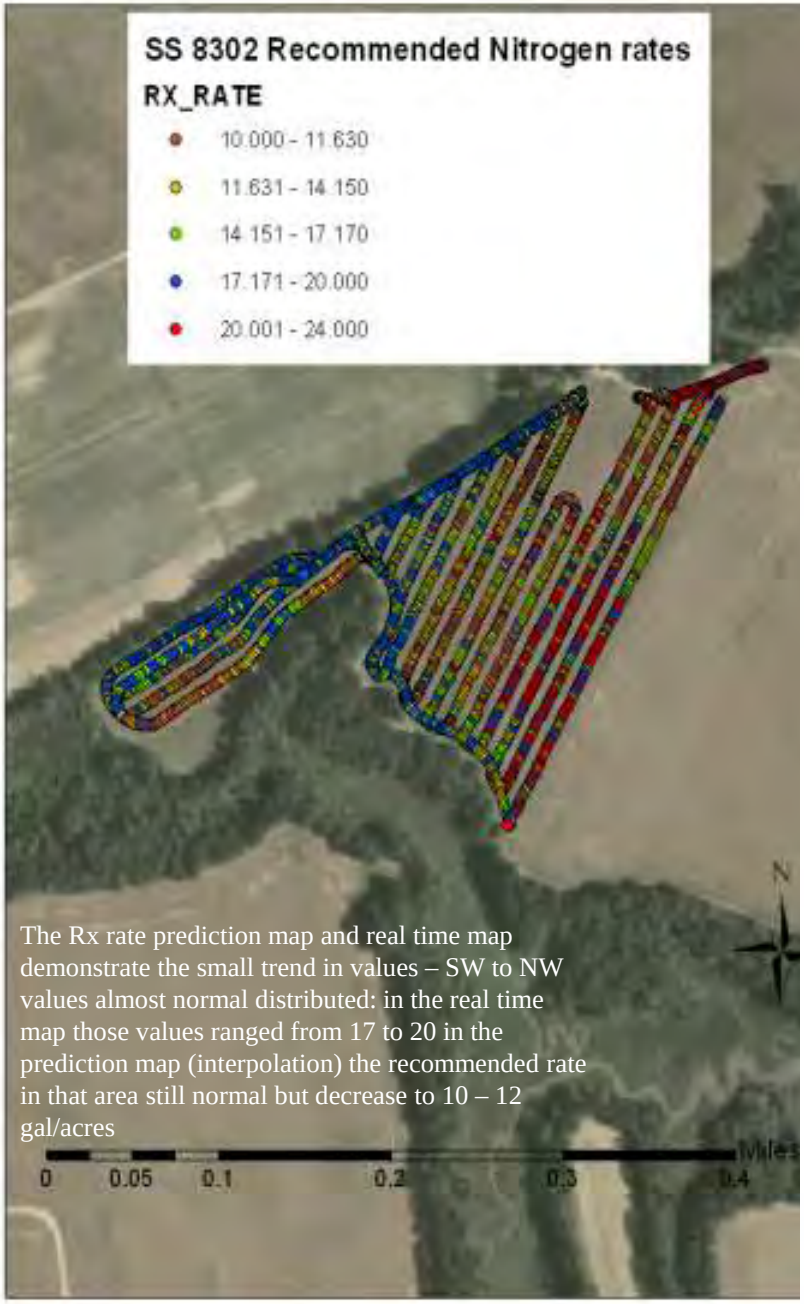
0 – 75 N kg/ha: (numerical rates): Predetermined Nitrogen rates applied in lb/acres

As-applied N rate, tissue test (STD) vs. Greenseeker (GS) recommended rate

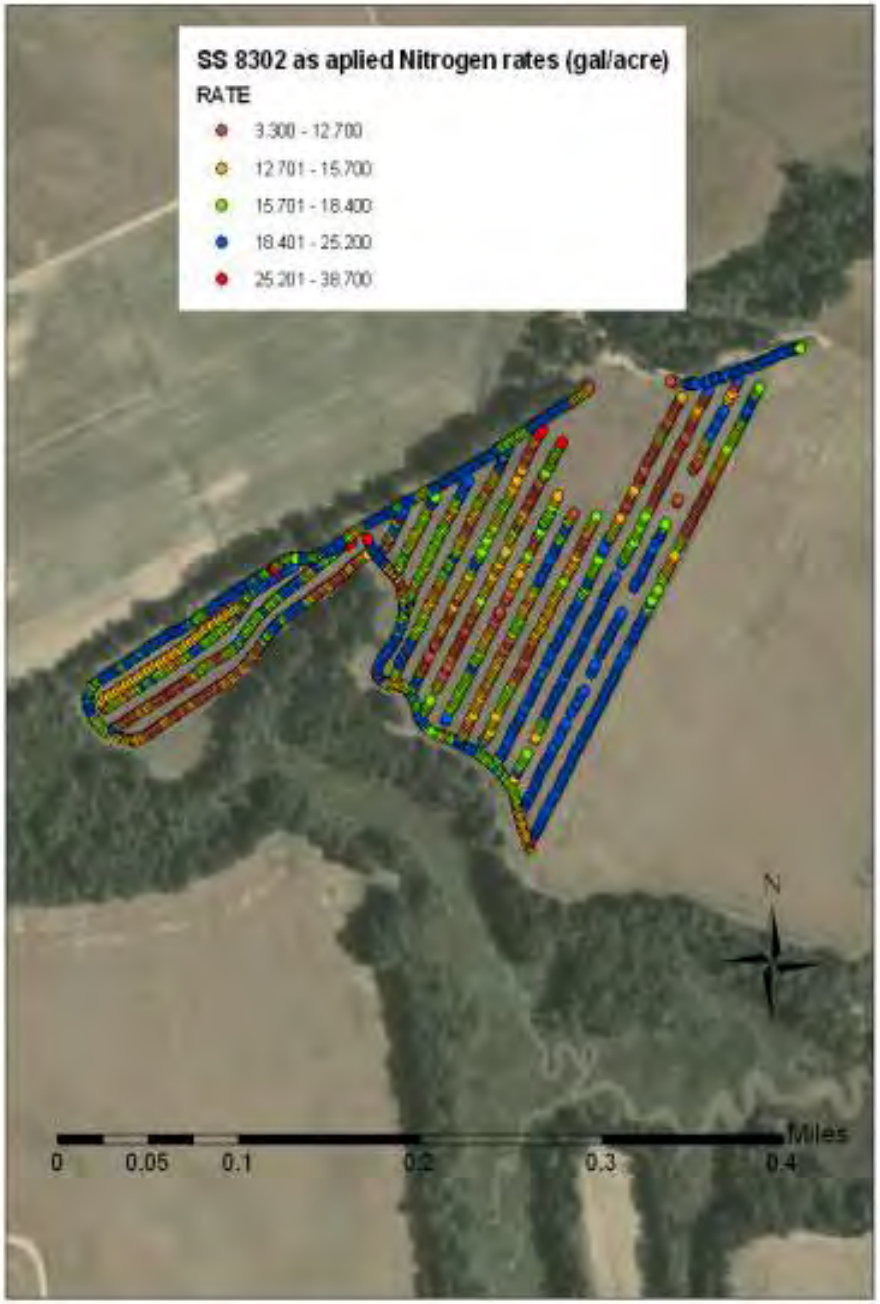


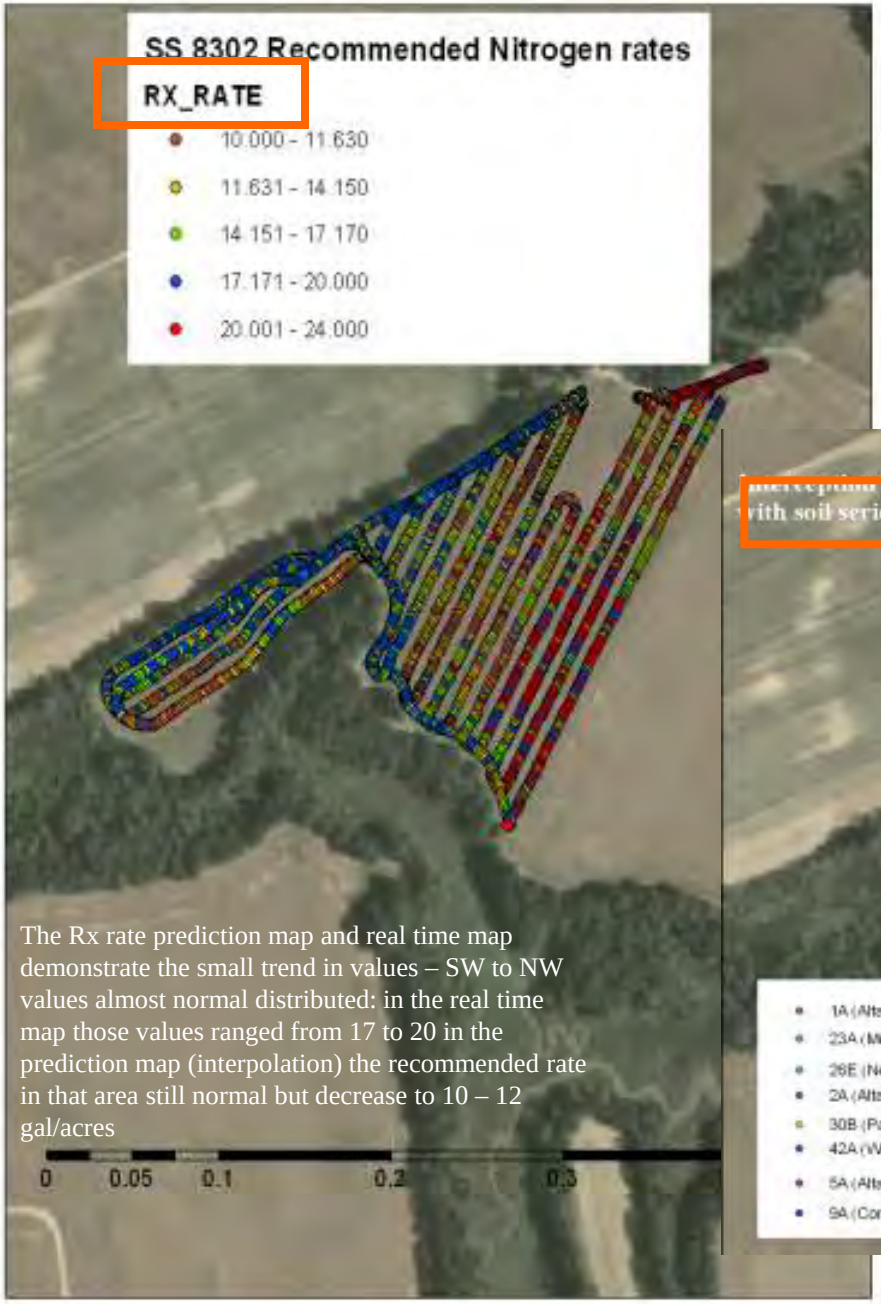
AVG of 16 site years





The Rx rate prediction map and real time map demonstrate the small trend in values – SW to NW values almost normal distributed: in the real time map those values ranged from 17 to 20 in the prediction map (interpolation) the recommended rate in that area still normal but decrease to 10 – 12 gal/acres





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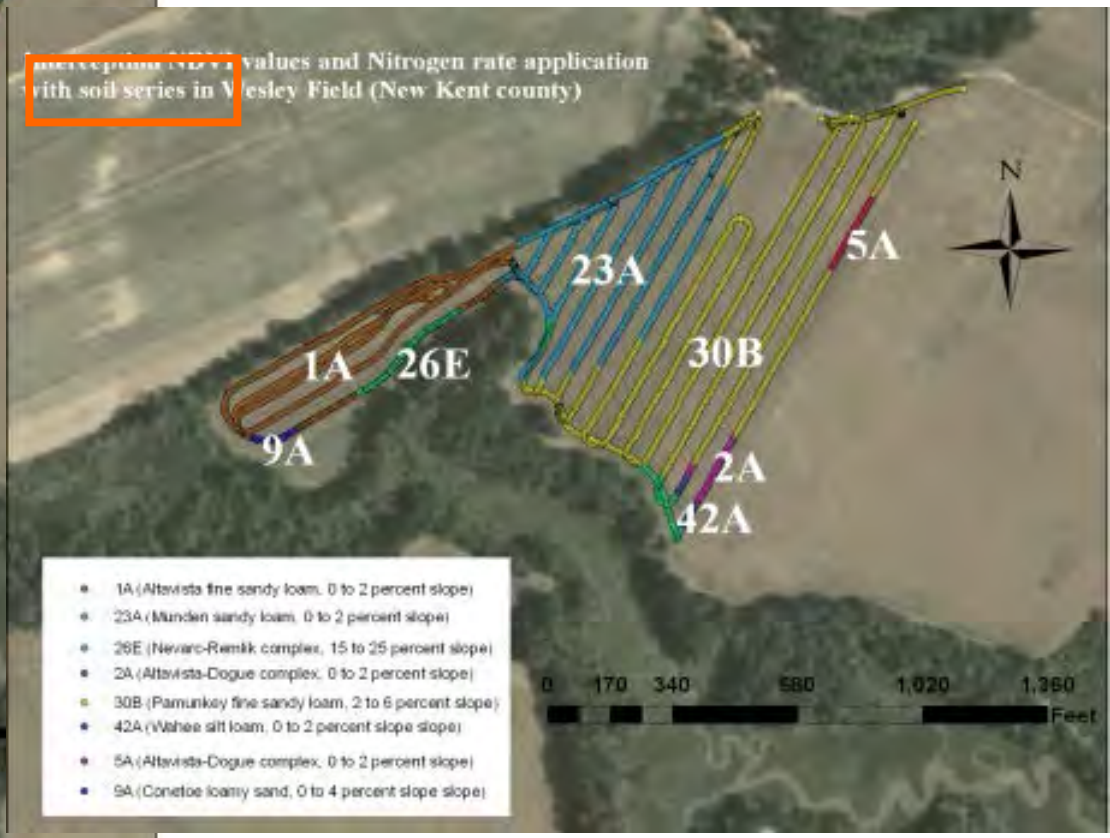
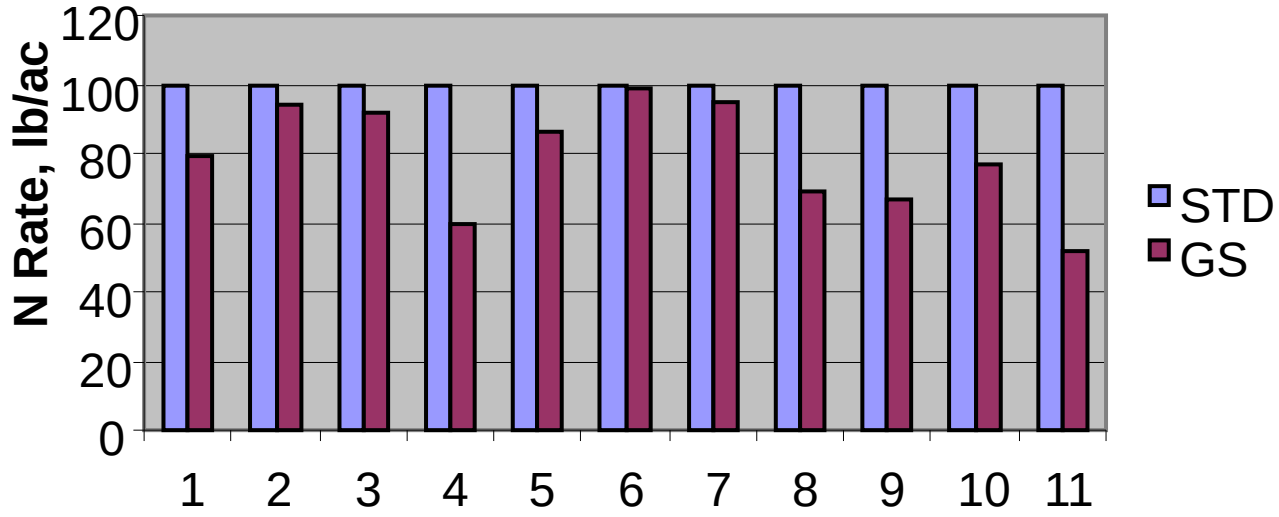
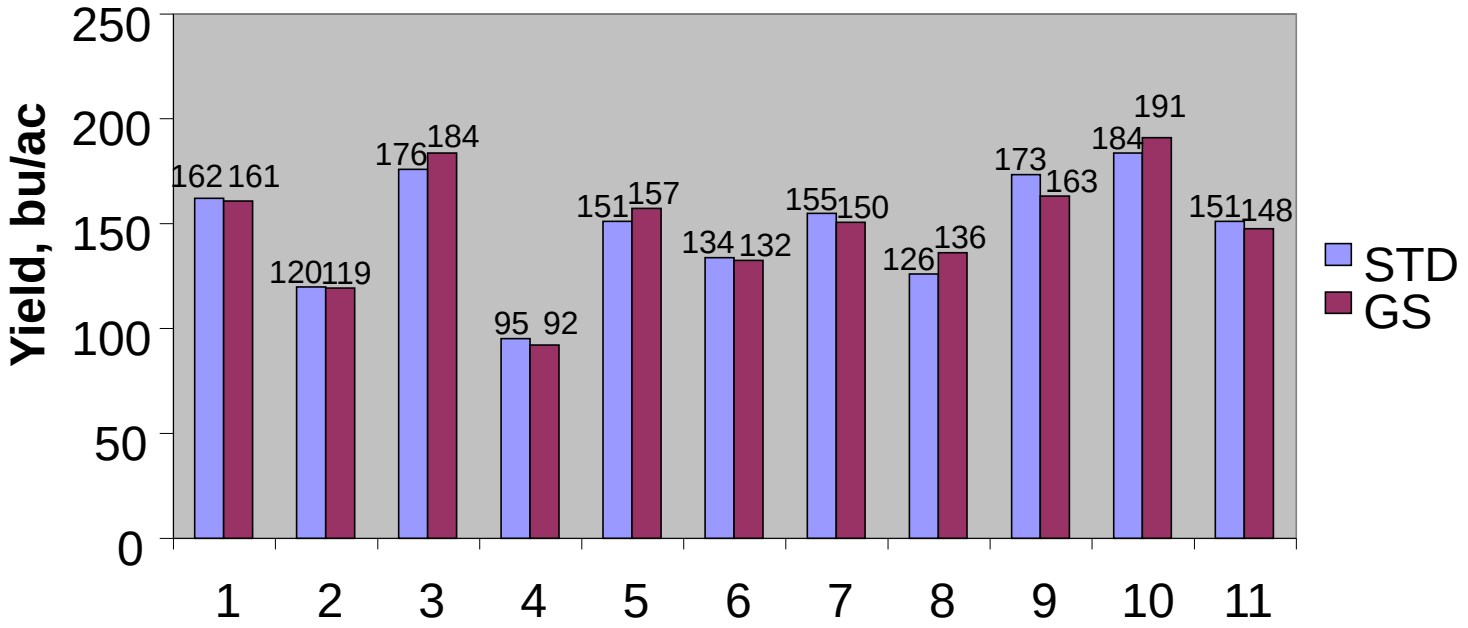


Corn Algorithm Performance





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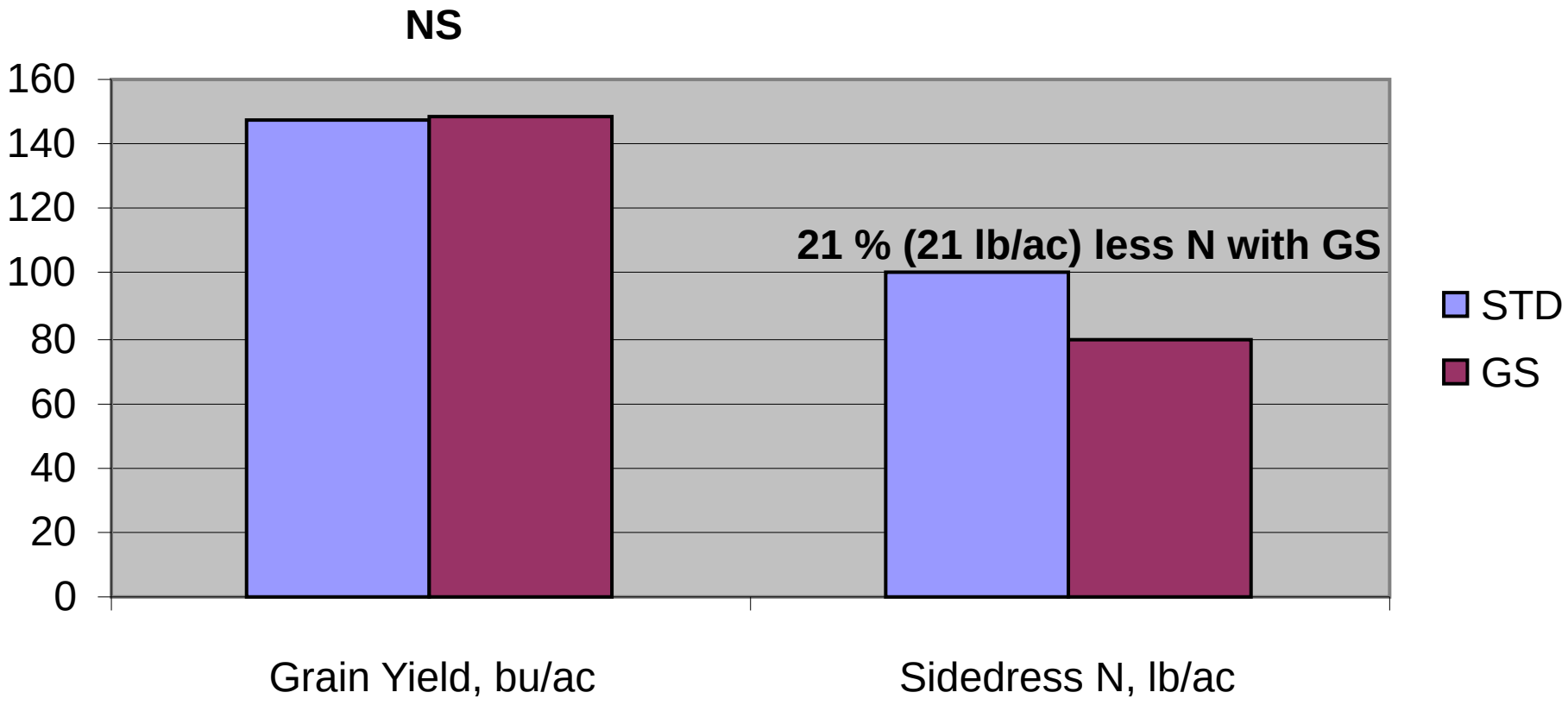
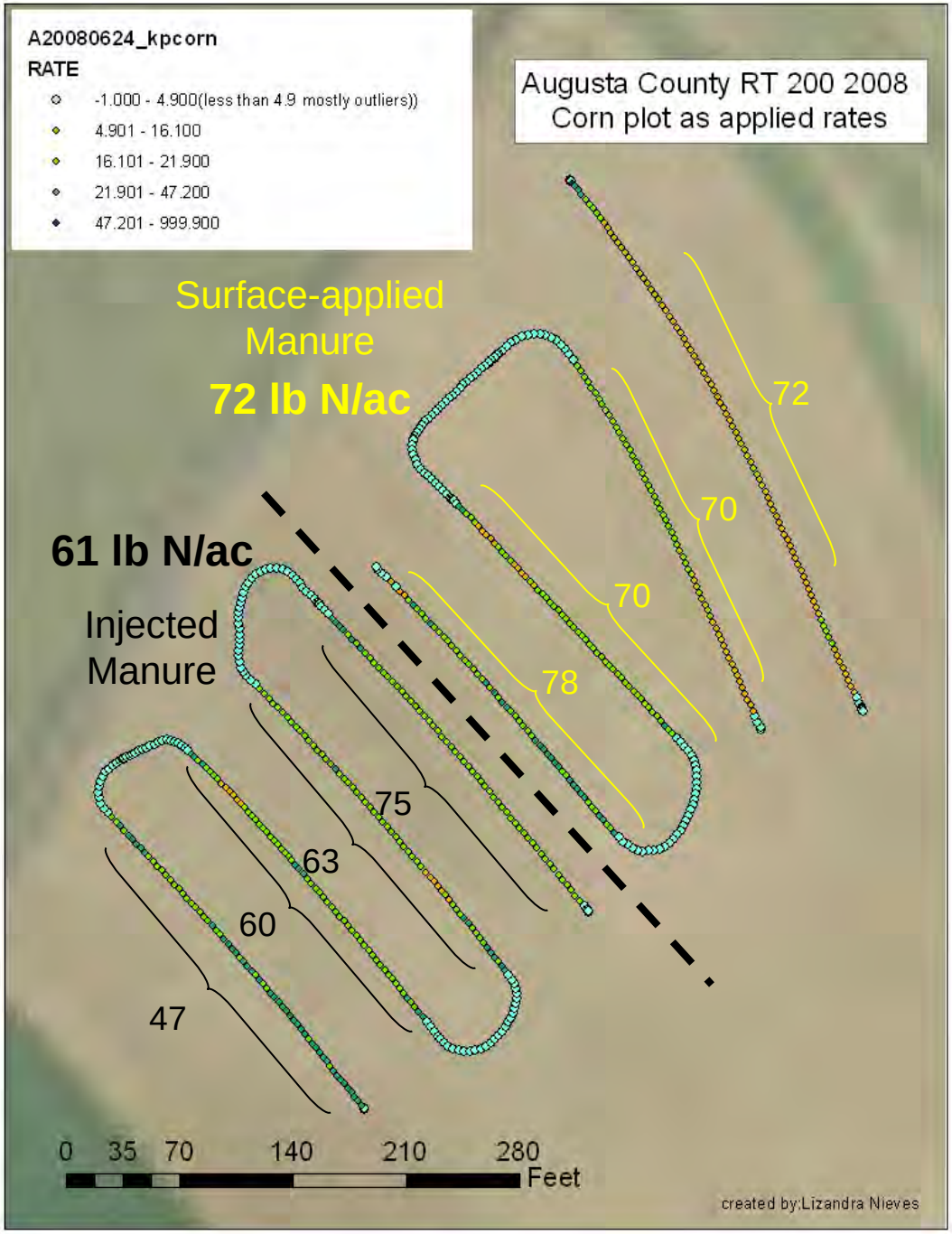
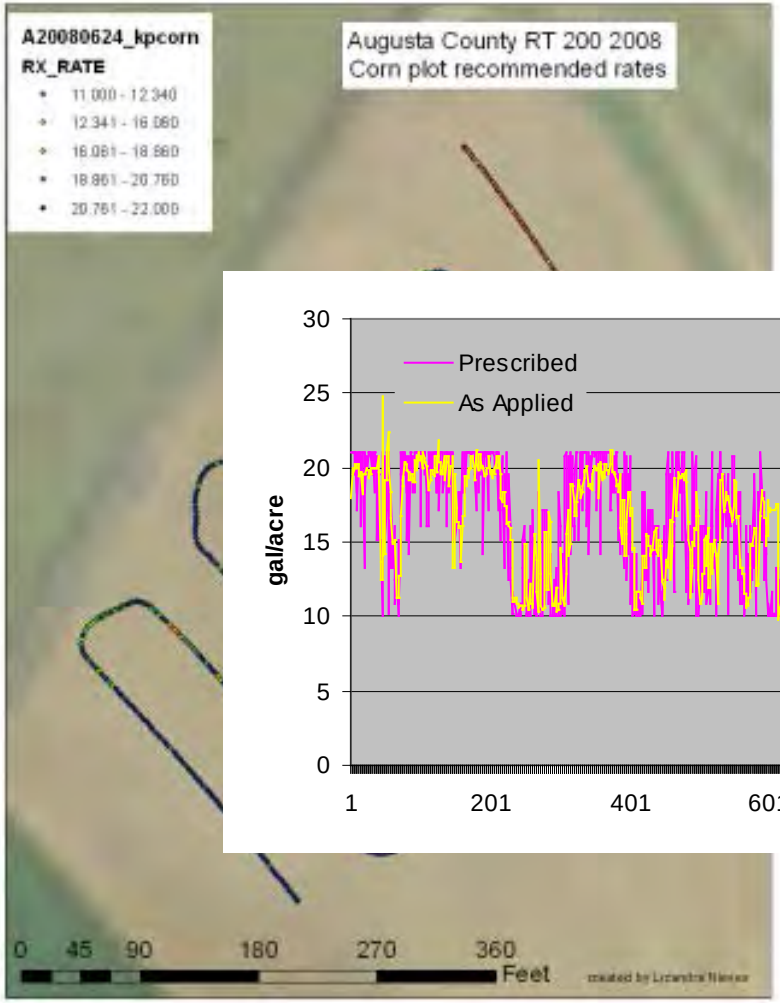
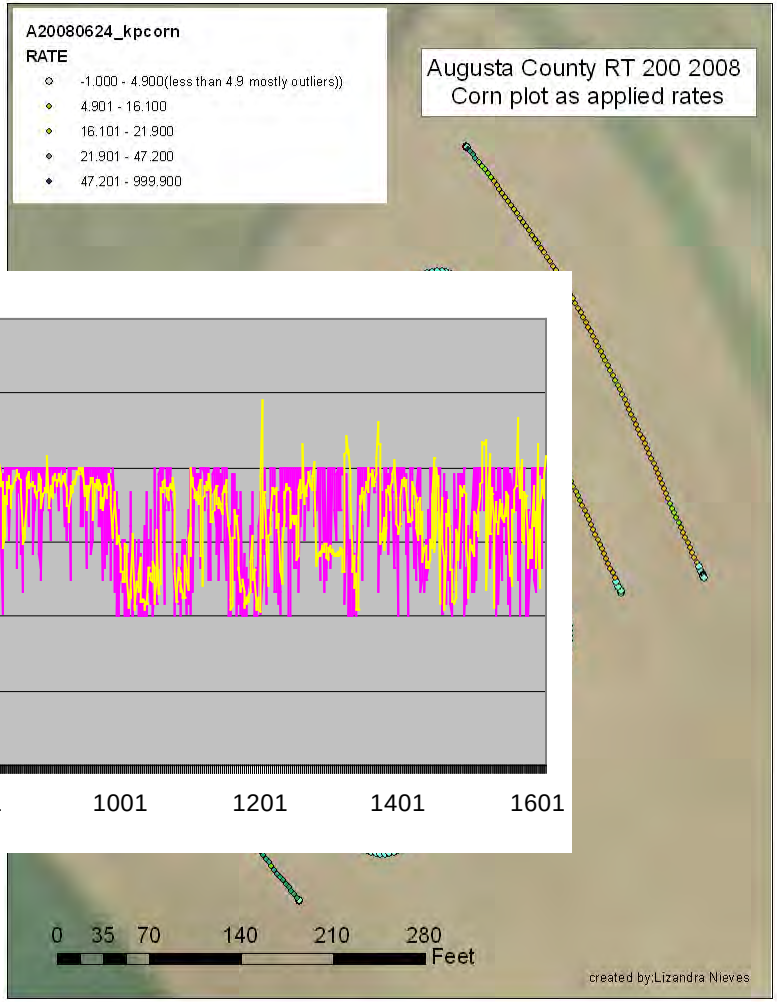
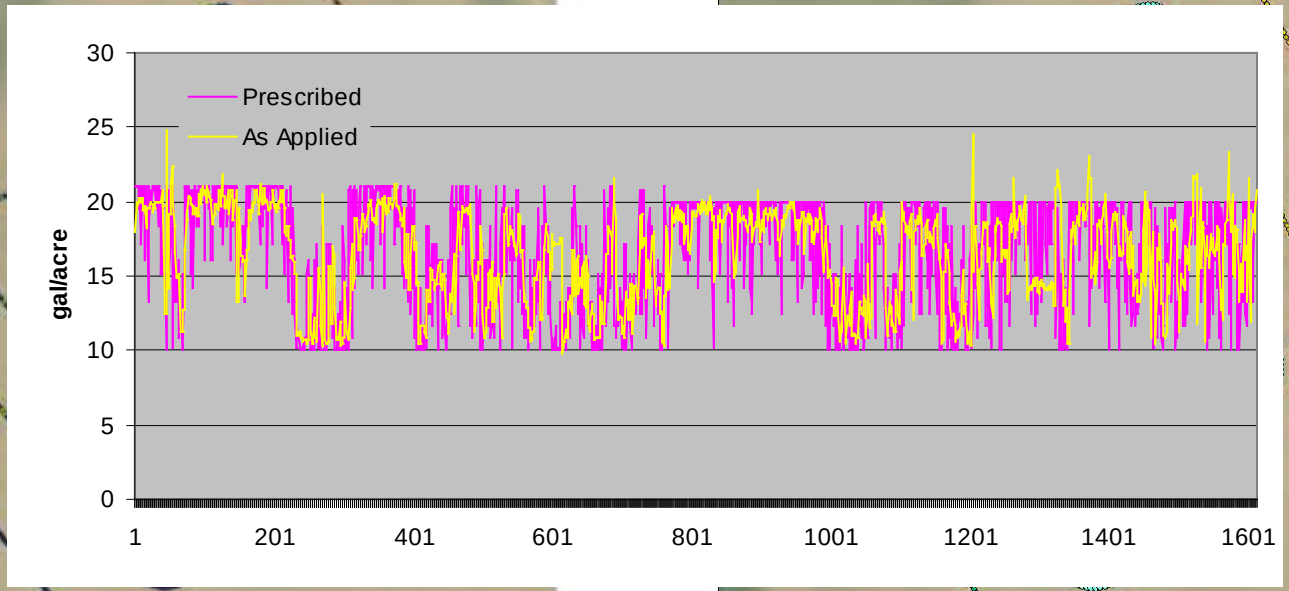



A20080624_kpcorn
RATE
-1.000 - 4.900(less than 4.9 mostly outliers))
4.901 - 16.100
16.101 - 21.900
21.901 - 47.200
47.201 - 999.900
Augusta County RT 200 2008
Corn plot as applied rates
Surface-applied
Manure
72 lb N/ac
61 lb N/ac
Injected
Manure
72
70
70
78
75
63
60
47
0 35 70 140 210 280
Feet
created by:Lizandra Nieves

RX vs. Applied Rates







Challenges

- N rich strips
  - Timing
  - Same Field
  - Same Hybrid/Variety
  - Mark it!
- N “poor” strips

NDVI	Low_Ref	Hi_Ref
0.65	**0.60**	**0.79**

Challenges

- Herbicide Applications

Challenges

- Skepticism
- How to tell if the system was “right”
- Risk
- Cost
  - EQIP cost share
  - Tax credits

Questions?