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Strategies to Maximize Soybean ROI

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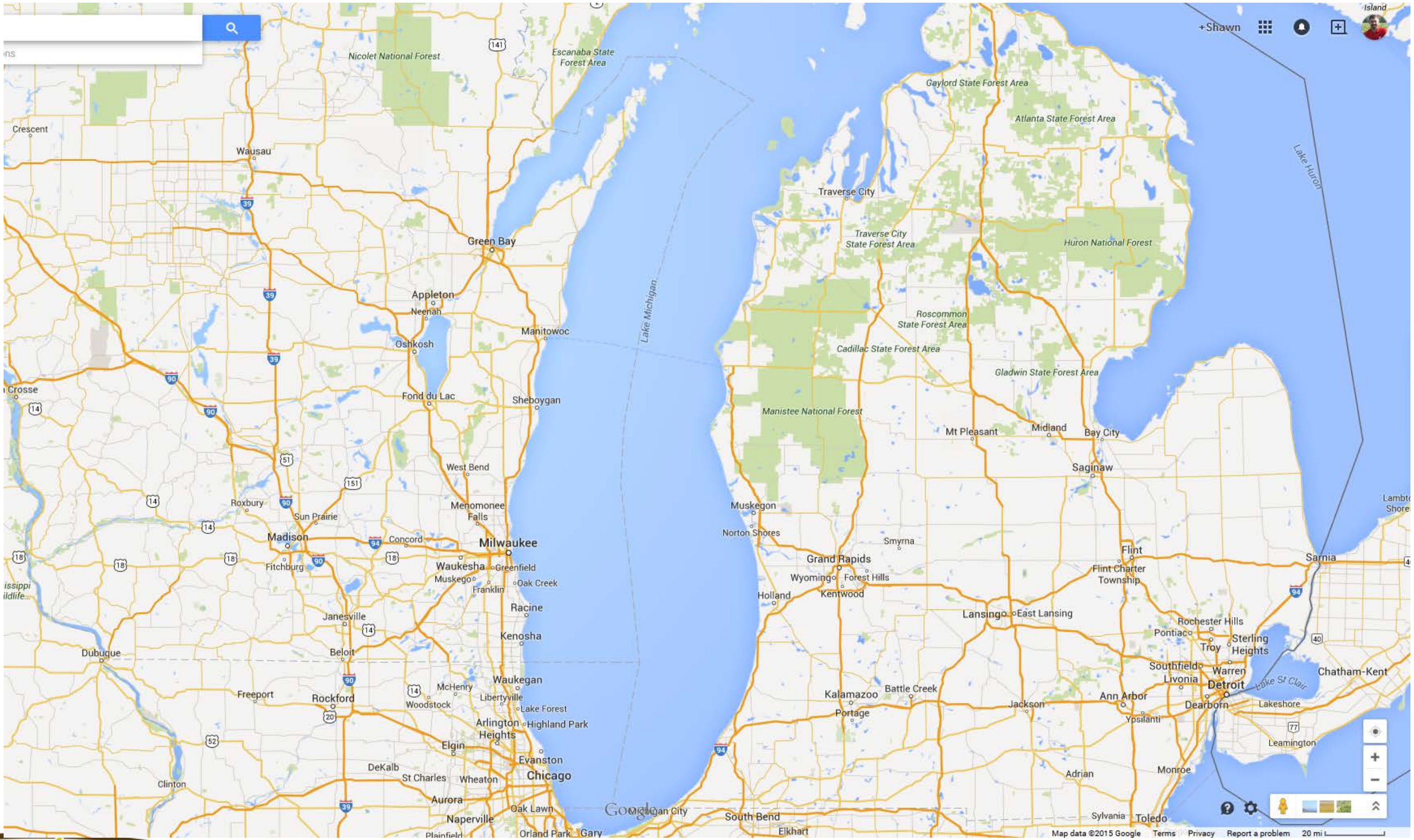
Geographical Comparison



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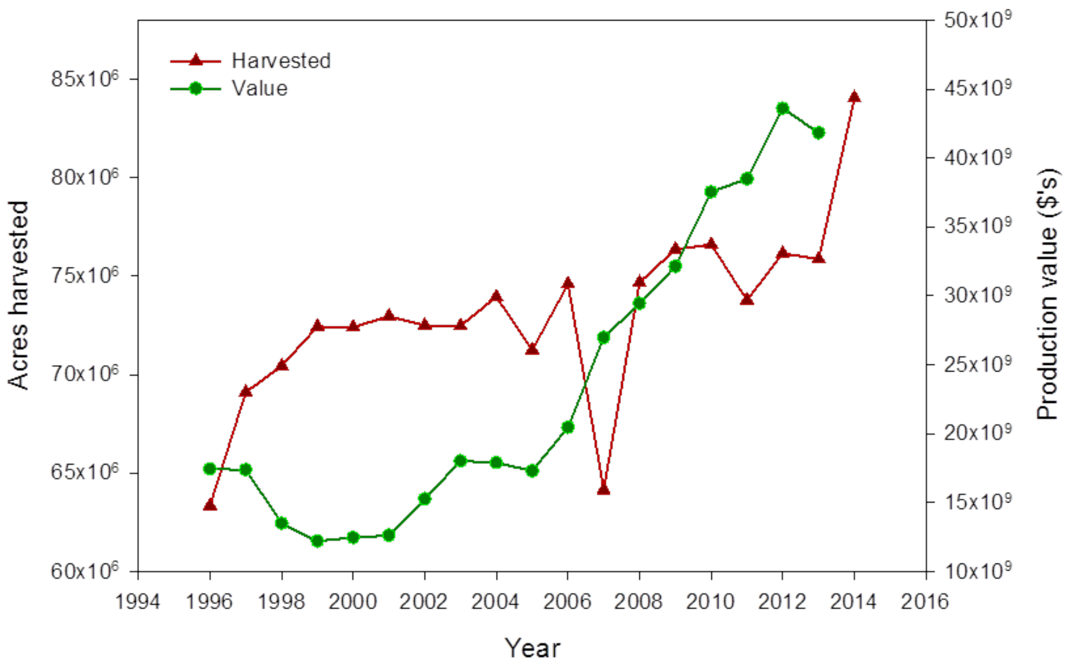
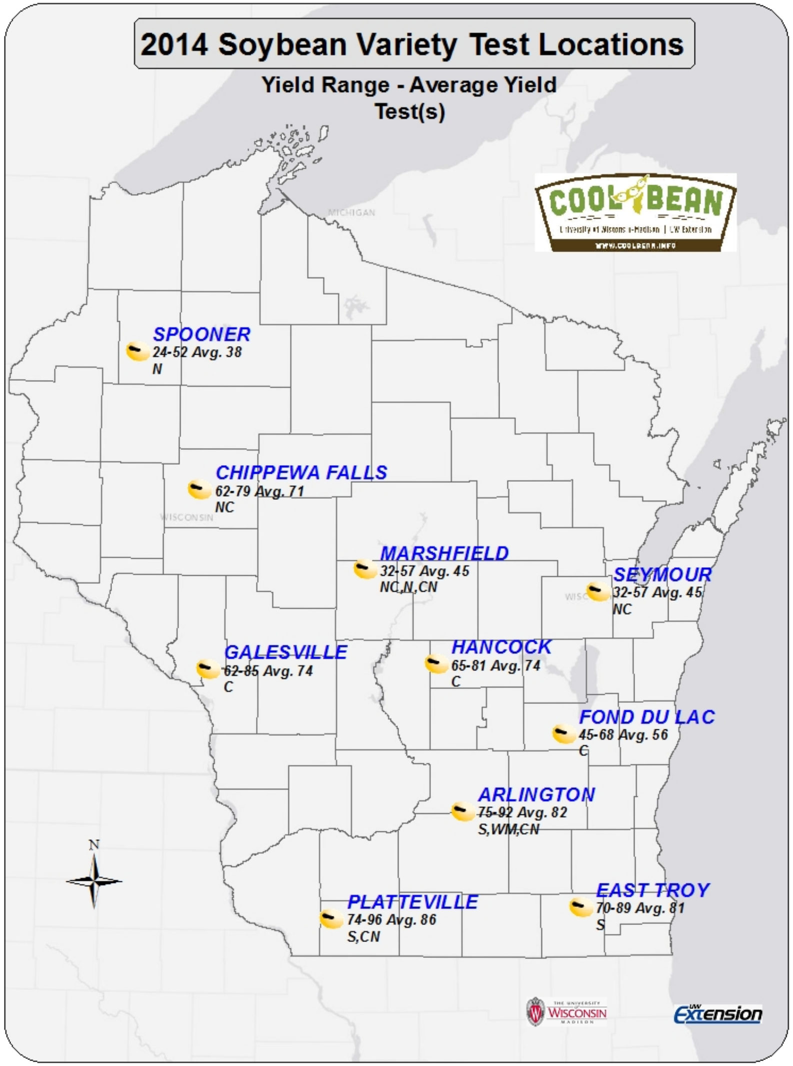
2014 the Year in Review





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2014 Southern Region Glyphosate Tolerant Soybean Test

Brand	Entry	Maturity Group	Yield (bu/A)
Asgrow	AG2035	2.0	85
Asgrow	**AG2433**	**2.4**	**89**
Asgrow	**AG2535**	**2.5**	**89**
Asgrow	AG2835	2.8	84
Channel	2508R2 Brand	2.5	86
Cornelius	CB20R44	2.0	87
Cornelius	CB23R98	2.3	84
Cornelius	CB24R99	2.4	84
Cornelius	CB25R78	2.5	86
Cornelius	CB26R30	2.6	85
Cornelius	CB28R58	2.8	85
Dairyland	DSR-2411/R2Y	2.4	86
Dairyland	DST26-005/R2Y	2.6	88
DuPont Pioneer	P22T69R	2.2	86
Dyna-Gro	S22RY64	2.2	87
Dyna-Gro	SX14823R	2.3	85
FS HiSOY	HS 19A42	1.9	85
FS HiSOY	HS 23A42	2.3	86
FS HiSOY	**HS 25A42**	**2.6**	**89**

Brand	Entry	Maturity Group	Yield (bu/A)
Great Lakes Hybrids	GL2469R2	2.4	85
Great Lakes Hybrids	GL2789R2	2.7	87
Hughes	201RR	2.1	84
Legacy	LS2414NRR2	2.4	85
Legacy	LS2834NRR2	2.8	88
LG Seeds	C2441R2	2.4	86
Mycogen	5B223R2	2.3	84
NK Brand	S19-Z9 Brand	1.9	84
NK Brand	S20-T6 Brand	2.0	86
NK Brand	S22-S1 Brand	2.2	84
NK Brand	S26-P3 Brand	2.6	85
NuTech/G2 Genetics	7273	2.7	85
Power Plus	26X5	2.5	87
ProHarvest / Brunner	**2071CR2Y**	**2.0**	**89**
Renk	**RS213NR2**	**2.1**	**89**
Renk	RS241R2	2.4	85
Renk	RS265NR2	2.6	85
Titan Pro	25M22	2.5	86

* Varieties shown are not significantly different (0.10 level) than the highest yielding cultivar. Three test average included Arlington, Janesville, and East Troy

Second Year Soybean Recommendations

1. Don’t do it!
2. Do not plant the same variety you planted in that field last year.
3. Pick a variety with high disease ratings
4. If you have scn… choose a different source of resistance if possible
5. Use a fungicide seed treatment (go with the high rate of a.i.)
6. Use a preemergence herbicide
7. Do not skimp on potassium
   – Soybean is a high demand user of K
   – Fertility deficiencies often exacerbate disease incidence and severity
8. Plant early – Always a good idea to maximize yield

What Drives Yield?

	Planting Date			
	End April	Begin May	End May	Begin June
Direct effect				
Pods m^{-2} → yield	1.86	1.77	1.75	1.33
Seed mass (g 100 $seeds^{-1}$) → yield	1.19	1.25	1.82	1.64
Seeds pod^{-1} → yield	0.81	0.54	0.94	1.08
Pods m^{-2}:seed mass (g 100 $seeds^{-1}$): seeds pod^{-1}	2.3:1.5:1	3.3:2.3:1	1.9:1.9:1	1.2:1.5:1

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Robinson et. al; 2008

U.S. trend toward earlier planting

Percent of U.S. Soybean Area Planted by Week for the Period 1980-2010 (5-Year Avg.)‡

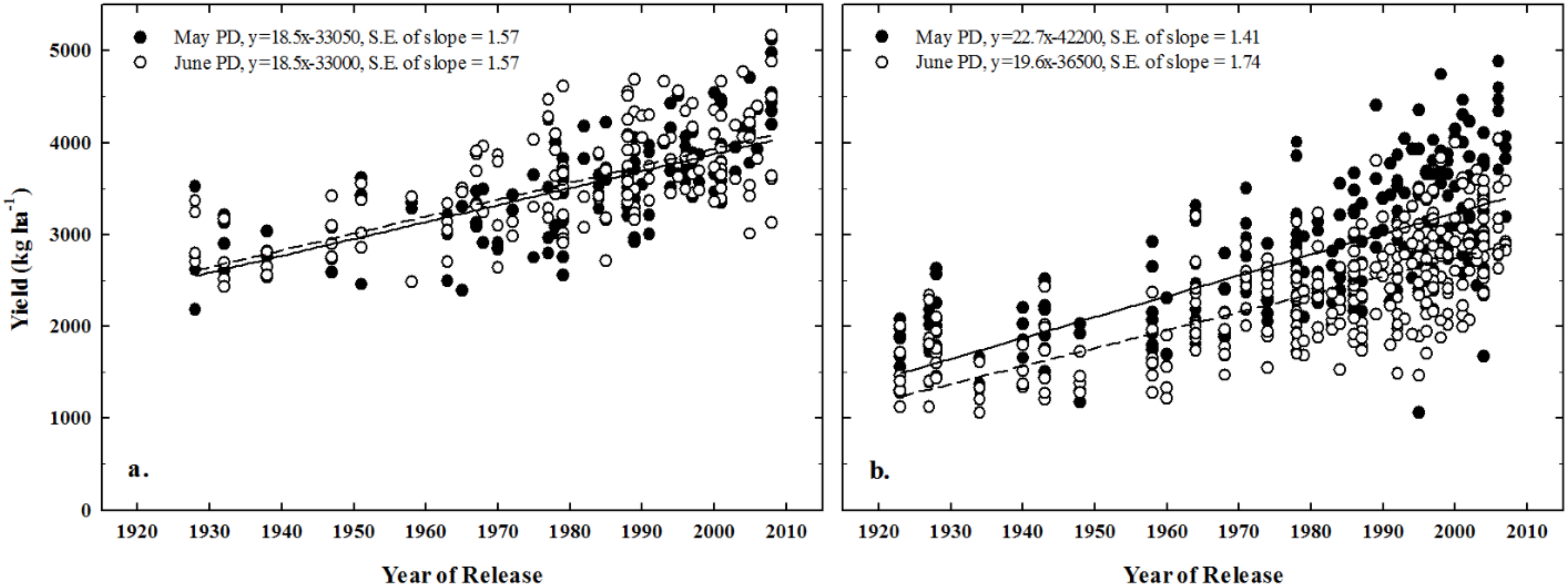
Week # †	17 24-Apr	18 1-May	19 8-May	20 15-May	21 22-May	22 29-May	23 5-Jun	24 12-Jun	25 19-Jun	26 26-Jun
Year										
1980	---	---	11	28	49	62	77	85	92	95
1985	---	3	11	23	40	55	71	81	88	94
1990	---	8	23	43	60	73	82	88	93	96
1995	---	---	19	37	53	67	78	86	93	---
2000	3	8	19	37	55	67	78	---	---	---
2005	9	23	39	56	71	82	90	94	---	---
2010	8	19	35	57	75	84	90	94	97	---

† - Date nearest corresponding week number

‡ - Average percent planted of previous 5 years

*Source: USDA-NASS, 2011

MG II(a) & MG III(b) yield at early and late planting (2010-2011)



- **Within MGs, yields have improved over cultivar year of release (*P*<0.001). Represents the successful efforts made by breeders to improve soybean yield over time.** (Luedders, 1977; Wilcox et al., 1979; Specht and Williams, 1984; Wilcox, 2001; De Bruin and Pedersen, 2008b).

- **Within MG IIIs, there was a difference (*P*<0.05) in the rate of yield improvement over time between early and late plantings. *<u>A synergistic interaction!</u>***

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Introduction

- *Fusarium virguliforme* causes sudden death syndrome of soybean

- Delaying planting has shown to reduce SDS symptoms
  - This work was done ~20 years ago (Hershman et al., 1990; Wrather et al., 1995)
    - Planting dates used in those studies started in mid May
  - Planting dates are trending earlier

F. virguliforme spores

Objective

- Quantify the impact of planting date on SDS development and yield loss
  - In other words, will planting earlier and increasing risk of SDS development be better or worse on yield than delaying planting and reducing risk of SDS development?

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Materials and Methods

- Hancock Ag Research Station (irrigated)
- Experimental design
  - Split-split plot RCBD with 4 reps
    - Main plots: Planting date (5/6, 5/24, 6/17)
    - Subplots: 10 varieties ranging in susceptibility to SDS
    - Sub-subplots: 2 inoculation treatments
      - Uninoculated vs. inoculated
        - Oat grains infested with *F. virguliforme* was placed in furrow at planting

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Materials and Methods

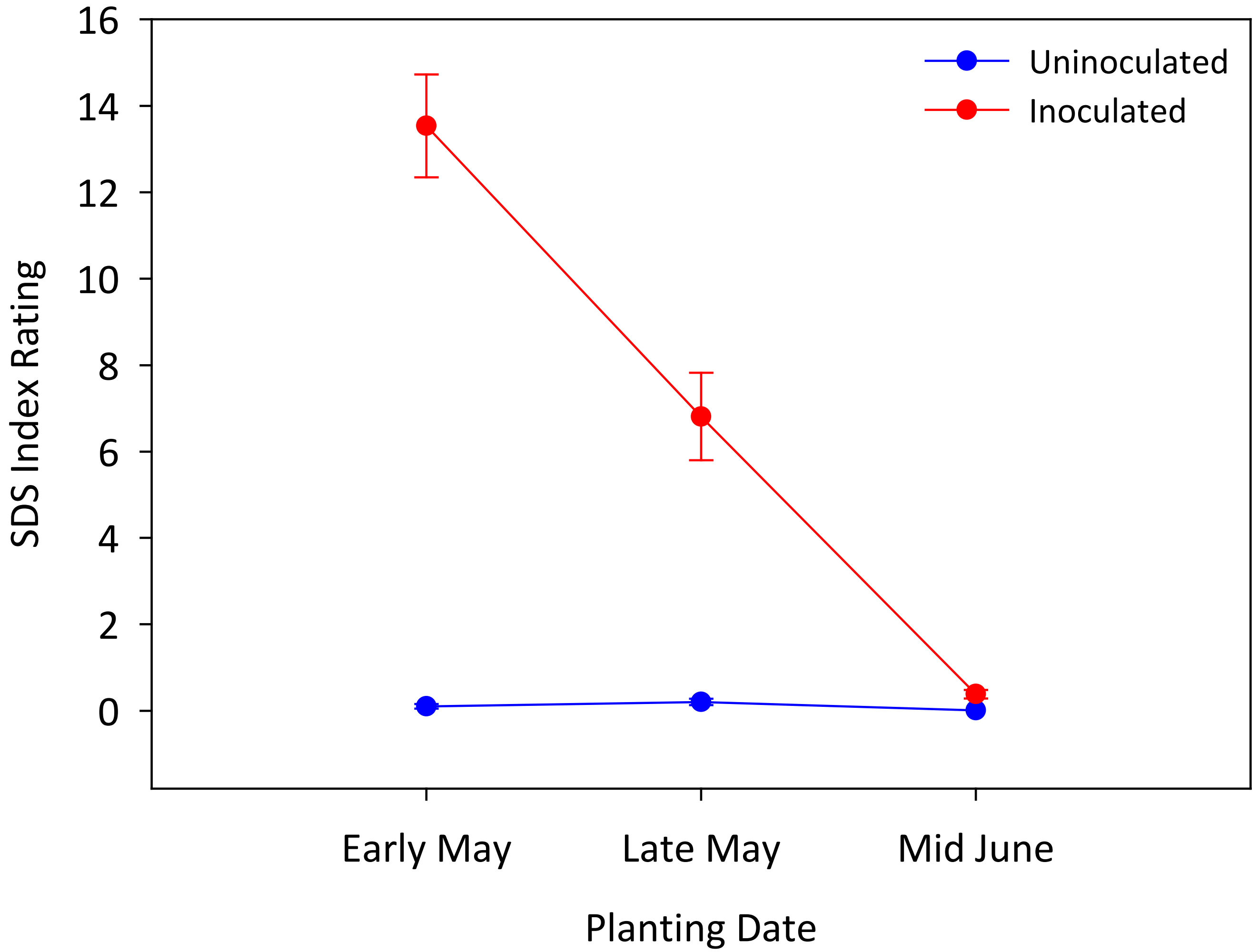
- Data collected
  - Soil samples at planting and R8 to determine SCN egg counts and *F. virguliforme* populations
  - Spring and fall stand counts
  - Weekly NDVI measurements
  - SDS ratings from R5.5/R6 to R7
  - Yield

Materials and Methods

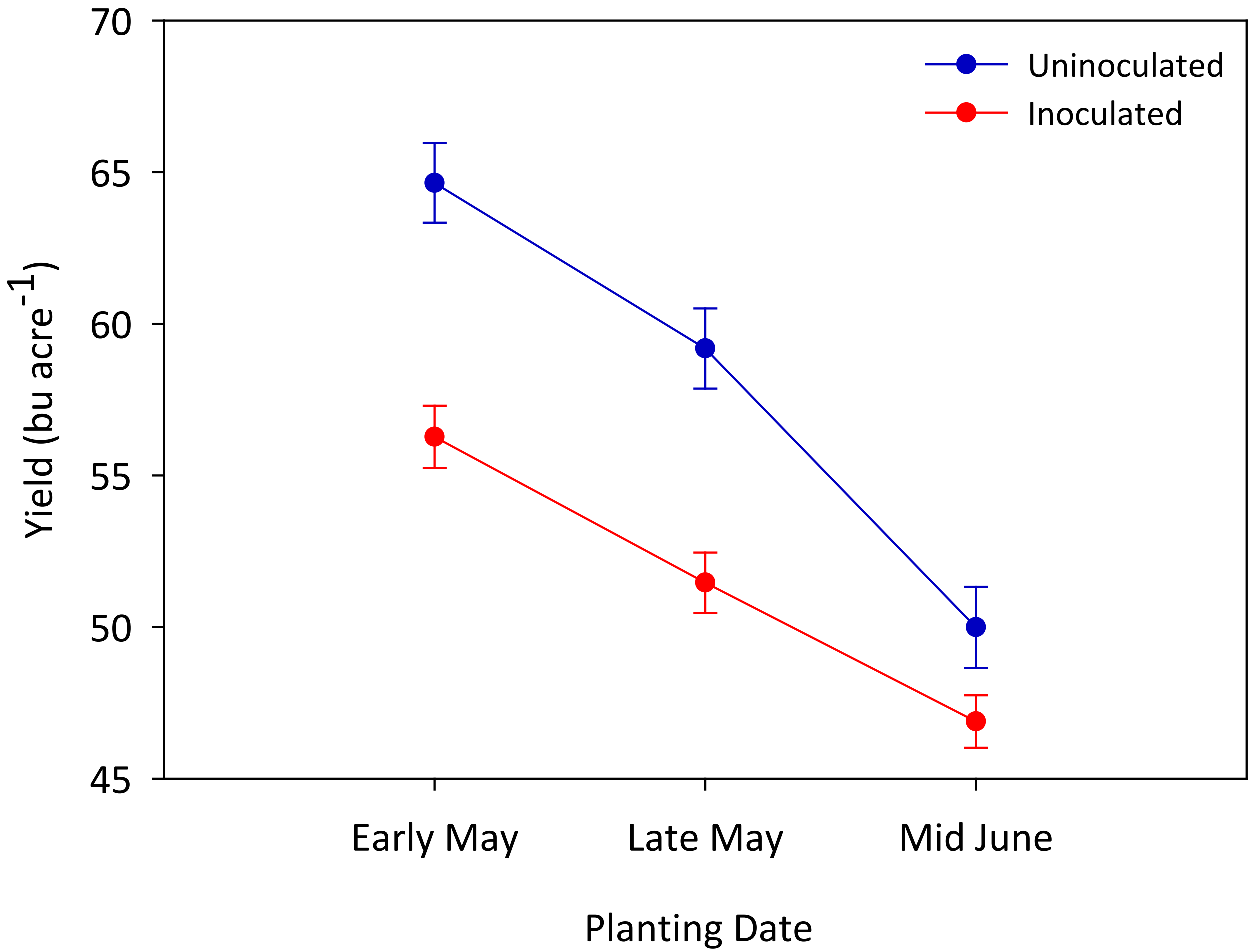
- SDS rating protocol gives a Disease Index (DX)
  - DX is a combination of disease incidence (DI) and disease severity (DS). It is calculated as DI x DS/9, and has a range of 0 (no disease) to 100 (all plants prematurely dead at or before R6).
  - Disease Incidence (DI) DI = % of plants with leaf symptoms, recorded in increments of 5.
  - Disease Severity (DS) Record in increments of 0.5, scoring ONLY those plants showing symptoms:

Score	Description of Symptoms
1	1-10% of leaf surface chlorotic, OR 1-5% necrotic
2	10-20% of leaf surface chlorotic, OR 6-10% necrotic
3	20-40% of leaf surface chlorotic, OR 11-20% necrotic
4	40-60% of leaf surface chlorotic, OR 21-40% necrotic
5	Greater than 60% of leaf surface chlorotic, OR greater than 40% necrotic
6	Premature leaf drop up to 1/3 defoliation
7	Premature leaf drop up to 2/3 defoliation
8	Premature leaf drop GREATER than 2/3 defoliation
9	Premature death

Planting Date by SDS Index Interaction 13/14

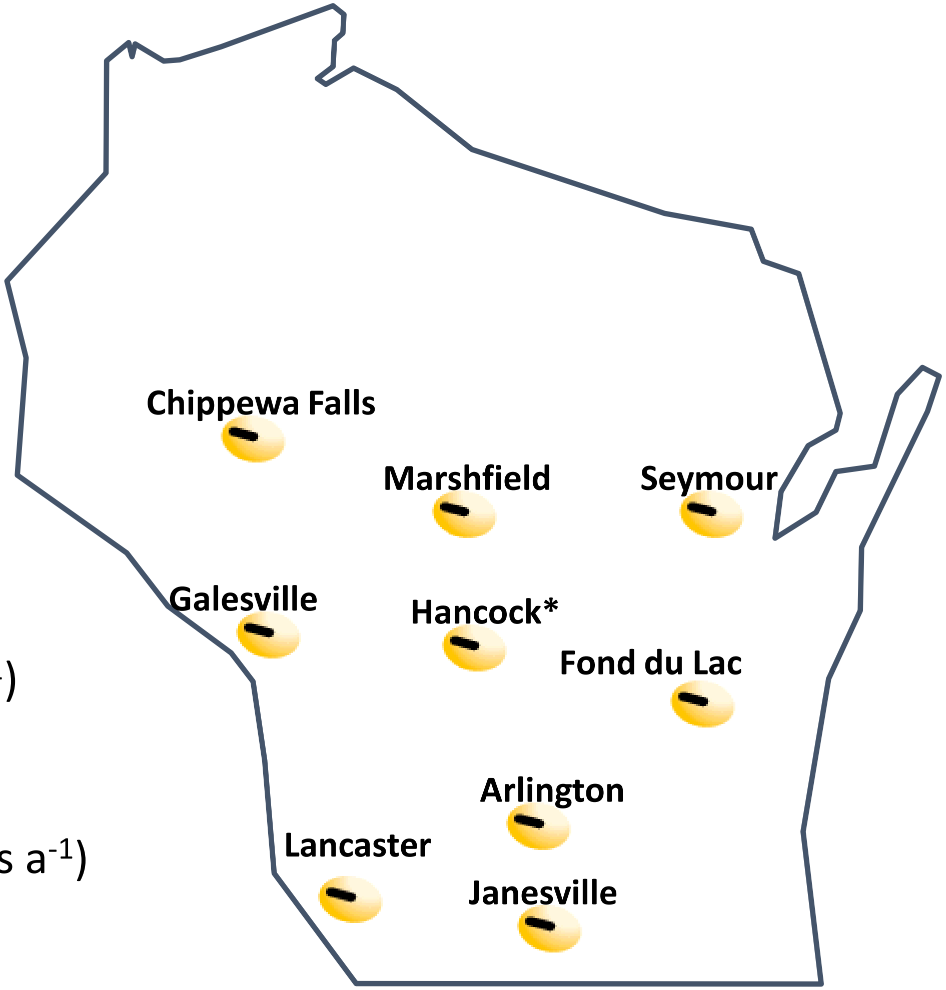


Planting Date by Seed Yield Interaction 13/14



Study Description

- Years (2012-2013) N =1296
- Regions
  - Southern
  - Central
  - N. Central
- Variety: NK Brand S20Y2
- Planting Date: First 3 weeks in May
- Row Spacing: 15 inches
- Seed treatments
  - UTC
  - ApronMaxx RFC (0.0094 mg ai seed^{-1})
  - CruiserMaxx (0.0858 mg ai seed^{-1})
- Seeding rates
  - 40, 60, 80, 100, 120, 140 (1000 seeds a^{-1})



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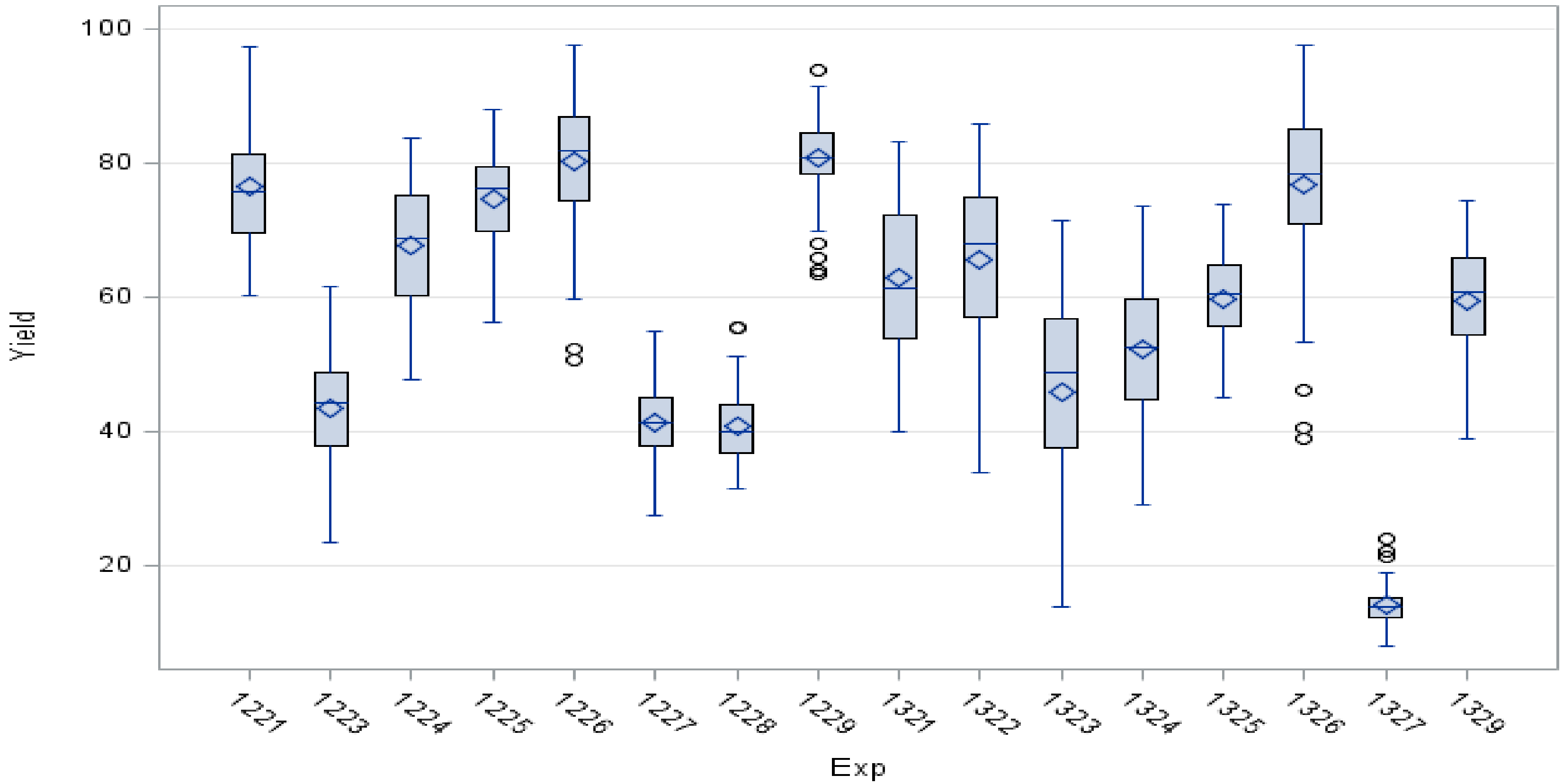
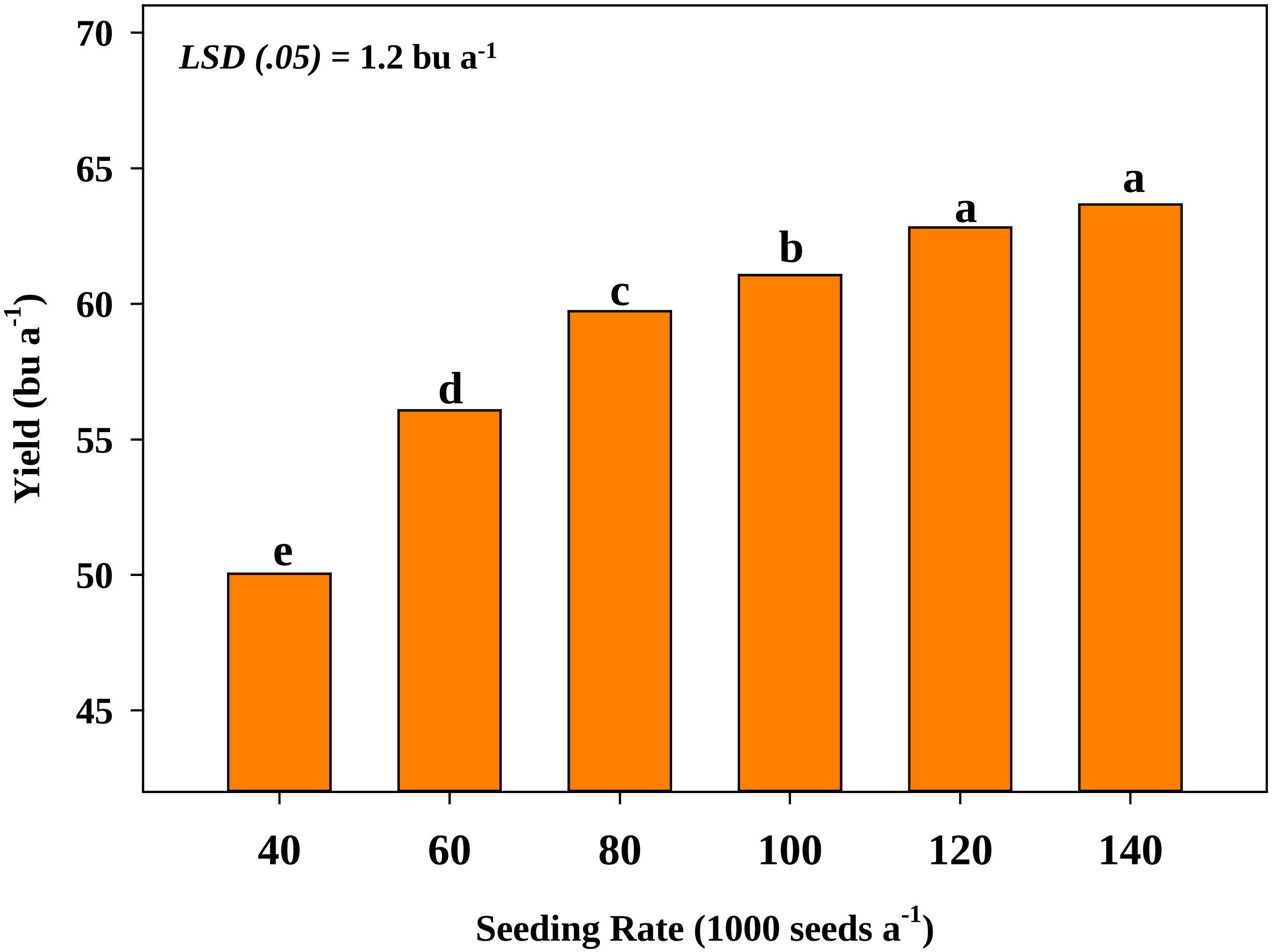
Yield Potential: Locations



- Looked at the treatments across various yield potentials and ultimately, responsive and non-responsive environments.

Main Effect: Seeding Rate



Soybean Canopy Development Time Lapse

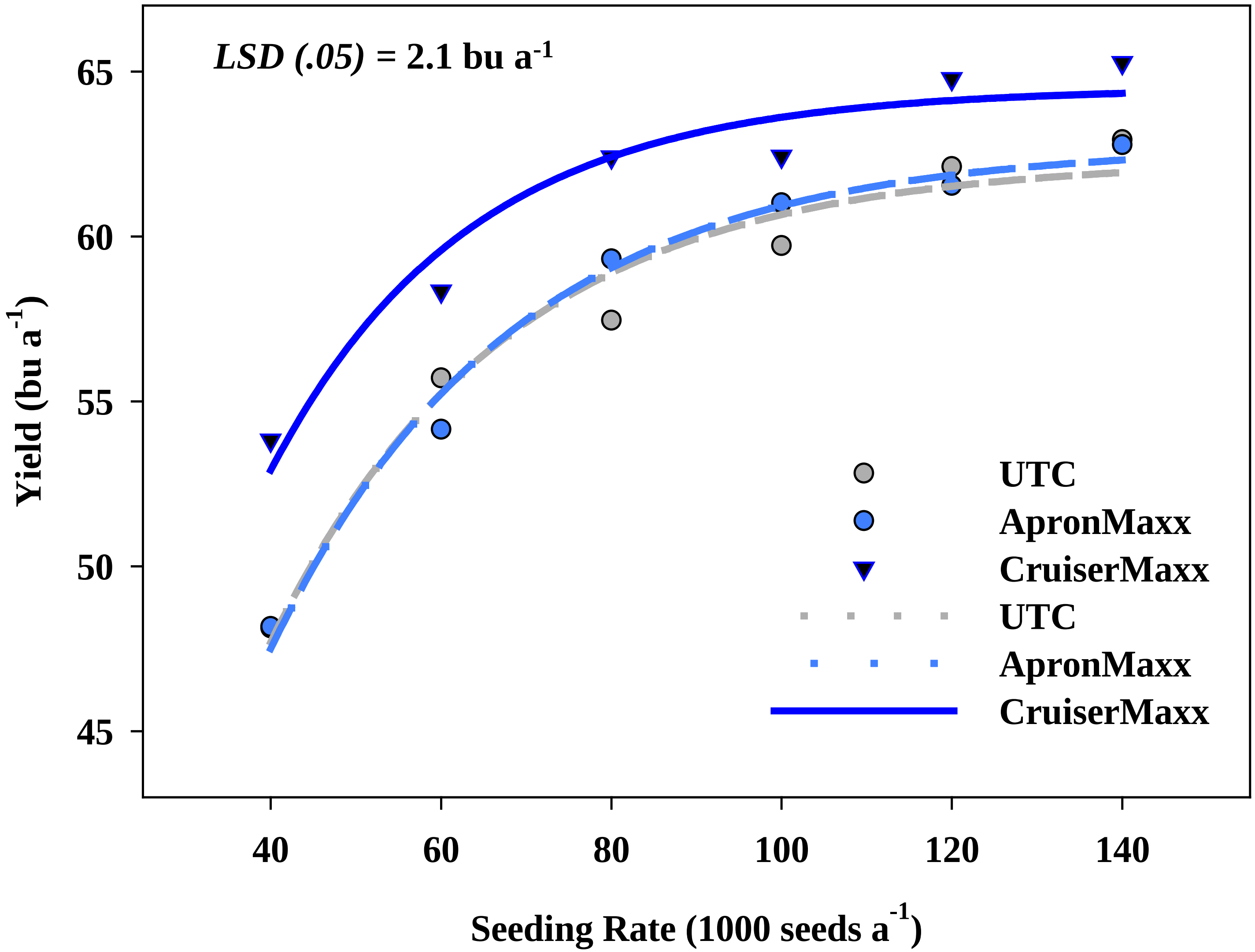
-No Seed Treatment

-May 11th Planting Date

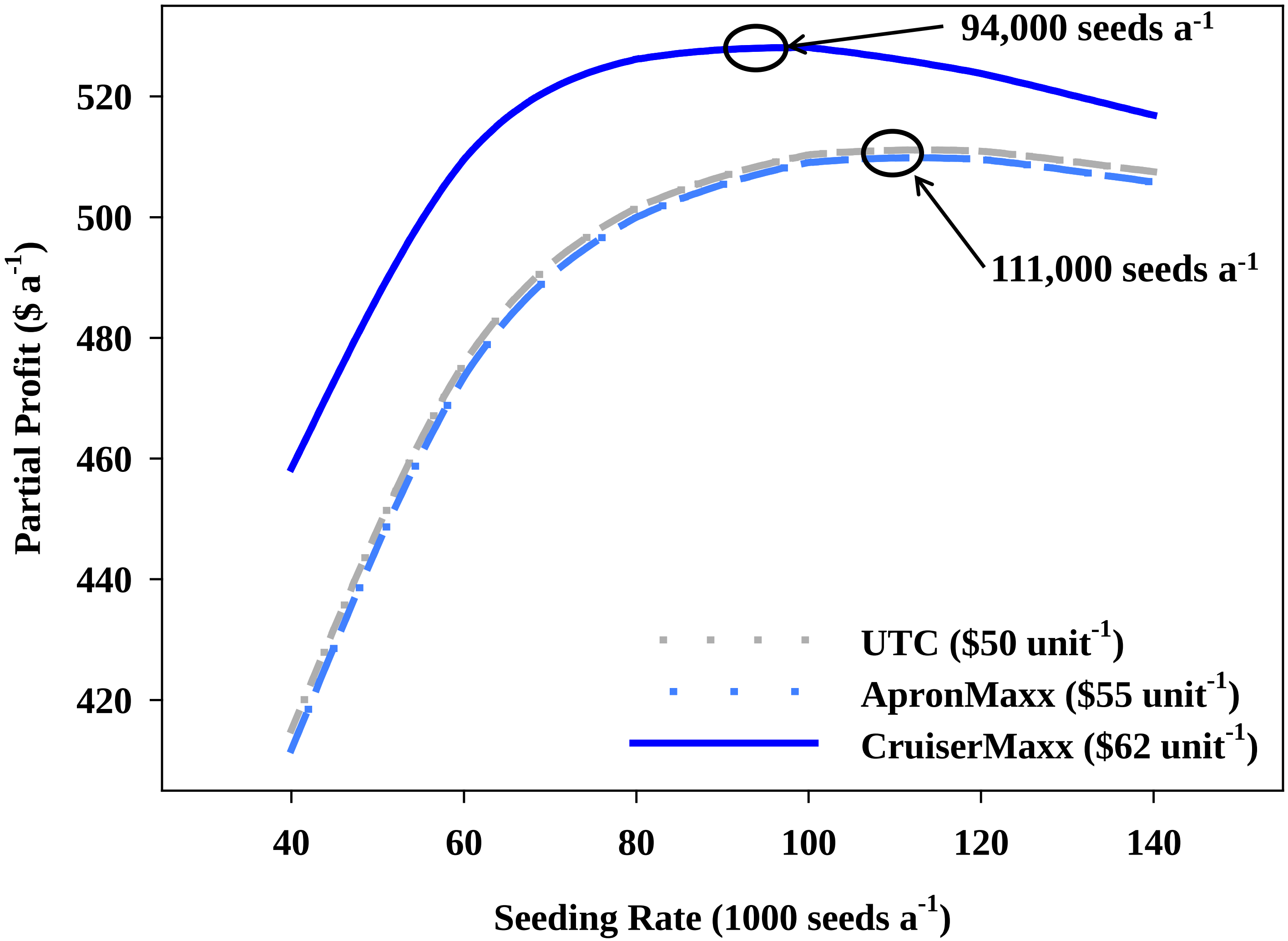
40 K **vs.** **140 K**

40 K % light interception	9	28	49	72	90	96	99	100
Date:	June 6th	June 13th	June 20th	June 27th	July 4th	July 11th	July 18th	July 25th
% light interception 140 K	22	61	84	92	95	98	99	100

Yield at Various Seeding Rates for Different Seed Treatments



Profit per acre at $\$9$ bu^{-1} Soybeans



Economic Risk

- Uncontrollable factors during the growing season
  - Planting date (2012 vs. 2013)
  - Cool and wet condition
  - Inclement weather shortly after planting
  - In field variability
  - Lowering grain markets

- Products and practices that are valuable:
  - Show consistent yield gains
  - Provide profit stability over a wide range of situations and environments
  - Help manage long term margins and economic risk

- Assessing Economic Risk at Various Seeding Rates & How Seed Treatment Affects Risk
  - "Base case" = 140k seeds a^{-1} with no seed treatment (UTC)
  - Our trial allows us 20 comparisons to the base case.
  - The break-even probability shows us the probability that a certain seeding rate x seed trt. combination will increase profit over the base case.
    - Or essentially the risk of a certain treatment combination

Economic Risk Table for $9 bu^{-1} Soybeans

Treatment combination			Avg. profit increase over the Base Case		
Seed Treatment	**Seeding Rate**	**Break-even probability**	**Positive outcomes**	**All outcomes**	**Negative outcomes**
	Seeds acre^{-1}			$ acre^{-1}	
UTC	120,000	0.91	3	3	-2
	100,000	0.69	5	2	-5
	80,000	0.26	4	-8	-12
	60,000	0.01	2	-34	-34
	40,000	0.00	na	-94	-94
ApronMaxx	140,000	0.46	14	-2	-15
	120,000	0.54	15	2	-13
	100,000	0.51	14	1	-13
	80,000	0.28	10	-9	-17
	60,000	0.02	6	-36	-37
	40,000	0.00	na	-98	-98
CruiserMaxx	140,000	0.71	18	10	-11
	120,000	0.83	21	16	-9
	100,000	0.89	23	20	-8
	80,000	0.86	21	17	-8
	60,000	0.51	14	0	-15
	40,000	0.01	5	-51	-52
EOSR					
UTC	111,500	0.84	4	3	-3
ApronMaxx	111,000	0.54	14	2	-13
CruiserMaxx	94,000	0.89	23	20	-8

Revamping Soybean Nutrient Uptake, Partitioning, and Removal Data of Modern High Yielding Genetics and Production Practices

A.P. Gaspar, C. Laboski, S. Naeve and S.P. Conley

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Background and Objective

- Soybean nutrient uptake and partitioning models are primarily built from work conducted in the 1960's; however, recent work highlighted the need for large increases in soybean nutrient uptake recommendations.

- Our objective is to determine soybean nutrient uptake, partitioning, and crop removal rates with modern genetics and production practices across a range of high yield potential environments.

Primary Questions to Answer With This Research

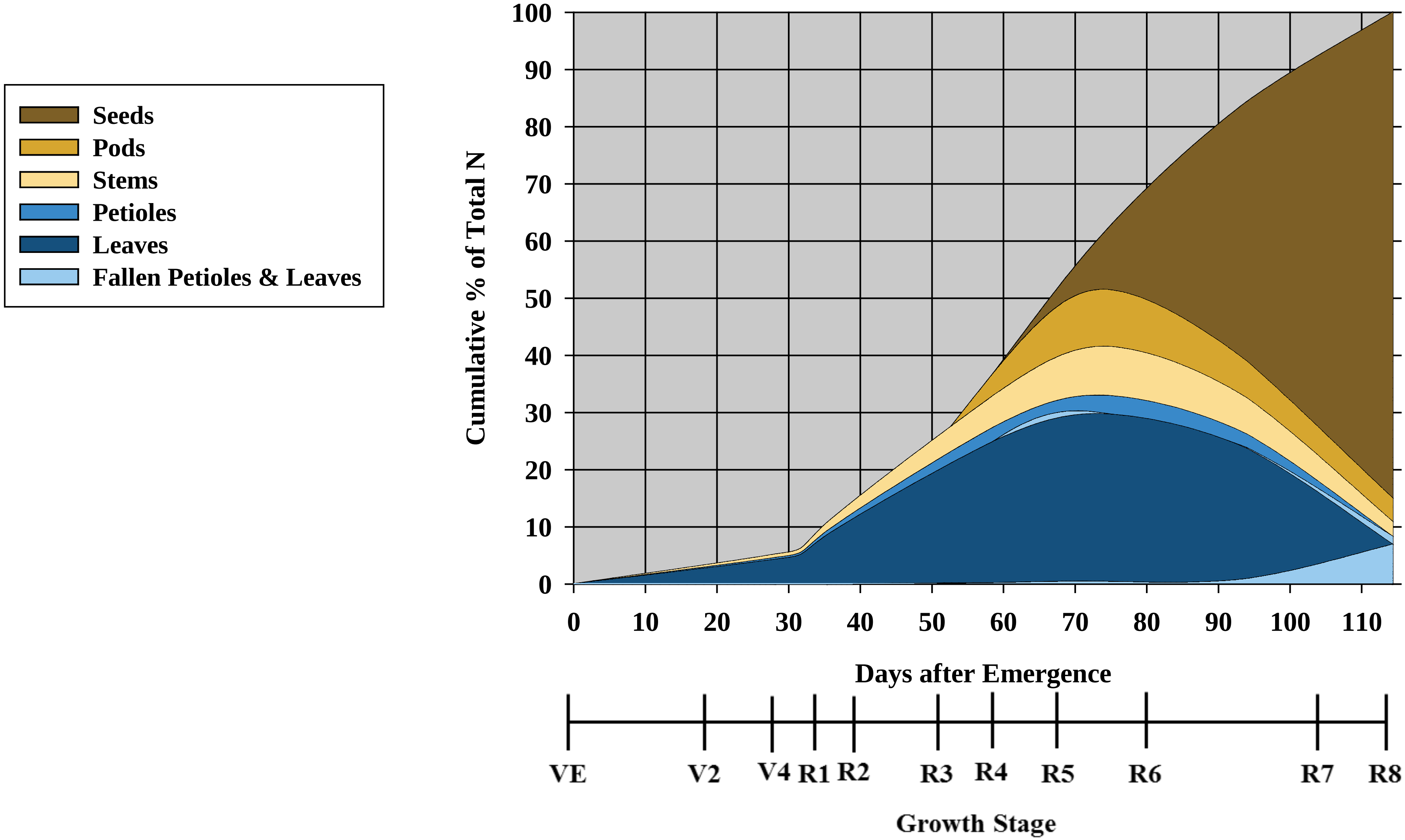
- What is the total plant nutrient uptake and partitioning to various plant parts throughout the growing season?
- Do uptake patterns vary by variety, environment, and yield range?
- When are the peak nutrient uptake periods?
- How do nutrients remobilize during grain fill?
- How do these results impact current fertility recommendations?

Study Description

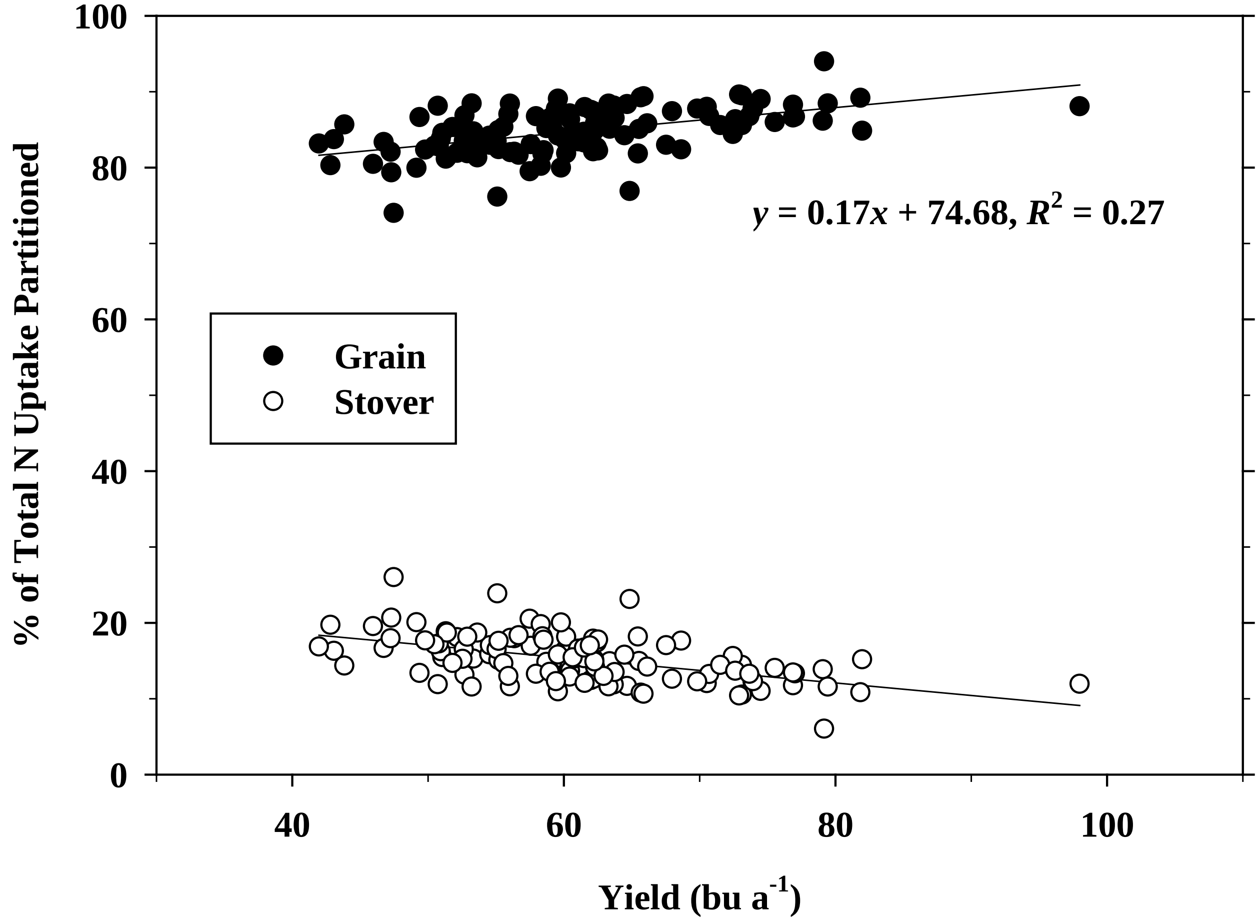
- **Environments:** 3 years at 3 locations with non-limiting fertility levels (Arlington and Hancock, WI; St. Paul, MN)
- **Varieties:** 8 Pioneer varieties within 4 maturity groups (RM 1.0-2.5)
- **Planting dates:** Early and late May
- **Plant Sampling:** Collected at the V4, R1, R4, R5.5, R6.5, and R8 growth stages and partitioned into the following parts:
  - Stems
  - Leaves
  - Seeds
  - Petioles
  - Pods
  - Fallen Leaves and petioles
- **Nutrients Quantified:** N, P, K, S, Ca, Mg, Zn, Mn, B, Cu, Fe, Al, and Na
- 3336 tissue samples are being analyzed that span a yield range of 35-85 bu/a

Method for Total Biomass Collection

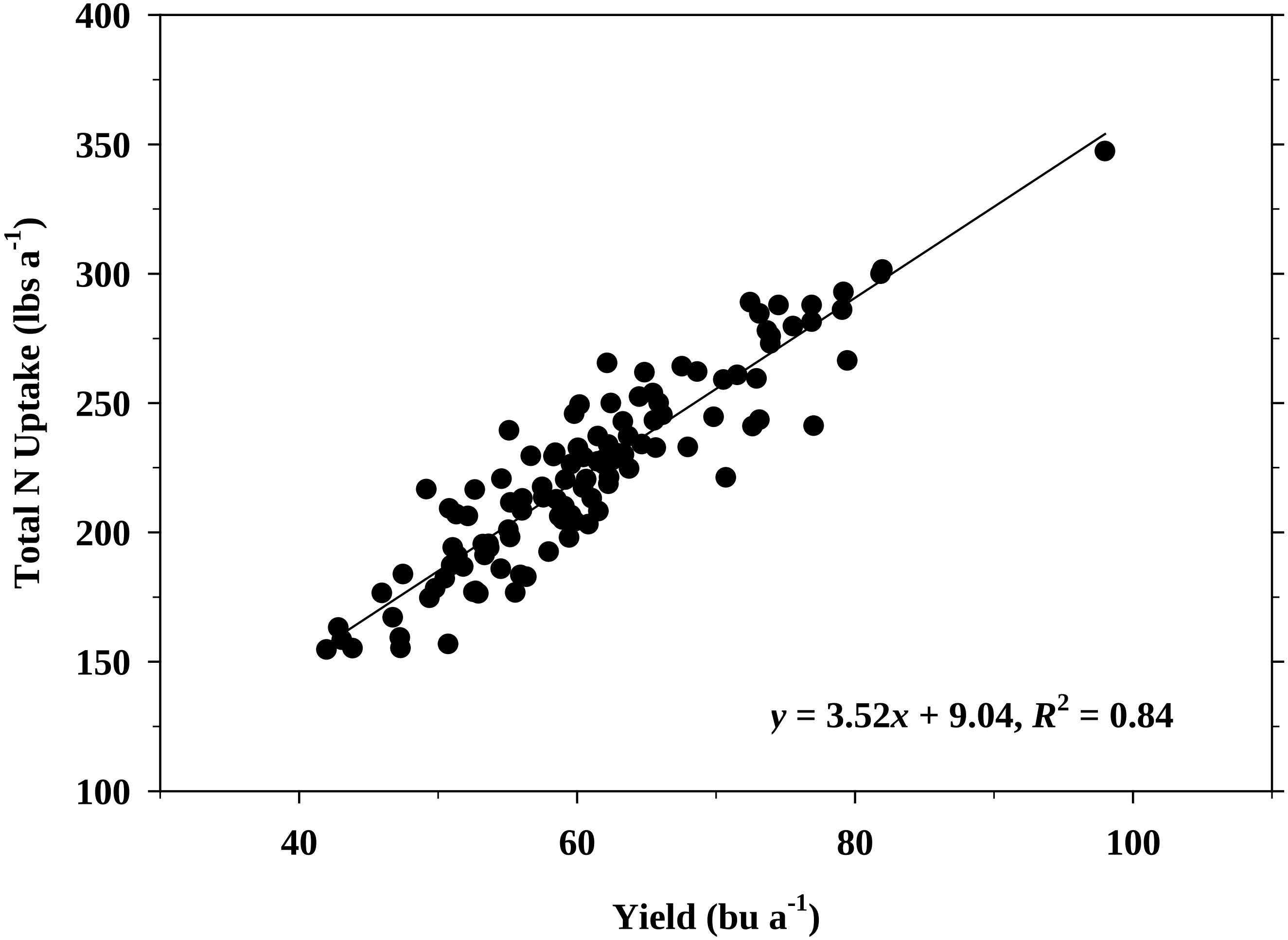
Nitrogen Partitioning Across Maturity Groups, Varieties and Planting Dates in 2014



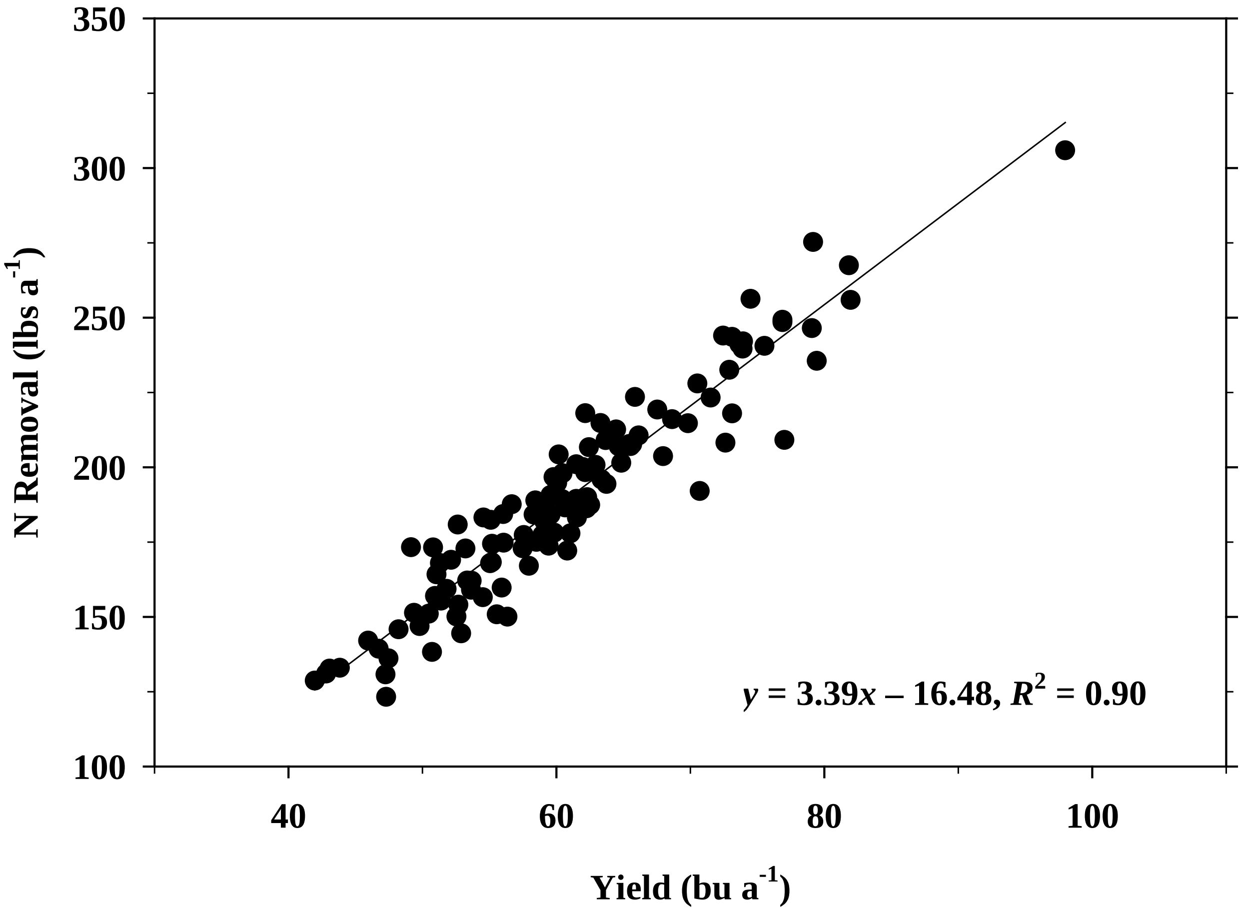
Nitrogen Partitioning Across a 60 bu/a Yield Range at R8



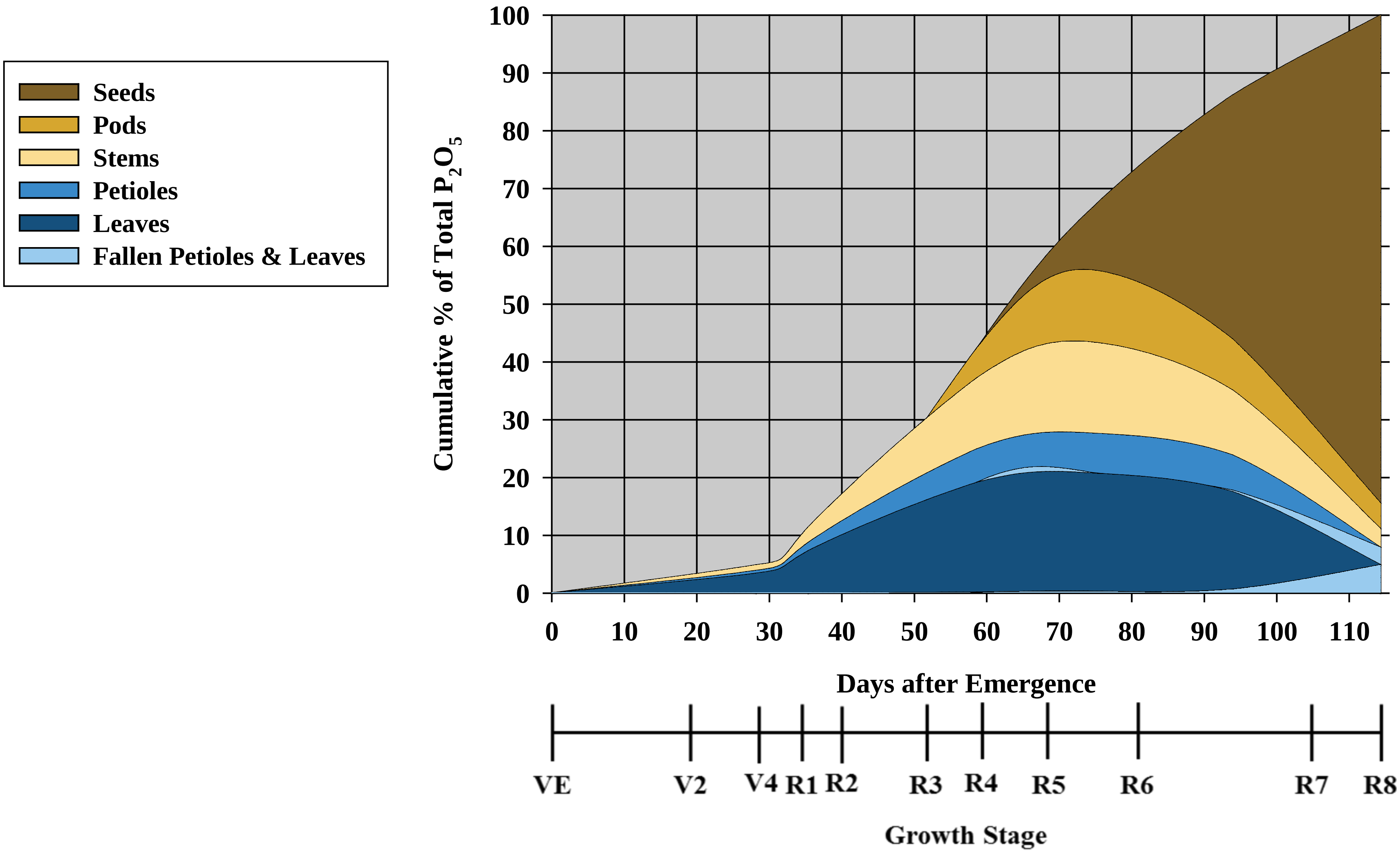
Relationship Between Grain Yield and Total Nitrogen Uptake in 2014



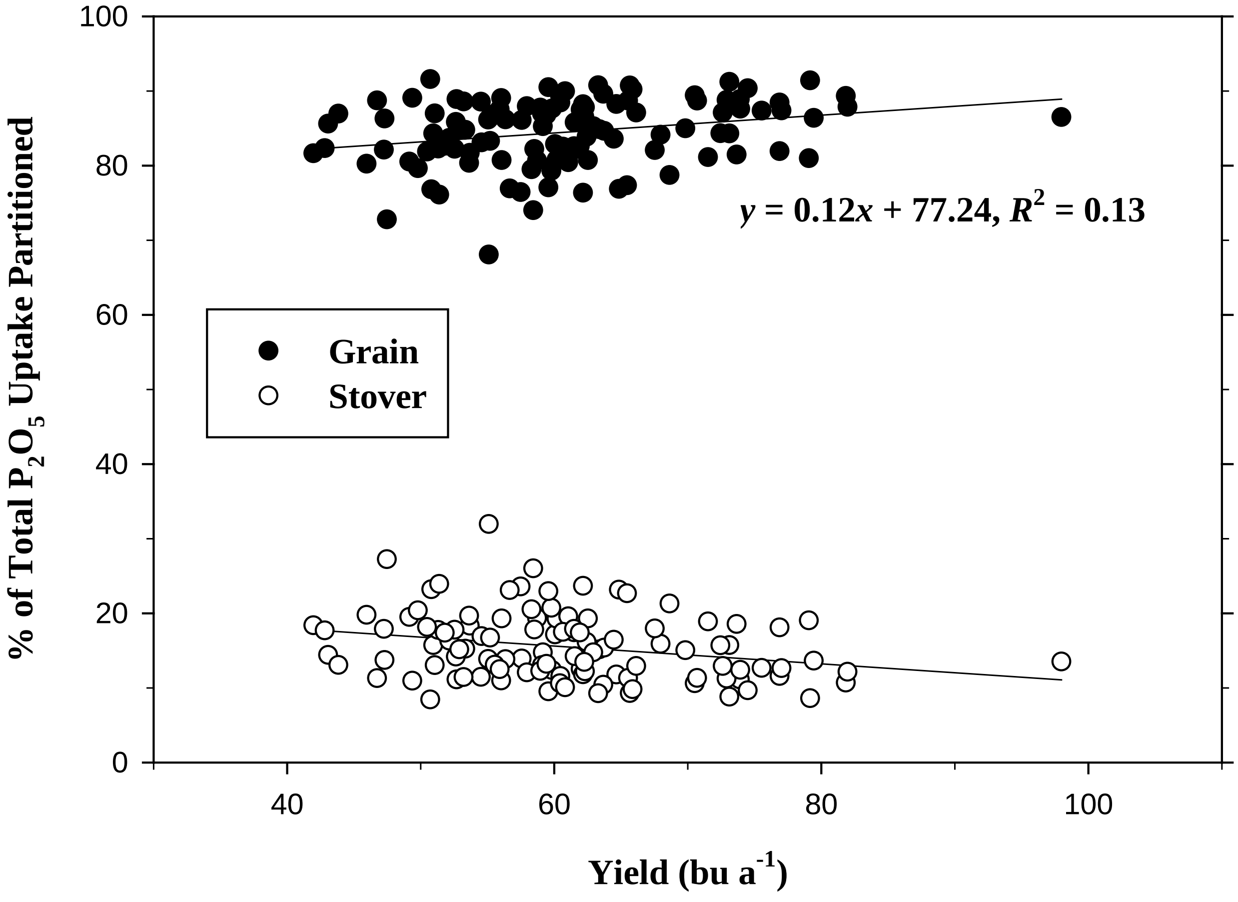
Relationship Between Grain Yield and Total Nitrogen Removal in 2014



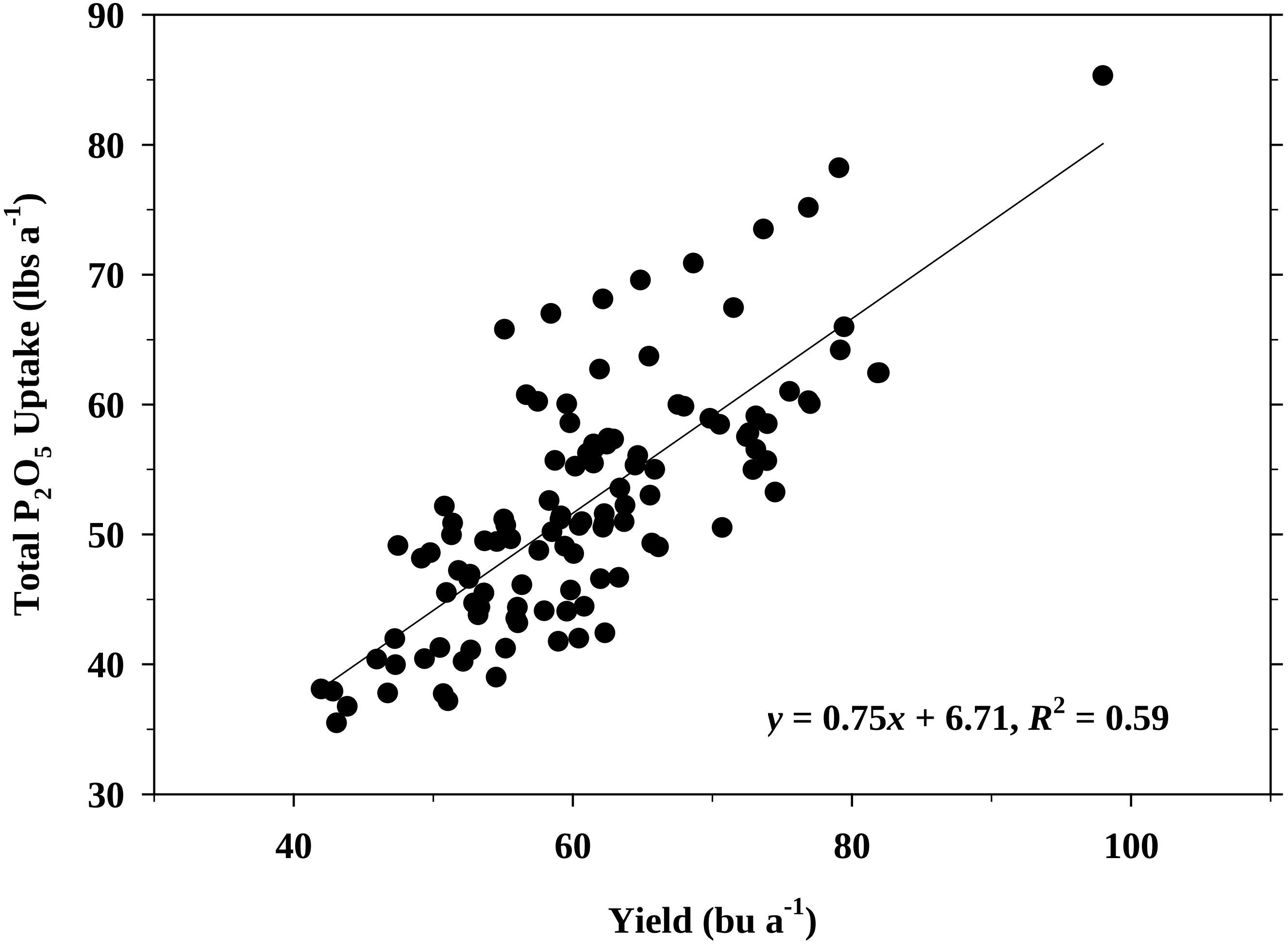
Phosphorus Partitioning Across Maturity Groups, Varieties and Planting Dates in 2014



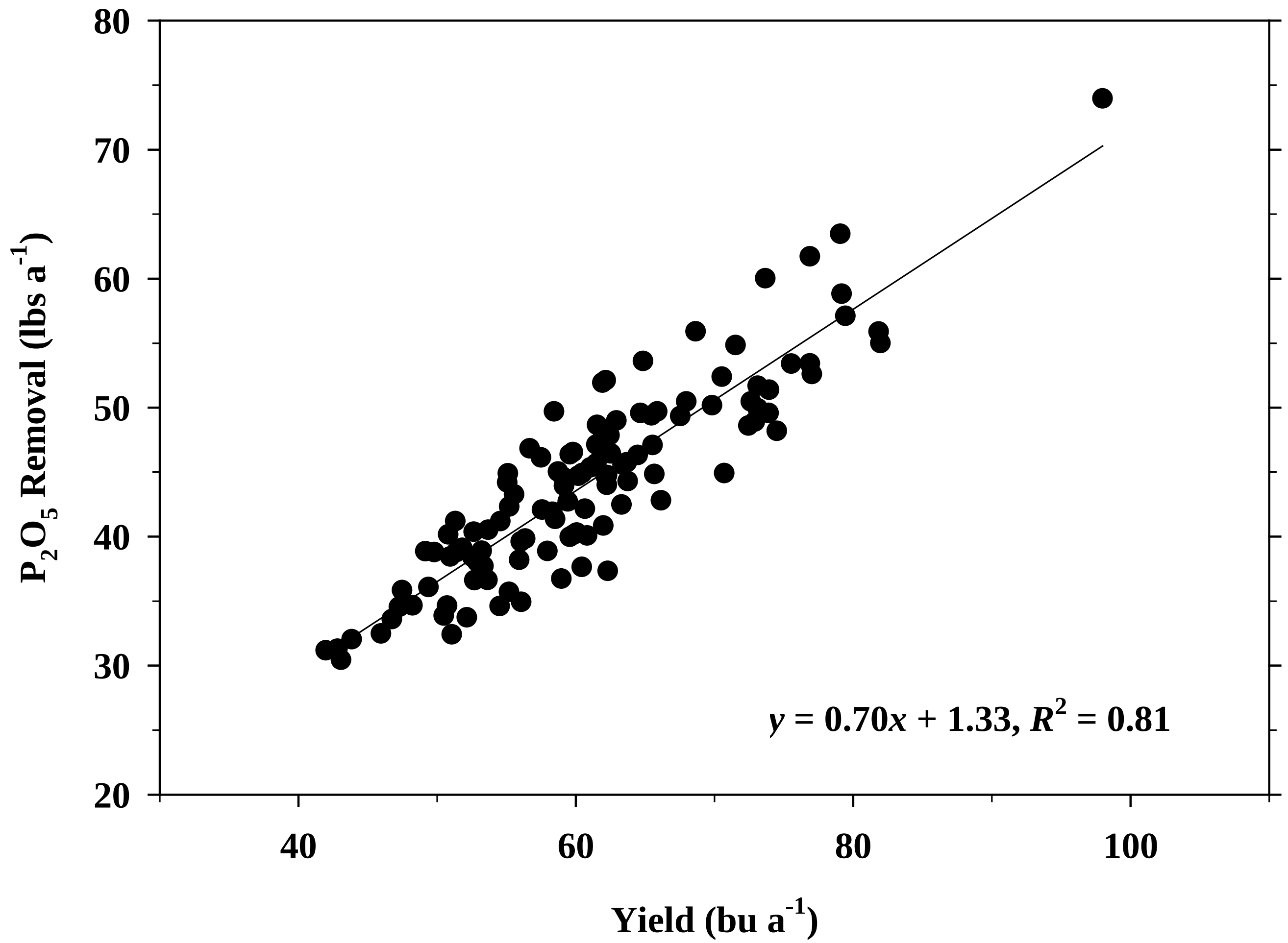
Phosphorus Partitioning Across a 60 bu/a Yield Range at R8



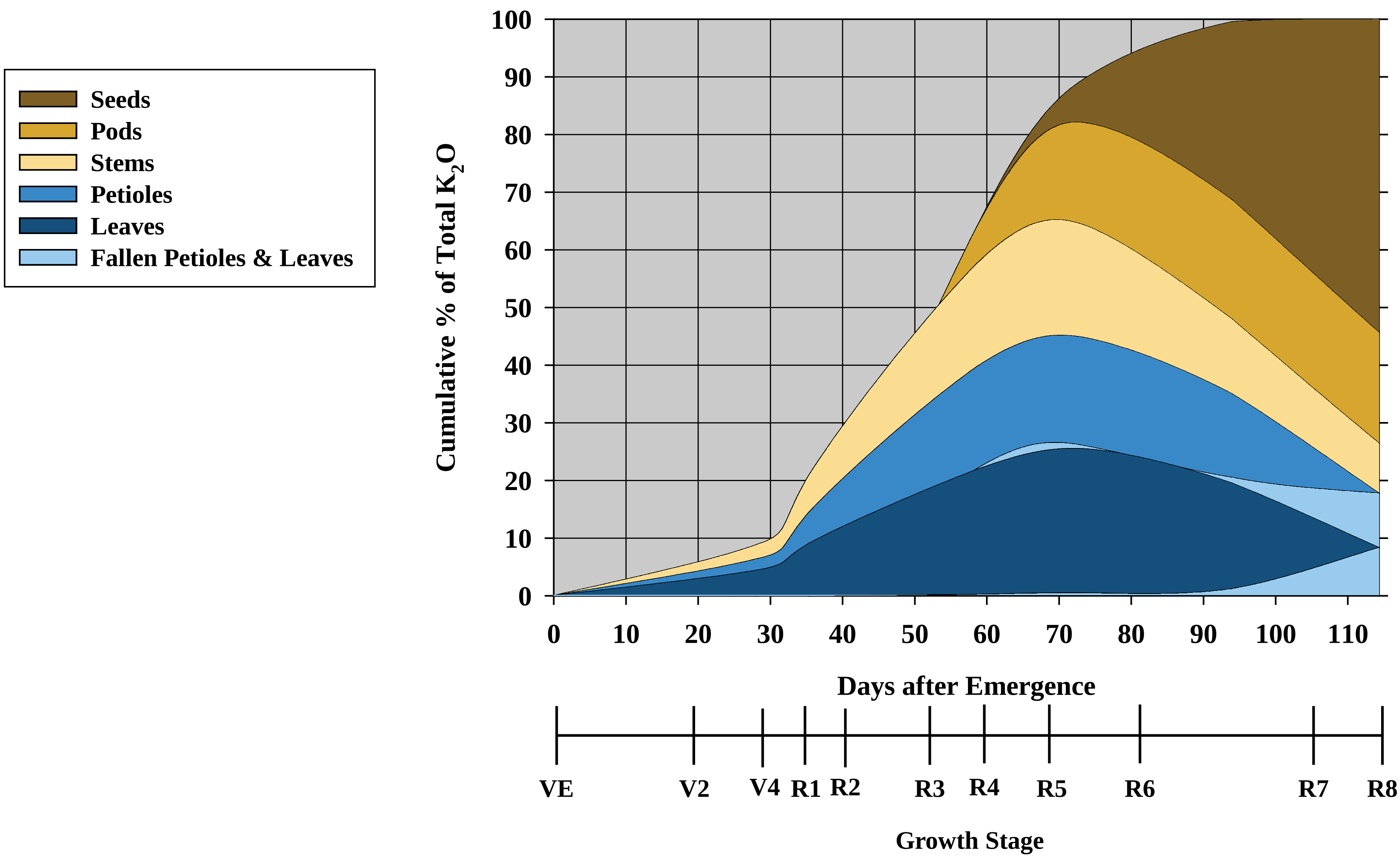
Relationship Between Grain Yield and Total Phosphorus Uptake in 2014



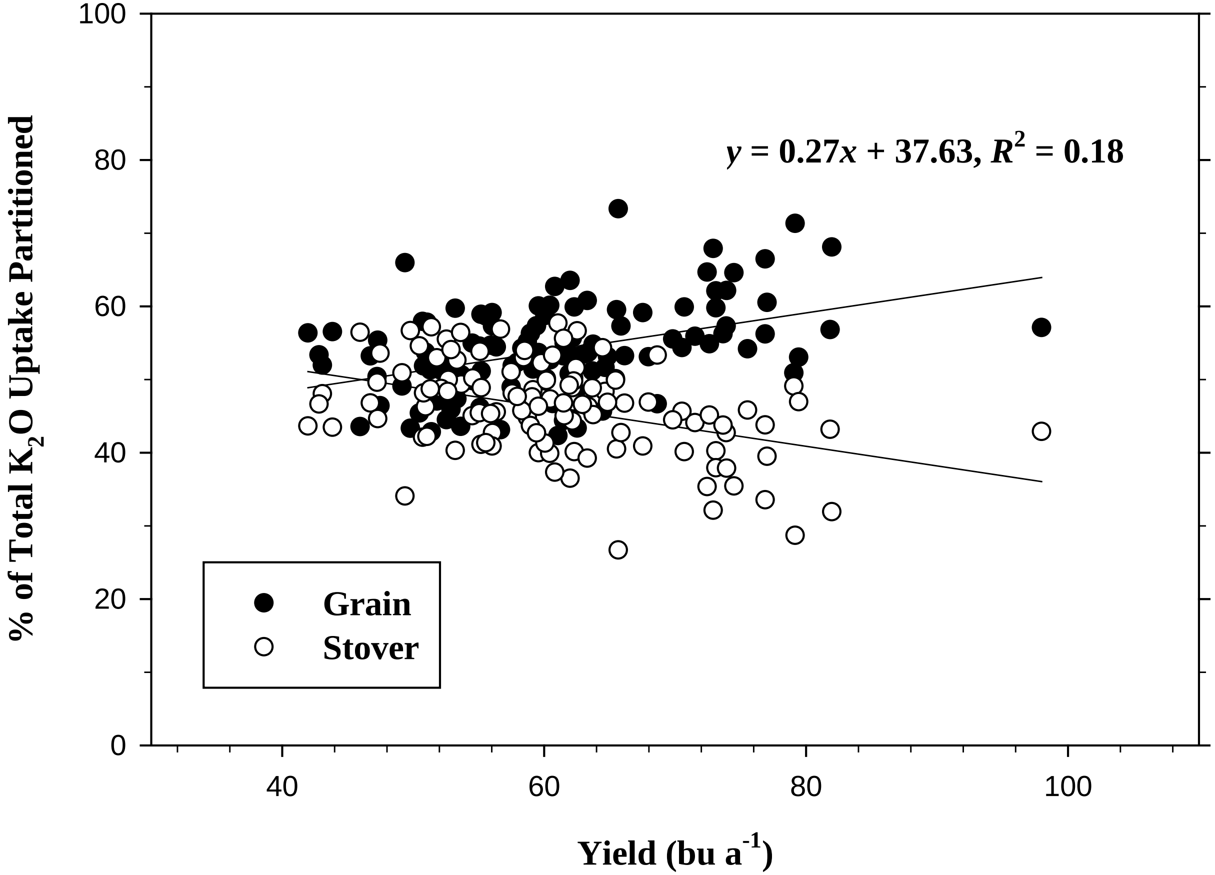
Relationship Between Grain Yield and Total Phosphorus Removal in 2014



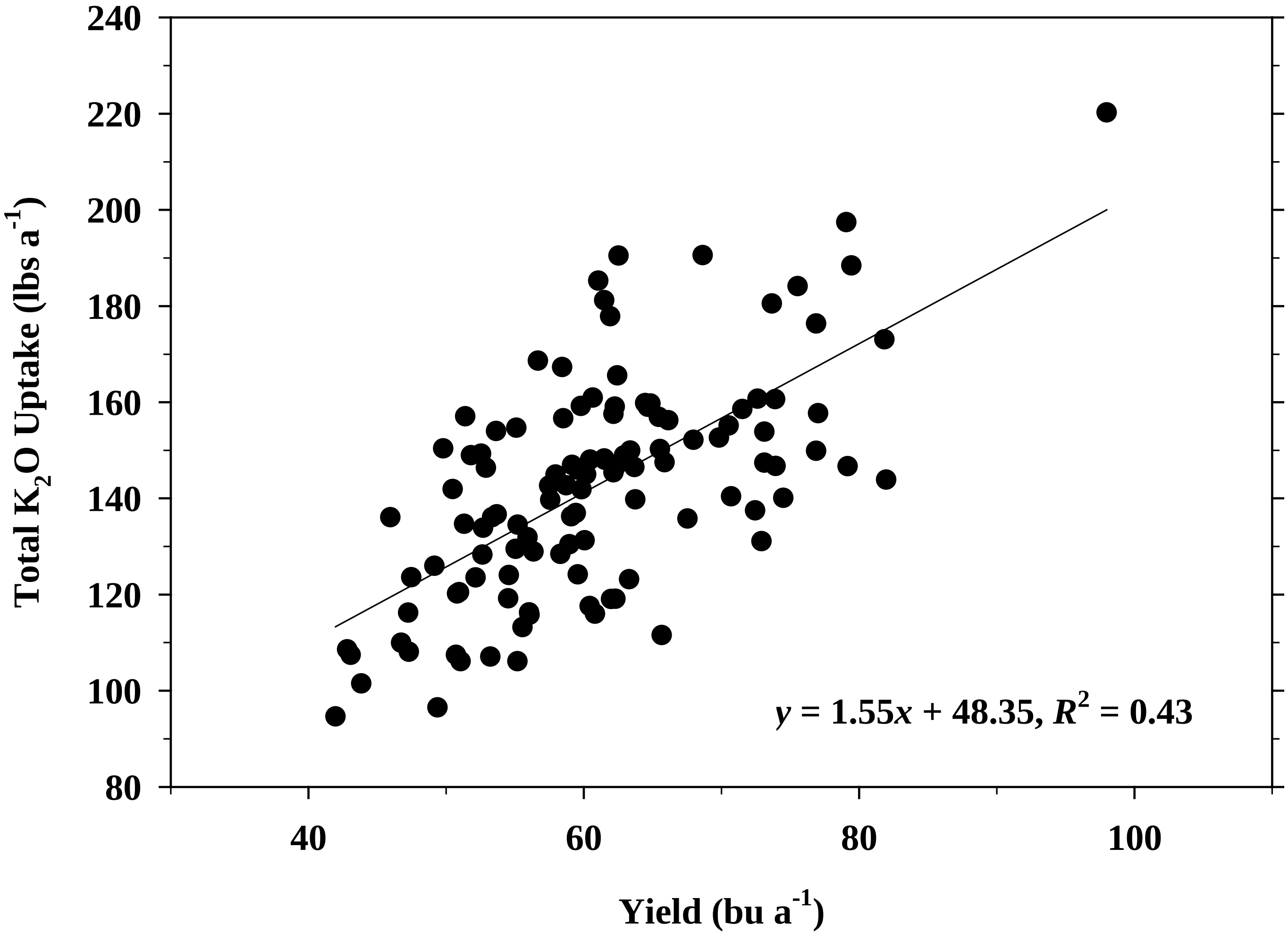
Potassium Partitioning Across Maturity Groups, Varieties and Planting Dates in 2014



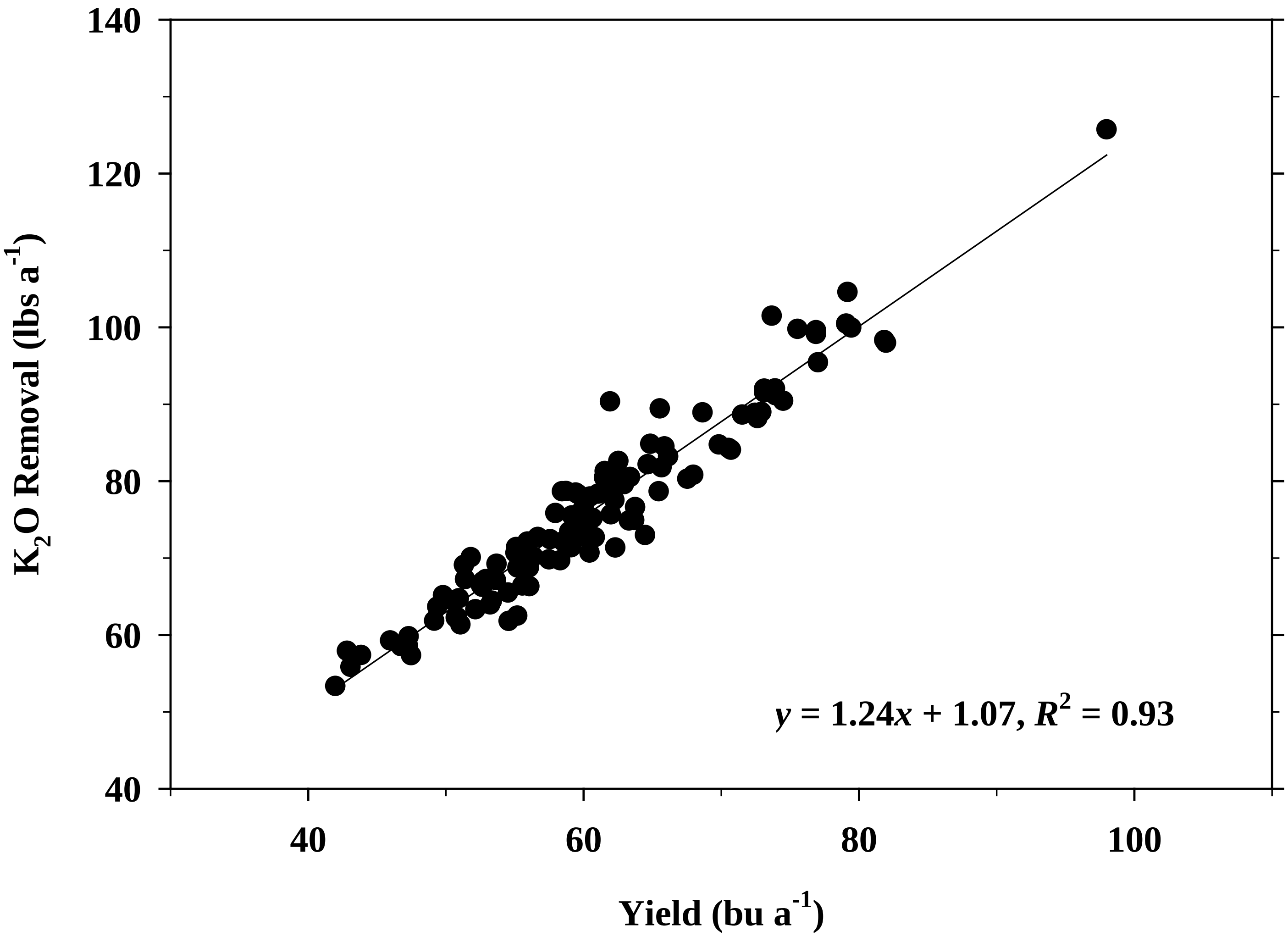
Potassium Partitioning Across a 60 bu/a Yield Range at R8



Relationship Between Grain Yield and Total Potassium Uptake in 2014



Relationship Between Grain Yield and Total Potassium Removal in 2014



Stover Harvest

Soybean stover nutrient concentrations and removal rates

Nutrient	Concentration %	Removal lbs ton^{-1} DM
N	0.91	18.2
P_2O_5	0.22	4.4
K_2O	1.80	36
Mg	0.45	9
Ca	1.29	25.8
S	0.11	2.2
Zn	0.00001	-
Mn	0.00007	-
Cu	0.000005	-
Fe	0.00008	-
B	0.00002	-
Al	0.00003	-
Na	0.0002	-

Can soybean growers benefit from precision ag data?

Ethan R. Smidt and Shawn P. Conley

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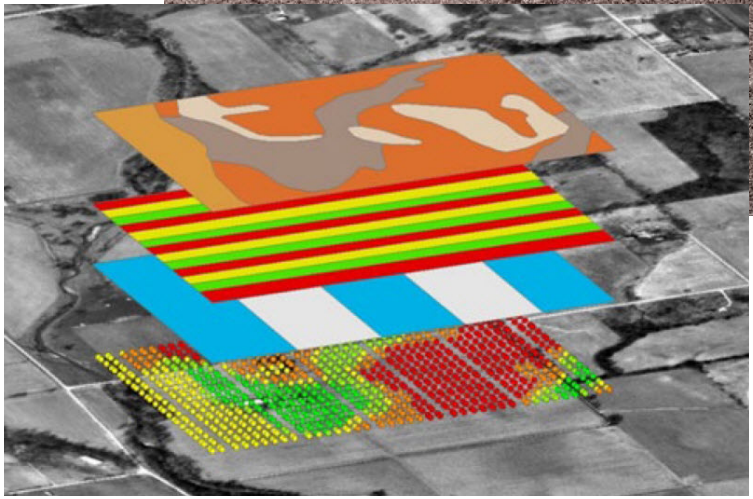
Introduction

- Growers are collecting multiple layers of data each year
- GPS and equipment advances have allowed for variable rate technology (VRT)
- Many growers are unsure which data layer(s) to use when creating these prescriptions



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Objectives

1. Find key parameters influencing soybean yield
2. Use those parameters to make accurate seeding rate prescriptions

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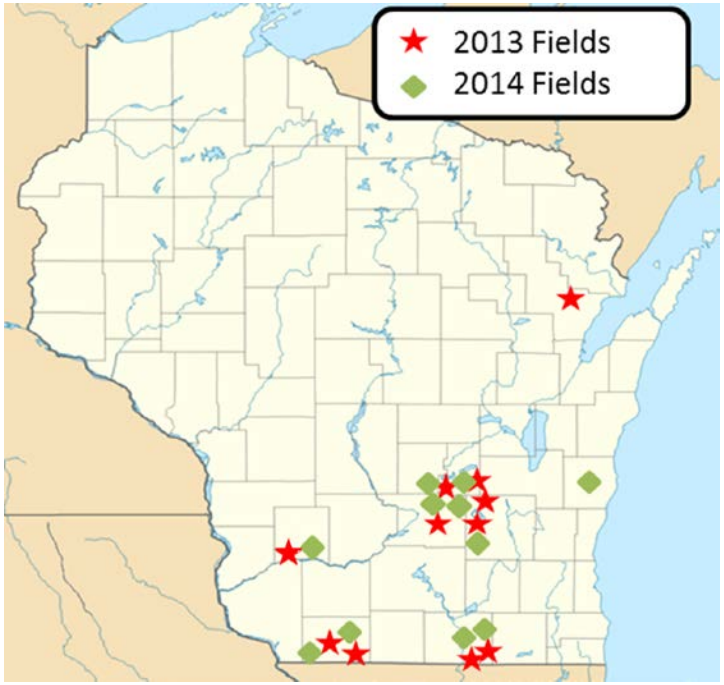
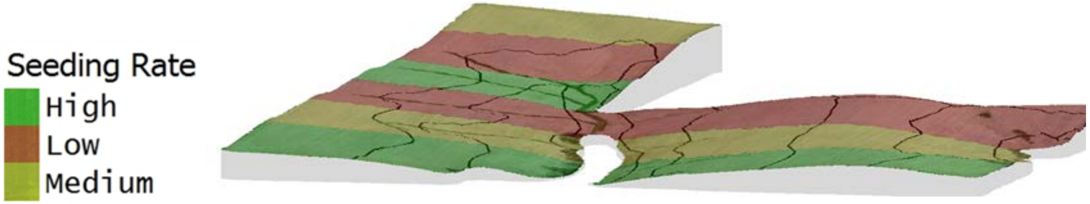
Materials and Methods

- Created prescriptions with high, medium, and low seeding rates running across soil types
- Rates were confirmed by as-planted data and stand counts
- Data layers also collected from soil samples, yield monitors, and soil surveys





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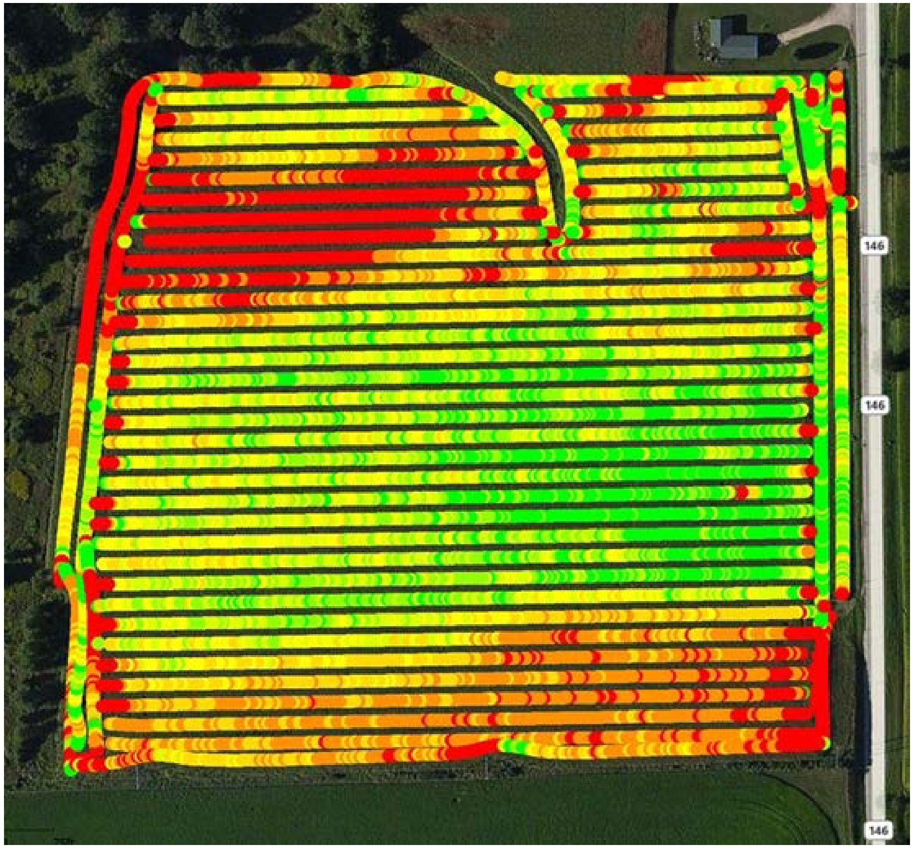
Materials and Methods (continued)

- We had a wide range of locations/conditions/soils
- Multiple varieties
- 15”, 20”, and 30” rows

Materials and Methods (continued)

- Soybean yield data was "cleaned" to discard outliers and incorrect data points
- Data analysis:
  - random forest model
  - cross-validation tests
  - decision tree models



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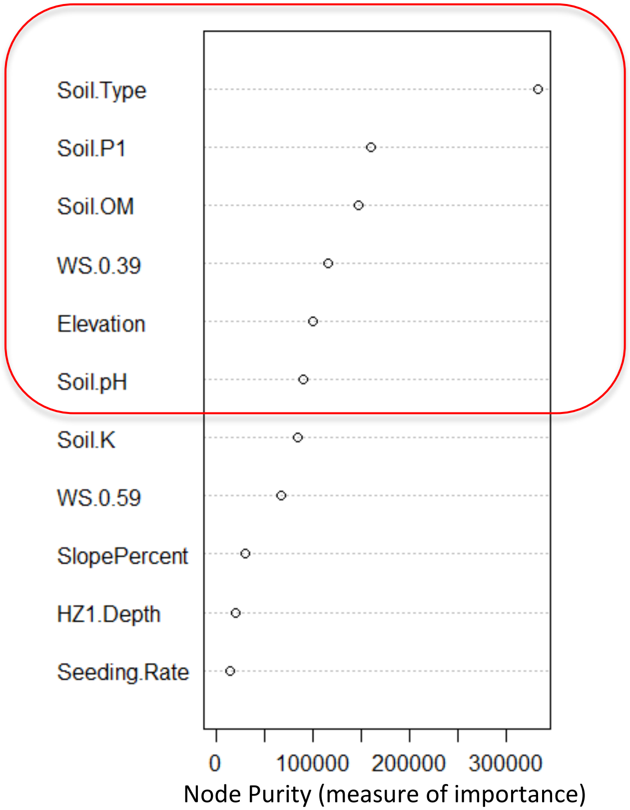
2013 Pooled Results

- <u>Soil type</u> was the most important variable in 2013 across Wisconsin
- Cross-validation indicated <u>soil phosphorus</u> (ppm), <u>soil organic matter</u> (%), <u>soil water storage capacity</u> from 0-39in (in), <u>elevation</u> (ft), and <u>soil pH</u> were also important in predicting yield

Ranking of Factor Importance – 2013 Pooled Data



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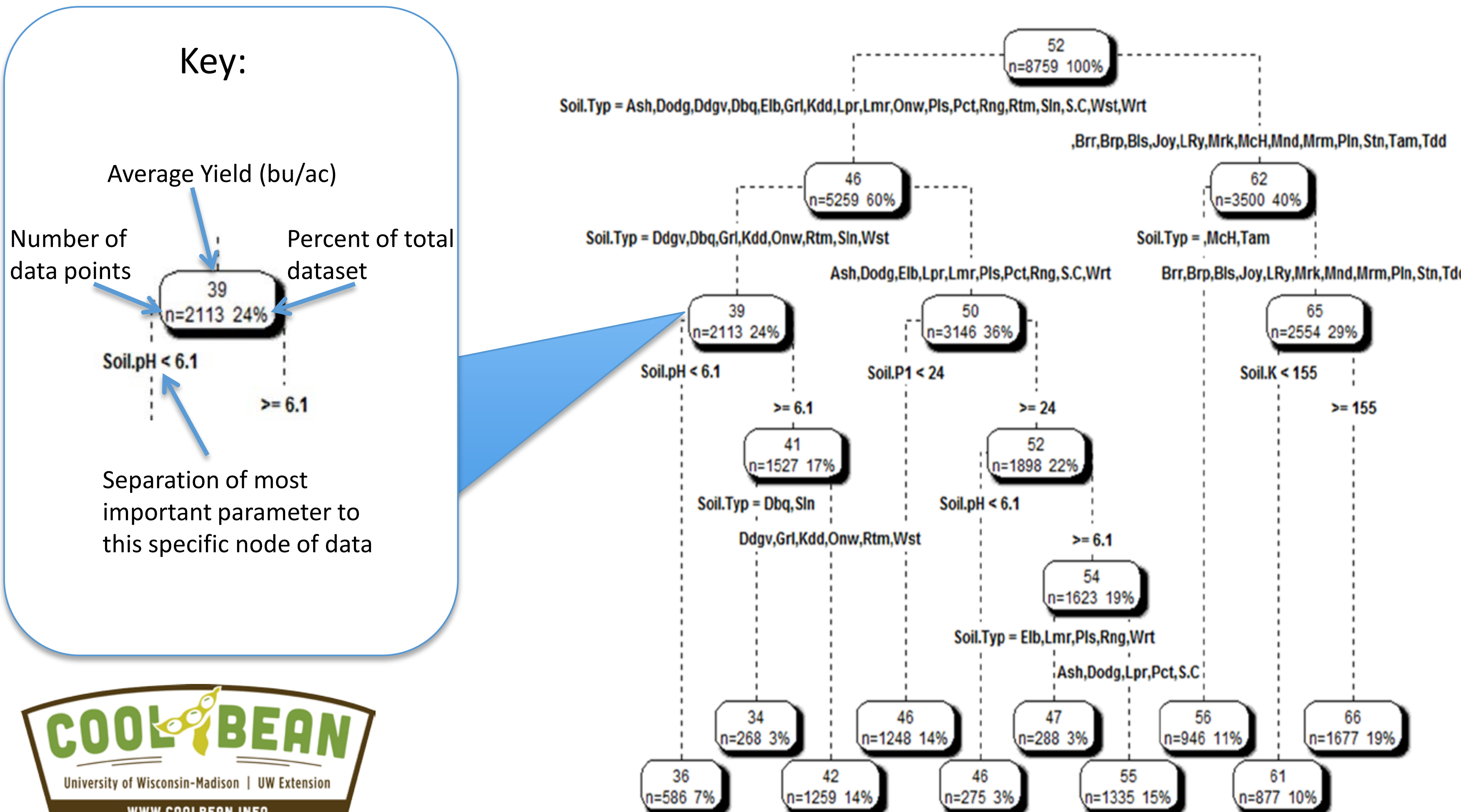
Decision Tree from Top 6 Parameters

Decision Tree – Full Model (2013)



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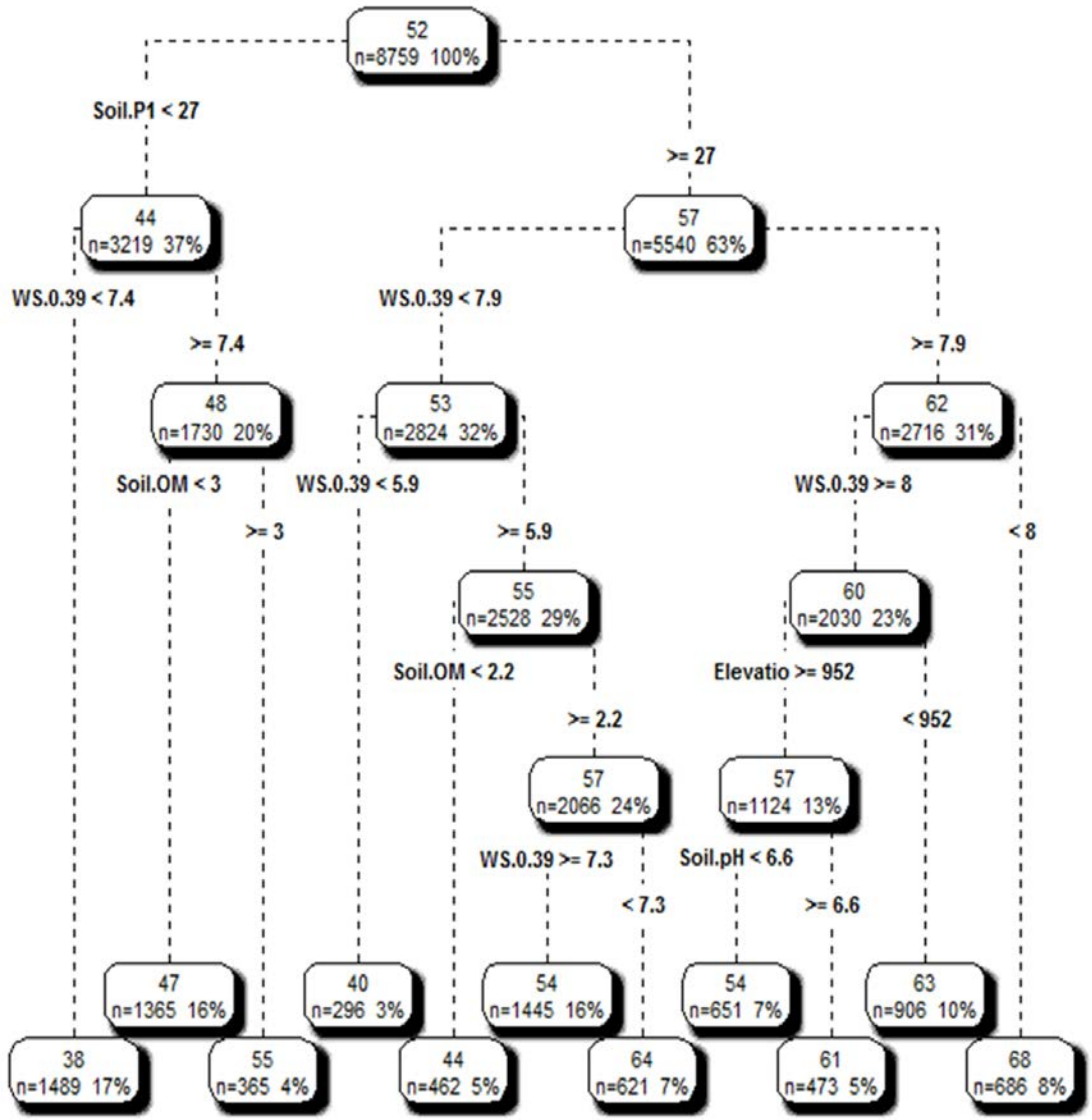
Soil Independent Decision Tree (2013)



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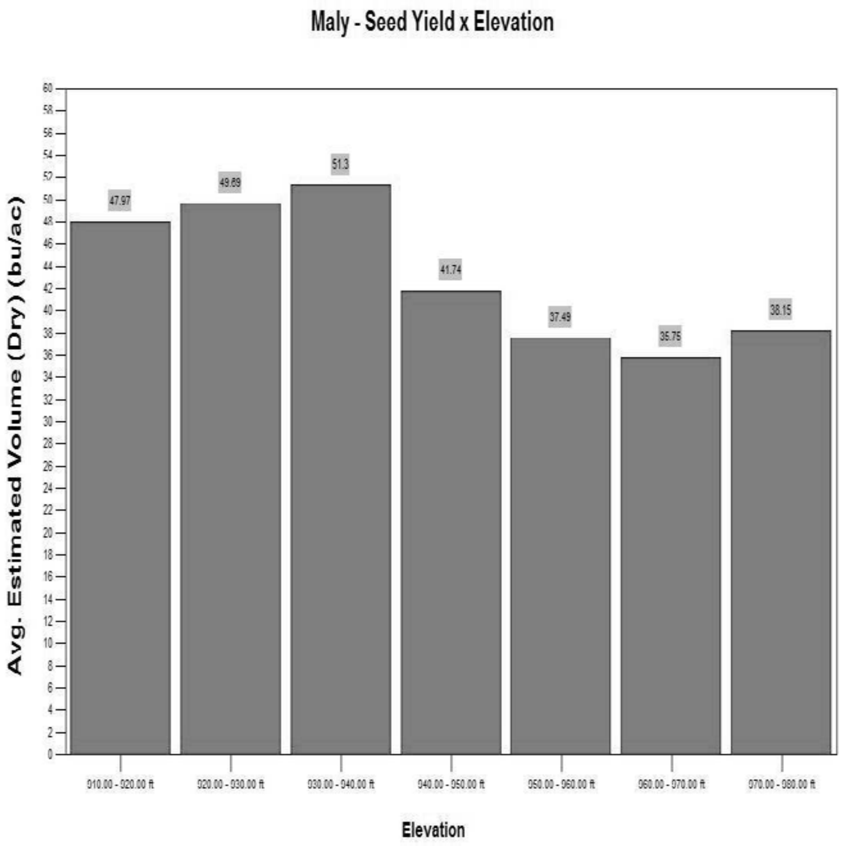
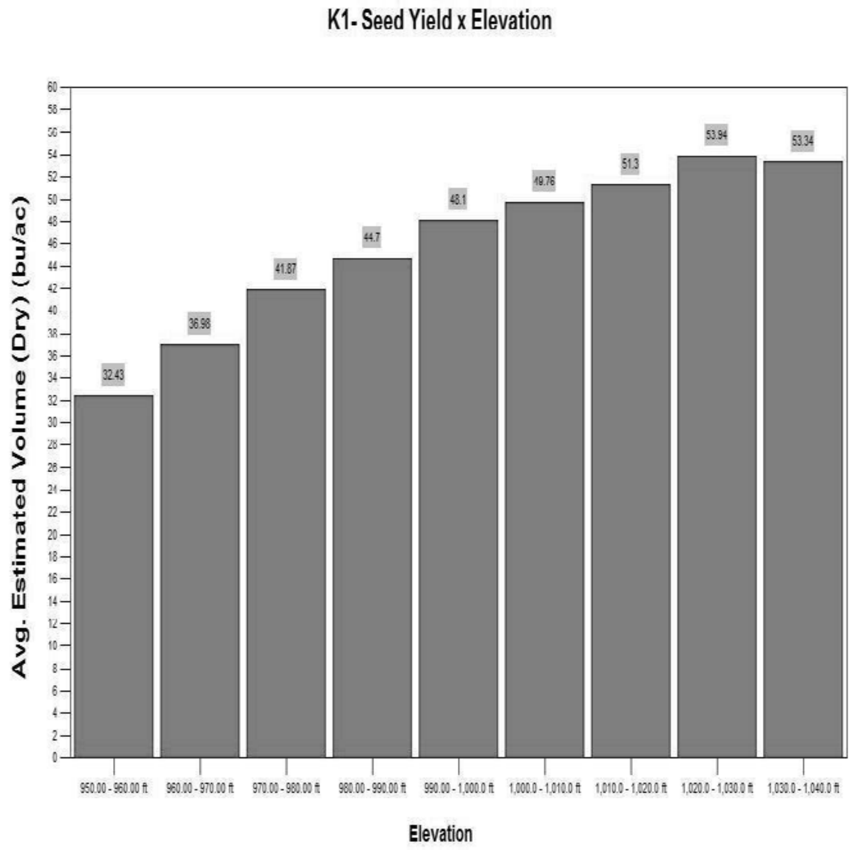
Results (continued)





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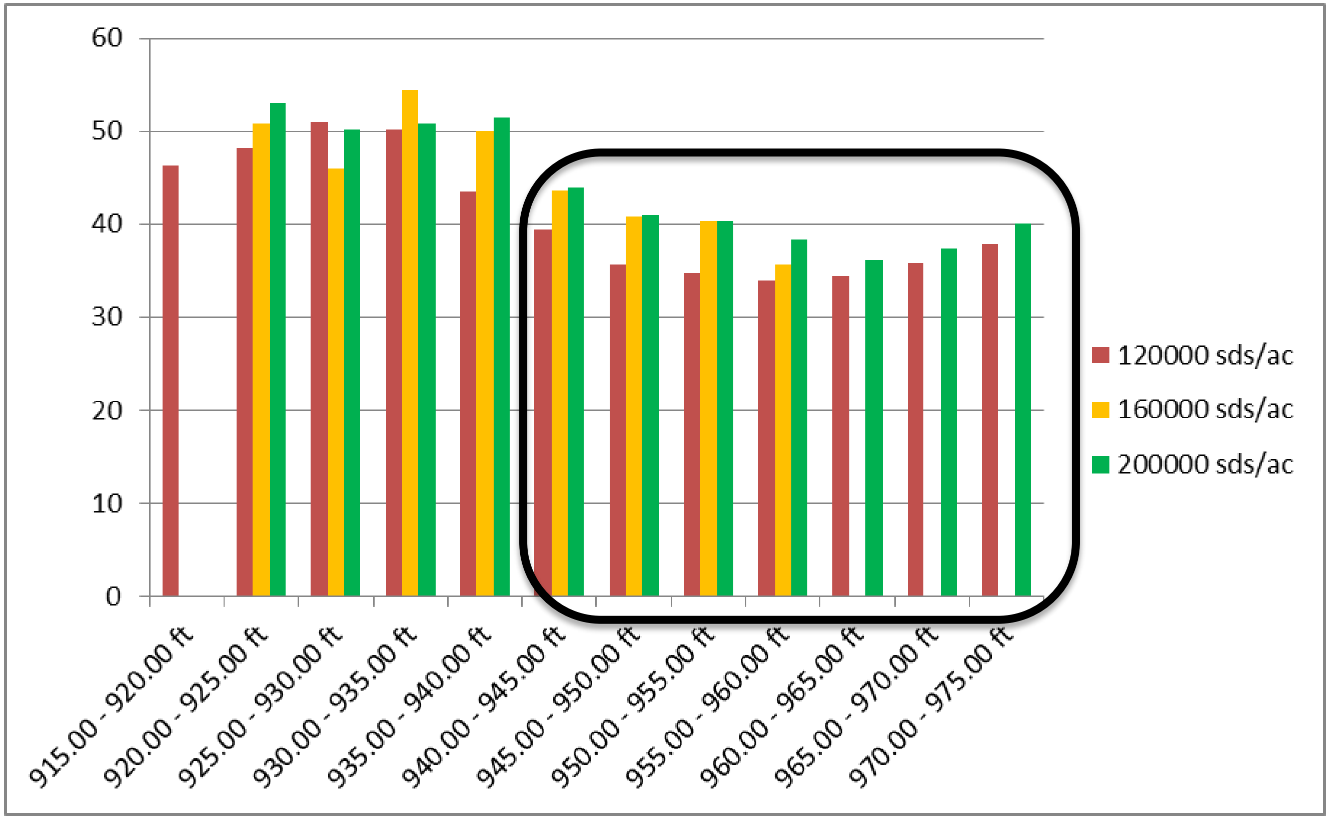
Results (continued)

Soybean Yield x Elevation x Seeding Rate



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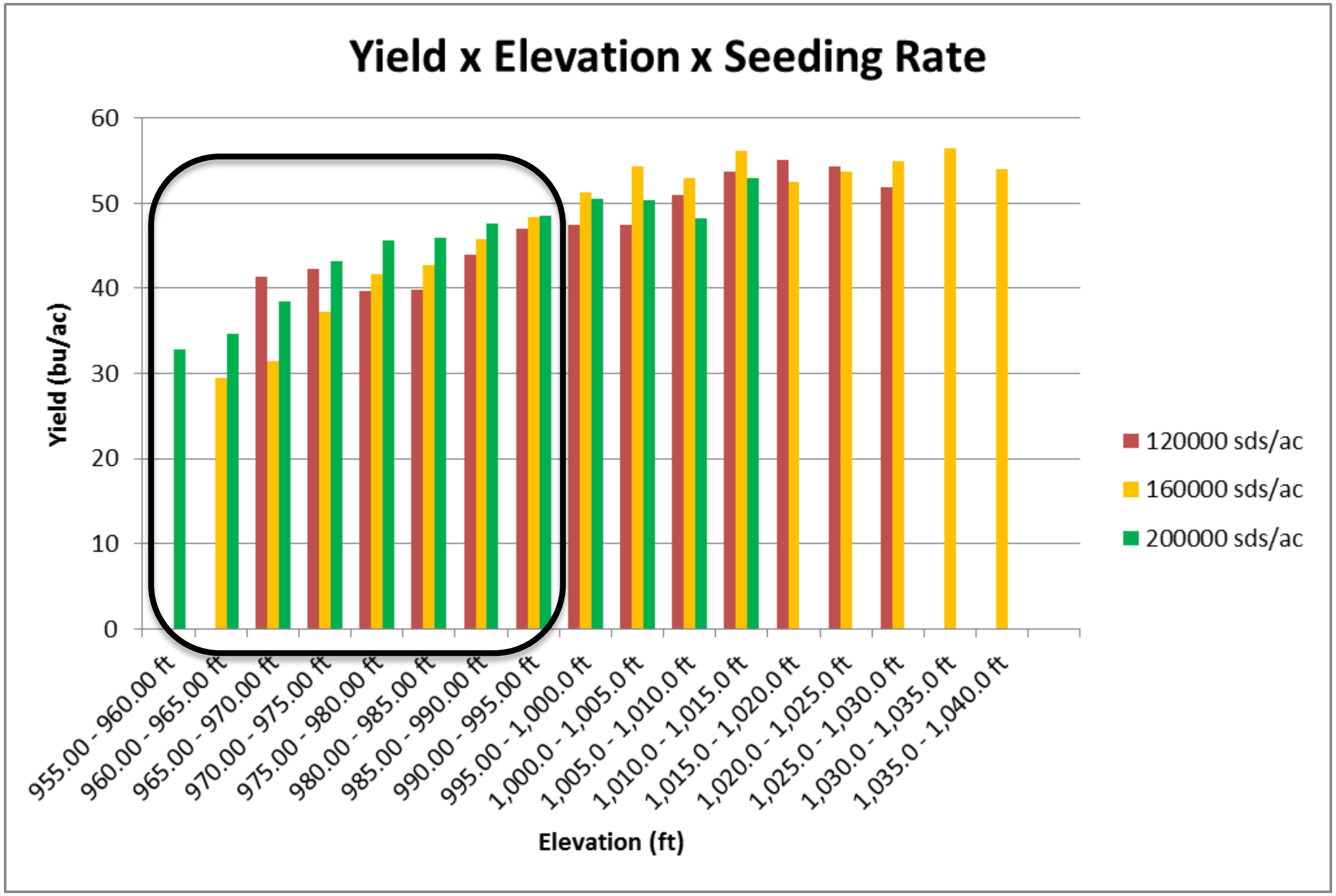
Results (continued)



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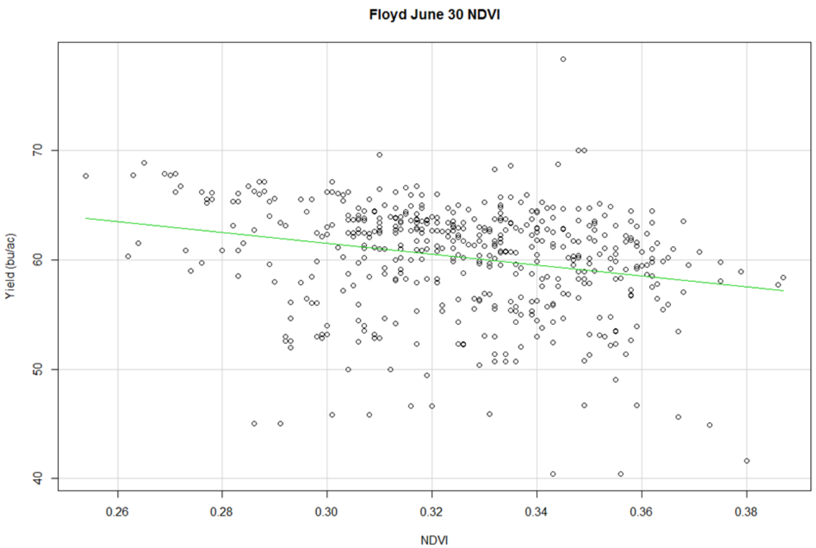
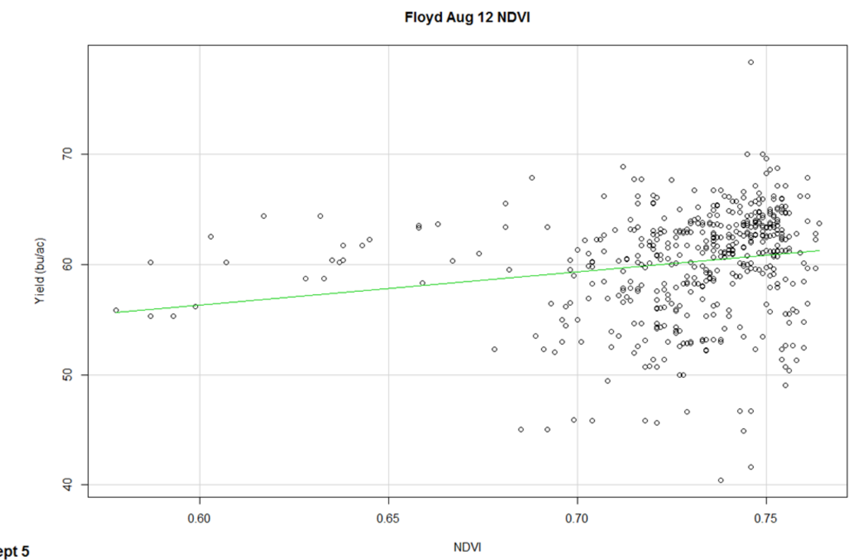
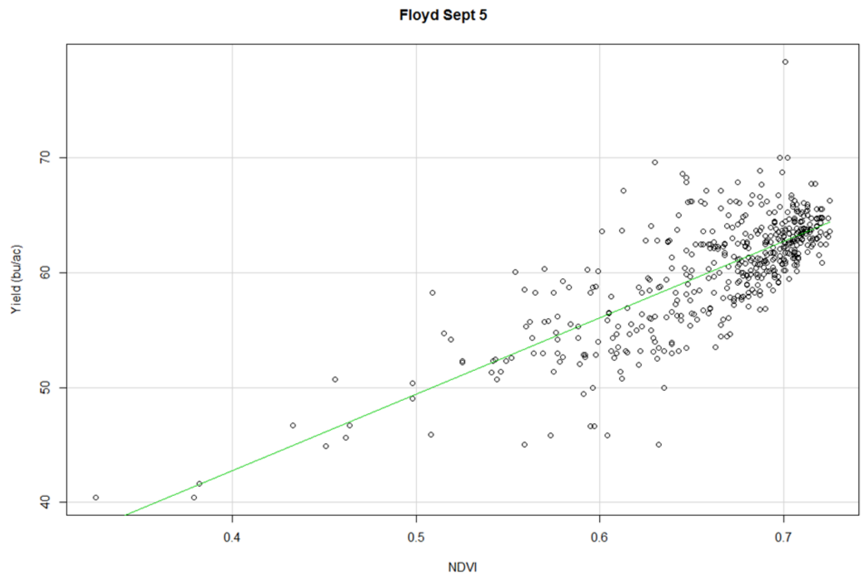
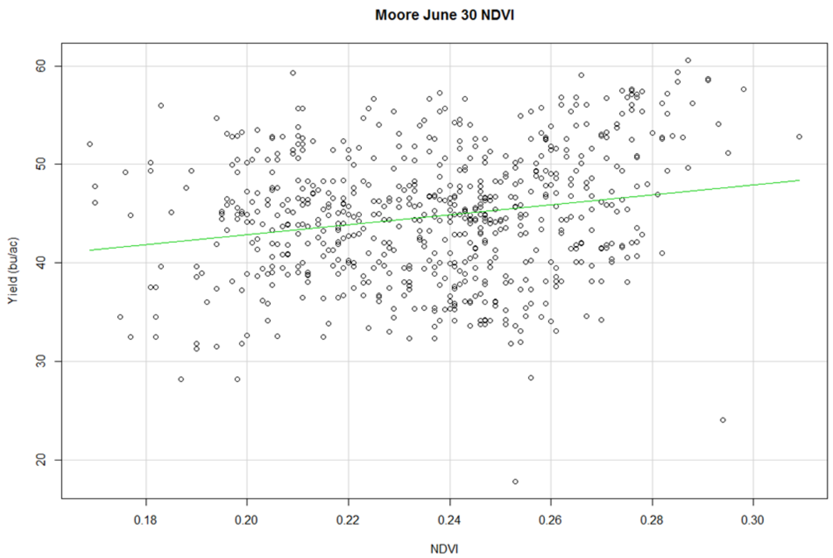
Results (continued)

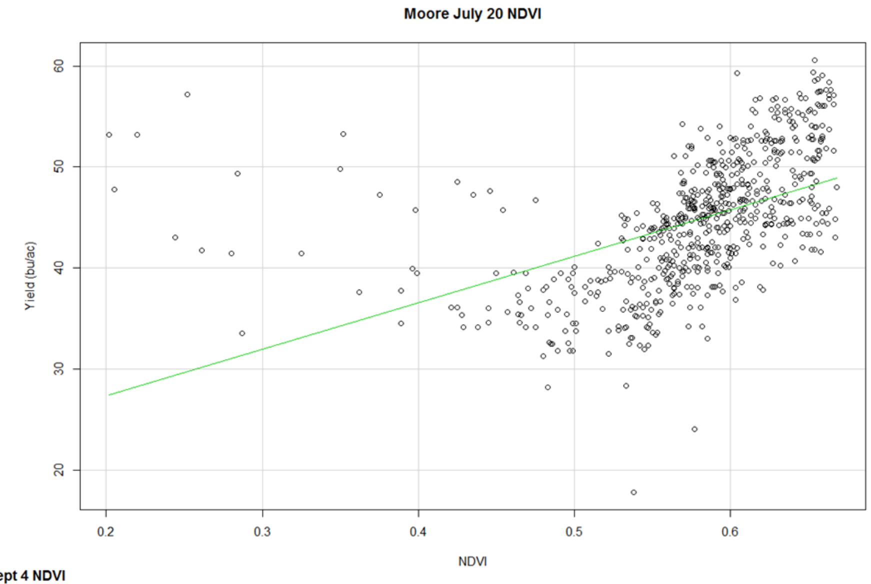


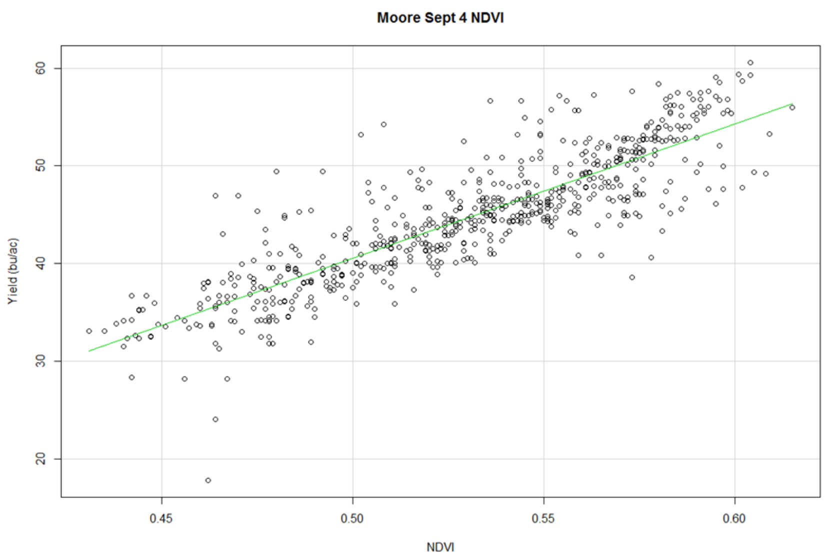




Results (continued)







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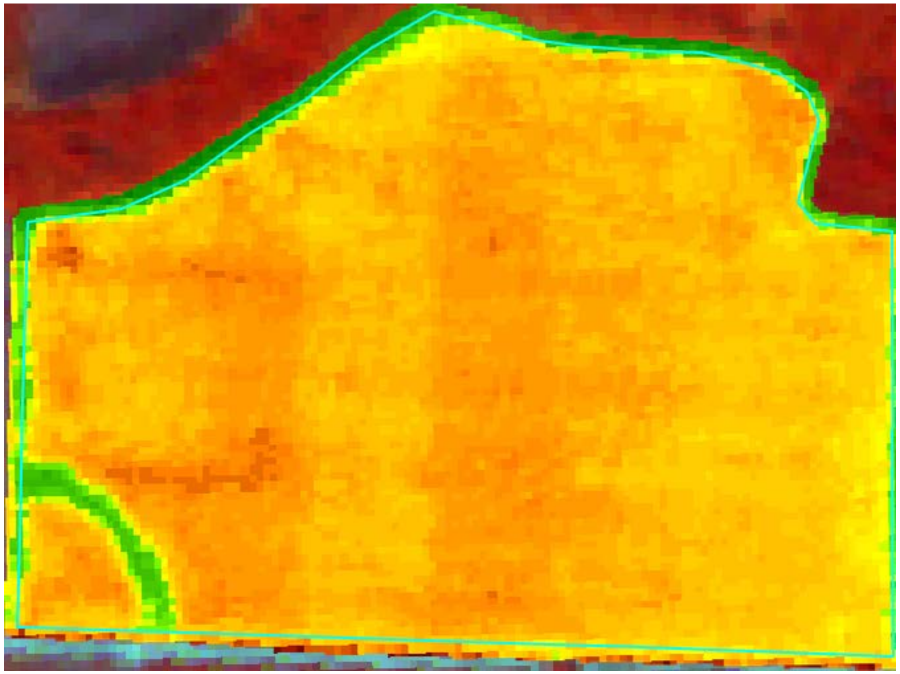
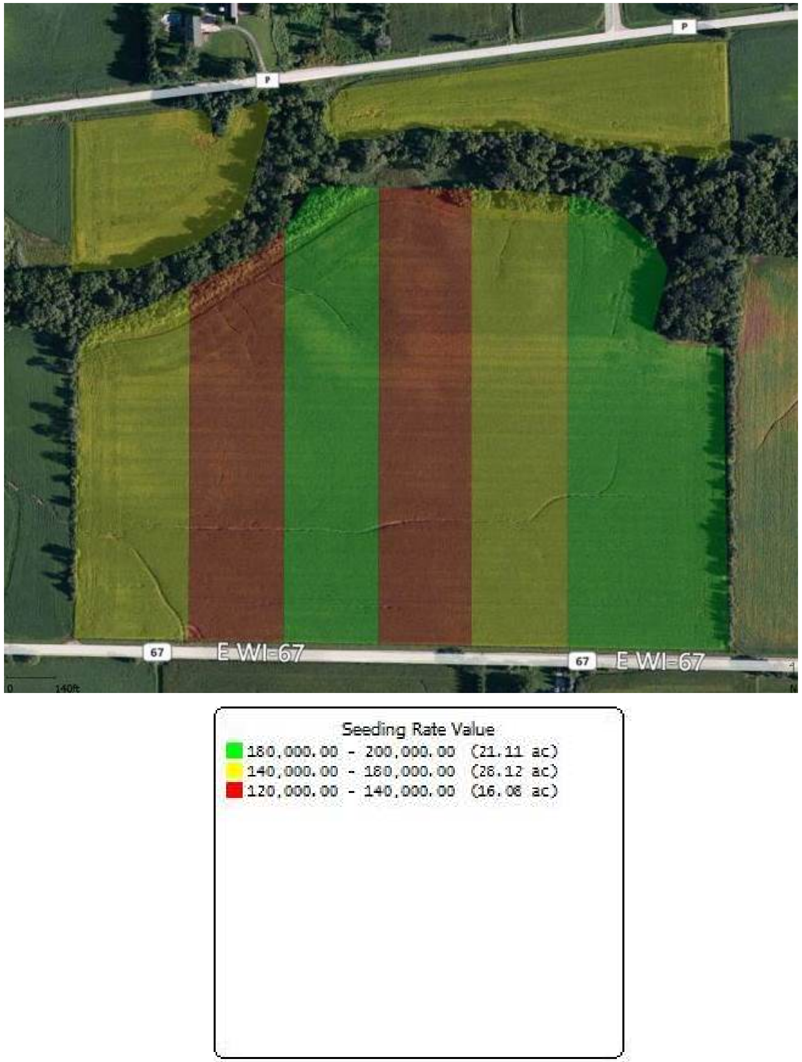
SatShot Data Example



NDVI Satellite Image – June 30



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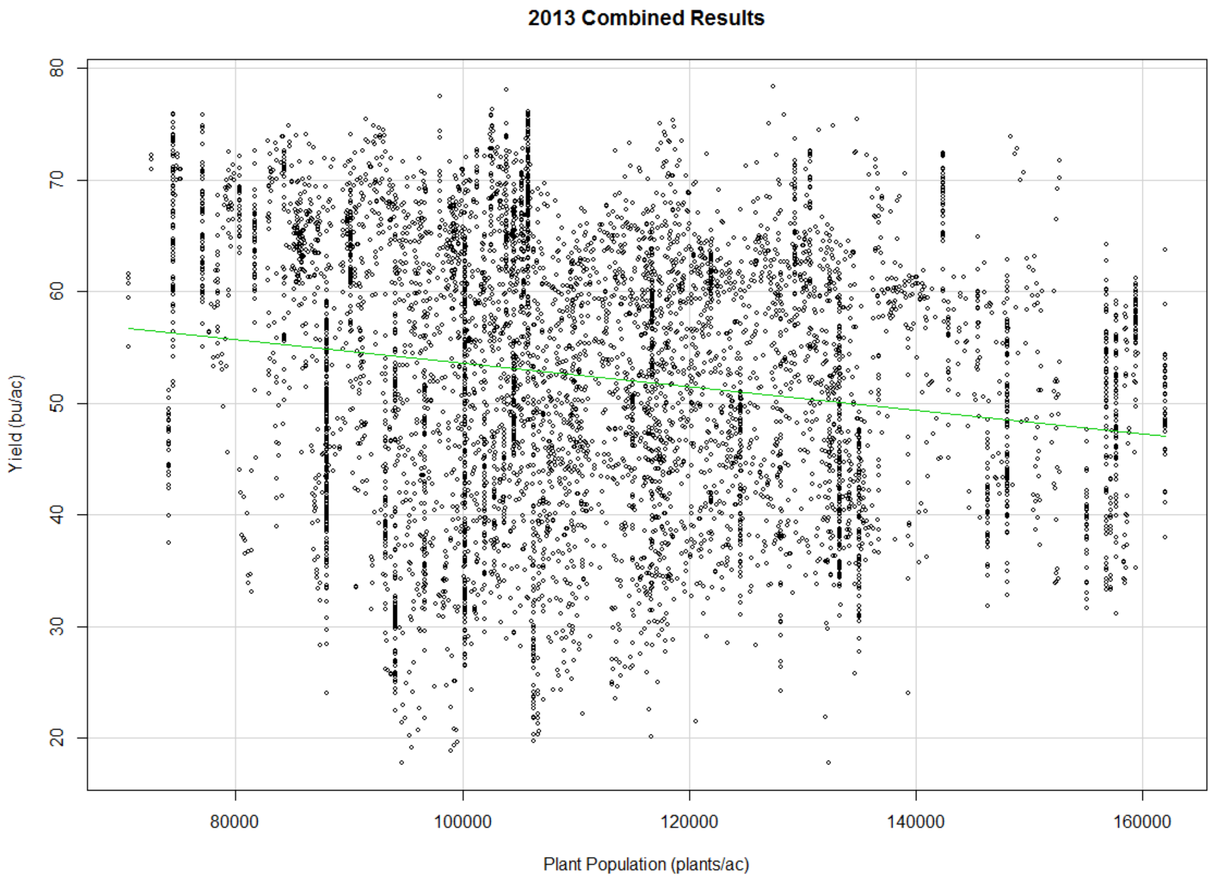
Yield x Plant Population (2013)



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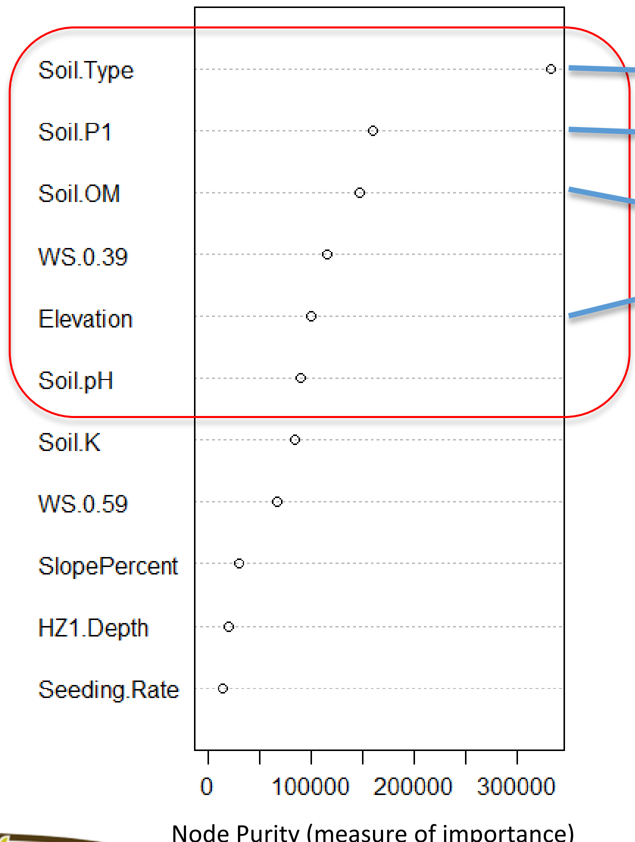
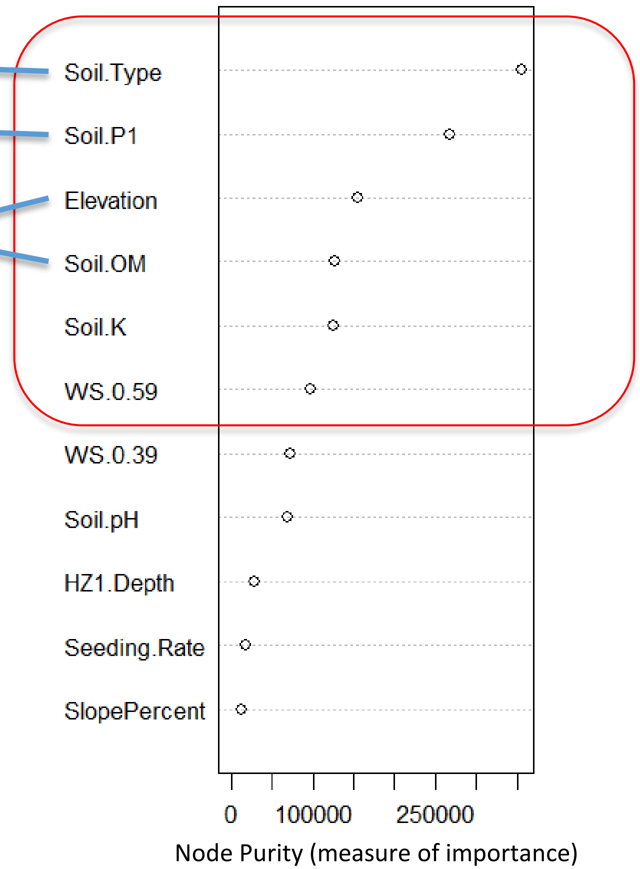
Combined Results

Most important variables – 2013 Pooled Data

Most important variables – 2014 Pooled Data





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Single Field Analyses

2013 Variable Rankings	2014 Variable Rankings
1. Elevation (1.73)	1. Elevation (2.00)
2. Soil Potassium (3.18)	2. Soil pH (3.09)
3. Soil Organic Matter (3.27)	3. Soil Potassium (3.18)
4. Soil pH (3.91)	4. Soil Organic Matter (3.36)
5. Soil Phosphorus (4.09)	5. Soil Phosphorus (3.82)

- Very different story
- Local knowledge is still very important
- All other variables (including soil type) ranked 6.00 or lower

Preliminary Conclusions

- Soil type was the most important variable in both 2013 and 2014 across Wisconsin
- Individual fields had very different results with elevation as the most important on average
- Seeding rate was not a statistically significant variable in either year

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What else are we learning?

- NDVI can be a good late-season yield predictor
- Low yielding areas may respond to higher seeding rates (more work needed)
- Precision farming data can be useful to soybean growers

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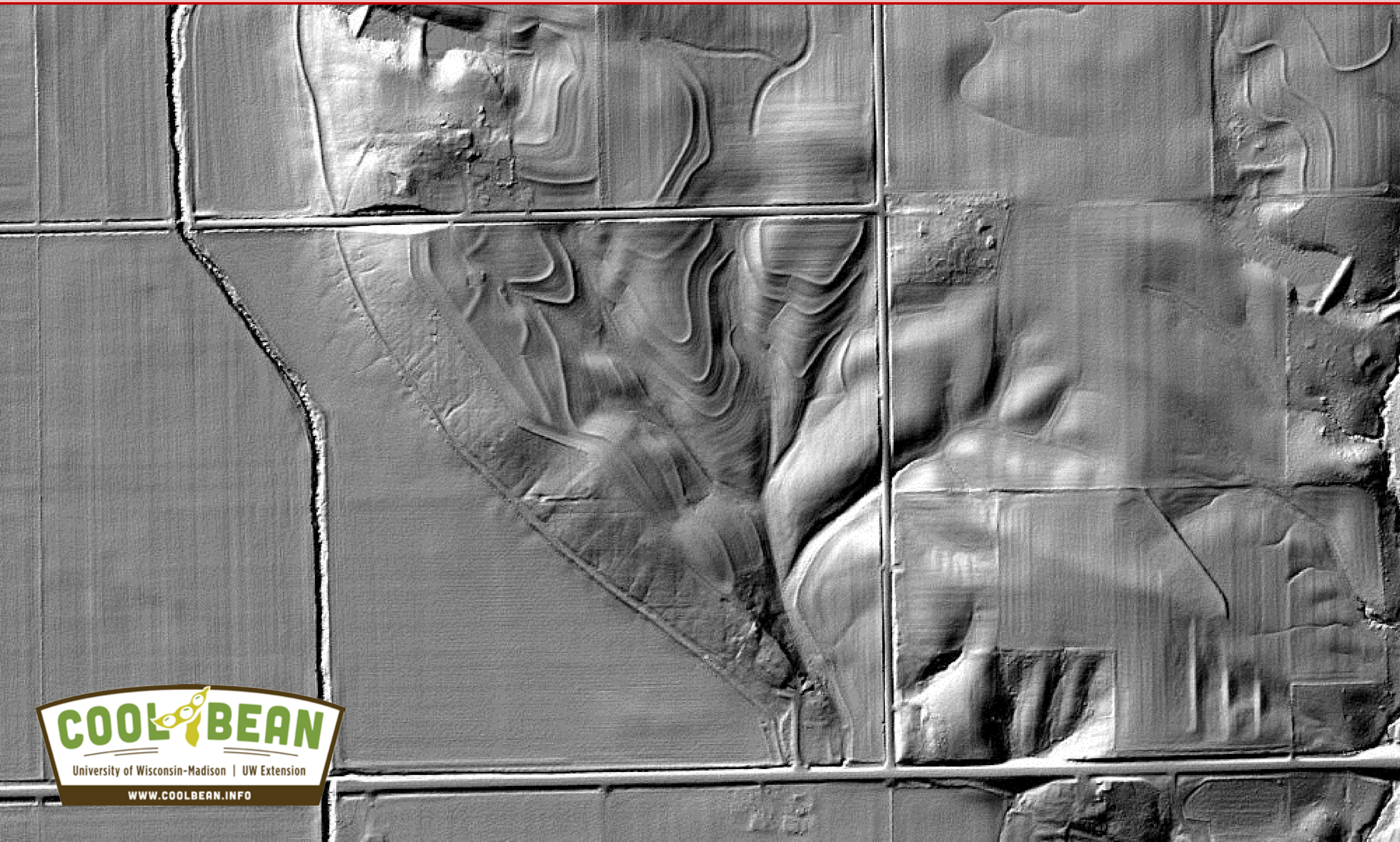
Can soybean growers benefit from precision ag data?



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Acknowledgements

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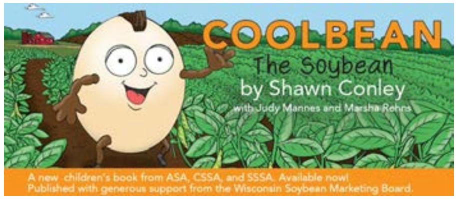

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