Special K: New Tools for Potassium Management in Soybean

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Topical Outline

- Common Nutrient CONCERNS in AR Soybean Production

- Economics of Potassium Fertilization

- Late-season Potassium Applications

- Dynamic Critical Tissue Potassium Threshold

- Key Takeaways

Soybean Production In AR

- ~3 million acres each year

- 90%+ irrigated (furrow or flood)

- Row spacing of 15-38"

- MG 4-early 5

BUSHELS

0 to 49,999

50,000 to 499,999

500,000 to 1,999,999

2,000,000 +
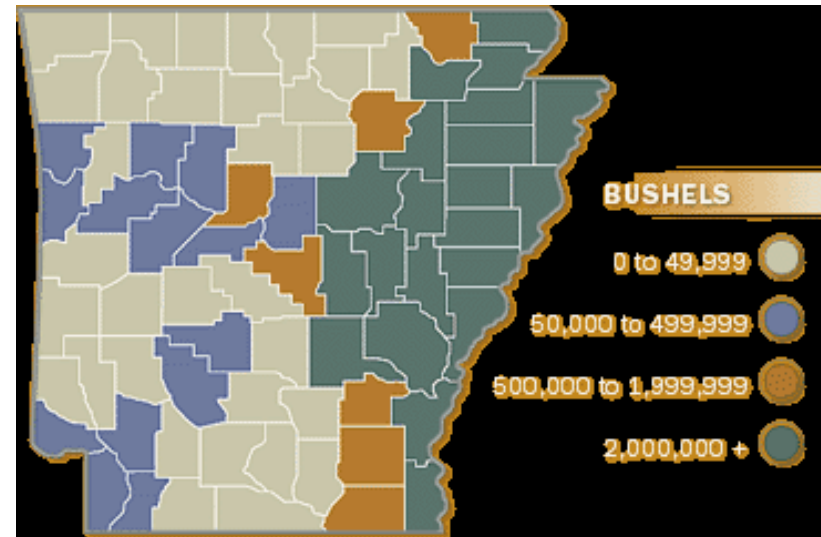
Common Nutrient Deficiencies/Toxicities in Arkansas Soybean Production

- Potassium

- Potash

- Boron

- K

- Water

- Chloride Toxicity

Soil Sampling and Analysis

Arkansas Soil Test-K Categories

Soil Test Category	Soil Test-K (ppm)	K Application Rate (lb K_2O/acre)	Estimated Row Crop Acreage (%)
Very Low	0-60	160	8-25
Low	61-90	120	14-30
Medium	91-130	75	25-39
Optimum	131-175	50	12-20
Above Optimum	>176	0	7-36

A significant portion of our row crop acreage (up to 40%) is situated on soils that fall within the Very Low to Low Soil Test-K categories where we would anticipate a significant response to K fertilization.

Soybean Profitability Closely Linked to K Application Rates

- Popp et al., 2020- Profit-maximizing Potassium Fertilizer Recommendations for Soybean

- https://agribusiness.uark.edu/decision-support-software.php#PRC

- Considers the following inputs
  - Soil Test-K
  - Projected Soybean Value
  - Projected K Fertilizer Cost
  - Application Cost

Profit-Maximizing K Rate Calculator

Fit to Screen

What is your expected soybean price? 8.00 $/bu ☐ Metric

What do you expect to pay for muriate of potash fertilizer? 350 $/ton 0.29 $/lb of K_2O

What is the yield potential of your field? 50 bu/acre

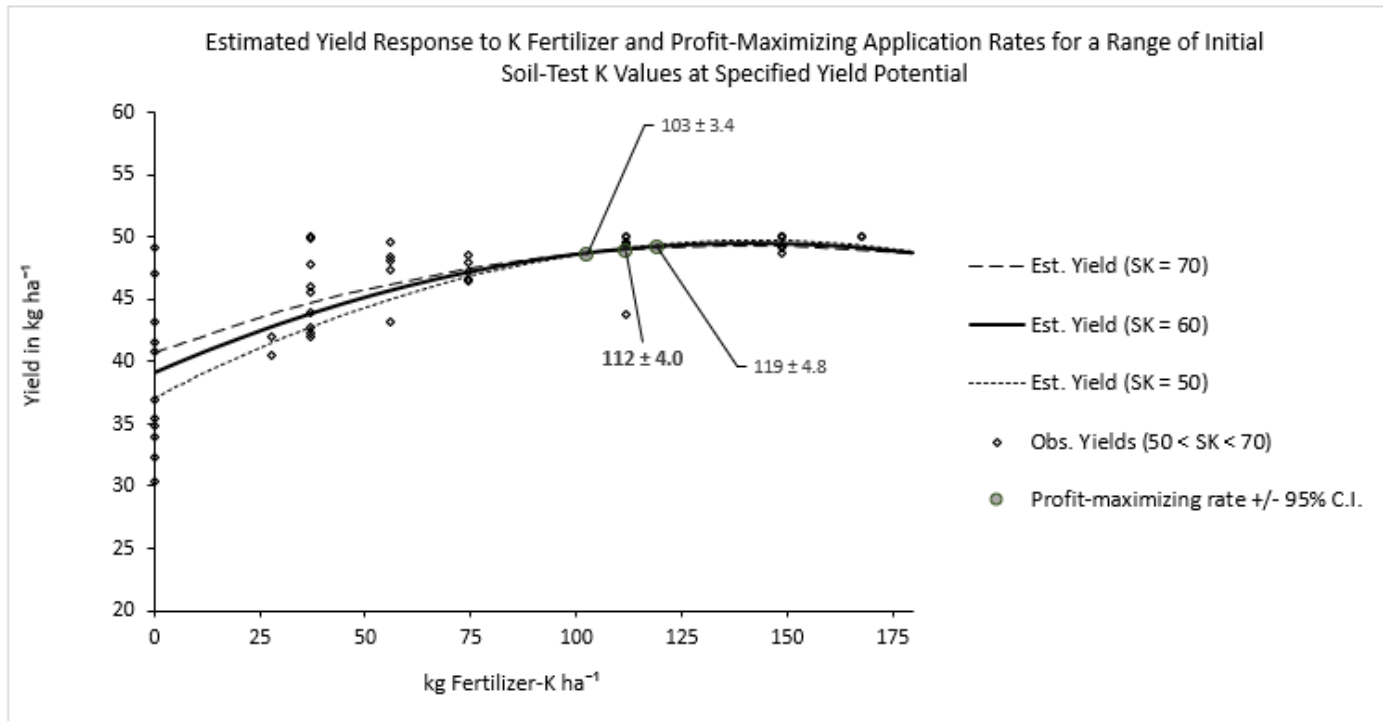What is your soil test-K value (SK) and range? 60 ppm Soil test range +/- 10

What is your cost to apply fertilizer (equipment, labor, fuel or custom)? 15.00 $/acre

Profit change comparing applying at 111.7lb K_2O/acre to no fertilizer: 30.31 $/acre

Estimated Yield Response to K Fertilizer and Profit-Maximizing Application Rates for a Range of Initial Soil-Test K Values at Specified Yield Potential

- — — Est. Yield (SK = 70)
- —— Est. Yield (SK = 60)
- ---- Est. Yield (SK = 50)
- ◇ Obs. Yields (50 < SK < 70)
- ● Profit-maximizing rate +/- 95% C.I.

Y-axis: Yield in kg ha^{-1}
X-axis: kg Fertilizer-K ha^{-1}

Labels on chart: 103 ± 3.4, 112 ± 4.0, 119 ± 4.8

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Experiment Station

Yield Potential Will Drive Profitable K Fertilization Rates
(Yield History of 60 bu/acre)

Soil Test Category	Profit Maximizing K Rate (lb K_2O/acre)	Difference from Standard Rec. (lb K_2O/acre)	Profit Compared to NO Fertilization ($/acre)
Very Low (45 ppm)	131	**-29**	93.14
Low (75 ppm)	111	**-9**	31.91
Medium (110 ppm)	68	**-7**	**-5.32**

Assumptions:
$9.00/bushel soybean price
$350/ton Potash Price ($0.29/lb K_2O)
~$15.00/acre application cost

Yield Potential Will Drive Profitable K Fertilization Rates
(Yield History of 80 bu/acre)

Soil Test Category	Profit Maximizing K Rate (lb K_2O/acre)	Difference from Standard Rec. (lb K_2O/acre)	Profit Compared to NO Fertilization ($/acre)
Very Low (45 ppm)	137	**-23**	142.20
Low (75 ppm)	120	0	58.79
Medium (110 ppm)	86	+11	5.39

Assumptions:
$9.00/bushel soybean price
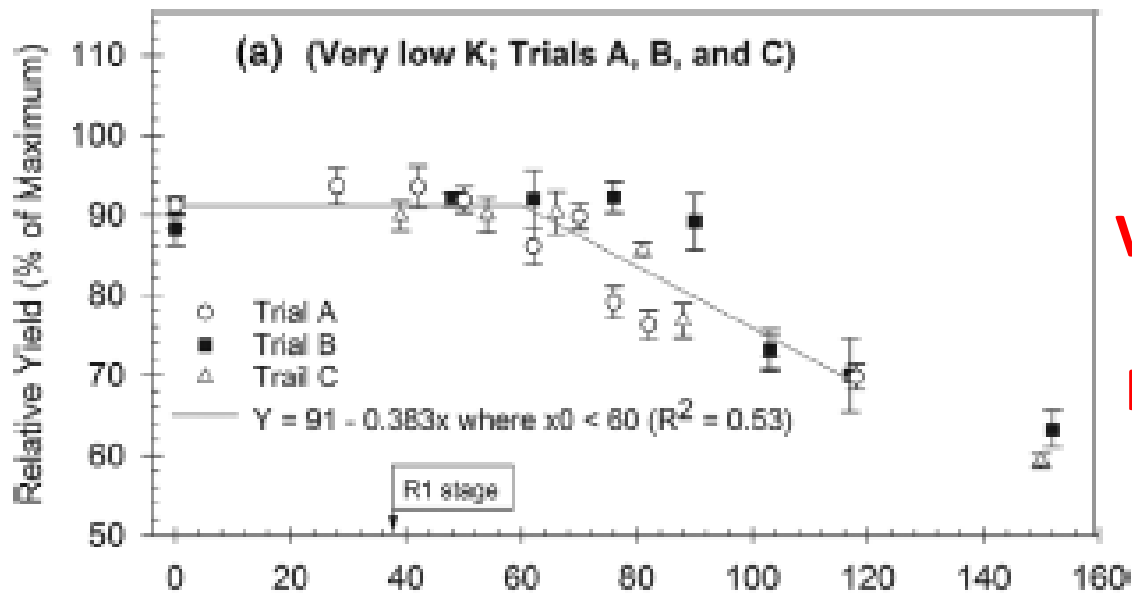$350/ton Potash Price ($0.29/lb K_2O)
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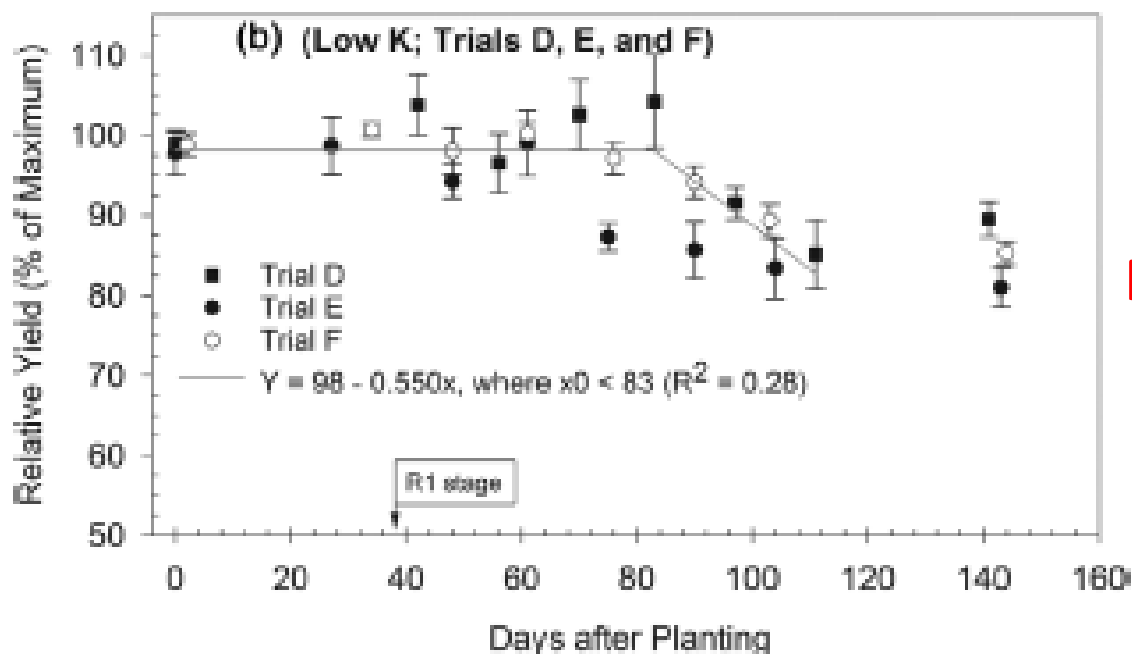
Profitable K Fertilization Rates

- Realistic Yield Goals are Critical!!!!

- The More Information You Have on Your Input Costs and Soybean Value the Better

- This is a Great Starting Point Knowing We Can Correct/Make Adjustments In Season

Soybean Response to Late-season K Fertilization

- Slaton et al., 2020- Irrigated Soybean Response to Granular Fertilizer Potassium Application Timing

- In-season K Applications are Taken Up Rapidly in Irrigated Systems

- Maximal Yield Can be Obtained with Fertilizer-K applied 20 Days After R1

- Hidden Hunger can be Corrected Up to 44 Days After R1

(a) (Very low K; Trials A, B, and C)

○ Trial A
■ Trial B
△ Trail C
— Y = 91 - 0.383x where x0 < 60 (R^2 = 0.53)

R1 stage

(b) (Low K; Trials D, E, and F)

■ Trial D
● Trial E
○ Trial F
— Y = 98 - 0.550x, where x0 < 83 (R^2 = 0.28)

R1 stage

Very Low STK Window-
R1 + 20 Days

Low STK Window-
R1 + 44 Days

Arkansas Agricultural Experiment Station

Dynamic Critical K Concentration

Excel-Based Tracking Platform

	A	B	C	D	E
Grower Name		Jim Bob		**State**	AR
Field Name		Back 40		**County**	Poinsett
Maturity Group		4.6		**Variety Name**	4609 Mission
Planting Date		1-Jun			
R1 (Flowering) Date		2-Jul			

Sample	Sample Date (Enter data)	Leaflet % K (Enter data)
1	4-Jul	2.64
2	19-Jul	1.89
3	3-Aug	1.62
4	10-Aug	1.45
5	25-Aug	1.21
6		
7		
8		
9		
10		

Leaflet Sufficiency

Chart — % Leaflet K vs. Days After R1 Stage (Predicted by SoyMAP)

Legend: ■ Field Data — 95% Sufficiency — 90% Sufficiency
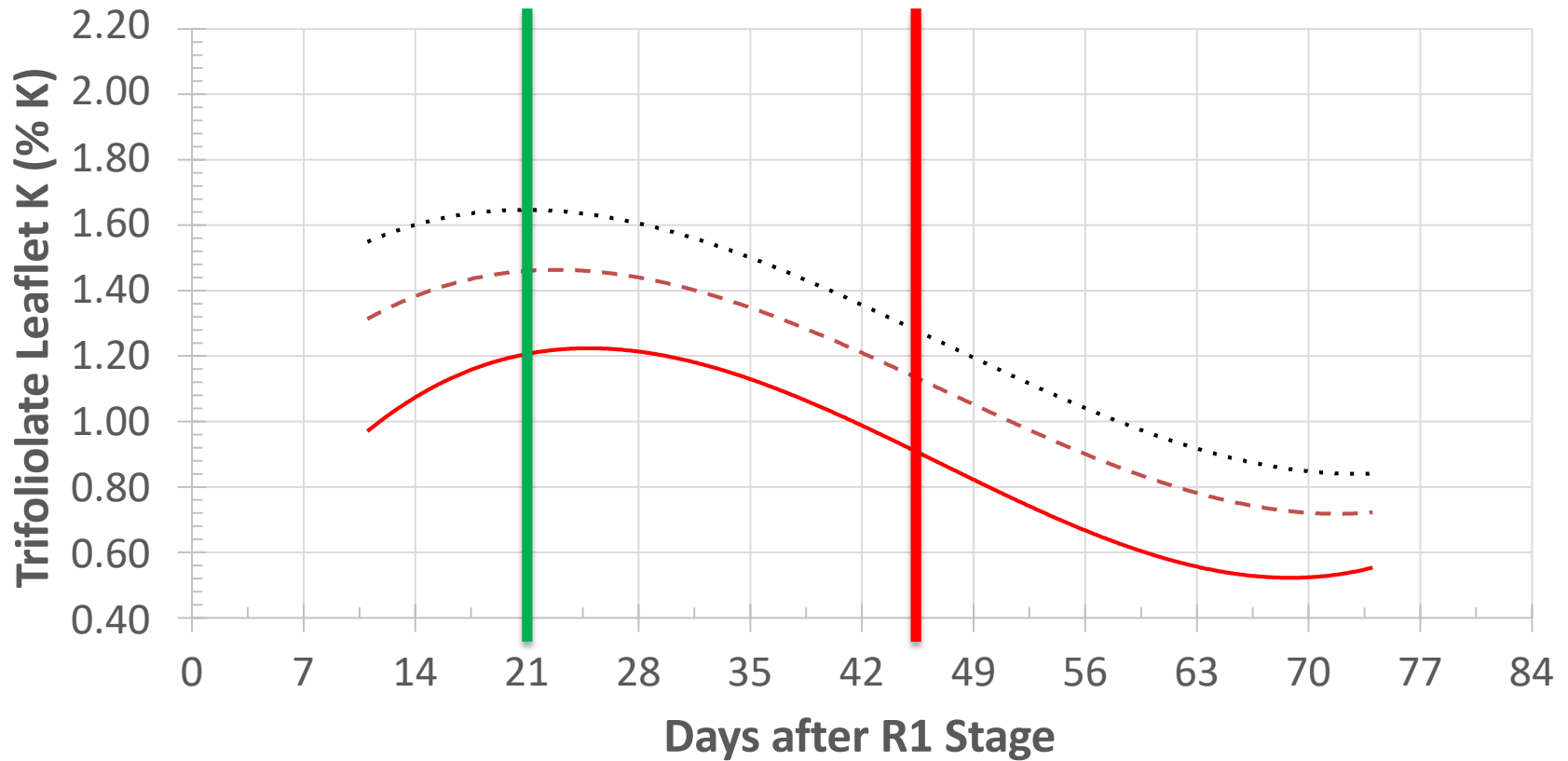
Proposed K Management for Soybean

- Soil Sampling to Determine Soil-Test K Level

- Apply Profit-maximizing K Rate Based on Inputs

- Adaptive Tissue Sampling Starting at R1 to Identify Hidden Hunger/Diagnose Need for Additional K

Key Takeaways for K

- Profitability of Soybean is Tightly Linked to K Fertilization

- K Deficiency in **Irrigated** Soybean Can be Corrected Well Into the Reproductive Growth Stages

- The Development of a Dynamic Tissue-K Critical Concentration Threshold will Allow Diagnosis of Hidden Hunger Beyond R2 Growth Stage

What Else Are We Missing?

- Adaptive Sampling Plan to Identify Field Variability of Tissue-K Concentrations

- Need Calibration Data to Determine K Fertilizer Rates When a Deficiency is Identified

- Evaluate Economics of In-season K Fertilizer Applications to Determine Profitability

Wish List!!

- Normal Year??

- Remote Sensing Platform to Help Identify Hidden Hunger or K Deficiency in Soybean

- For Everyone to Have a Happy and Safe 2021!!

Acknowledgements

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Questions?

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