Identifying Soybean Yield Limiting Factors

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Factors That Influence Soybean Yield

- Light (Temperature)
- Water (Drainage)
- Nutrition
- Pest management

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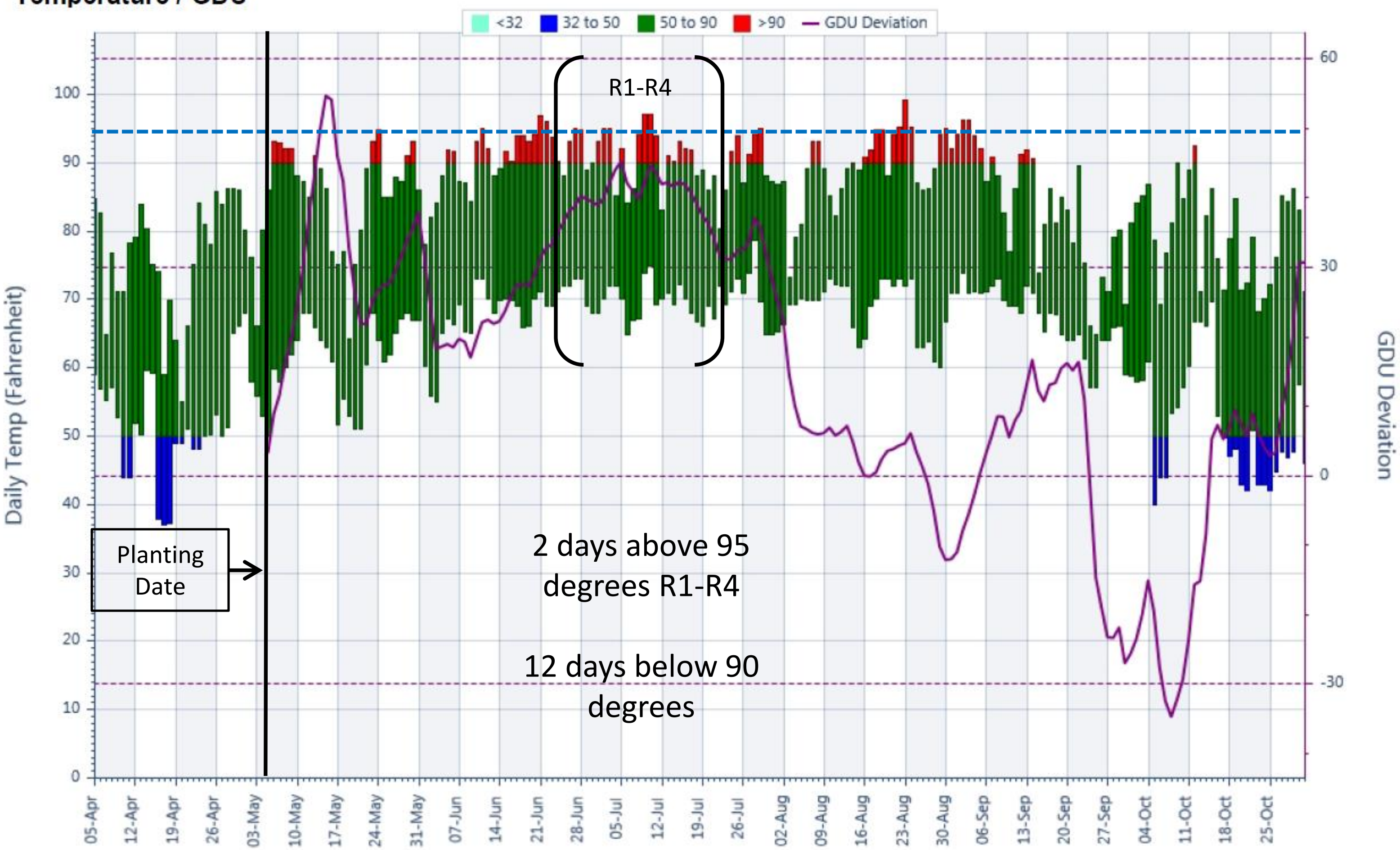
Combined Effect of Light, Water, and Nutrition

2014 Field Environment Profile – Darlington County, SC

Business Partner: 2014 SC 54T94 Corrected
Field:
County: Darlington

Operation:
Farm:
State: South Carolina

Temperature / GDU



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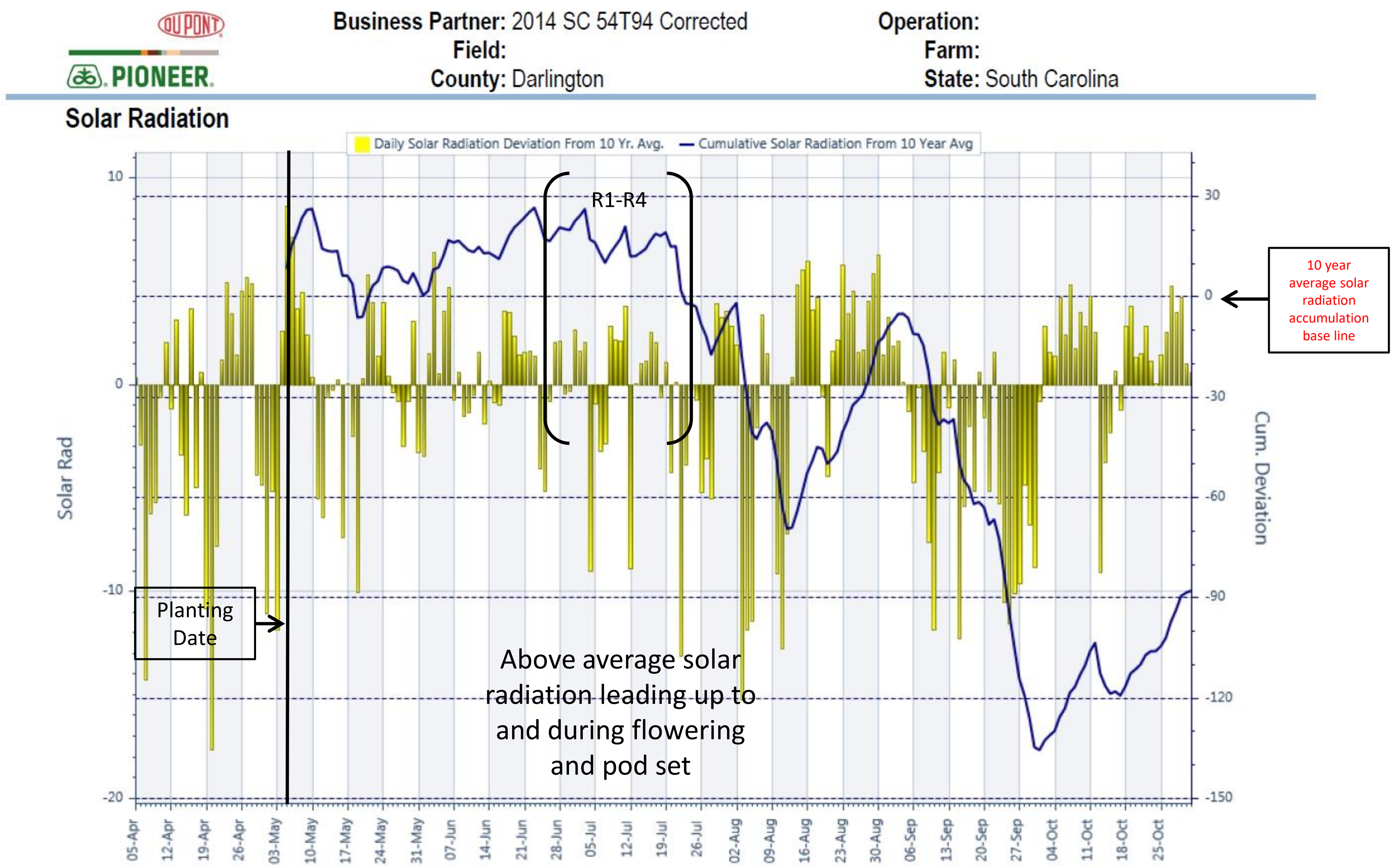


- Well Irrigated
- Fertilized for Corn
- Cool Growing Season
- Lots of Sunlight

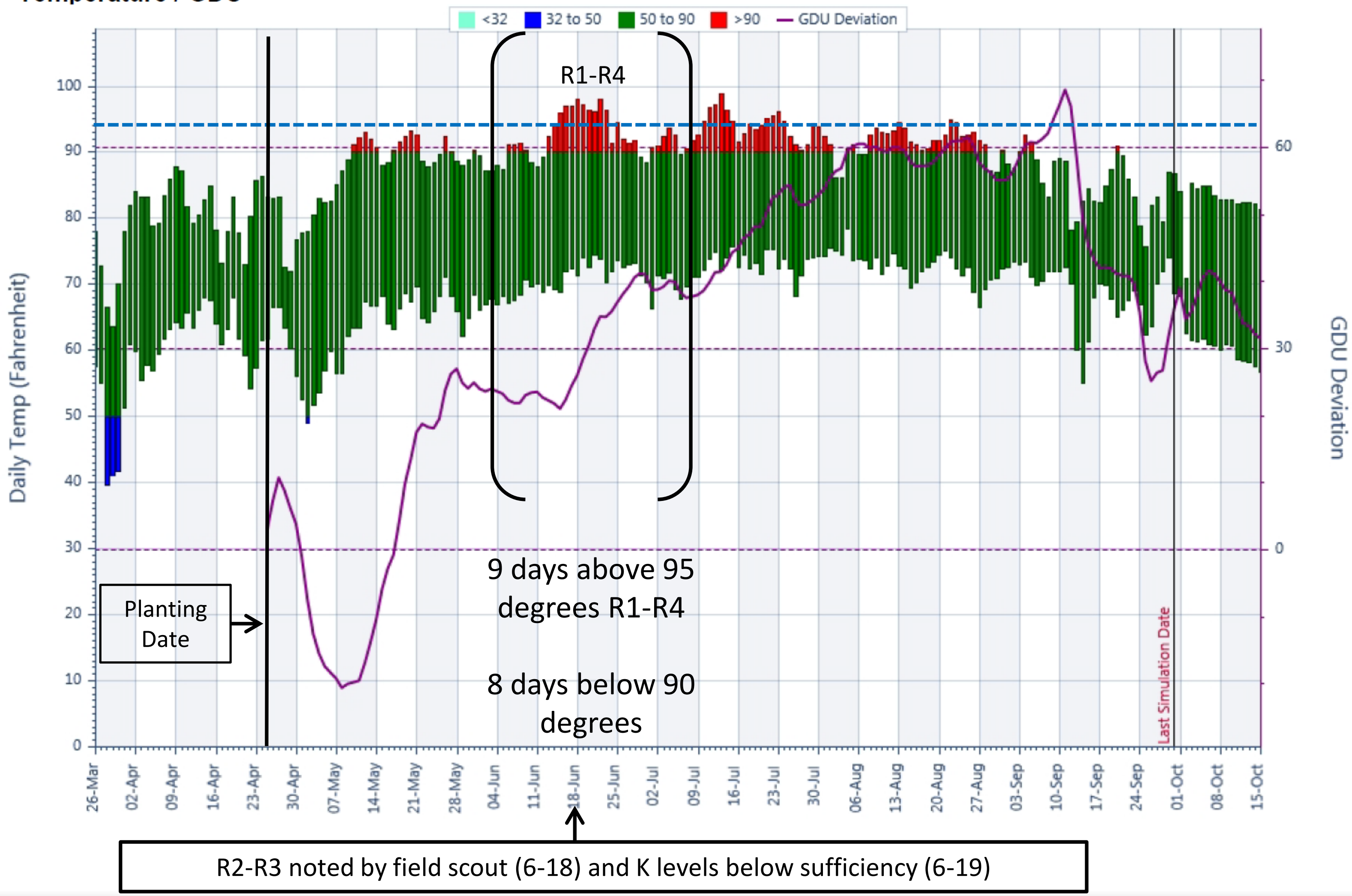
Don Gause
109.1 Bu/A
Scranton, SC
2014

2015 Field Environment Profile – Lowndes County GA

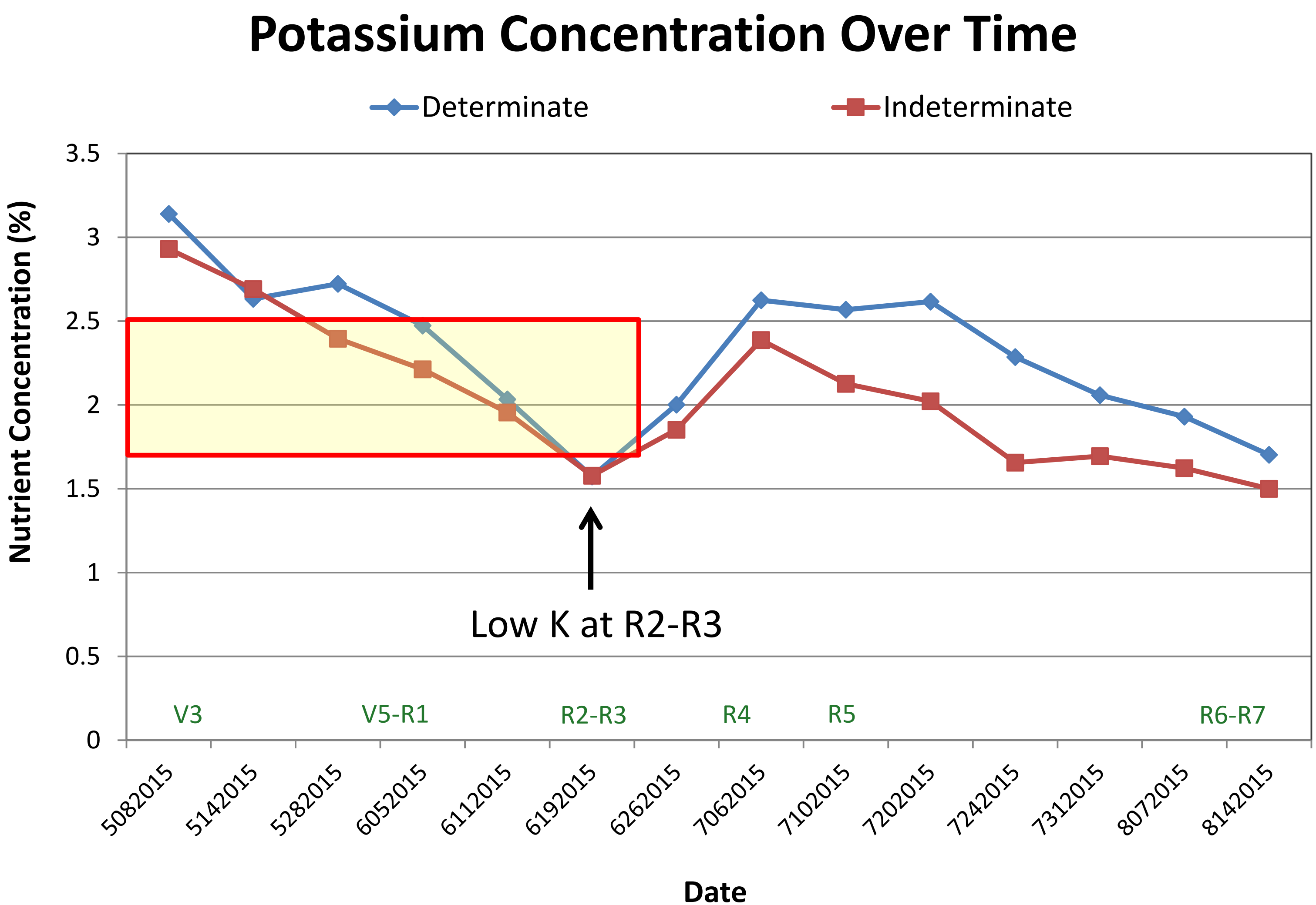
Business Partner: 2015 Dowdy Lowndes Co
Field: Grain Bin Field
County: Lowndes

Operation: Dowdy Farms
Farm: Lowndes County
State: Georgia

Temperature / GDU



Nutrient Tracking – Lowndes Co.



2015 Field Environment Profile – Lowndes County GA

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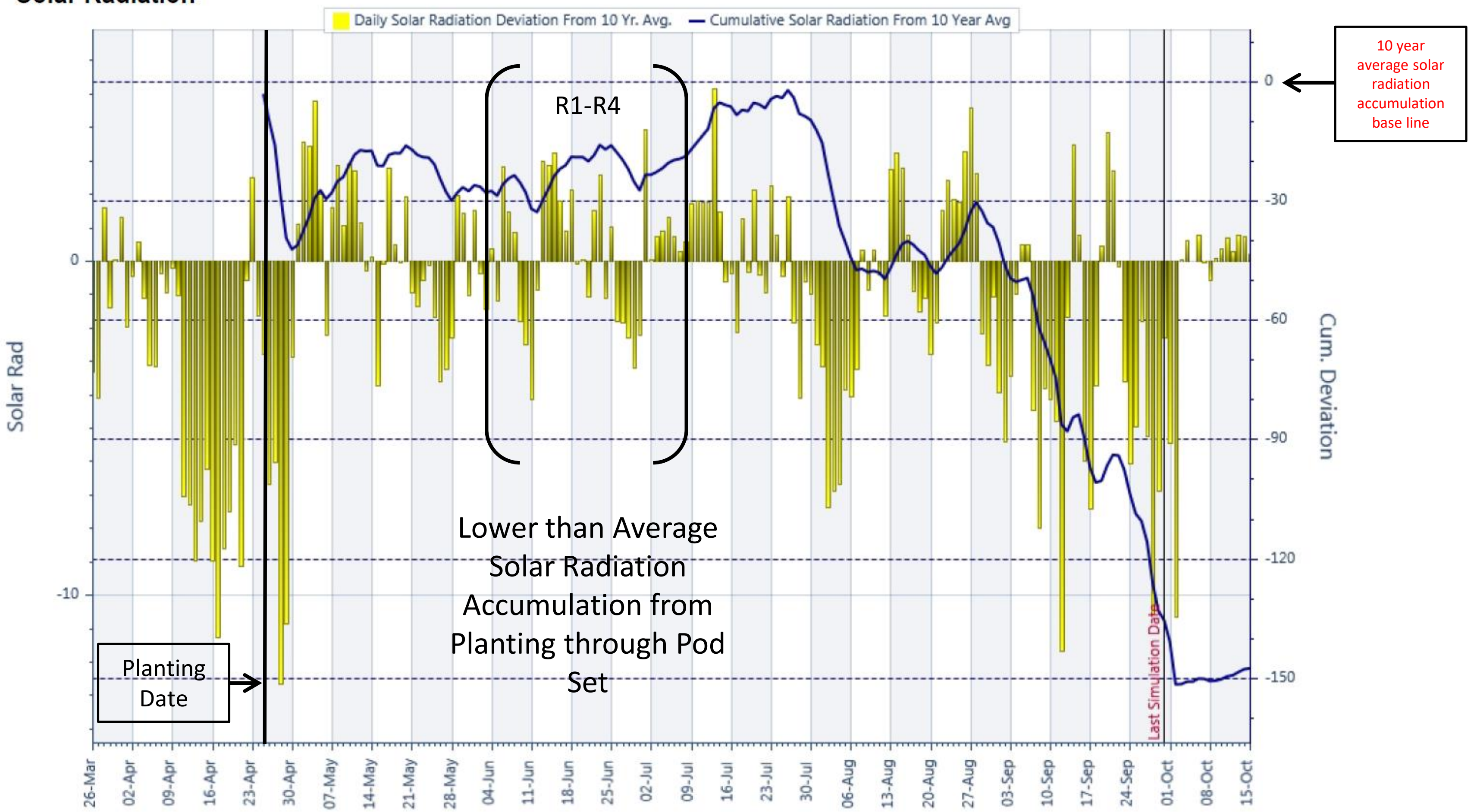
Solar Radiation



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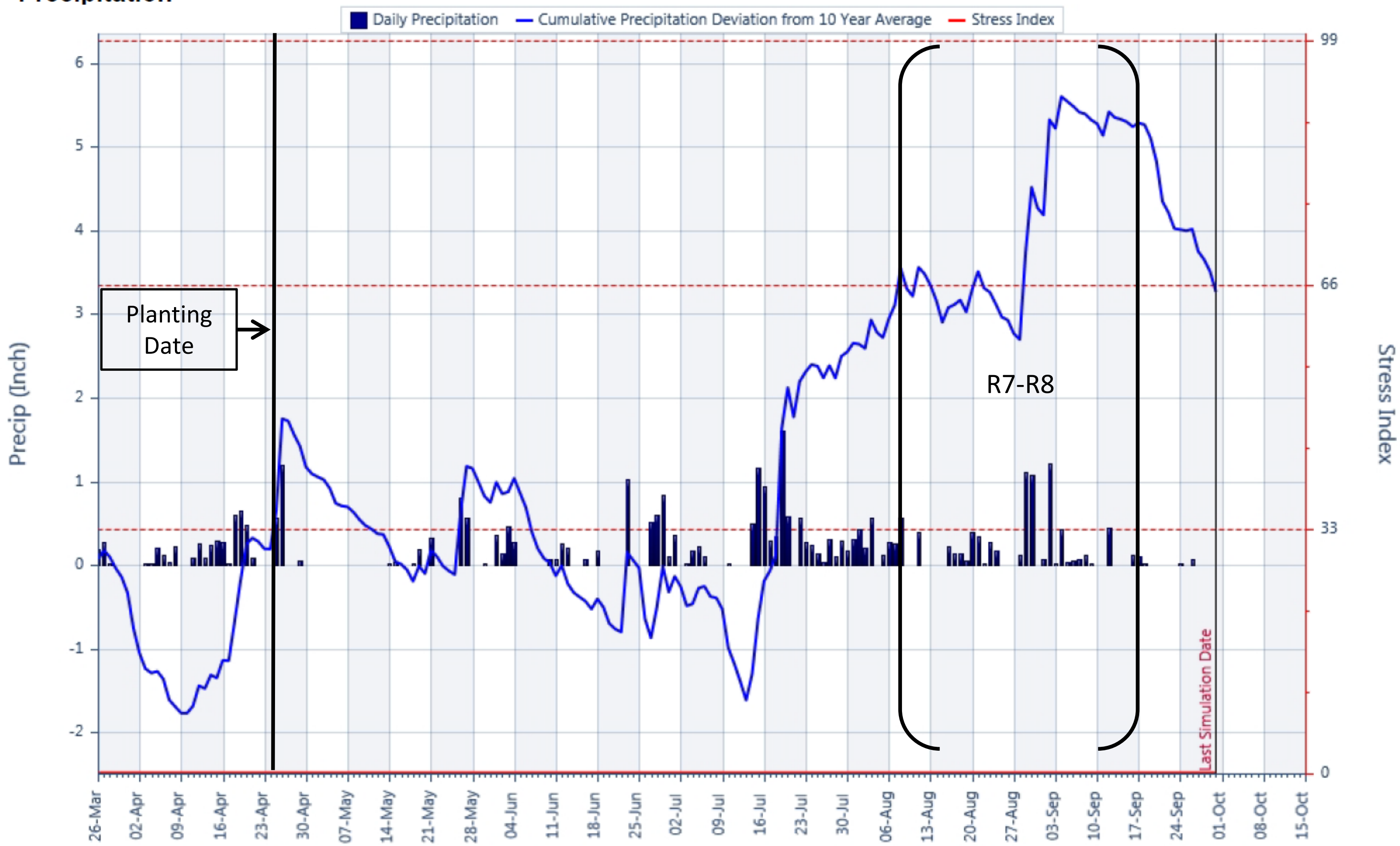
Precipitation



Seed Quality - 2015

70-75 Bu/A

Plant Nutrition: Asking the Right Questions

- How much of each nutrient do we really need to produce 100+ Bu/A soybeans?
- What is the right balance of all nutrients?
- How do I meet peak in-season and late-season nutrient demand?
- Where must my nutrients reside in the soil profile at various times during the growing season to meet nutrient demand?
- Can my soils hold the nutrient load required to produce these yield levels?

Soybean Nutrient Uptake and Partitioning

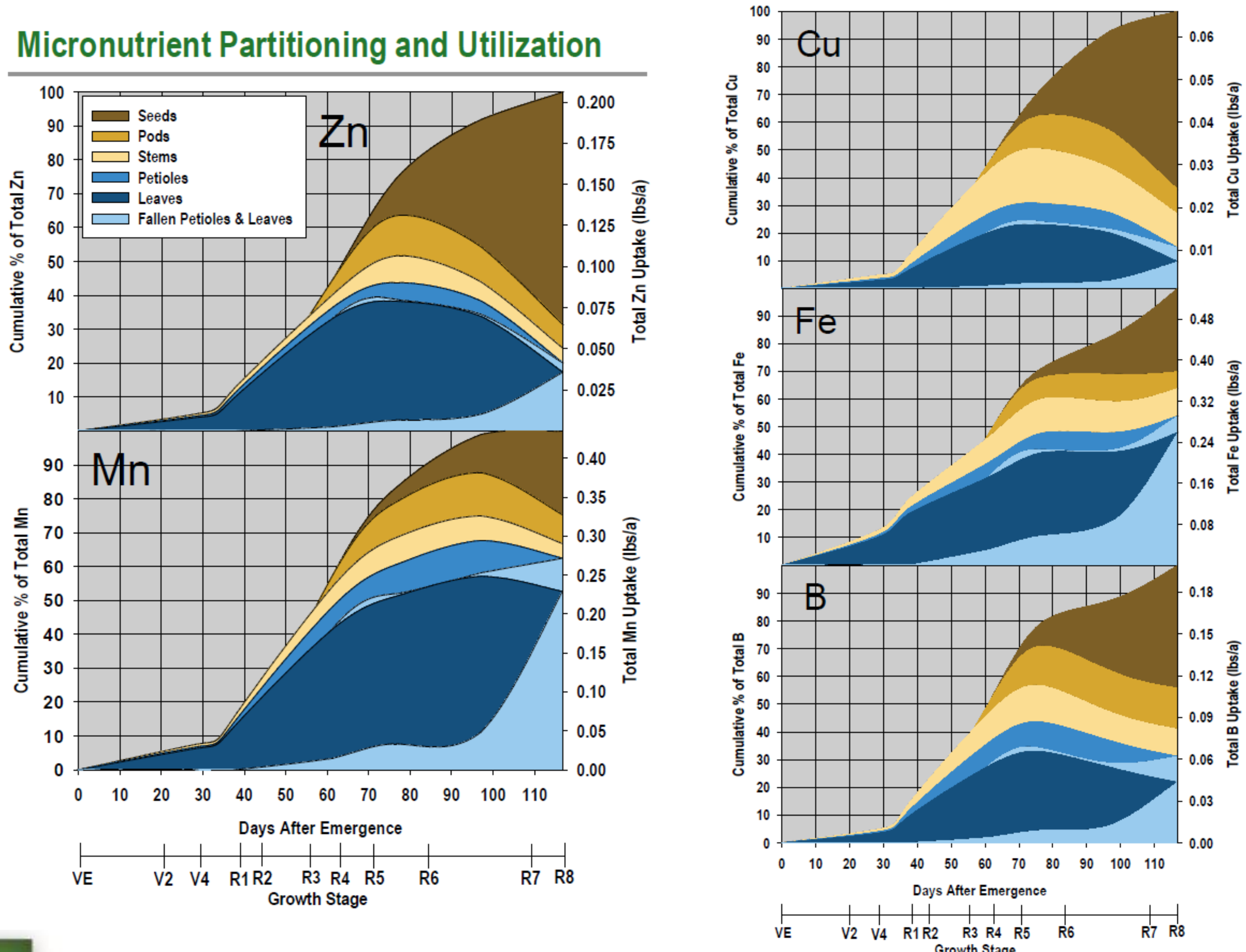


Figure 3. Micronutrient uptake, partitioning, and remobilization through the growing season for a 66 bu/acre soybean crop.

Soybean Nutrient Uptake and Partitioning

P_2O_5 and K_2O Partitioning and Utilization

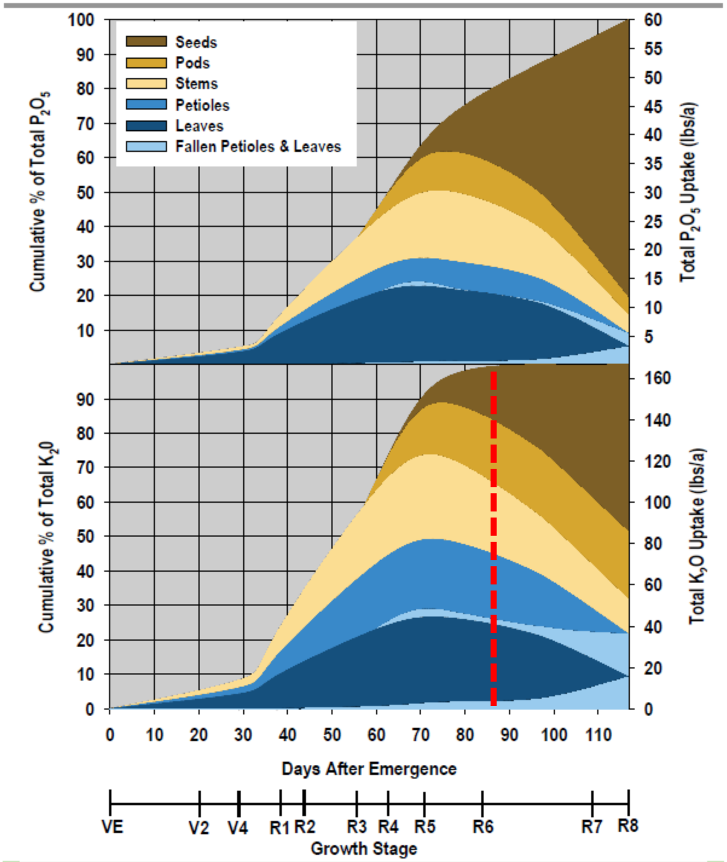


Figure 3. P_2O_5 and K_2O uptake, partitioning, and remobilization through the growing season for a 66 bu/acre soybean crop.

N and S Partitioning and Utilization

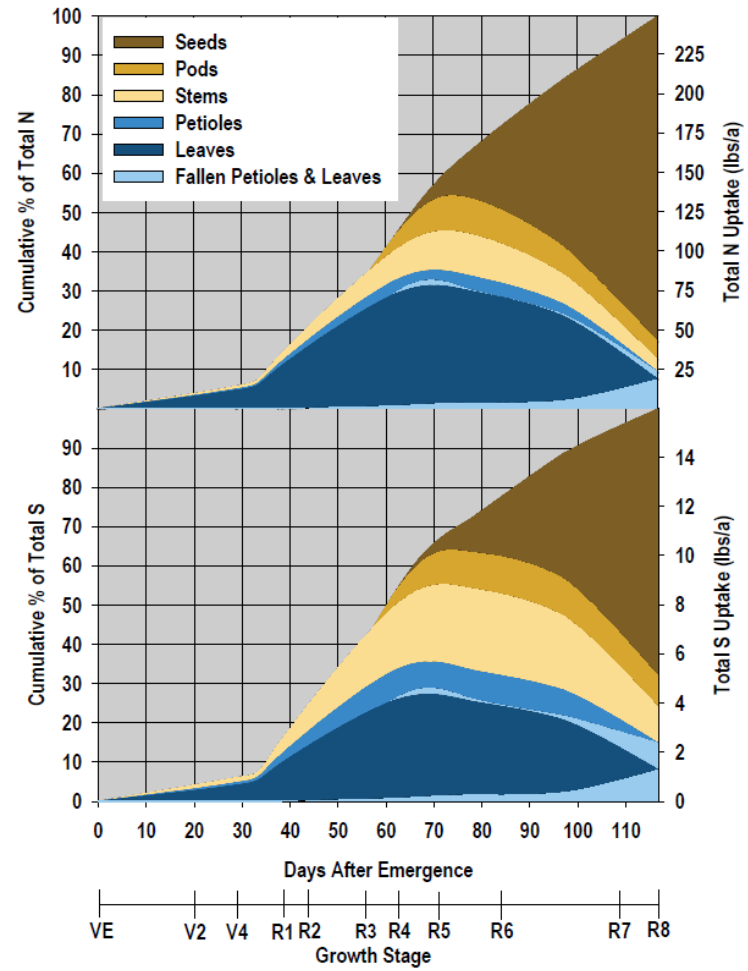
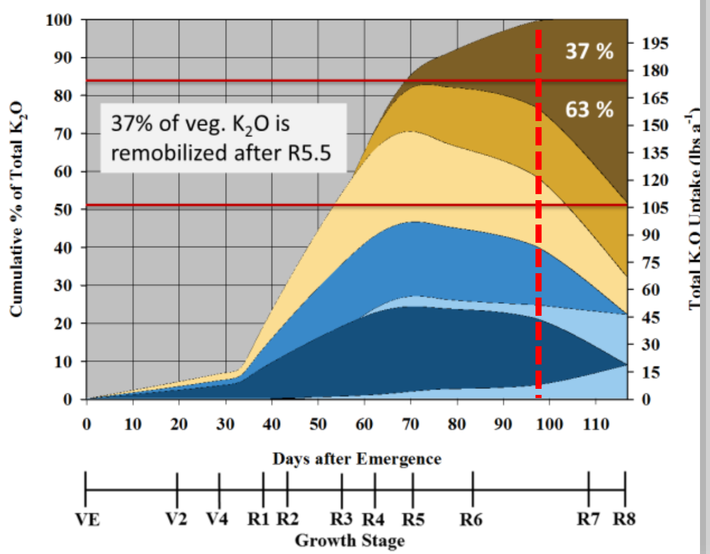


Figure 3. N and S uptake, partitioning, and remobilization through the growing season for a 66 bu/acre soybean crop.

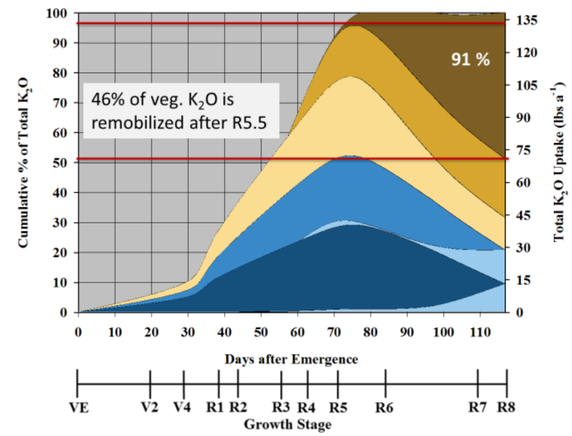
Soybean Nutrient Uptake and Partitioning

Potassium Partitioning: High



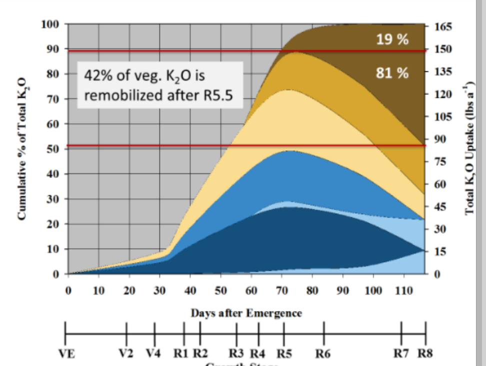
- Uptake after R5.5 = 9.3%

Potassium Partitioning: Low



- Uptake after R5.5 = 1%

Potassium Partitioning: Avg.



- Uptake after R5.5 = 3%

Soybean Nutrient Uptake and Partitioning

High Yield Soybean Nutrient Uptake

R. Flannery, 101 Bu/A Soybeans

Soybean Stage	Days	Nutrient Uptake per Day: N	P_2O_5	K_2O	
		- - - - - lb/a/day	- - - - -		
3rd trifoliate	40	0.75	0.25	0.68	
6th trifoliate	11	1.45	0.55	2.72	
Full Bloom	16	7.81	1.75	5.75	≈ 90 lbs/A
Early pod	15	9.13	2.27	9.6	≈150 lbs/A
Soft seed	21	11.43	2.76	2.43	
Maturity	16	-3.38	-1.25	-2.25	
	Total	548	136	344	

Soybean Nutrient Uptake and Partitioning

P_2O_5 and K_2O Uptake Rate

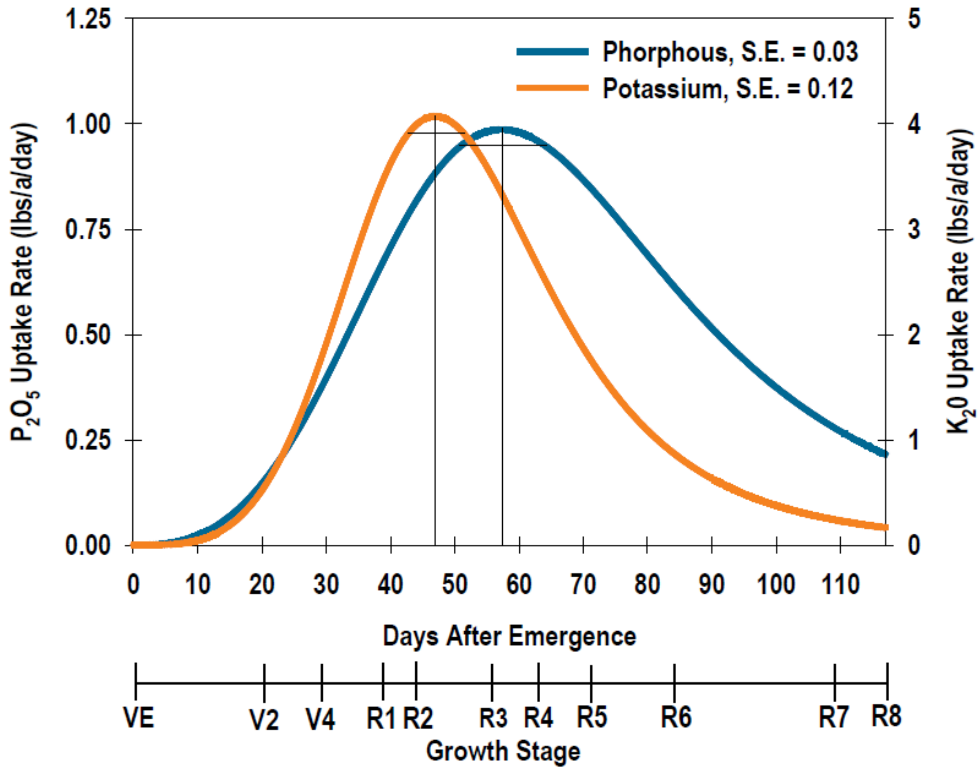


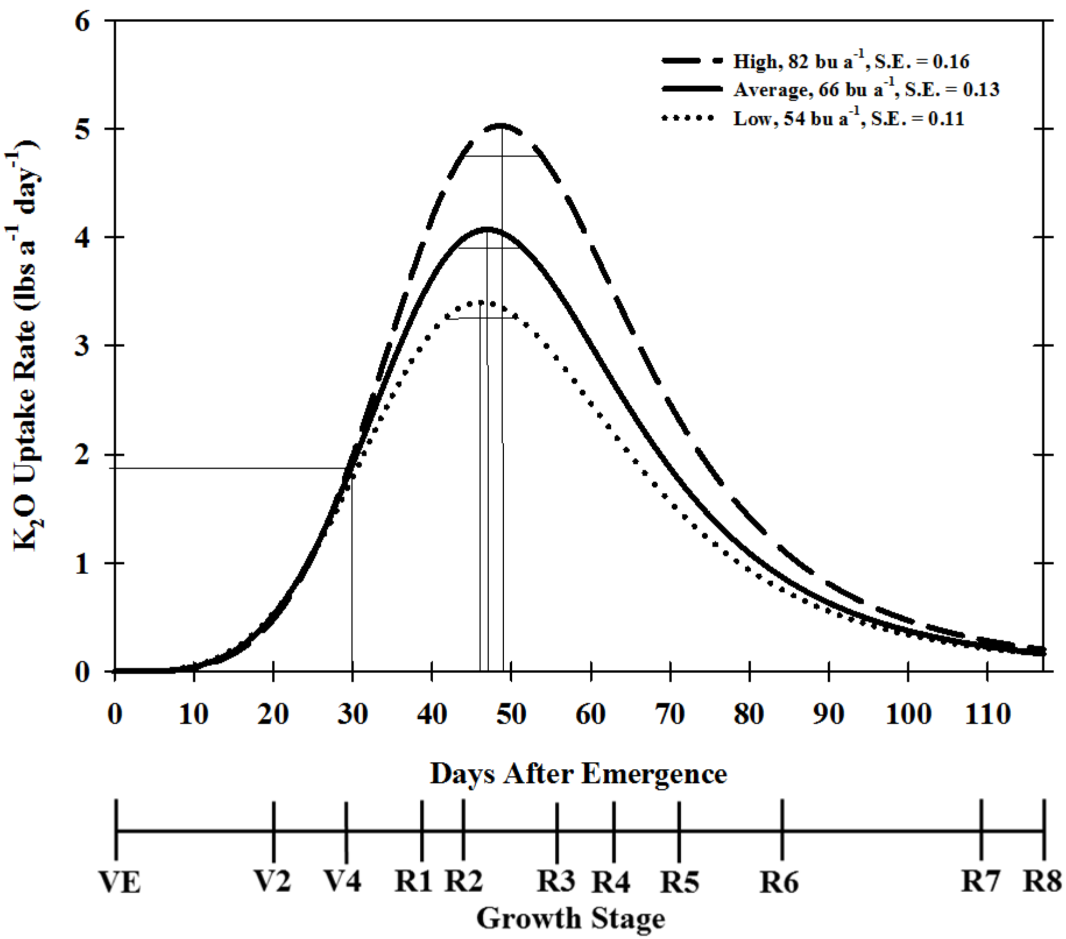
Figure 2. P_2O_5 and K_2O uptake rate through the growing season for a 66 bu/acre soybean crop. Duration of peak uptake period is represented by a horizontal black line.

DISCUSSION

- Peak K uptake rate = 4 Lbs/A per day for 66 Bu/A
- Flannery 9.6 Lbs per acre per day for 101 Bu/A
- What for 150 Bu/A?
  - 9.1 to 14.3 Lbs/A per day depending on data set.
- High demand could last for 30 days.
- How many Lbs needed in soil?
- How many Lbs supplemented in season?
- What sources?
- How do you apply?

Soybean Nutrient Uptake and Partitioning

K_2O Uptake by Yield Level



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Soybean Nutrient Uptake and Partitioning

Total P_2O_5 and K_2O Uptake

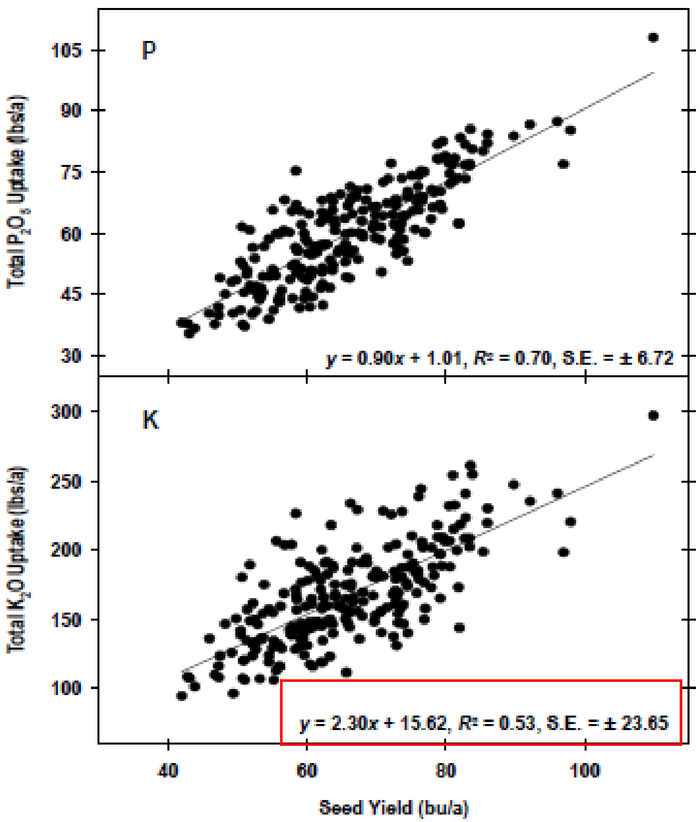


Figure 1. Total whole plant P_2O_5 and K_2O uptake at growth stage R8 (full maturity) across all environments and varieties.

Where do you Start?

- Suggests 360 lbs/A K20 uptake for 150 bu/A (10,050 kg/ha) beans assuming linear relationship.
- Roots explore approximately 3% of soil.
- How many pounds of extractable K in top 12 inches of soil based on 6 inch soil sample to facilitate needed uptake?
- Perhaps 2X or 600 to 700 lbs/A or 300 to 350 ppm for sandy soils?
- How about peak demand periods? Do we supplement? How much?
- Perhaps 100 to 200 extra pounds to be available at peak demand?

Plant Tissue Analysis

- Plant tissue analysis is often used to diagnose nutrient deficiencies after visual symptoms appear.
- Plant tissue analysis is rarely used to proactively track nutrient levels throughout the growing season.
- Using plant tissue analyses in strategic fields on pre-planned intervals that coincide with critical growth stages may allow time to take corrective measures before deficiencies significantly reduce yield.
- Plant tissue analysis can also be used to compare nutrient levels in highly productive fields to those from problem fields.
- Objective was to collect plant tissue samples from highly managed soybean fields in an effort to identify critical nutrient levels required to produce soybean yields in excess of 100 Bu/A.

Assessing Nutritional Limitations

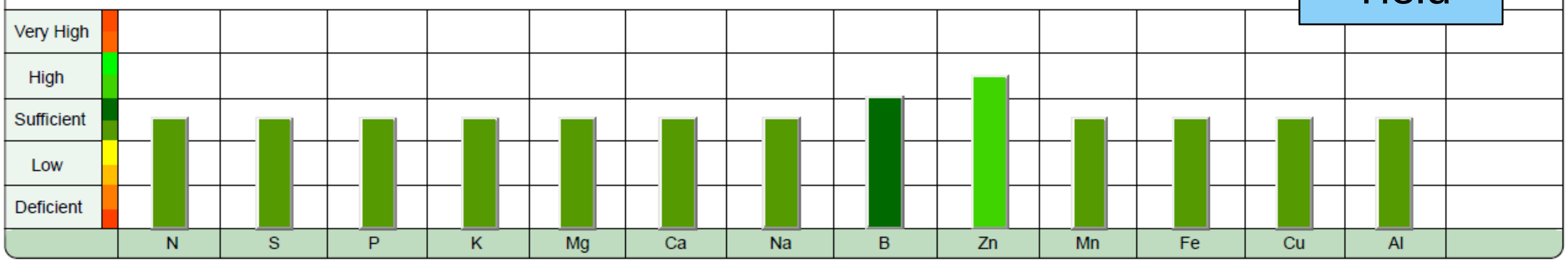
Field id: **High Yield Field** Crop : **Soybeans***

Sample Id : **Y2** Growth Stage : **Prior to pod set (R2-R3)** Plant Part: **Recent fully developed leaf (25+)**

	Nitrogen %	Sulfur %	Phosphorus %	Potassium %	Magnesium %	Calcium %	Sodium %	Boron ppm	Zinc ppm	Manganese ppm	Iron ppm	Copper ppm	Aluminum ppm
Analysis	4.42	0.28	0.36	2.27	0.32	1.07	0.02	54	52	56	105	15	29
Normal Range	4.10	0.21	0.26	1.70	0.25	0.50	0.01	20	21	30	50	10	0
	5.50	0.49	0.54	5.50	1.00	2.00	0.03	60	50	100	350	30	300

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn	Ca/K	Ca/Mg
Actual Ratio	15.8	1.9	1.3	69.2	7.1	405.4	198.1	1.9	0.5	3.3
Expected Ratio	13.7	1.3	1.1	112.7	5.8	553.8	312.5	3.1	0.3	2.0

74 Bu/A Yield

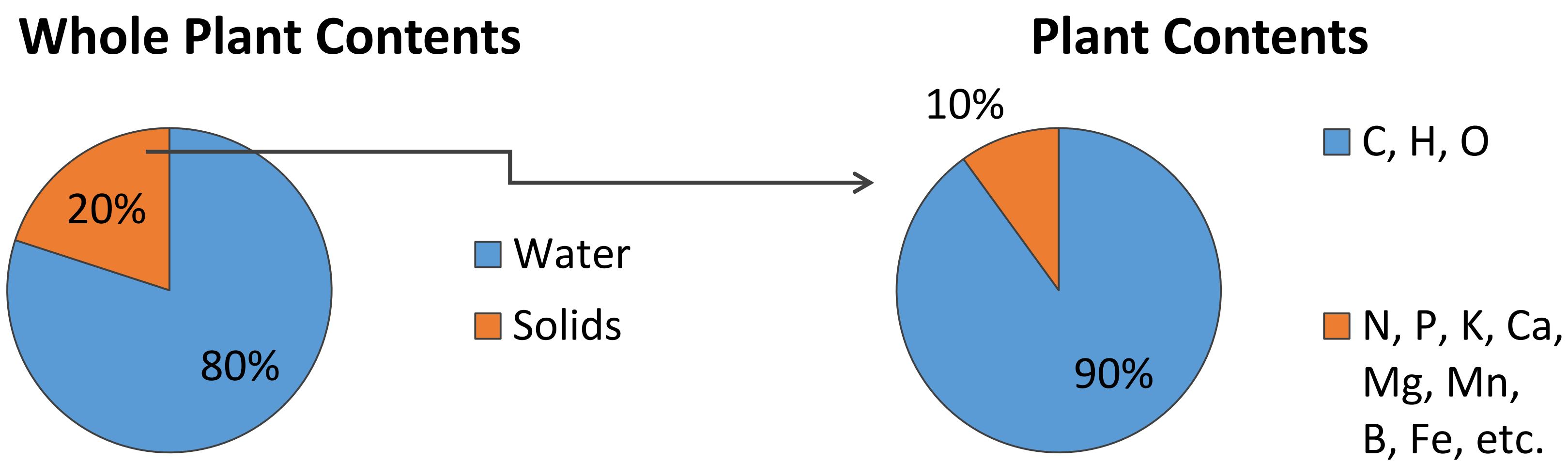


Comments :

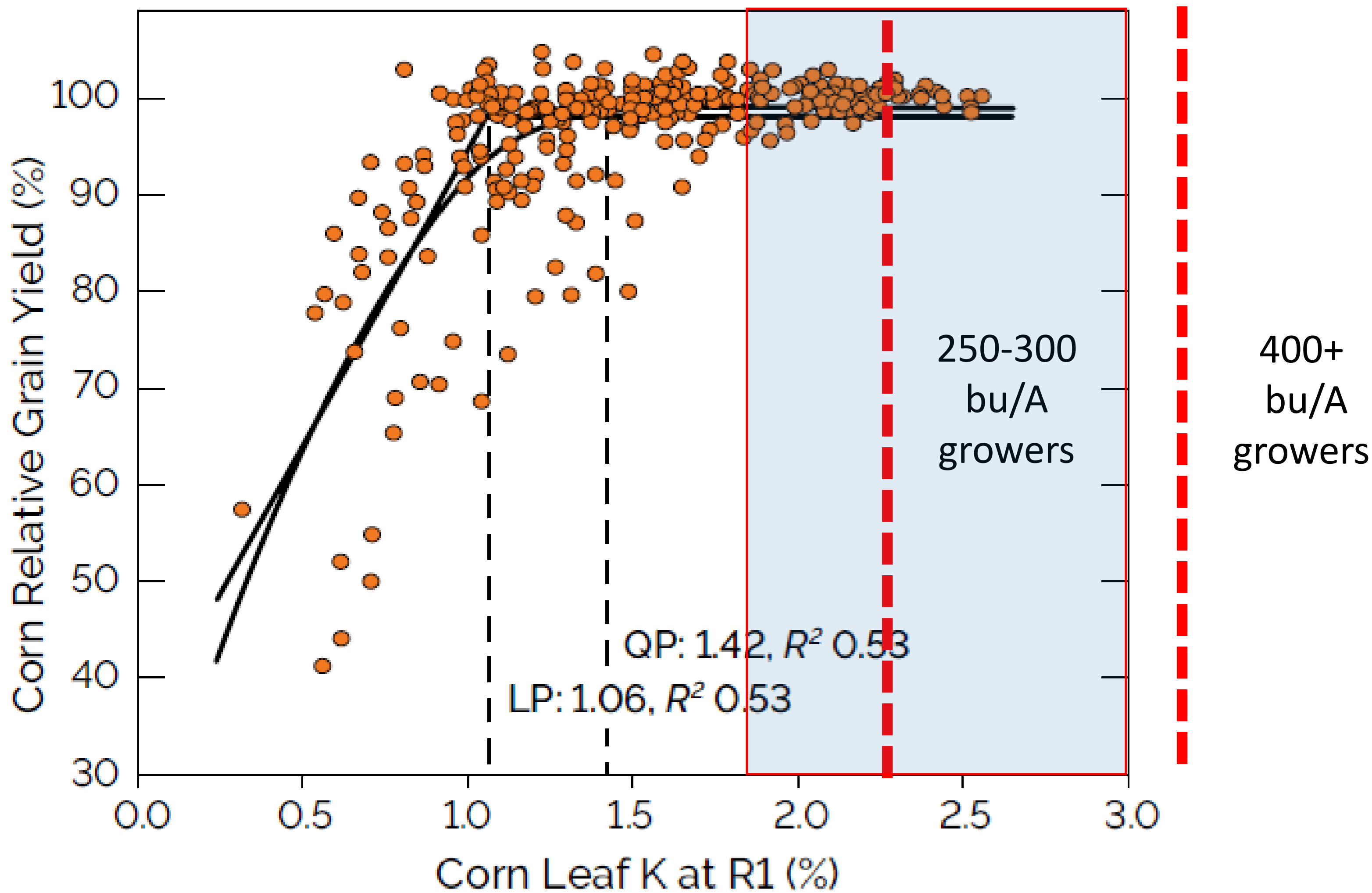
02002) Nutrient levels are adequate at this time.

<u>Question:</u> Why am I only producing 70-75 Bu/A soybeans when all of my tissue samples are showing sufficient?

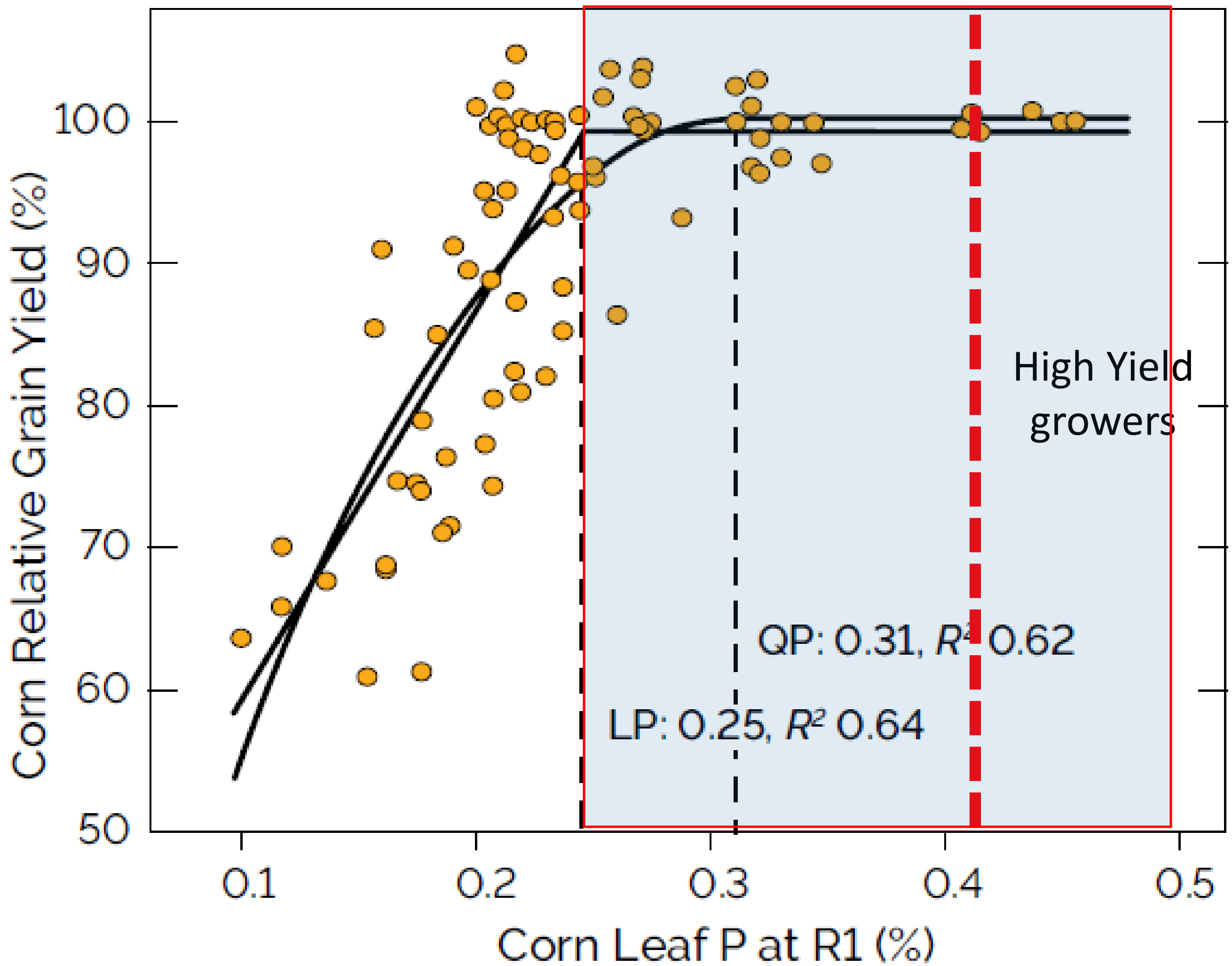
What is in Plant Material?



Plant Tissue Analysis – Potassium (corn)



Plant Tissue Analysis – Phosphorus (corn)



Assessing Nutritional Limitations

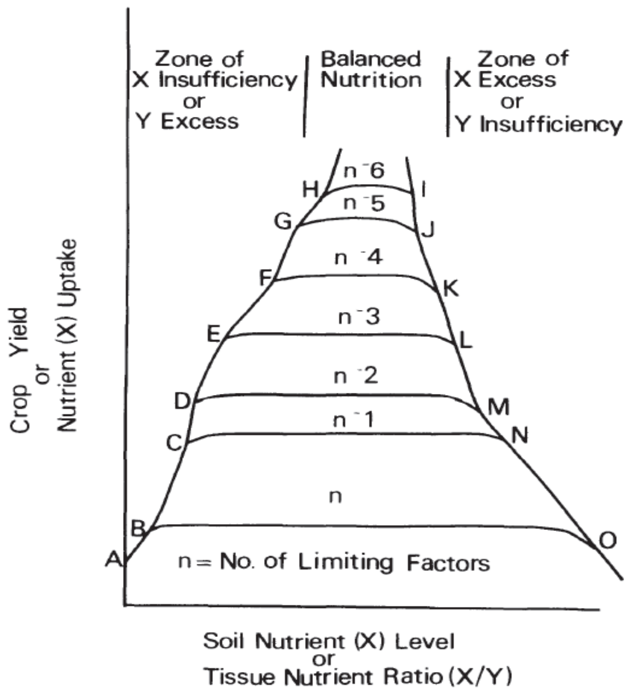


Figure 3. Diagrammatic representation of crop response to a number of limiting factors. From Sumner and Farina (1986).

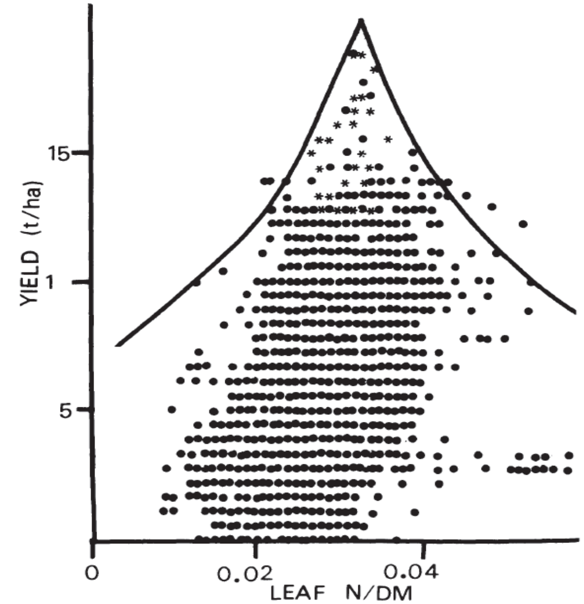
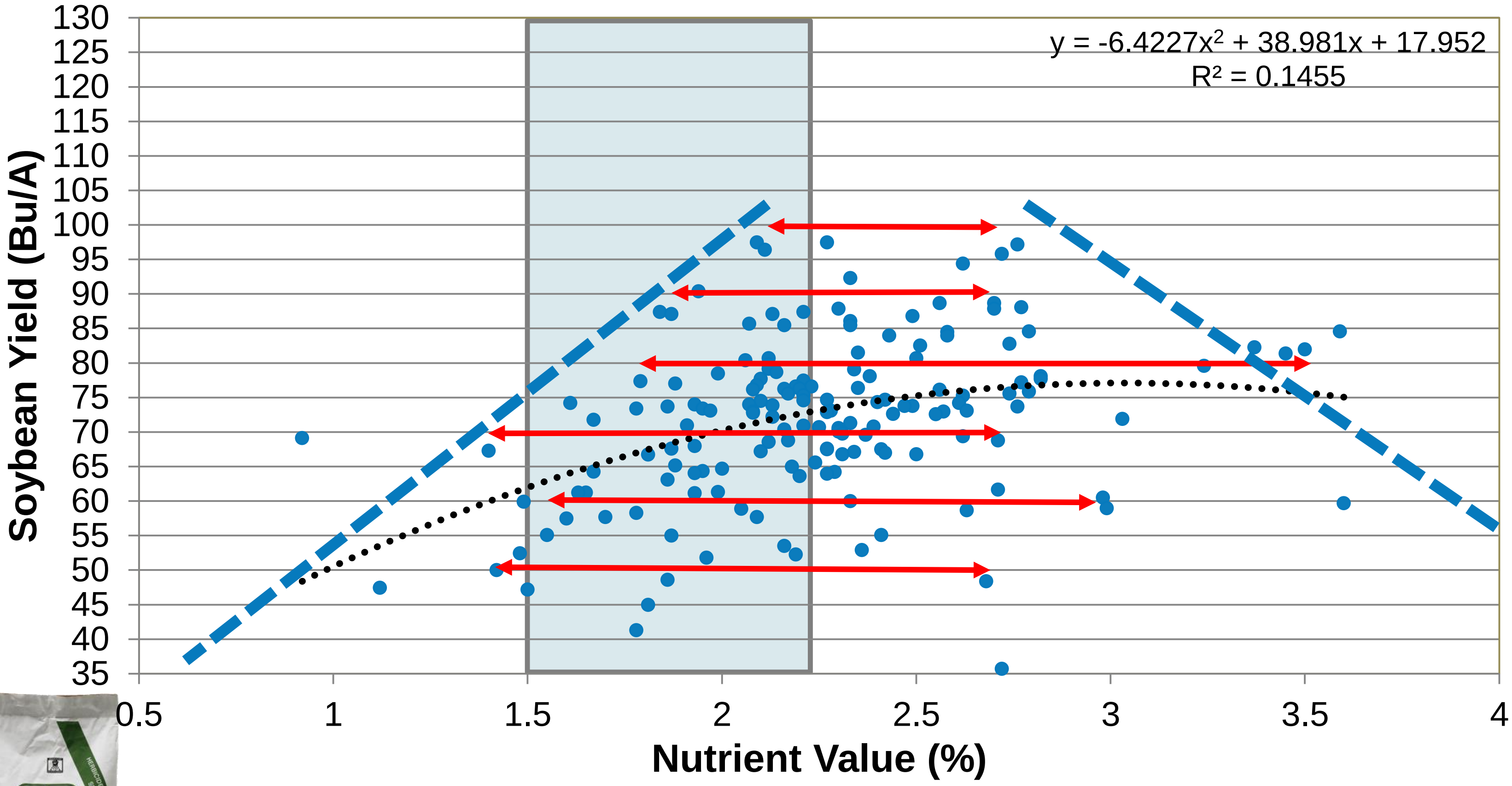
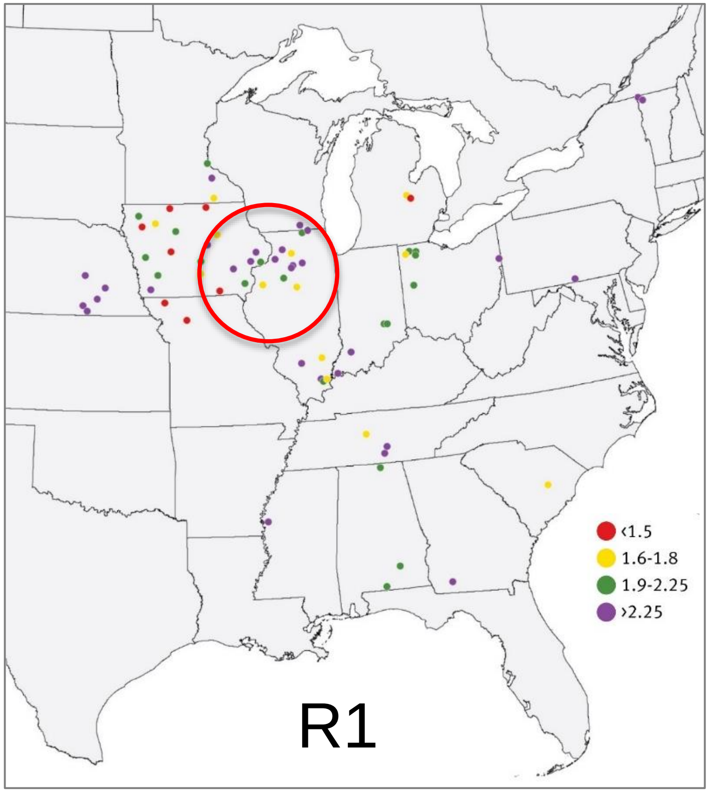


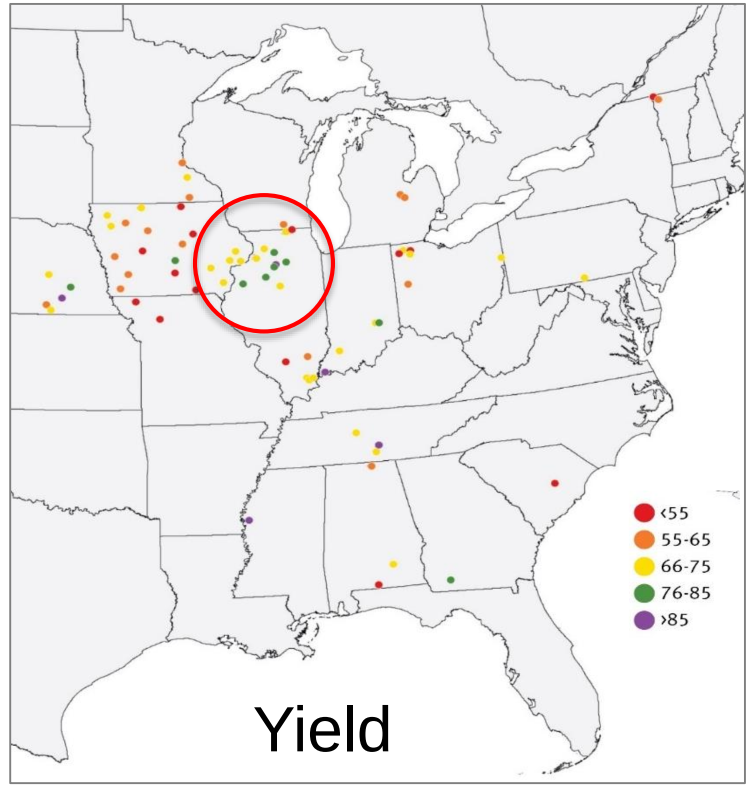
Figure 4. Maize yield versus leaf N/DM (percent per 100) including over 8000 data points collected worldwide. Included is a boundary line confining the data. From Walworth *et al.* (1986a).

% Leaf Potassium – Early Bloom (R1) 2017-18

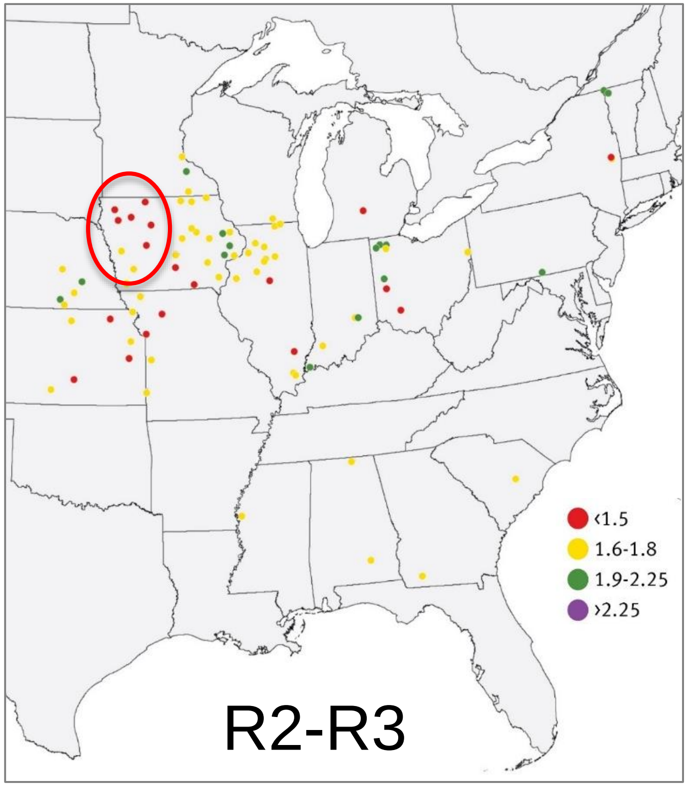


Soybean Tissue Potassium Levels – R1





Soybean Tissue Potassium Levels – R2-R3



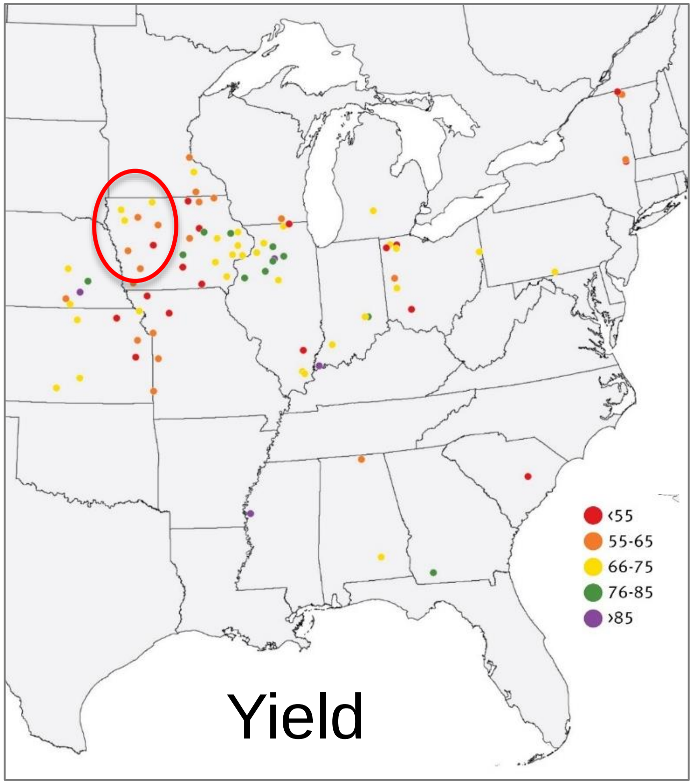


Table 1. Percent of Tissue Samples Testing Below Sufficiency at 3 growth stages in 2017and 2018.*

Nutrient	Early Bloom (R1) n =184		Pre-Pod Set (R2-R3) n = 134		Pod Filling (R4-R6) n = 116	
Nitrogen (N)	2	38	4	5	7	18
Sulfur (S)	7	12	1	5	4	23
Phosphorus (P)	1	26	1	6	5	5
Potassium (K)	4	27	14	26	58	11
Magnesium (Mg)	1	15	3	15	22	43
Calcium (Ca)	4	12	0	2	0	43
Sodium (Na)	0	0	0	0	NA	7
Boron (B)	3	15	2	3	2	21
Zinc (Zn)	0	21	1	18	0	42
Manganese (Mn)	0	10	0	0	0	17
Iron (Fe)	0	8	4	8	2	17
Copper (Cu)	0	13	15	15	15	3
Aluminum (Al)	NA	11	NA	22	NA	15

*Values in right yellow shaded column under each growth stage based on suggested new sufficiency ranges for high yield (>85 Bu/A) soybeans. Ranges based on mean +- 1 standard deviation.

R^2 Values - Polynomial Curve Fits for Each Nutrient at Various Growth Stages

	Growth Stage		
Nutrient	R1	R2-R3	R4-R6
N	0.0388	0.0193	0.0324
S	0.0286	0.0150	0.0522
P	0.0457	0.0127	0.0119
K	0.1455	0.0875	0.0167
Mg	0.0285	0.0051	0.0441
Ca	0.0269	0.0118	0.0368
Na	0.0081	0.0025	0.0038

	Growth Stage		
Nutrient	R1	R2-R3	R4-R6
B	0.0640	0.0006	0.0176
Zn	0.0611	0.0183	0.1579
Mn	0.0045	0.0368	0.0952
Fe	0.0169	0.0232	0.0239
Cu	0.0984	0.0378	0.0244
Al	0.0069	0.0235	0.0230
AVG.			

Assessing Nutritional Limitations

Field id: **High Yield Field** — Crop : **Soybeans***

Sample Id : **Y2** — Growth Stage : **Prior to pod set (R2-R3)** — Plant Part: **Recent fully developed leaf (25+)**

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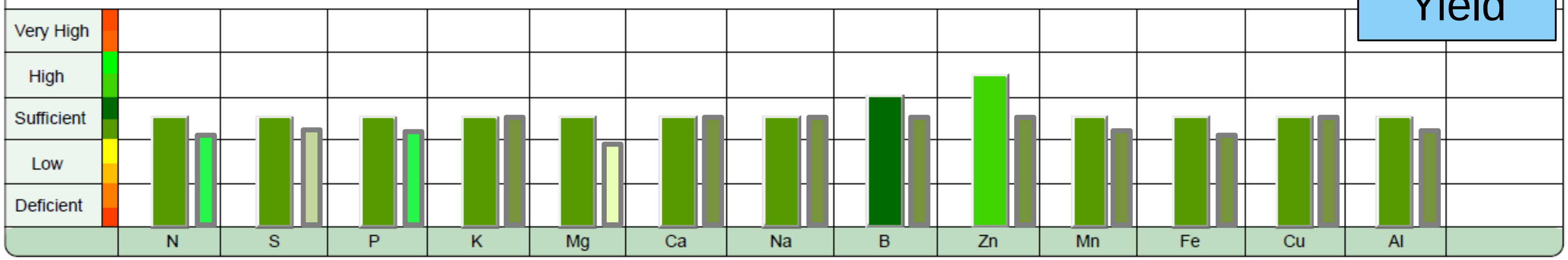
Normal Range	4.10	0.21	0.26	1.70	0.25	0.50	0.01	20	21	30	50	10	0
	5.50	0.49	0.54	5.50	1.00	2.00	0.03	60	50	100	350	30	300
	4.3-6.1	0.24-0.34	0.32-0.62	1.8-2.4	0.32-0.46	0.7-1.5	0.01-0.03	24-72	41-69	31-173	75-169	10-16	14-38

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Ca/B	Fe/Mn	Ca/K	Ca/Mg
Actual Ratio	15.8	1.9	1.3	69.2	7.1	405.4	198.1	1.9	0.5	3.3
Expected Ratio	13.7	1.3	1.1	112.7	5.8	553.8	312.5	3.1	0.3	2.0
	18	2.5	1.6	85	5.4	205	229	1.2	0.5	2.8

74 Bu/A Yield



Comments :

02002) Nutrient levels are adequate at this time.

- Need more N, P, Mg, Mn

R^2 Values - Polynomial Curve Fits for Agronomic Factors x Yield - 2017

Factor	R^2 Value
Planting Date	0.2168
Solar Radiation Early	0.0368
Solar Radiation Mid	0.0600
Solar Radiation Late	0.1310
Solar Radiation Total	0.0923
Rainfall Early	0.0330
Rainfall Mid	0.1565
Rainfall Late	0.0979
Rainfall Total	0.0600
Avg. Temp Total	0.0077

Early planting to max light harvest.

Sunlight to fill pods.

Water to set pods.

Achieving High Soybean Yields: MFF High Yield Demonstration

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Soybean Situation – Southeast

- MG 5-8 determinate varieties still prevalent
- Multiple crop choices for many farms
- May, June and July planting
- Resistance to Southern Root Knot nematode needed
- RKI resistance in Indeterminate varieties may change production practices
- ESPS using indeterminate varieties not thoroughly evaluated but interest is increasing
- Increasing interest in MG 3-4 indeterminate varieties

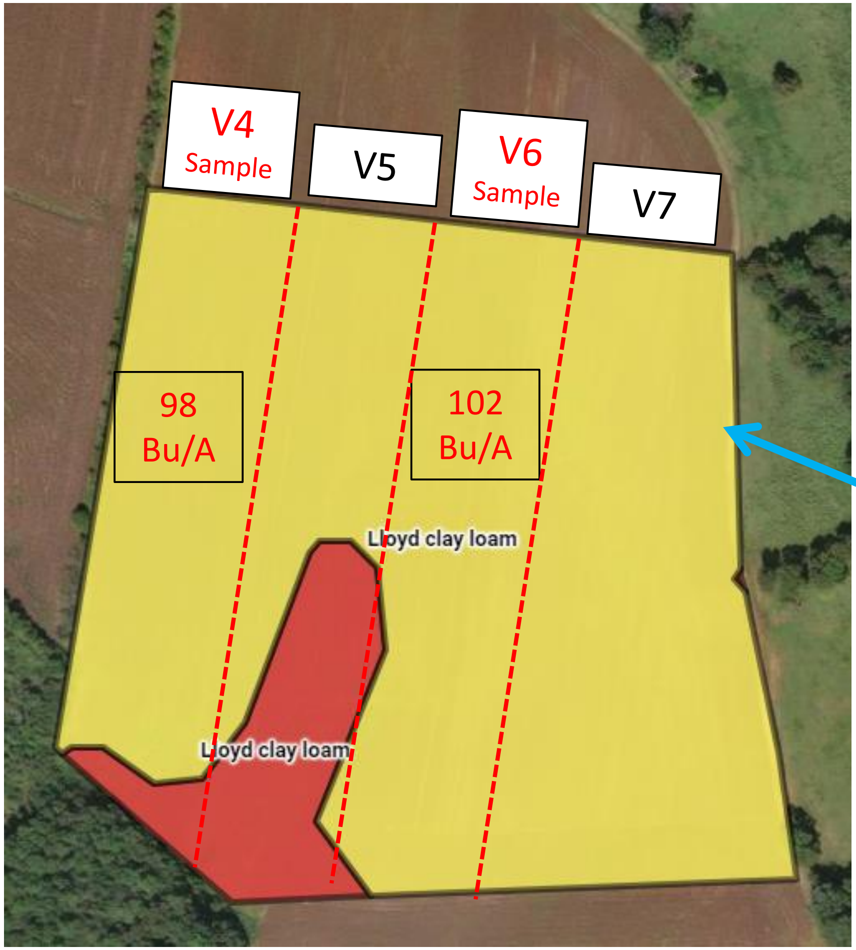
Key Premises of High Yield Plan

- Early Soybean Production System
  - Indeterminate varieties
  - April planting
- Meet nutrient demand on time for all nutrients
- Irrigate to keep nutrients in solution and to keep plants cool
- Aggressively control insects
- Proactively control diseases
- Timely harvest
- Adjust Management Practices Each Year and Make Improvements

Project Qualifications

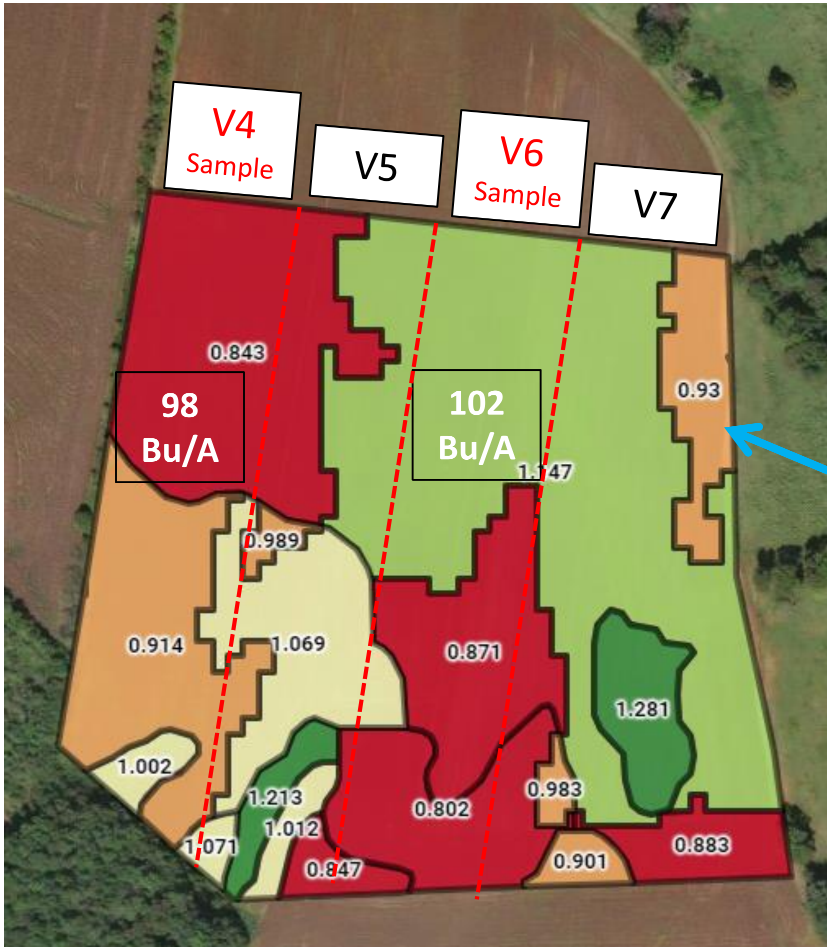
- Demonstration type data
- Data should NOT be viewed as definitive but as a starting point to begin discussions about the drivers of high yield soybeans
- Most data are based on limited sampling points and not truly replicated.

Field Information – Soil Types

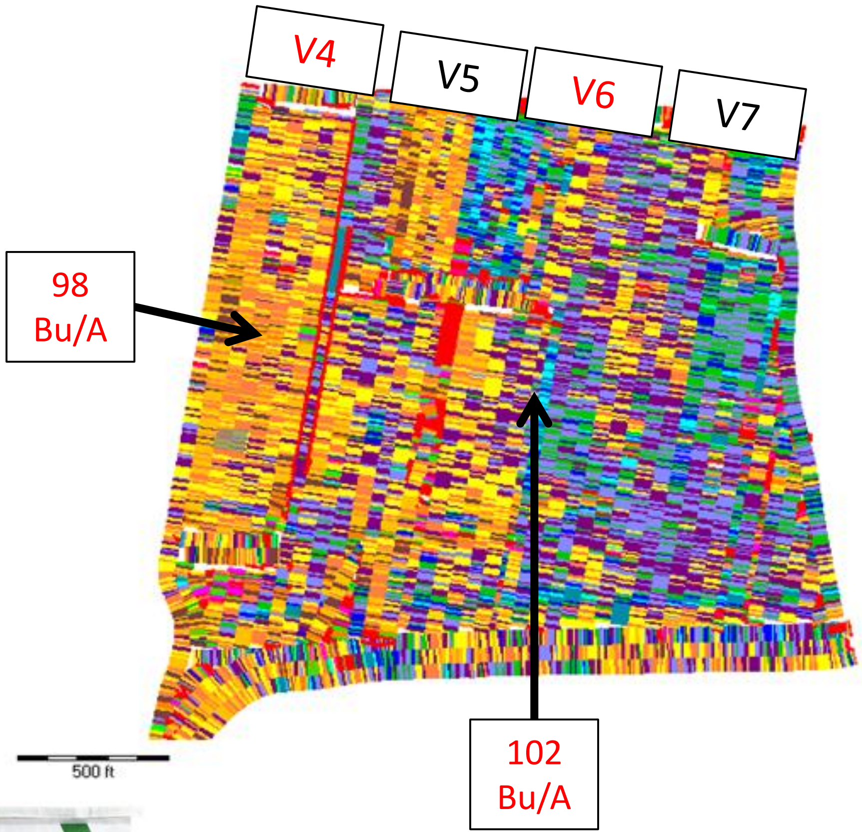


Dryland Yield Potential: Corn = 107 Soybean = 44

Field Information – Mgt. Zones



Field Information – Yield Map



Field Information – Soil

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SDI System Limitations

- Water supply is from river
- Can't pump when sediment levels are high
- Difficult to supply early season nutrients when wet

Field Information – Fall Soil Test (Lbs./A)

Field	Area	Centroid
irrigated	122.87 acres	35.799588,-80.542361

	Min	Max	Avg
P	54.0	190	113
K	352	1199	524
Mg	498	821	669
Ca	1712	3030	2195
S	50.0	96.0	69.4
B	1.0	2.4	1.3
Cu	2.7	7.7	4.4
Fe	108	275	152
Mn	197	435	338
Zn	11.0	63.2	31.1
pH	5.3	6.7	6.3
bpH	7.5	7.7	7.6
OM	2.2	4.0	3.1
CEC	9.8	14.1	12.0
%K	3.6	11.3	5.6
%Mg	18.9	27.1	23.3
%Ca	37.8	56.0	45.6
%H	20.6	33.1	25.5

P:Zn ratio too low

Need more Fe relative to Mn

Low pH in some zones

High %Mg Saturation

Ratio Analysis

Level/Ratio	Target	CV4	CV6	Spring	Status	Action
Ca:Mg	3:1 (Sand) 7:1 (Clay)	3:1	3:1	3:1	Low	More Ca
K:Mg	1:1	0.6:1	0.5:1	0.8:1	Low	More K
P:Zn	10:1	3:1	4:1	7:1	Low	More P
K:Na	4:1	--	--	10:1	OK	None
Fe:Mn	Up to 2:1	0.4:1	0.4:1	0.4:1	Low	More Fe
P:S	1:1	1:1	1.5:1	4:1	High	More S

Base Saturation Analysis

Nutrient	Suggested Ranges: General	Suggested Ranges: Sand	Suggested Ranges: Clay	Coolemee (Lloyd Clay Loam): CV4-Fall (98 Bu/A)	Coolemee (Lloyd Clay Loam): CV6-Fall (102 Bu/A)	Coolemee (Lloyd Clay Loam): Spring (Avg.)
Ca	68	60	70	46	46	48
Mg	12	20	10	26	24	24
K	3 - 5	3 - 5	3 - 5	4	4	5
H	10 - 15	10 - 15	10 - 15	24	26	21
Others	2 - 4	2 - 4	2 - 4	--	--	2

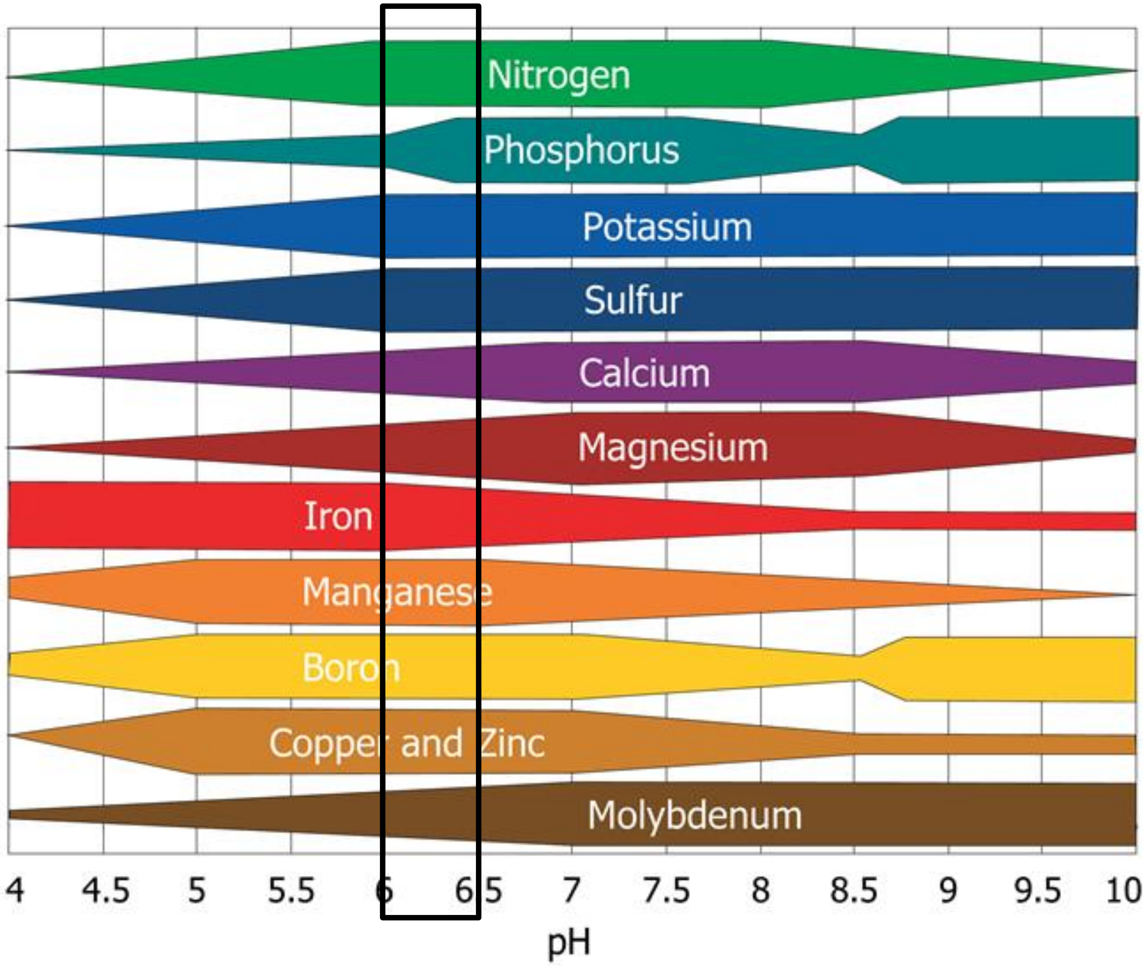
	CV4-Fall	CV6-Fall	Spring
CEC	11.7	11.8	8.4
Ca:K	6.5	5.0	4.5
pH	6.3	5.9	6.3

Corrective Measures Needed:

- High Calcium Lime (pH 6.7+ target)
- Increase Potassium
  - Poultry Litter, Dry, SDI
- Increase Phosphorus
  - Poultry Litter, Dry, SDI
- Manage micros especially Fe and Mn

*Comparison of saturation values from lab to lab may not be advised. It is important for you to understand and interpret the values from the lab that you are using. Intent is to show the relative differences in saturation values with various yield levels.

Understanding Crop Nutrients and Uptake



Strachan, S.D. 2016. Nutrient Uptake in Corn. DuPont Pioneer Crop Insights, Vol. 26 No. 14.

- P uptake could be limited
- Mg uptake should not be a problem given high soil levels
- Ca uptake could be limited
- Mo and Fe could be issues
- In-season tracking
- Quick corrections of downward trends with SDI and foliar

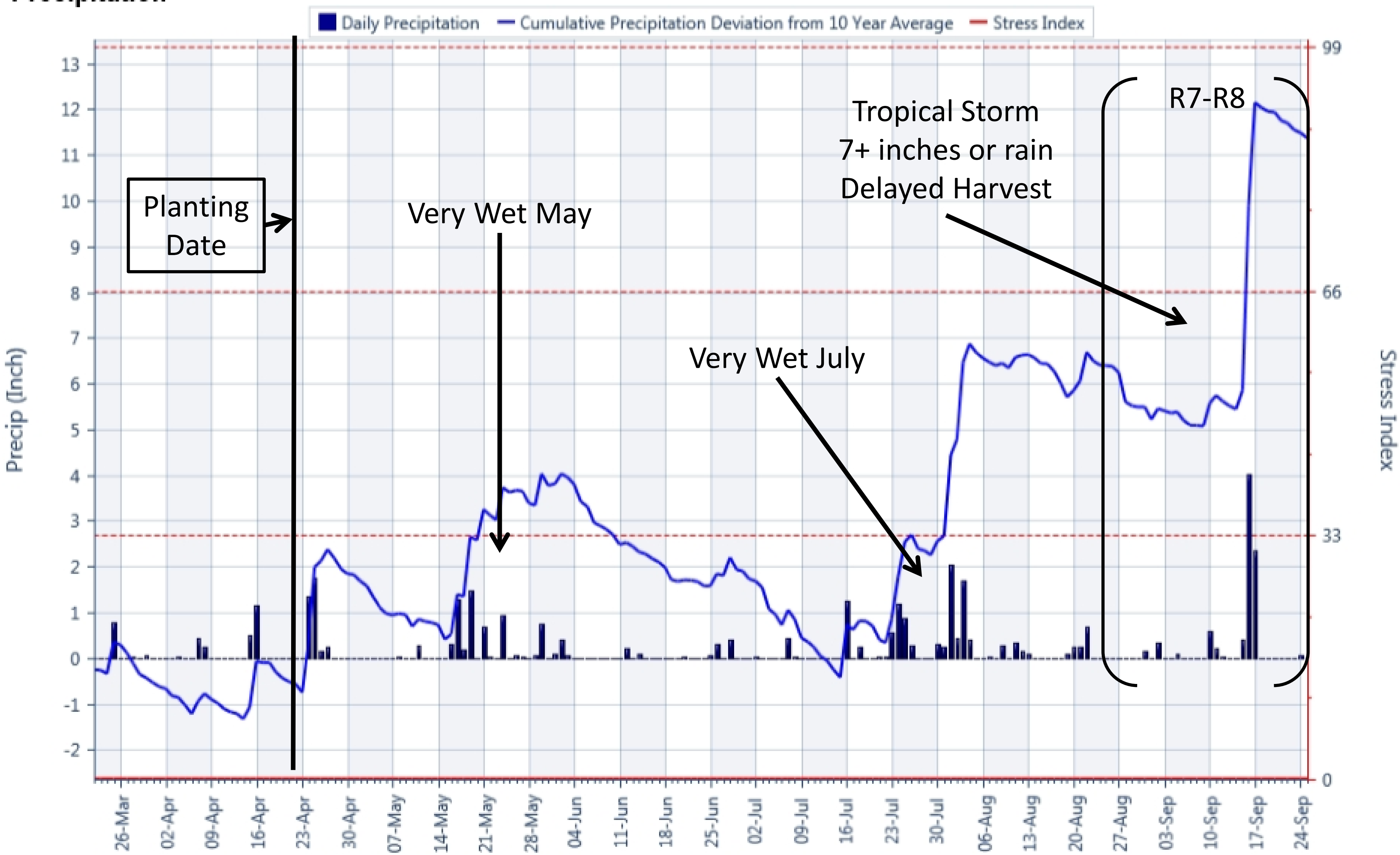
WITH YOU FROM THE WORD GO

DUPONT PIONEER.

Business Partner: Matthews Family Farms of NC
Field:
County: Yadkin

Operation: Matthews Family Farms of NC
Farm:
State: North Carolina

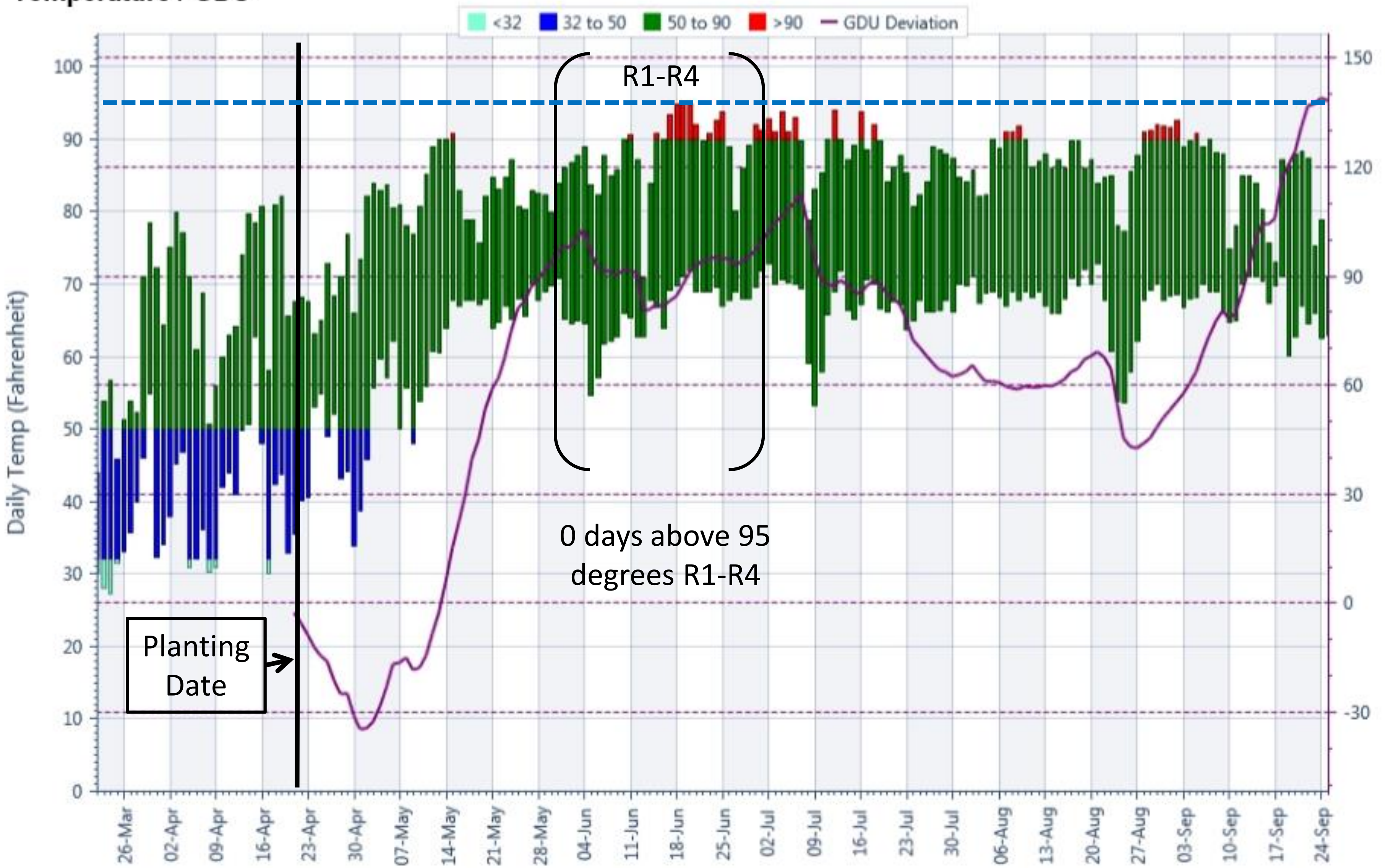
Precipitation



Business Partner: Matthews Family Farms of NC
Field:
County: Yadkin

Operation: Matthews Family Farms of NC
Farm:
State: North Carolina

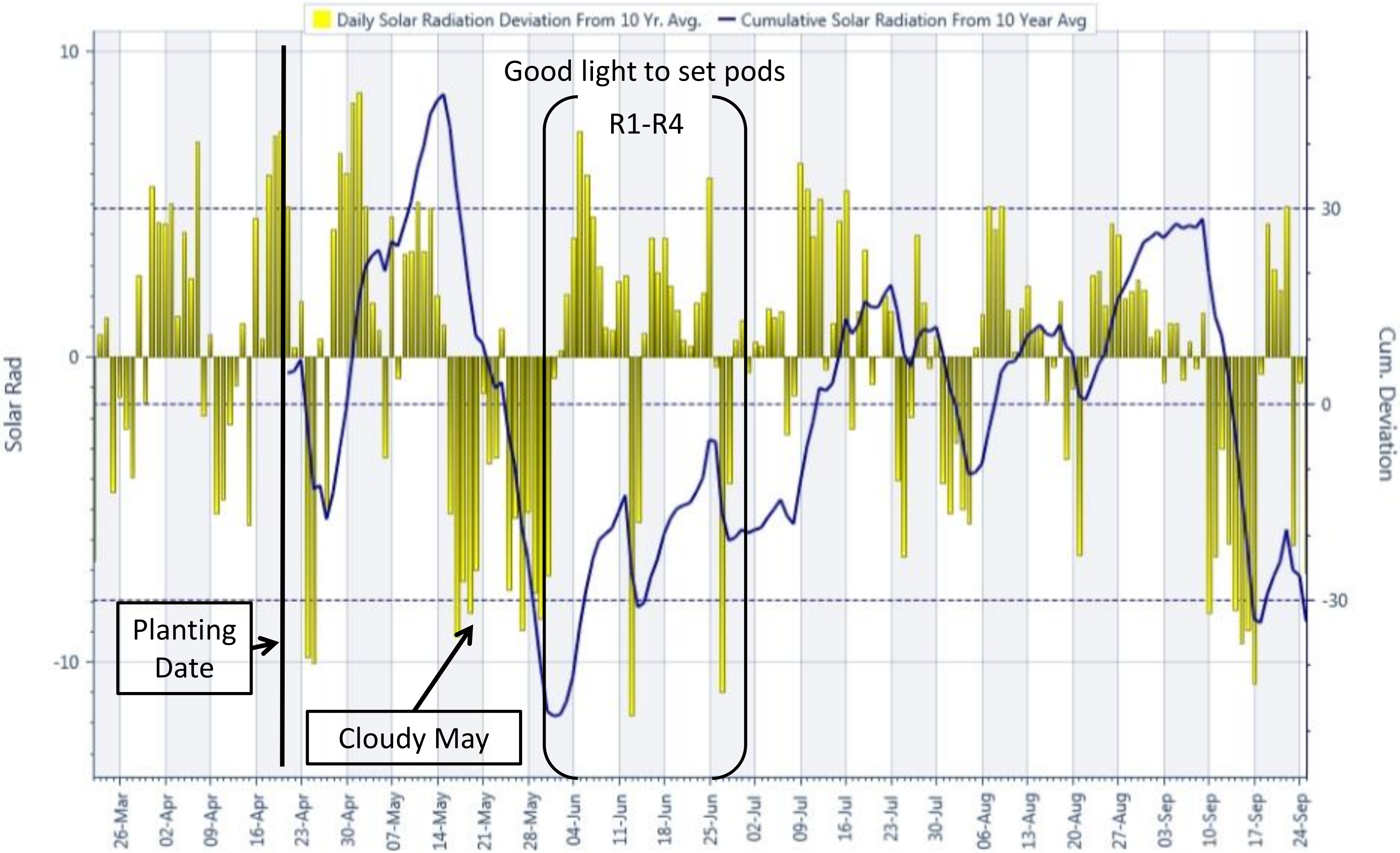
Temperature / GDU



Business Partner: Matthews Family Farms of NC
Field:
County: Yadkin

Operation: Matthews Family Farms of NC
Farm:
State: North Carolina

Solar Radiation



NC Soybean Yield Contest

NC SOYBEAN PRODUCERS ASSOCIATION

ABOUT US ▾ NCSPA NEWS ▾ THE CHECKOFF ▾ THE ASSOCIATION ▾ GROWER RESOURCES ▾

2018 YIELD CONTEST WINNERS ANNOUNCED

Karen Wing | January 16, 2019 | From the Field | 0 | Post Permalink

104.5 Bu/A

Matthews Family Farm of Davie County won the annual North Carolina Soybean Yield Contest for the second year in a row with an entry of 104.5 bushels per acre. Kevin Matthews received the award for the highest yield at the annual NC Commodities Conference of the corn, cotton, small grains and soybean associations in Durham, N.C. The soybean yield contest is administered by North Carolina State University Cooperative Extension and the awards are sponsored by the North Carolina Soybean Producers Association. The winning entries were announced on Jan. 10, 2019.

Matthews (pictured left receiving his award from NCSPA president John Fleming, with Rachel Vann, N.C. State Extension Soybean Specialist and Marsha McGraw, Davie County extension agent) was awarded a plaque and one expense-paid trip to Commodity Classic, the national conference and trade show for the U.S. corn, sorghum, soybean and wheat industries, in Orlando, Fla. on Feb. 27- Mar. 2 2019. Davie County extension agent Marsha McGraw was the soybean agent for Matthews' entry. McGraw will receive one expense-paid trip to Commodity Classic for her role in producing the winning yield.

Typical Plants

- 20-22 main stem nodes
- Large number of 6 pod nodes
- Impressive pod compensation in thin areas

PKP Plot Yields – Indet. and Det.

Variety/ Brand	Yield (bu/a 60#)	Facto r(s)	Mst (%)	AGI	Yield Rank	YM Verified Yld	YM Verified Mst (%)	YM AGI	YM Yield Rank	# Rows Planted	Harvest Date (Julian Date)	Harvest Width (Inch)	Moisture	Planting Date	Planting Rate (Number per 1/1000 Acre) (Entry)	Row Width (Inch) (Entry)	Tst Wt (lb/bu)
P37A69X	104.3		12.8	$860	4					12		240.00	12.8		130.0		53.0
P38T42R	96.8		12.9	$799	8					12		240.00	12.9				53.0
P42A96X	109.4		13.5	$903	1					12		240.00	13.5				53.0
P46A16R	103.4		13.5	$853	5					12		240.00	13.5				53.0
P46A93X	99.4		14.2	$820	7					12		240.00	14.2				53.0
P46A57BX	102.2		13.2	$843	6					12		240.00	13.2				53.5
P48A60X	107.5		14.3	$887	3					12		240.00	14.3		130.0		52.5
P52A26R	109.2		14.3	$901	2					12		240.00	14.3		130.0		52.5

Avg. Yield
104 Bu/A

Avg. TW
52.9 Lb/Bu

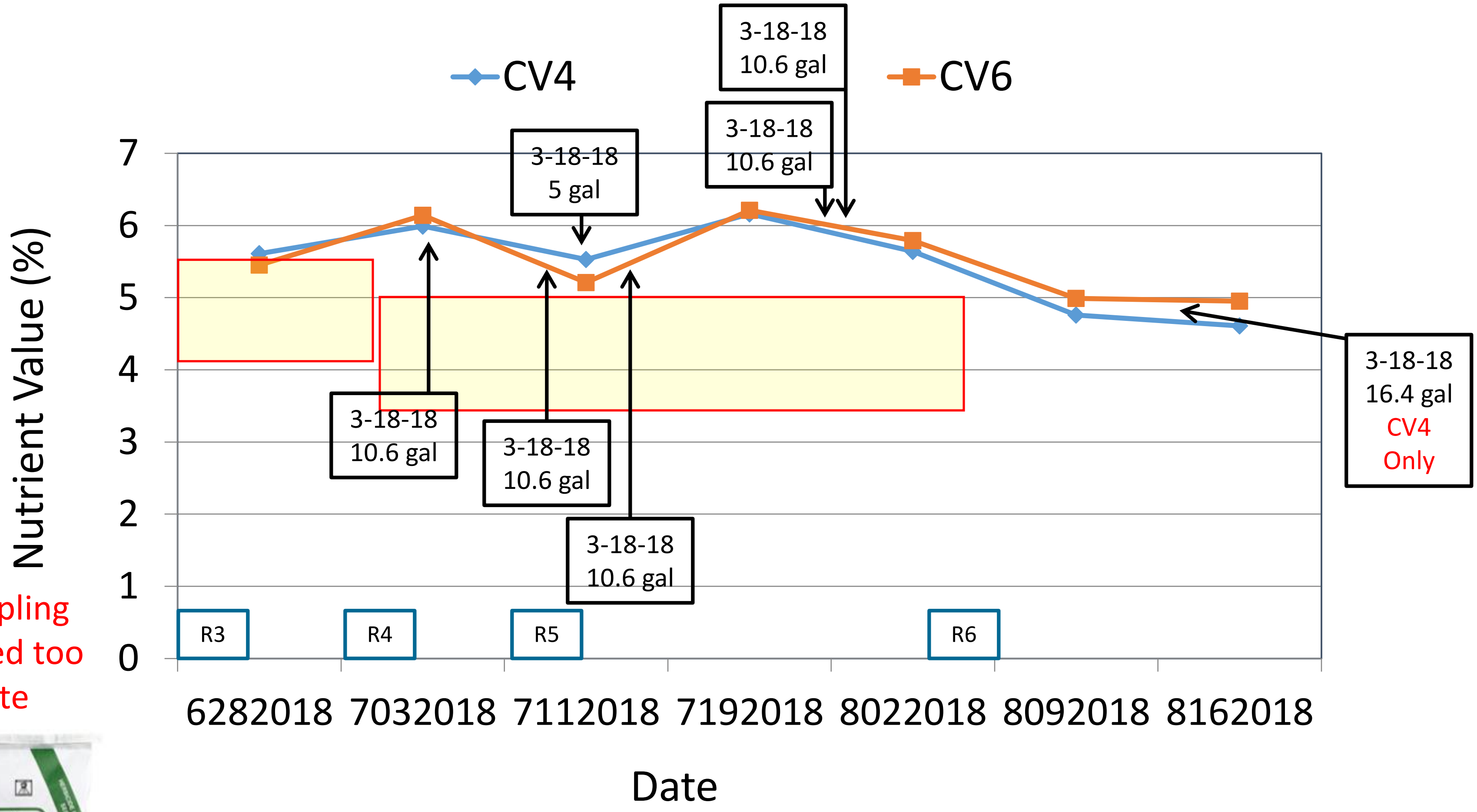
Variety/ Brand	Yield (bu/a 60#)	Facto r(s)	Mst (%)	AGI	Yield Rank	YM Verified Yld	YM Verified Mst (%)	YM AGI	YM Yield Rank	# Rows Planted	Harvest Date (Julian Date)	Harvest Width (Inch)	Moisture	Planting Date	Planting Rate (Number per 1/1000 Acre) (Entry)	Row Width (Inch) (Entry)	Tst Wt (lb/bu)
P51A61X	94.7		14.8	$781	1					12		240.00	14.8		130.0		55.0
P52T50R	92.6		14.8	$764	3					12		240.00	14.8				56.0
P54A75X	93.3		14.1	$770	2					12		240.00	14.1				55.0
P55T81R	81.5		14.7	$672	5					12		240.00	14.7				56.0
P55A49X	88.5		14.6	$730	4					12		240.00	14.6				55.5
P60T95X	76.6		15.0	$632	6					12		240.00	15.0		130.0		55.0

Avg. Yield
88 Bu/A

Avg. TW
55.4 Lb/Bu

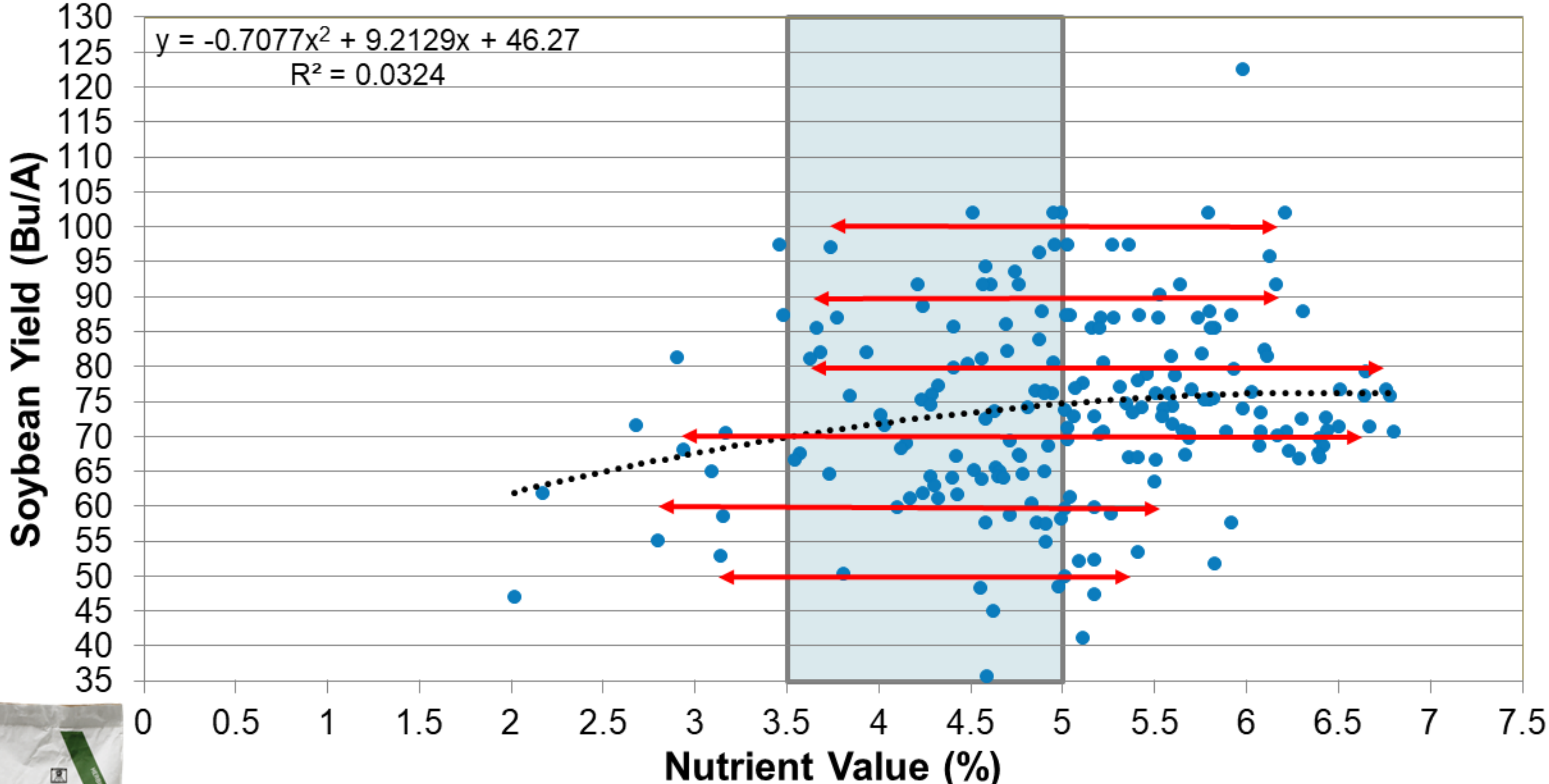
Nutrient Tracking

% Nitrogen – Soybeans 2018

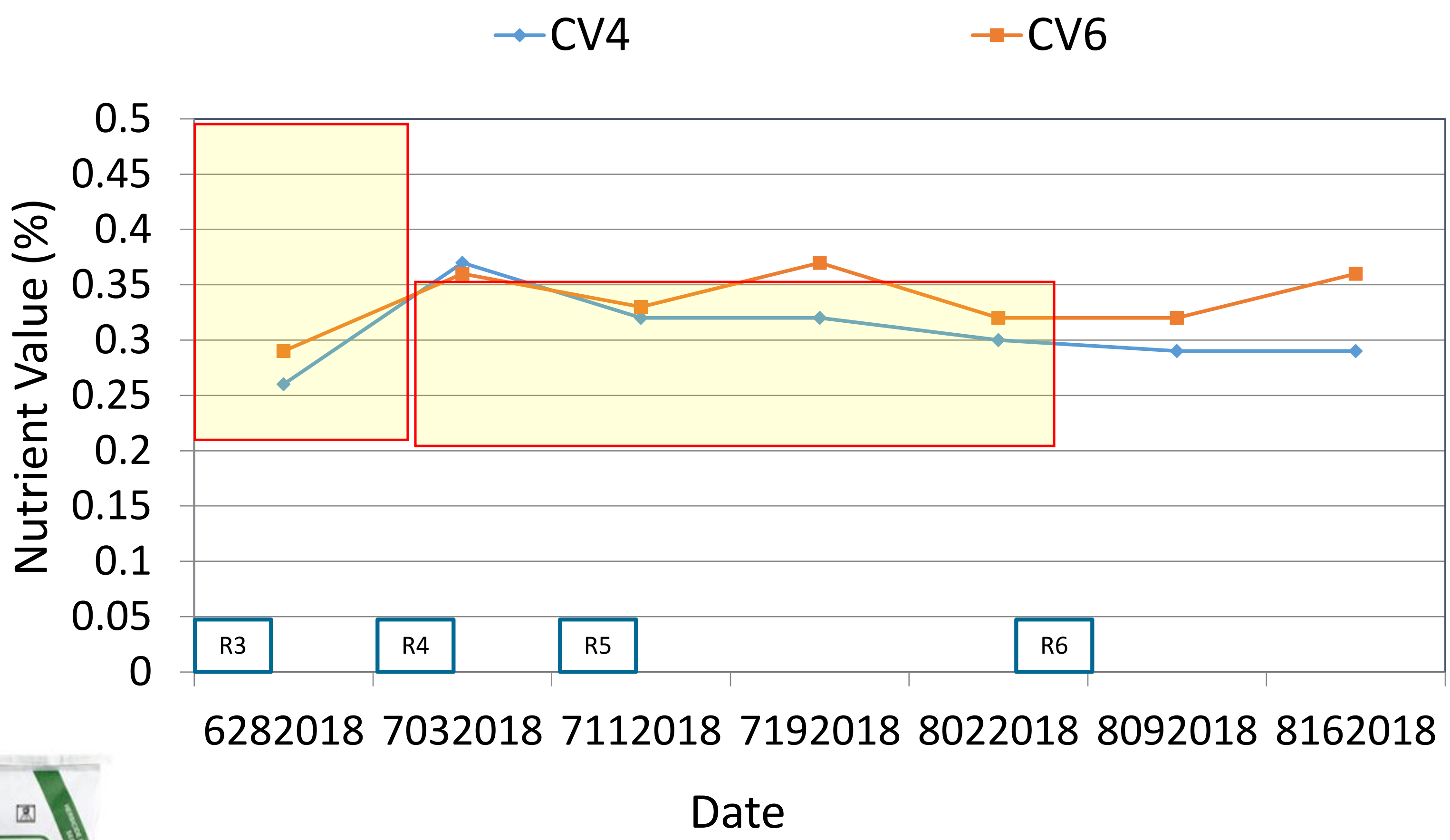


Sampling started too late

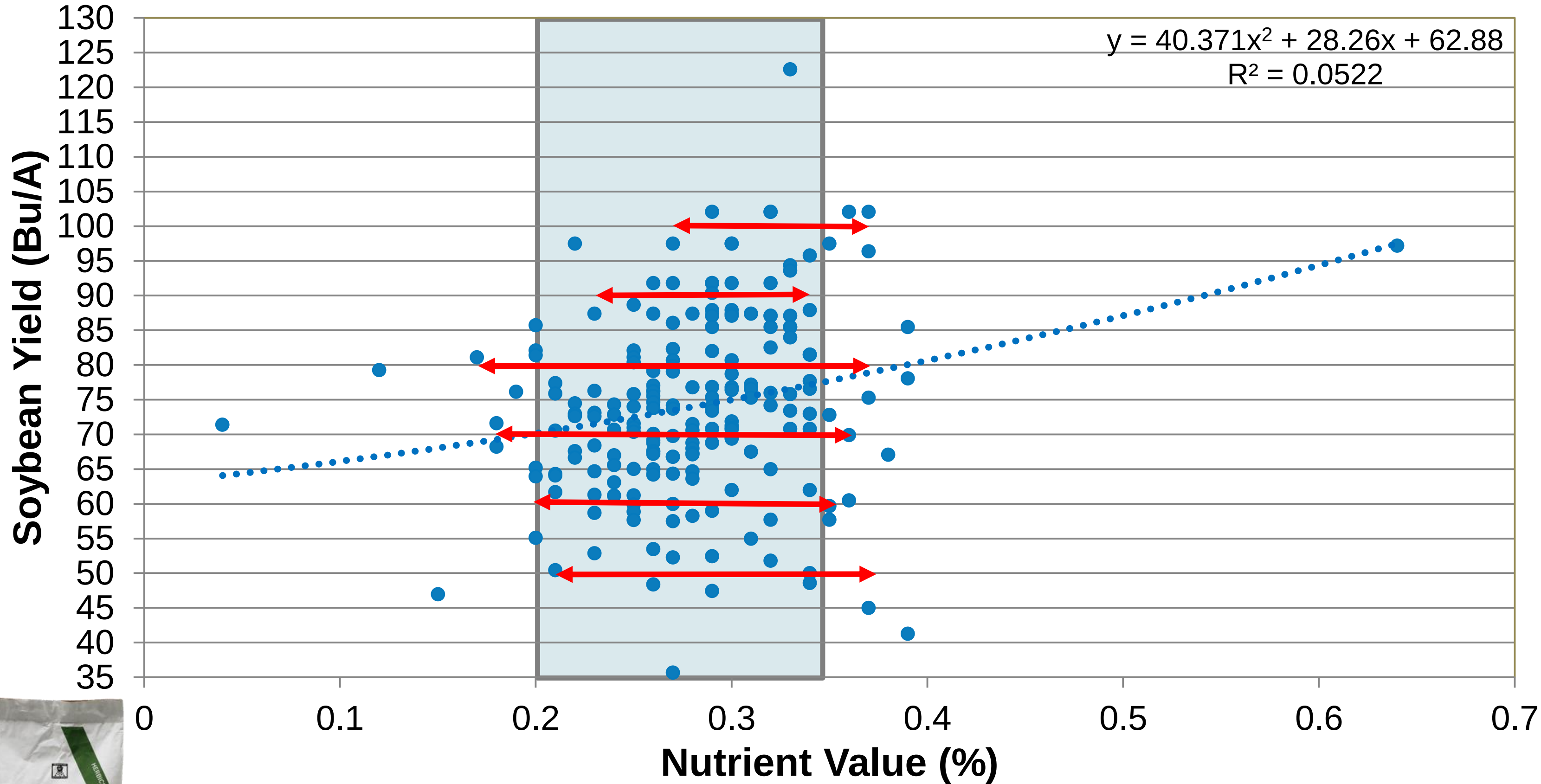
% Leaf Nitrogen – Pod Filling (R4 – R6) 2017-18



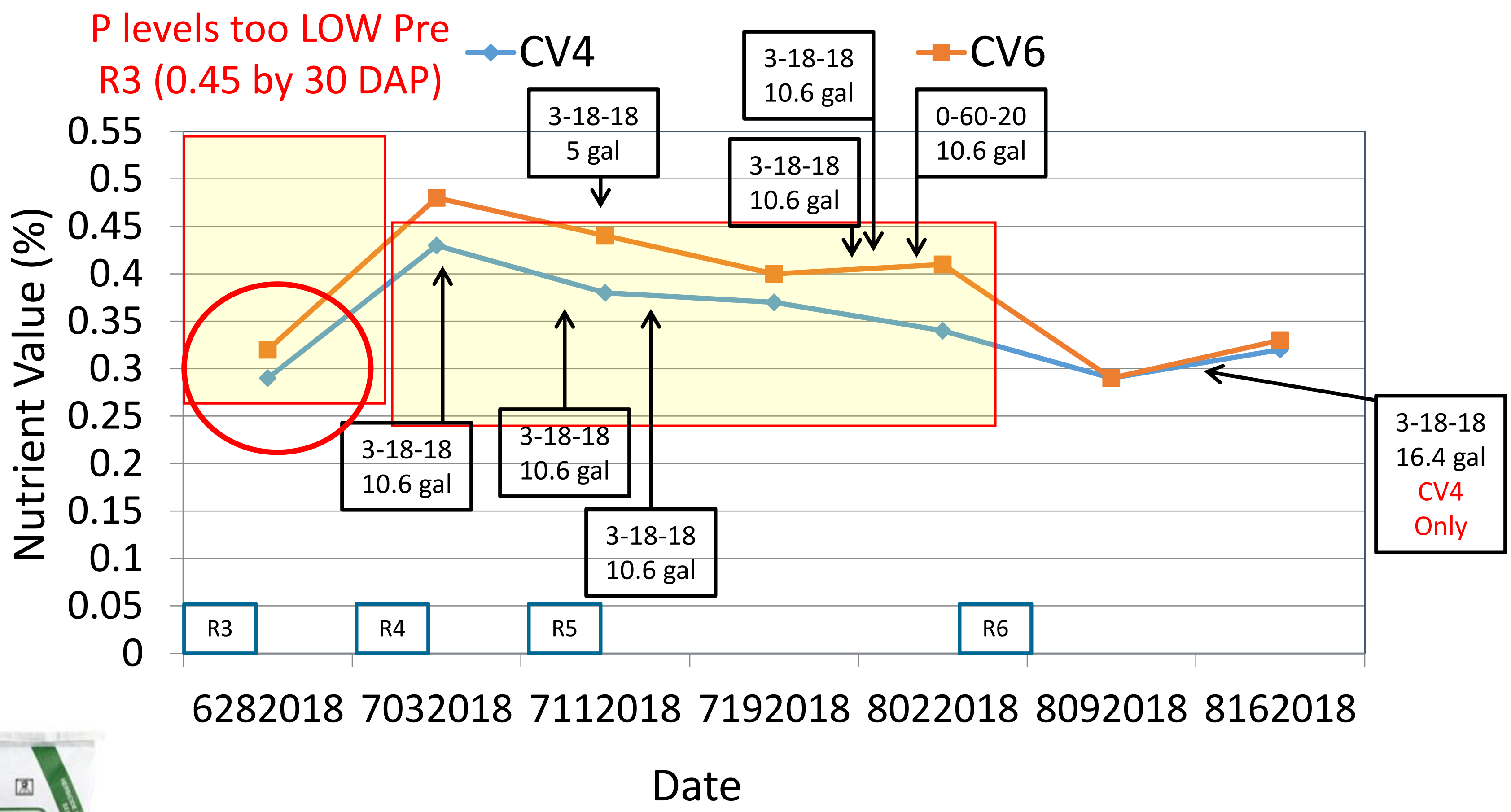
% Sulfur – Soybeans 2018



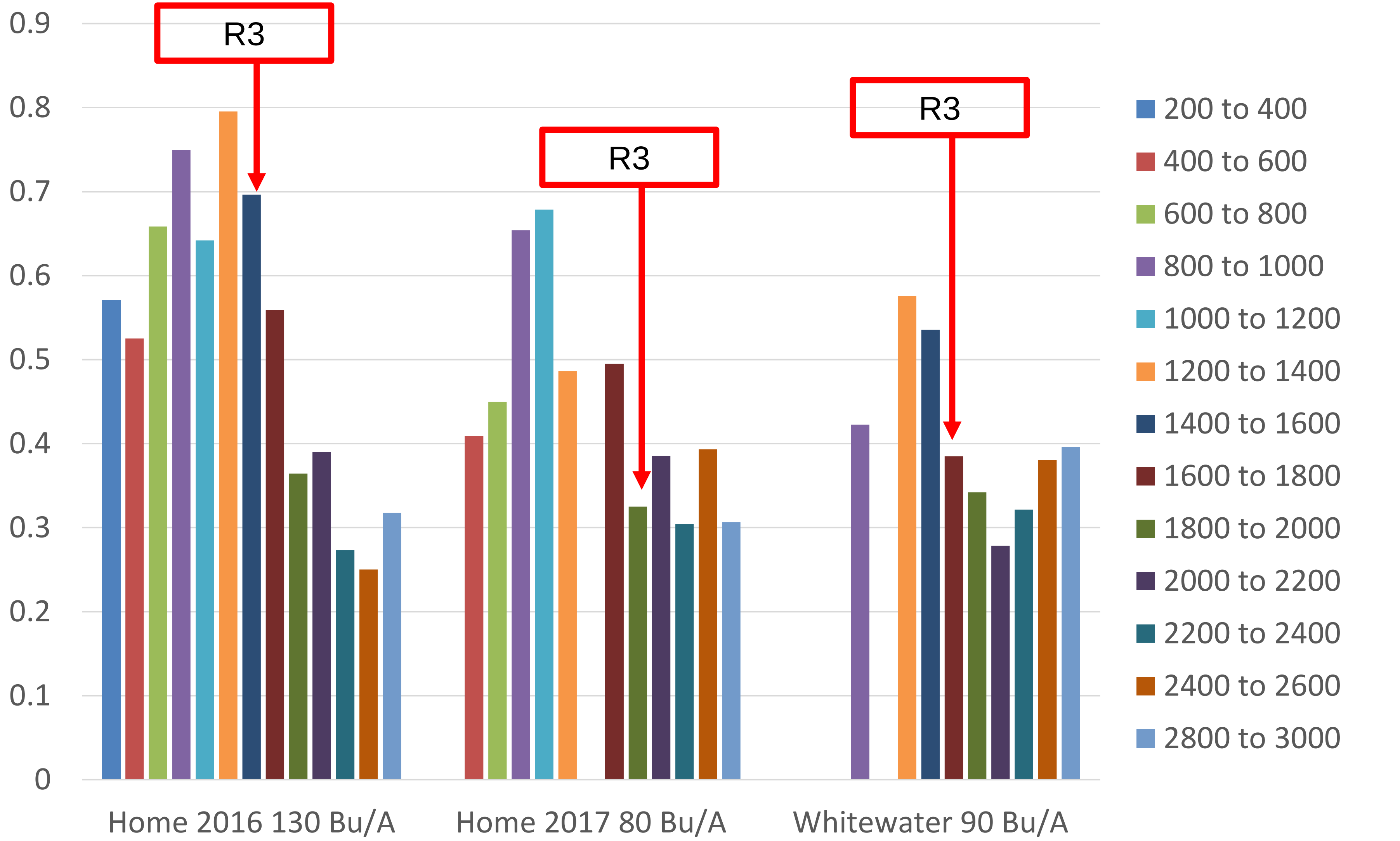
% Leaf Sulfur – Pod Filling (R4 – R6) 2017-18



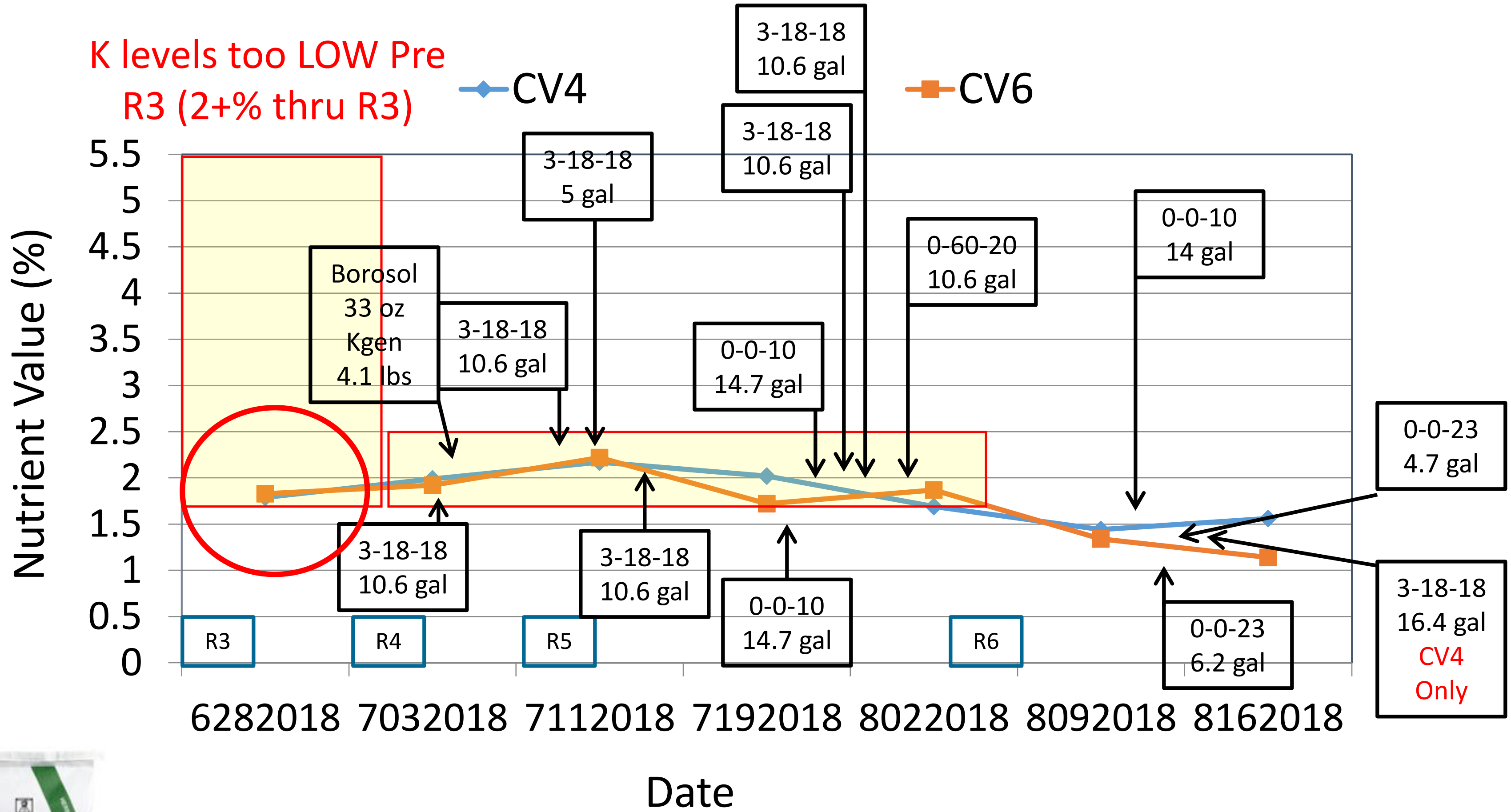
% Phosphorus – Soybeans 2018



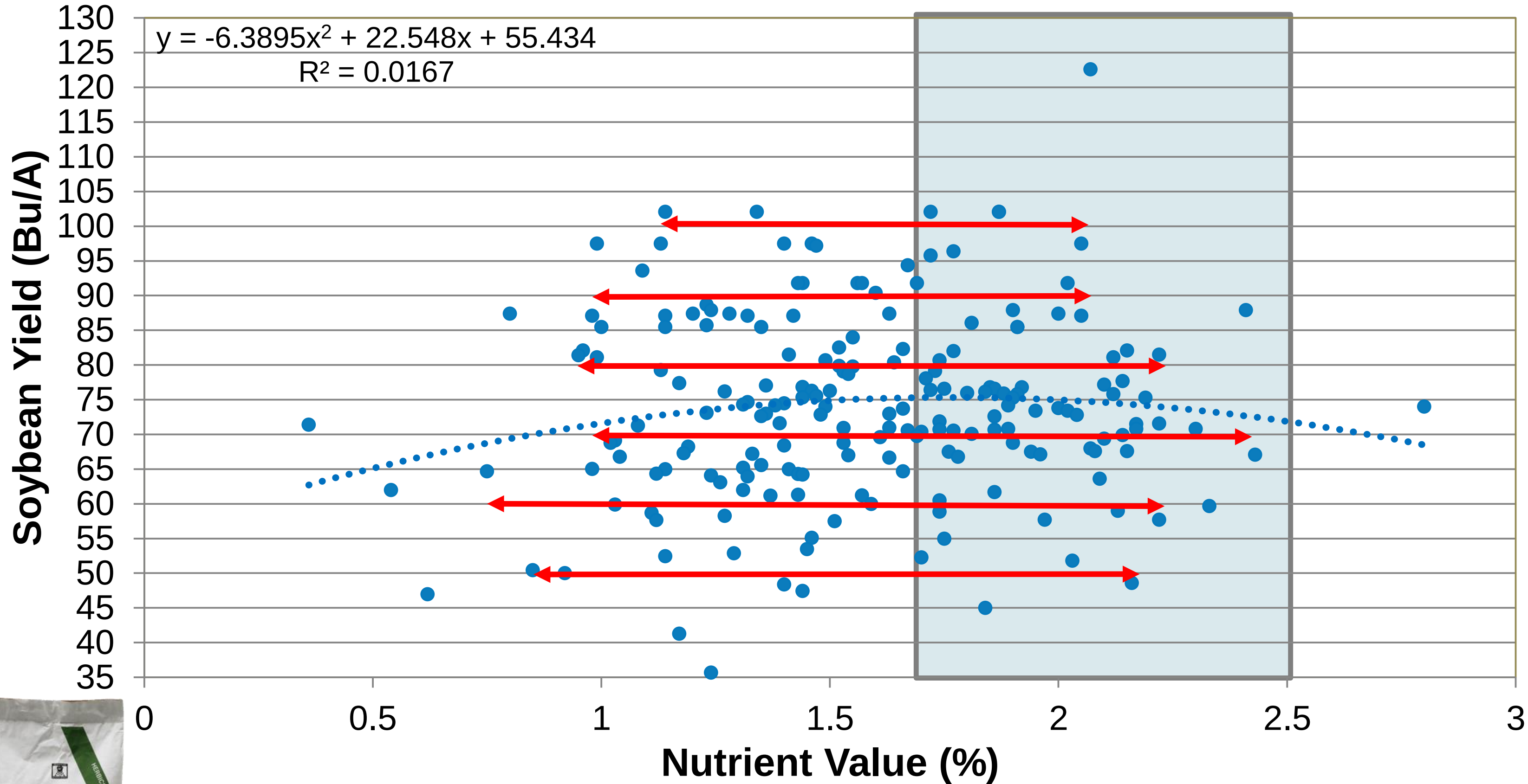
Nutrient Level Comparisons - Phosphorus



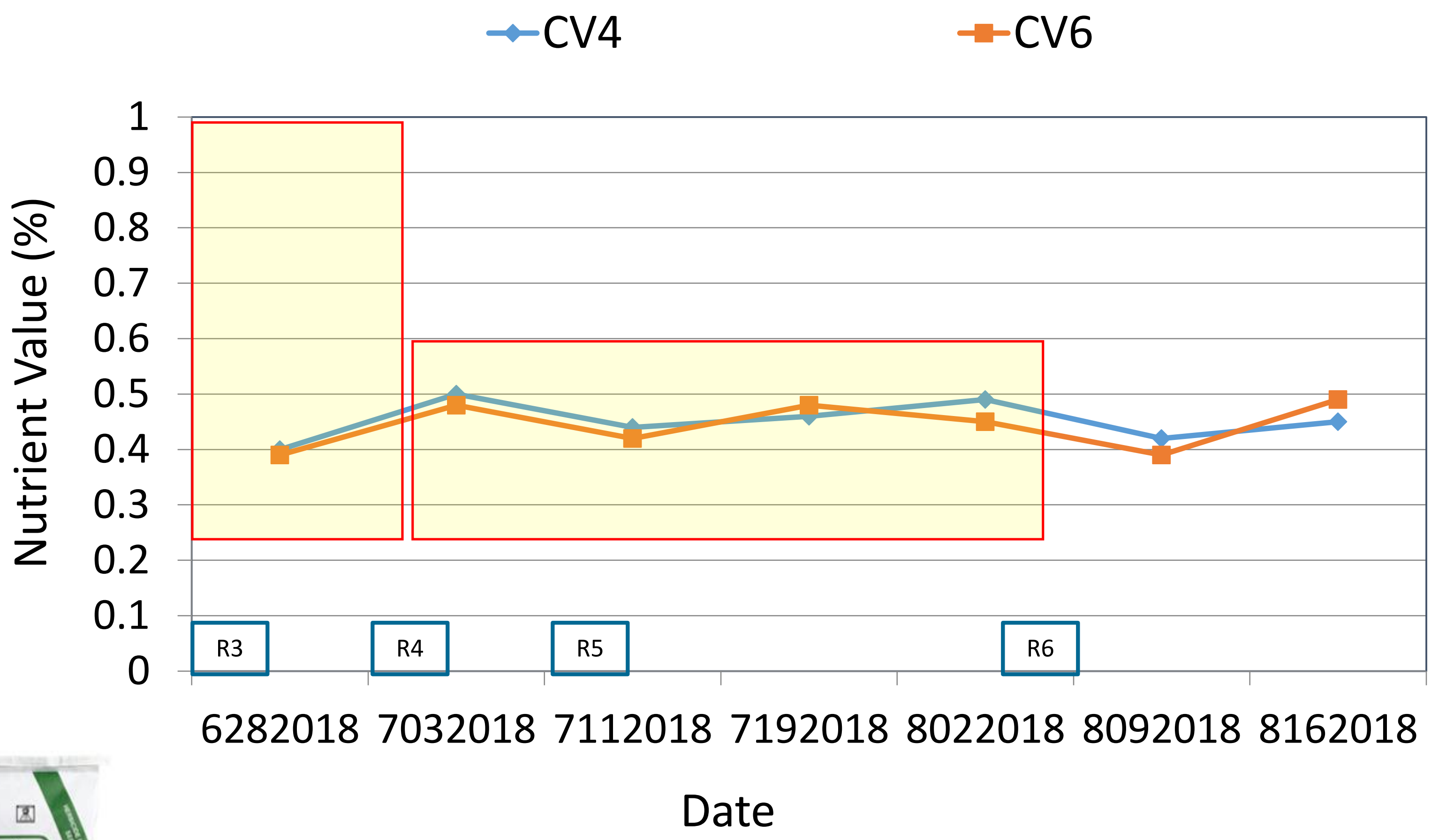
% Potassium – Soybeans 2018



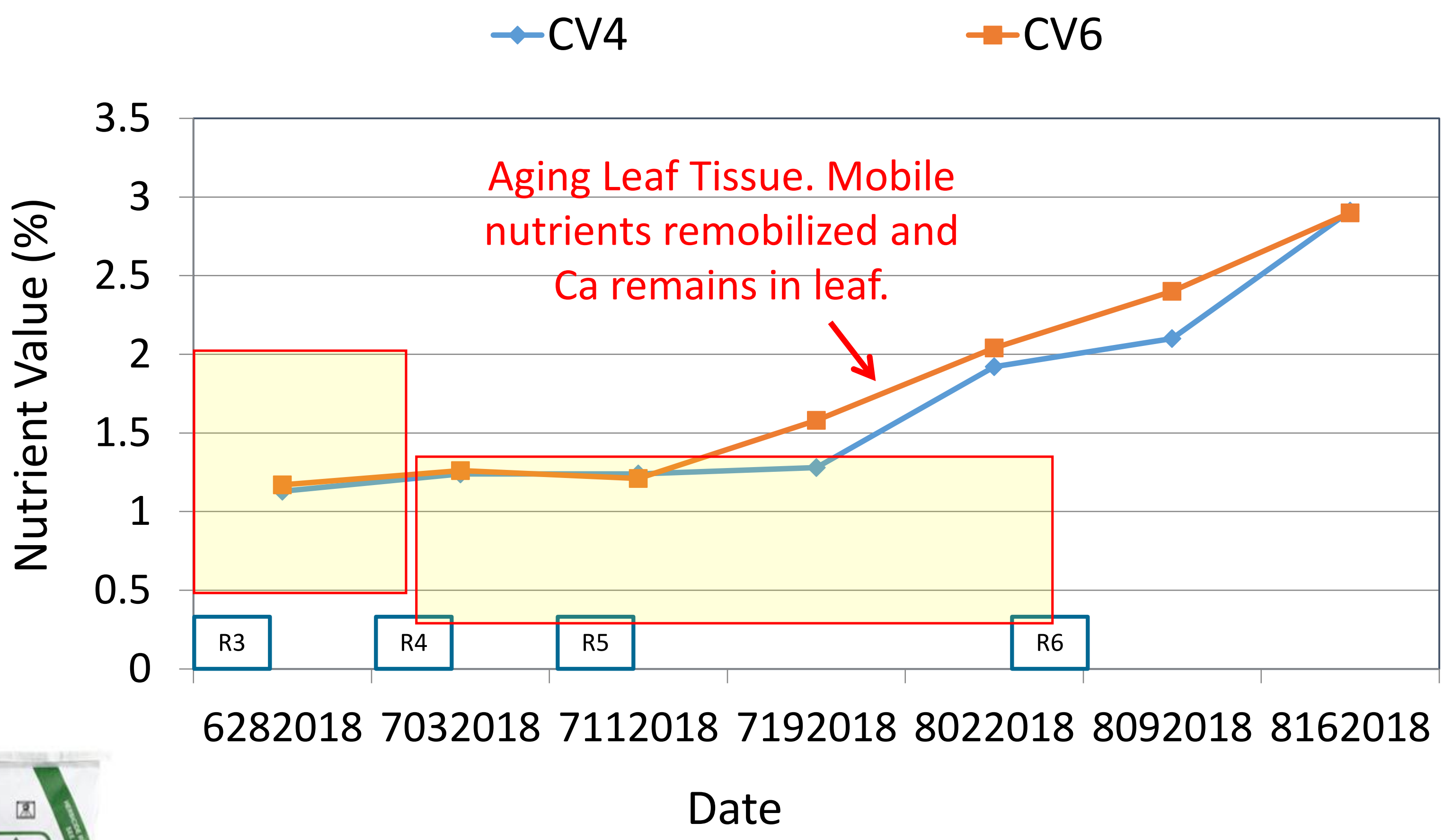
% Leaf Potassium – Pod Filling (R4 – R6) 2017-18



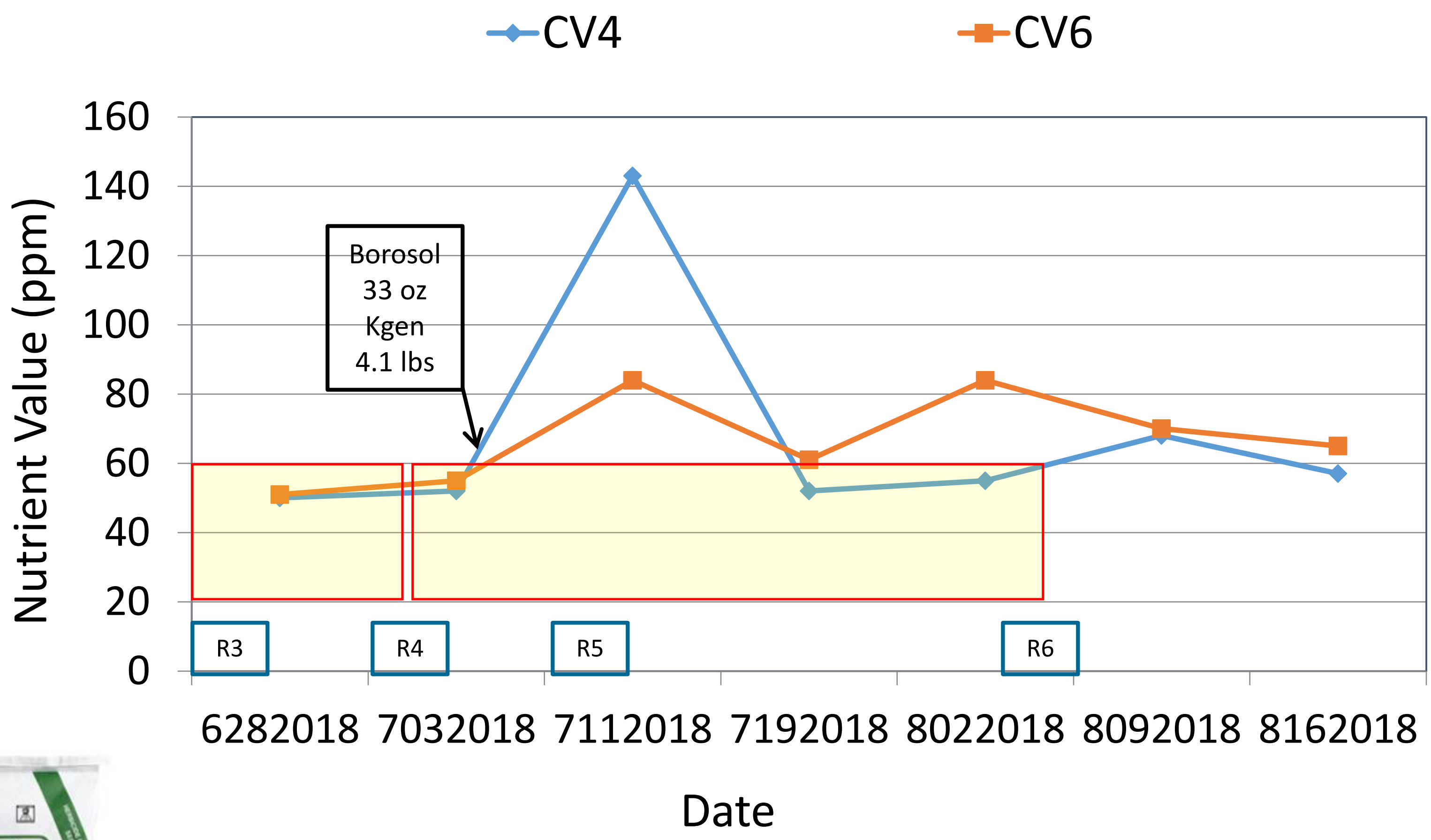
% Magnesium – Soybeans 2018



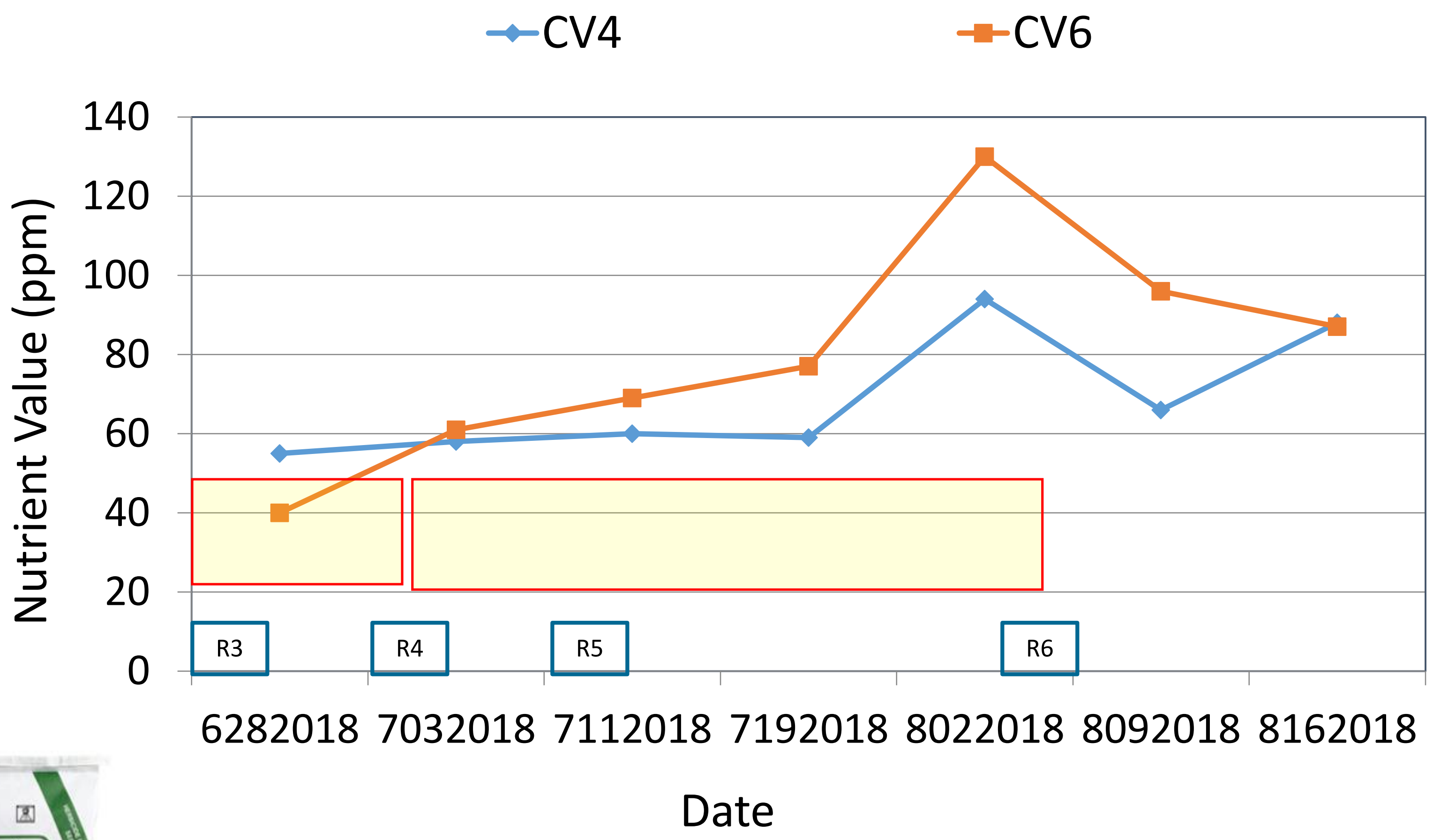
% Calcium – Soybeans 2018



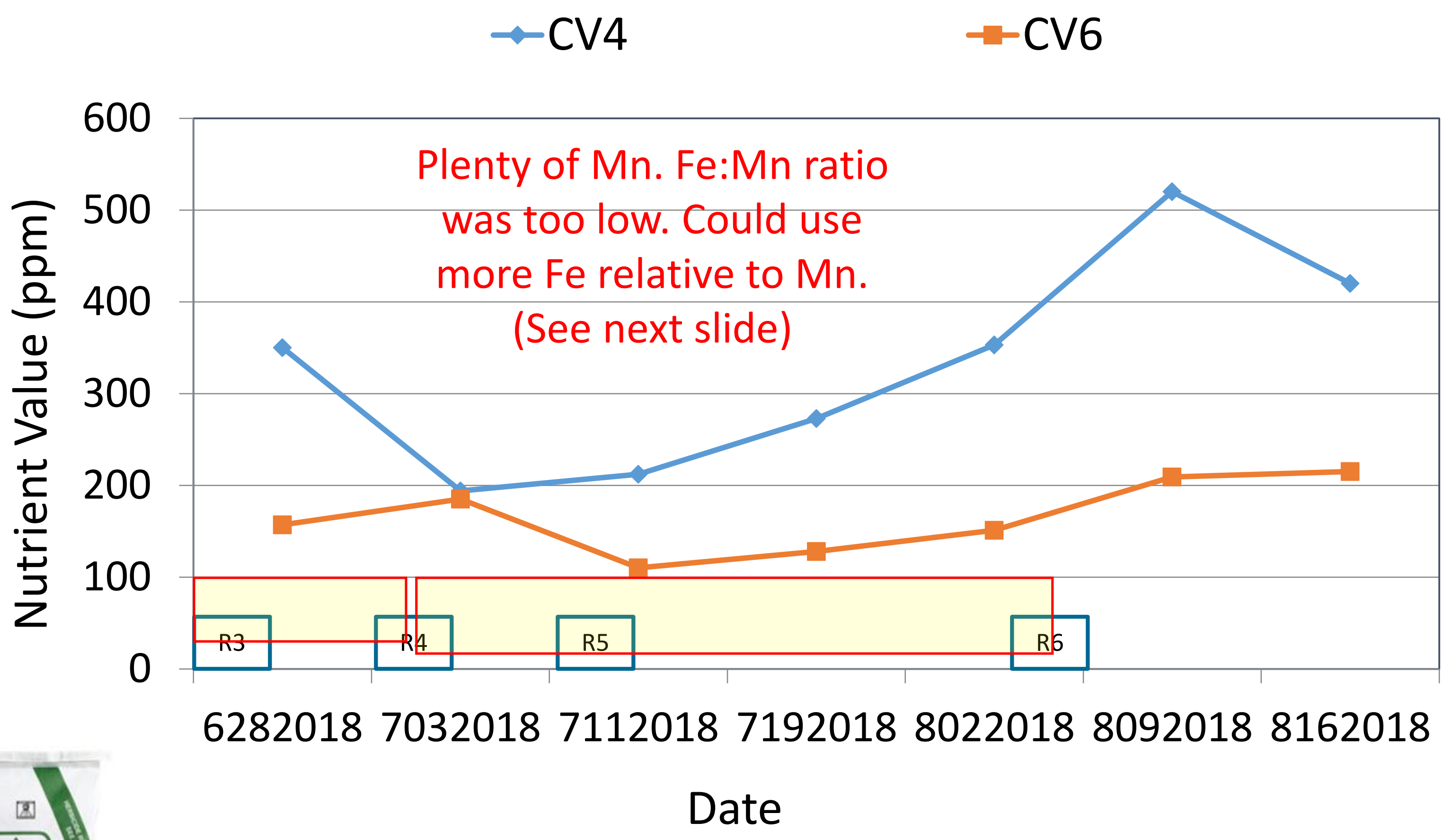
Boron ppm – Soybeans 2018



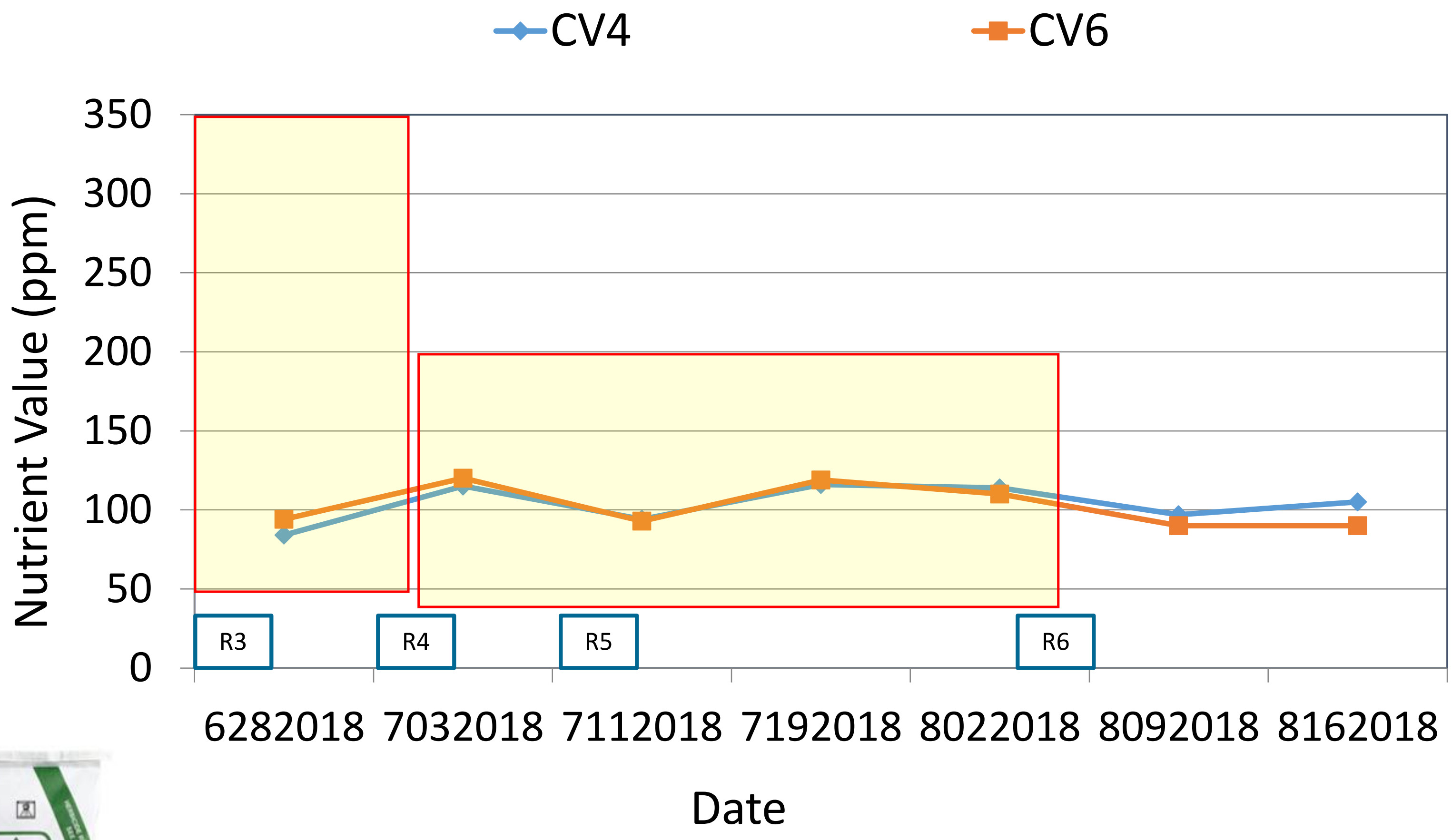
Zinc ppm – Soybeans 2018



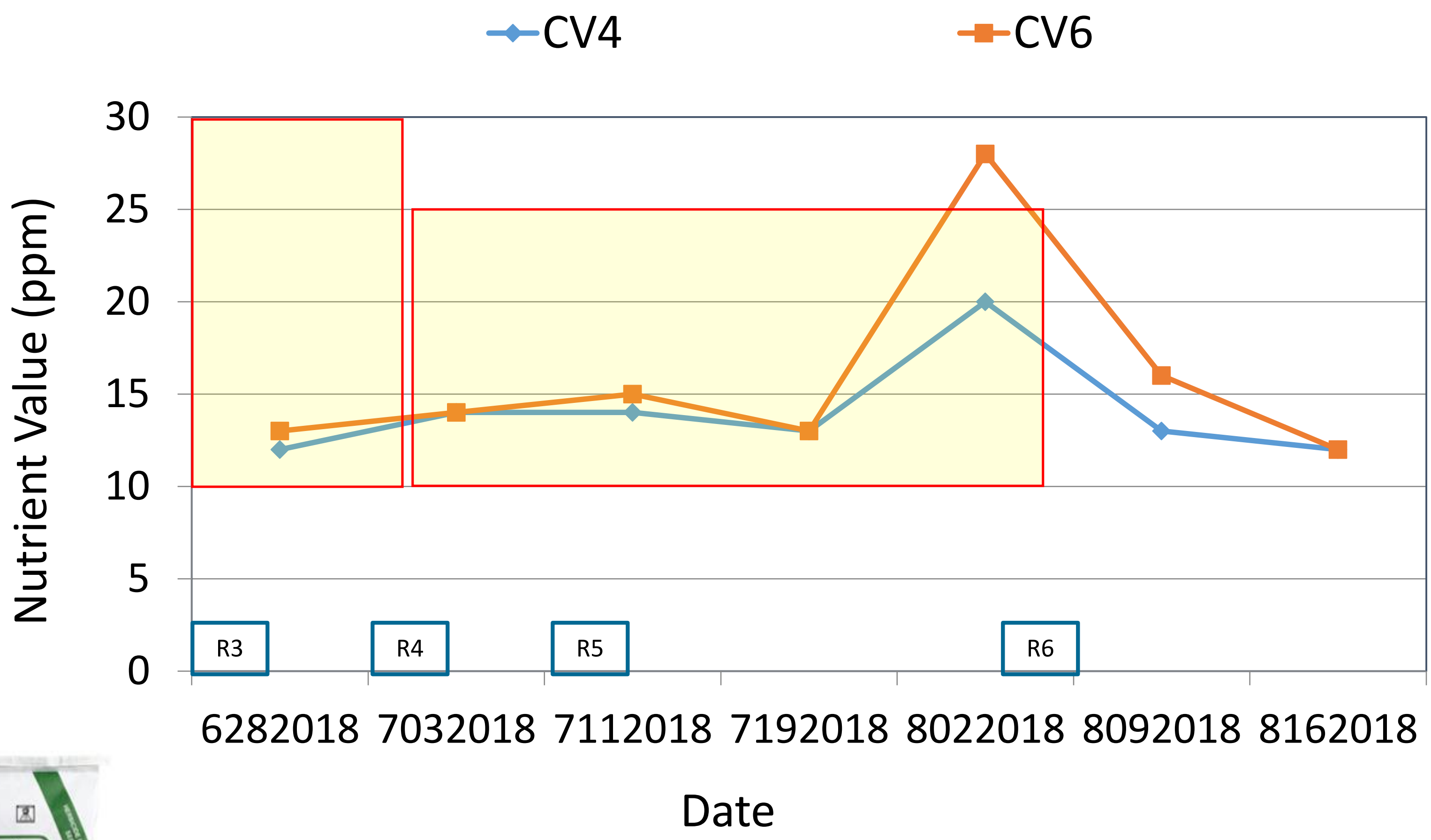
Manganese ppm – Soybeans 2018



Iron ppm – Soybeans 2018



Copper ppm – Soybeans 2018



In-Season Applications*^

Date	Product	Amount
4-21-18*	2.9-17-21	14.9 gal
5-3-18*	3-18-18	1.24 gal
6-9-18*	3-18-18	1.14 gal
6-16-18*	Weatherguard	1.62 oz
6-16-18*	RoundUp	22.24 oz
6-16-18*	Borosol (10% B)	33.42 oz
6-16-18*	Priaxor	4.18 oz
6-16-18*	Weatherguard	1.04 oz
6-16-18*	Lokomotive (2-0-25)	66.83 oz
6-16-18*	Carbose	2.09 oz
6-16-18*	VitaNterra	33.42 oz

Date	Product	Amount
6-19-18*	Tombstone Helios	1.4 oz
6-19-18*	HR1	1.6 gal
6-22-18	0-0-10	10 gal
6-24-18	0-0-10	10 gal
6-27-18	0-0-10	10 gal
7-3-18	3-18-18	10 gal
7-4-18*	Borosol	33.1 oz
7-4-18*	Carbose	14.5 oz
7-4-18*	Kgen	4.1 Lbs
7-4-18*	Tombstone Helios	2.5 oz
7-4-18	3-18-18	5 gal
7-9-18	3-18-18	10.6 gal

Date	Product	Amount
7-11-18	3-18-18	5 gal
7-12-18	3-18-18	10.6 gal
7-21-18	0-0-10	14.7 gal
7-22-18	0-0-10	14.7 gal
7-29-18	3-18-18	10.6 gal
7-30-18	3-18-18	10.6 gal
8-1-18	0-60-20	10.6 gal
8-12-18	0-0-10	14 gal
8-13-18	0-0-23	6.2 gal
8-14-18	0-0-23	3.4 gal
8-14-18^	3-18-18	16.4 gal

*Denotes application by ground rig.
^Application made only to CV 4.

In-Season Nutrient Amounts

Product	Total Amount	N	P	K	B
3-18-18	60.8* gal	21	128	128	0
2.9-17-21	14.9 gal	5	28	34	0
0-0-10	73.4 gal	0	0	72	0
0-0-23	9.6 gal	0	0	28	0
0-60-20	10.4 Lbs	0	6.24	2.08	0
Borosol	66.52 oz	0	0	0	0.6
Total Applied		26	162	264	0.6
Uptake 101 Bu/A Flannery		548	60	286	---
Uptake 101 Bu/A Gaspar		488^	40	204	0.24#

*Extra application made only to CV 4.
^Value estimated by Pioneer.
#Values from Gaspar et al. Value likely underestimated.

How big is the factory?

- 60 Bu/A Soybeans
  - 36 g dry weight per plant
  - 9,000 lbs biomass
- 95 Bu/A Soybeans
  - 40 g dry weight per plant
  - 10,949 lbs biomass
- 103 Bu/A Soybean
  - 57 g dry weight per plant
  - 12,594 lbs biomass

Key Observations

- Early SDI difficult due to river sediment and wet field conditions
  - Too much dependence on SDI to deliver early nutrients
  - Need to build soil nutrients levels to optimum
- Need to focus more on micronutrients in future
  - Balance Fe:Mn
  - Monitor and address others as needed
- Timely Harvest extremely critical
  - 10-20 Bu/A yield loss due to rain delays from tropical storm
- May need some sulfur via SDI
- More Ca into system to improve soil porosity

Questions?