

# SULFUR NUTRITION IN ROW CROPS

Ross Bender  
Sr. Agronomist  
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Twitter: [@RossRBender](https://twitter.com/RossRBender)



# GET TO KNOW ROSS...

- Contrasting Cleveland's...


	Cleveland, MS	Cleveland, WI
Location	34.5° Lat	43.5° Lat
Dec 4 <sup>th</sup> Record Low	16°F	-16°F
City Population	12,101	1,492
Bovines in County	?	~110,000

- State Laws:

- Illegal to serve margarine at restaurant unless requested
- Cows always have the right of way





A green tractor is positioned on a paved road, facing a large group of cows that have blocked the way. The scene is set in a rural area with green grass and trees in the background. The tractor's hood and front fenders are visible in the foreground. The cows are gathered across the road, some standing and some appearing to be pulling something. The overall atmosphere is one of a rural roadblock.

**Do cows enjoy being treated like royalty  
or do they have a genius plan to take  
over WI and if so, why!?**



# WHO IS MOSAIC?

Who We Are: World's largest single source supplier of finished phosphates and potash.

Mission: Help the world grow the food it needs.

Premium Products:

***MicroEssentials***<sup>®</sup>  


**MicroEssentials S10:** 12-40-0-10S

**MicroEssentials SZ:** 12-40-0-10S-1Zn

**Both products:** Sulfur is a 50:50 blend of sulfate and elemental sulfur

***Aspire***<sup>®</sup>  


**Same Analysis:** 0-0-58-0.5B

**New Formulation of B:**

50:50 blend of fast and slow release

***KMag***<sup>®</sup>  

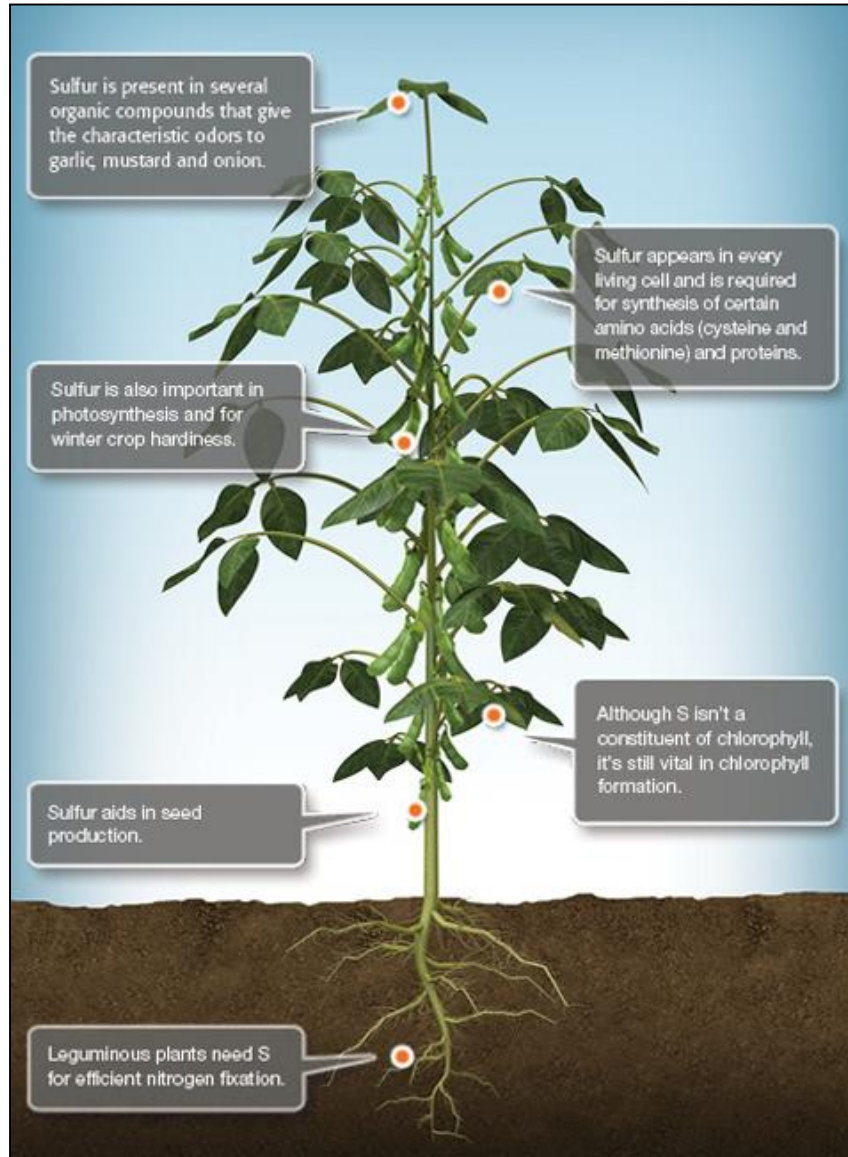

**Analysis:** 0-0-21.5-10.5 Mg-21 S

***Mosaic***<sup>®</sup>  


# TODAY'S OBJECTIVES

- **WHAT ARE THE SULFUR BASICS?**
- **DO CROPS NEED SULFUR?**
- **WHAT TOOLS ARE AVAILABLE?**
- **Q&A (TIME PERMITTING)**

# SULFUR NUTRITION



- **Secondary macronutrient.**
- **4<sup>th</sup> most needed nutrient after N, P, and K.**
- **Atmospheric sulfur deposition has been greatly reduced.**
- **Required for protein synthesis (2 amino acids).**
- **Required for nodule formation on the root hairs of legume crops.**
- **Plants do not mobilize S from older tissues.**

# RELATIVE CONTRIBUTIONS OF SULFUR FOR CURRENT PRODUCTION SYSTEMS

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**Source of S**

**Relative Amount**

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**Organic Matter**

**Atmospheric Deposition**

**Plant Remobilization**

**Fertilizer**

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Information expressed here is not based on actual data, and only represents the thoughts of Ross Bender.



# ORGANIC MATTER (OM) MINERALIZATION

## Each 1% OM Contains...

- 100 lbs/ac of organic S (unavailable)
- 2.0-2.5 lbs/ac inorganic S (available)

## Key factors influencing availability

- Moisture
- Temperature

## Conditions for deficiency?

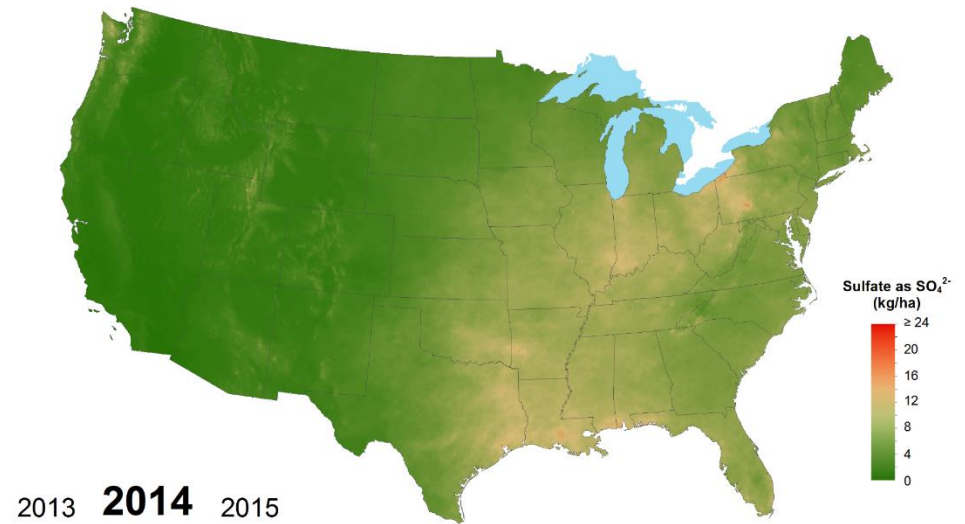
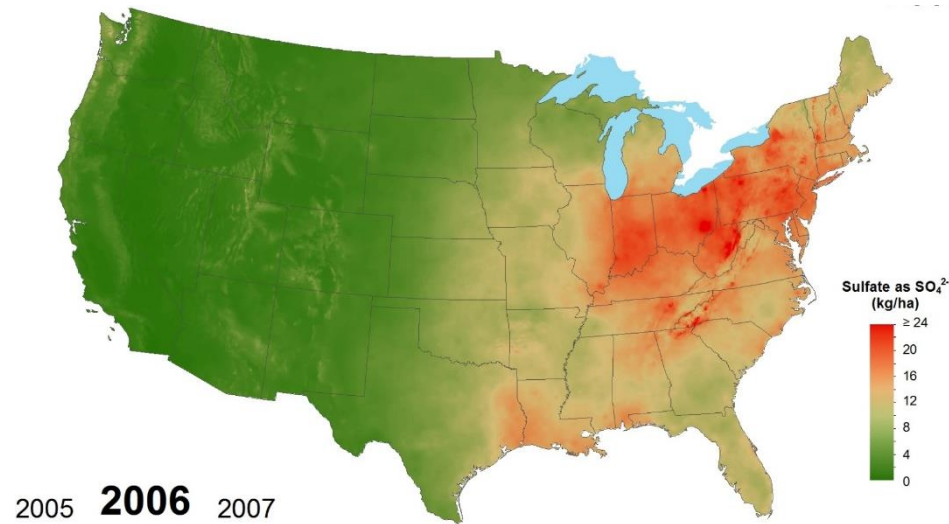
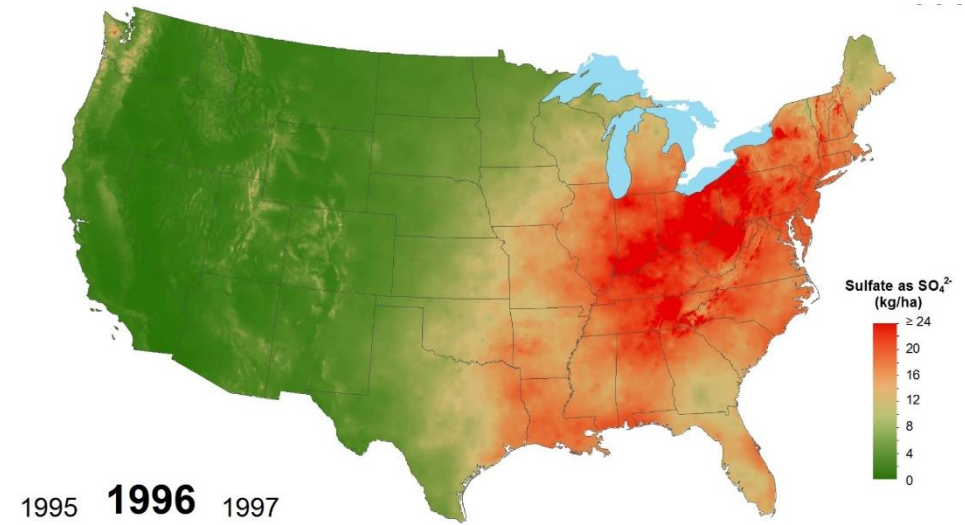
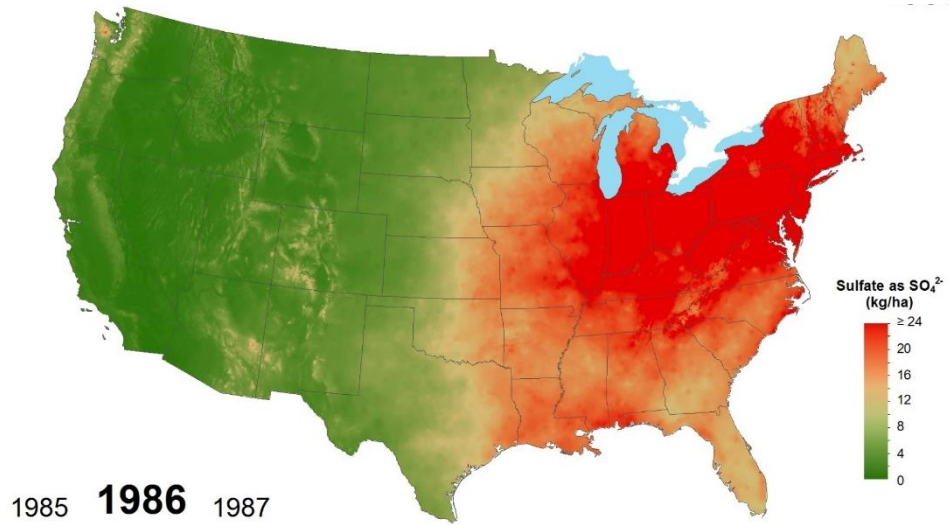
- Vegetative: cool/wet
- Reproductive: hot/dry

## Recommendations for Sulfur on Corn (Purdue University)

- **Low CEC soils: 25 lbs S/Ac annually**
- **Medium – High CEC Soils: 15 lbs S/Ac annually**
- **When using elemental sulfur only, combine with sulfate source**
- **More info: <https://www.agry.purdue.edu/ext/corn/news/timeless/SulfurDeficiency.pdf>**

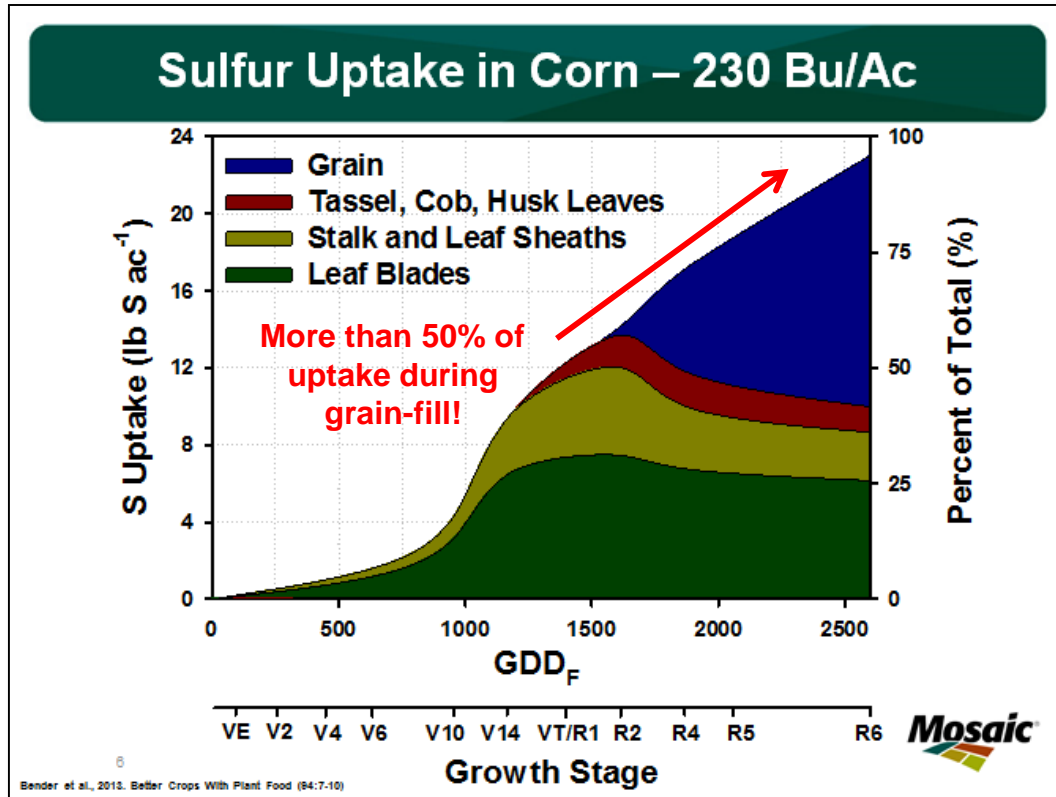


# REDUCED ATMOSPHERIC DEPOSITION OF S

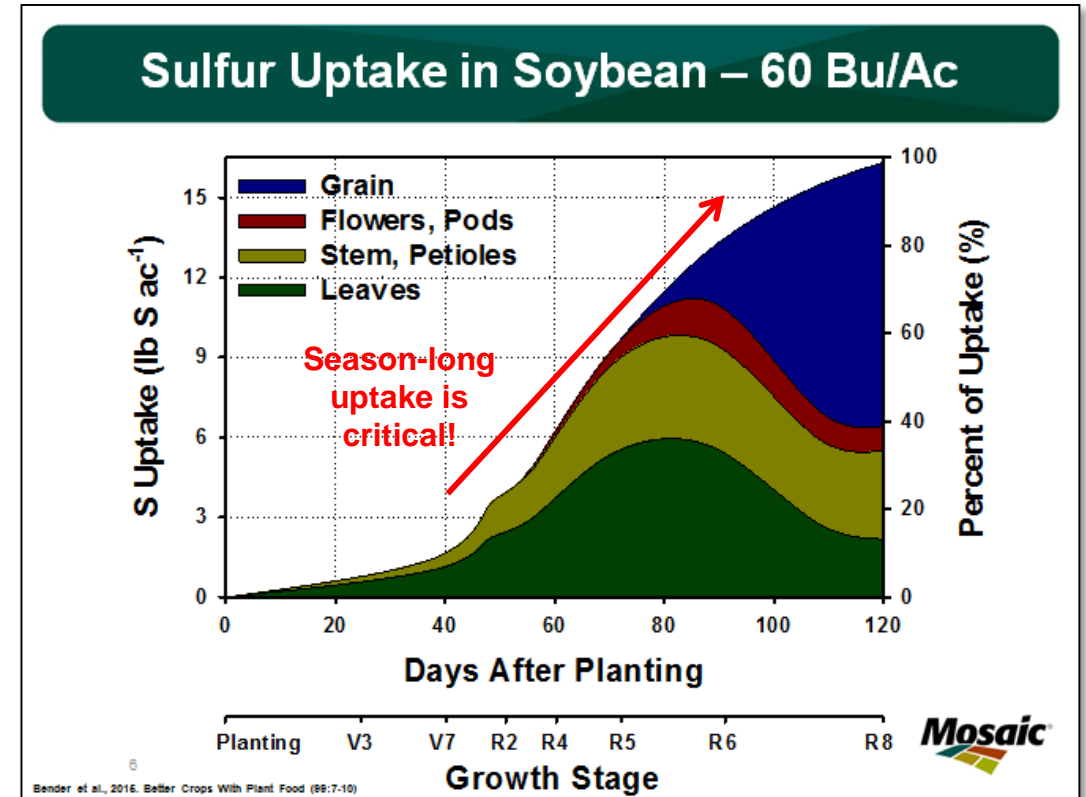


# WHY IS SULFUR IMPORTANT?

Maximum grain productivity requires season-long S availability, especially for corn and soybean:



Note the limited plant mobility of S in corn to supply intra-seasonal periods of plant stress.



# SOYBEANS NEED SEASON-LONG SULFUR

Parameter	Yield Level		
	Low	Medium	High
Yield (bu/ac)	54	66	82
S Uptake (lbs/ac)	13.3	15.8	19.0
S Removal (lbs/ac)	9.1	10.9	13.4
Root Uptake (%)	50	54	58
Remobilization (%)	50	46	42





# RELATIVE CONTRIBUTIONS OF SULFUR FOR CURRENT PRODUCTION SYSTEMS

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**Source of S**

**Relative Amount**

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**Organic Matter**

**Medium**

**Atmospheric Deposition**

**Low**

**Plant Remobilization**

**Low**

**Fertilizer**

**High**

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# MASS BALANCE OF SULFUR

	Corn (230 bu/Ac)	Soybean (60 bu/Ac)
<b>Need:</b>	———— lbs S/Ac ————	
Uptake	<b>23</b>	<b>17</b>
Removal	<b>13</b>	<b>10</b>
<b>Supply:</b>		
Atmospheric Deposition	<b>6</b>	<b>6</b>
Organic Matter (2% * 2.5 lbs S/Ac)	<b>5</b>	<b>5</b>
Previous ES Application	<b>?</b>	<b>?</b>
<b>Deficit:</b>	<b>12</b>	<b>6</b>
<b>Suggested application rate (based on 60% efficiency)</b>	<b>20 lbs</b>	<b>10 lbs</b>

Hypothetical scenario only

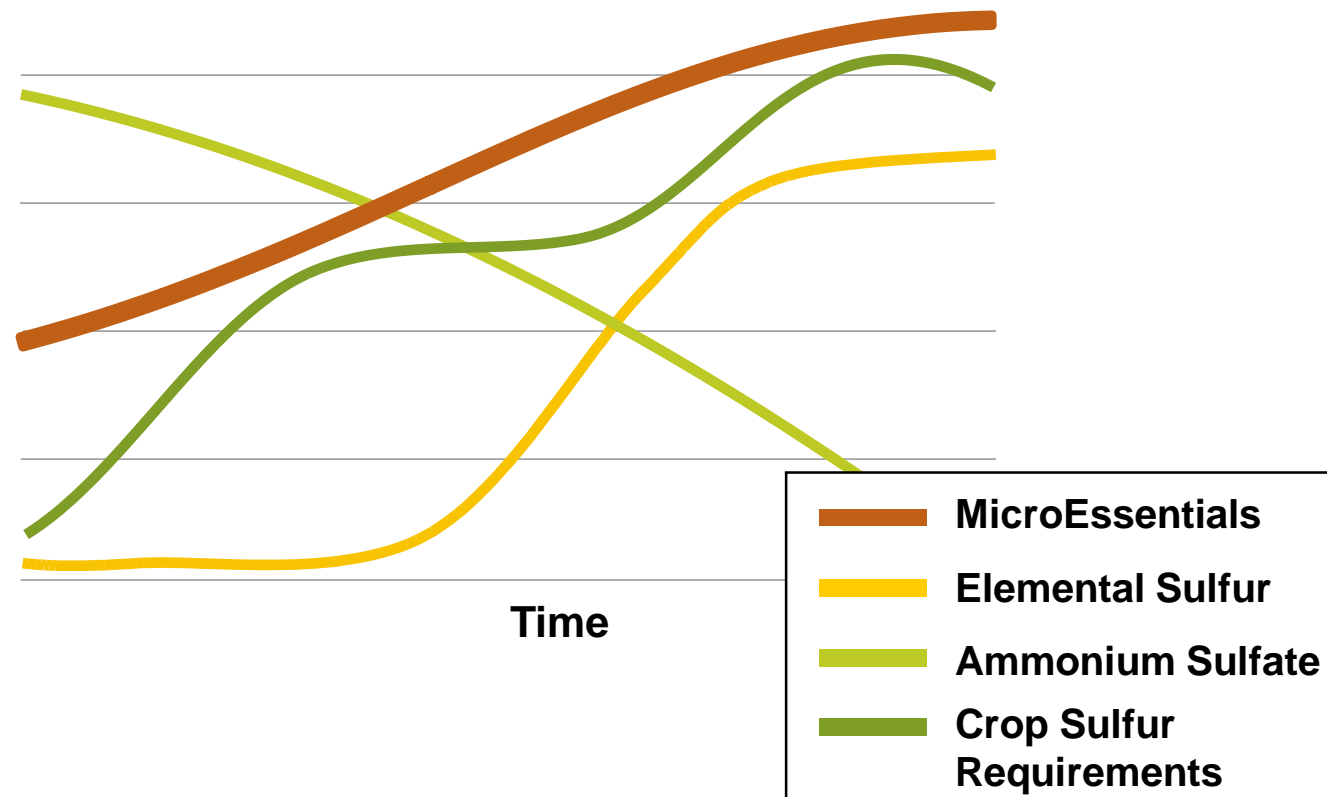
**Higher yields and lower amounts of S from acidic rainfall continue to encourage S fertilization on corn and soybean!**

# DUAL SOURCES FOR MAXIMUM AVAILABILITY

MicroEssentials has both fast (Sulfate) and slow-release (Elemental S) sulfur sources for season-long S availability.

## MicroEssentials S10 Analysis:

Total Nitrogen	12%
Total P <sub>2</sub> O <sub>5</sub>	40%
Total Sulfur	10%
<i>Sulfate Sulfur</i>	<i>(5%)</i>
<i>Elemental Sulfur</i>	<i>(5%)</i>

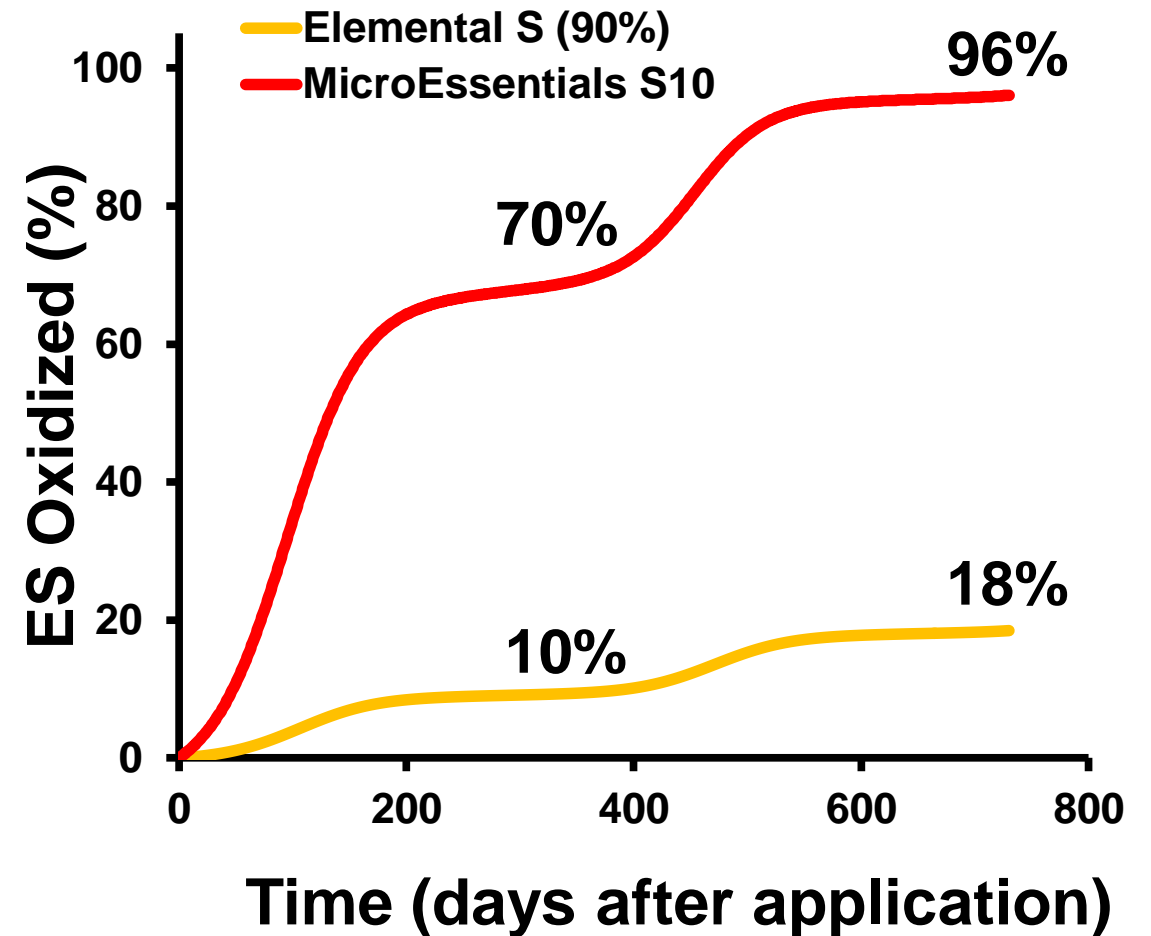
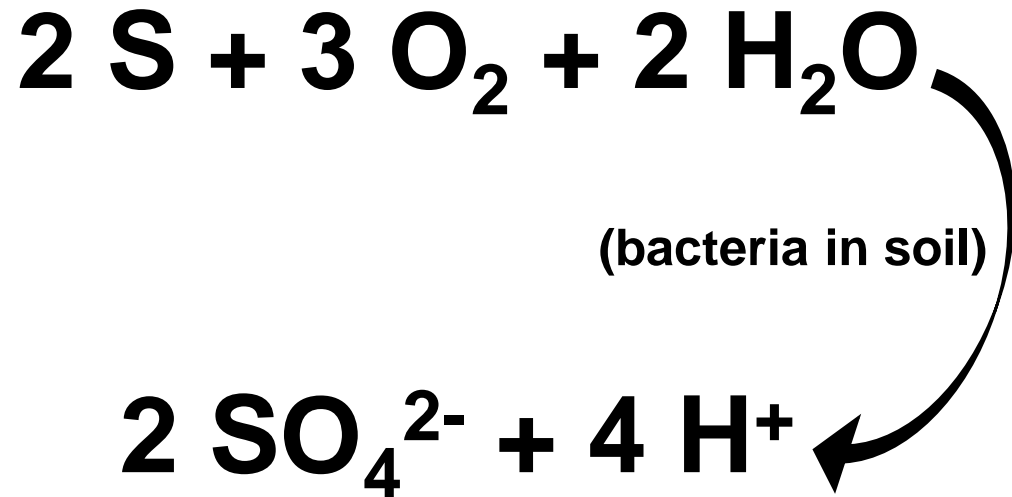




# OXIDATION 101: FORMATION OF PLANT AVAILABLE SULFATE

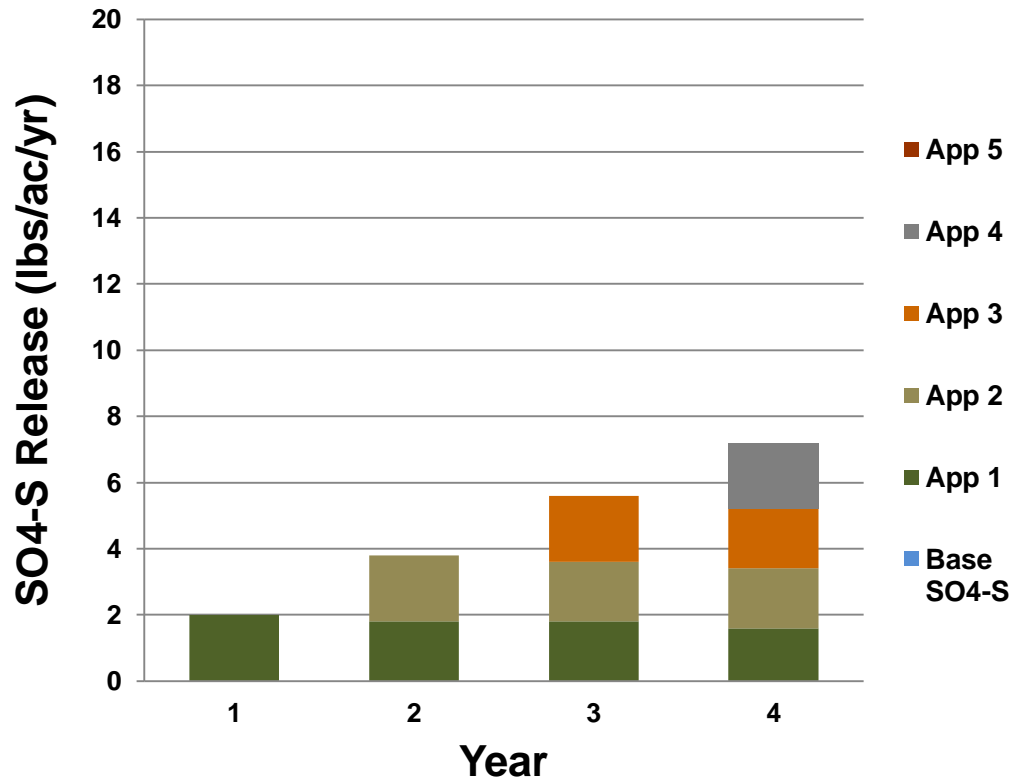
## Oxidation:

Conversion of plant unavailable elemental sulfur to plant available sulfate:

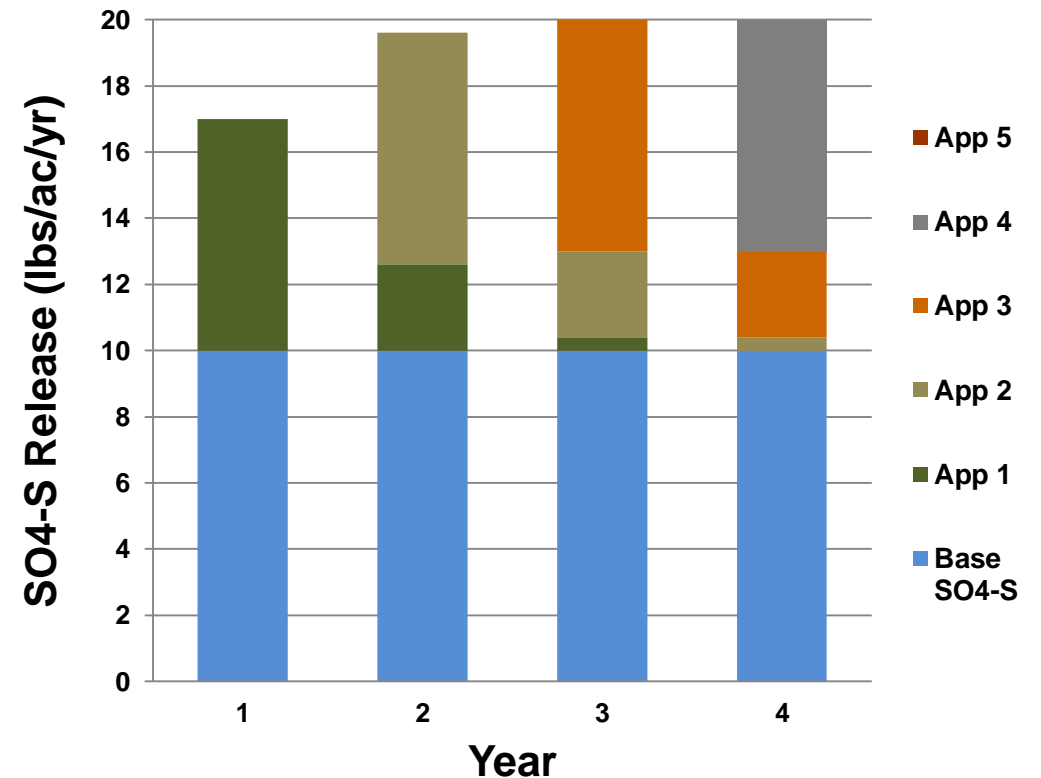


# OXIDATION 201: ANNUAL S APPLICATIONS

## Granular Elemental S (20 lbs ES)



## MicroEssentials SZ (10 lbs SO<sub>4</sub><sup>2-</sup> + 10 lbs ES)



# WHAT IS BALANCED CROP NUTRITION?

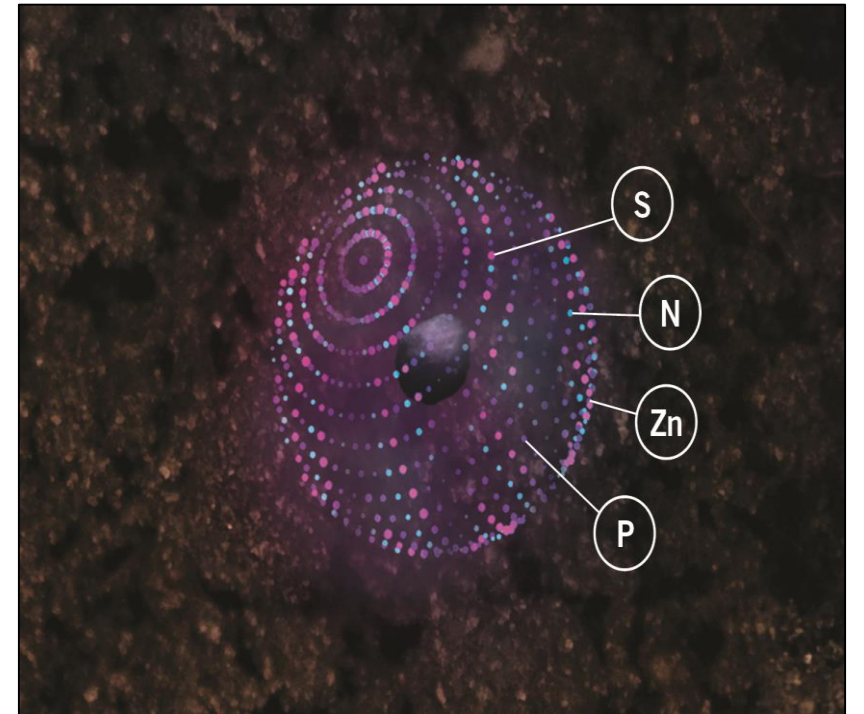
Providing the right mixture of nutrients in a ratio that optimizes yield and profitability.

**FUSION**<sup>™</sup>  
TECHNOLOGY

Analysis: **MicroEssentials S10**

**MicroEssentials SZ**

Total Nitrogen	12%
Total Phosphate (P <sub>2</sub> O <sub>5</sub> )	40%
Total Sulfur	10%
<i>Sulfate Sulfur</i>	(5%)
<i>Elemental Sulfur</i>	(5%)
<b>Total Zinc</b>	<b>1%</b>





# MICROESSENTIALS ON CORN

## MicroEssentials® S10™ vs. DAP

### Trial Details

#### Locations and Crop Management:

**CROP:** Corn (*Zea mays*)

**YEARS:** 2008–2013

**DATA SOURCE:** Field studies conducted by university and/or third-party, independent researchers.

#### CROPPING CONDITION:

- **P Rate:** 65–90 lbs P<sub>2</sub>O<sub>5</sub>/ac
- Balanced across all treatments

5.4  
bu/ac

## MicroEssentials® SZ™ vs. DAP

### Trial Details

#### Locations and Crop Management:

**CROP:** Corn (*Zea mays*)

**YEARS:** 2004–2013

**DATA SOURCE:** Field studies conducted by university and/or third-party, independent researchers.

#### CROPPING CONDITION:

- **P Rate:** 65–90 lbs P<sub>2</sub>O<sub>5</sub>/ac
- Balanced across all treatments

8.8  
bu/ac

# MICROESSENTIALS ON COTTON

## Trial Details

### Locations and Crop Management:

**CROP:** Cotton (*Gossypium hirsutum* L.)

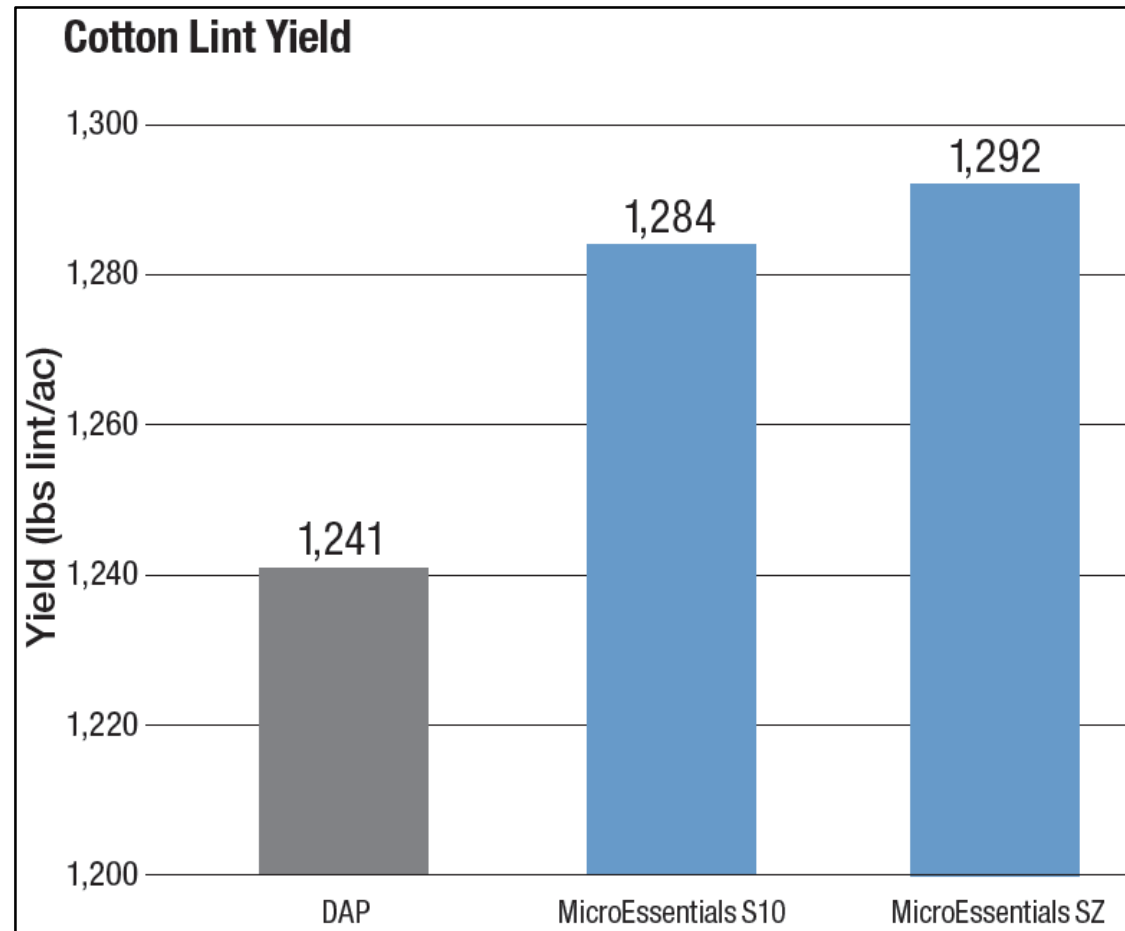
**YEARS:** 2016–2017

**LOCATIONS:** 8 trials across the United States  
– GA, MS, NC, SC, TN, TX

### CROPPING CONDITIONS:

All trials conformed to local cropping practices.

- **P Rate:** 50 lbs P<sub>2</sub>O<sub>5</sub>/ac applied as DAP (18-46-0), MicroEssentials S10 (12-40-0-10S) or MicroEssentials SZ (12-40-0-10S-1Zn)
- **S Rate:** 12.5 lbs S/ac from the MicroEssentials treatments
- **K Rate:** As required by soil test
- **Application Timing:** Preplant
- **Application Method:** Broadcast incorporated



**51**  
lbs lint/ac

Increase with MicroEssentials SZ  
over DAP

**43**  
lbs lint/ac

Increase with MicroEssentials S10  
over DAP

# SULFUR ON SOYBEAN

## TRIAL OBJECTIVE

Evaluate MicroEssentials S10 (12-40-0-10S) fertilizer vs. MAP (11-52-0) vs. MAP + AS (21-0-0-24S) with a base application of MOP (0-0-60).

## TRIAL DETAILS

**CROP:** Soybean

**YEAR:** 2016

**LOCATION:** 8 trials (IL, IN, MI, IA, OH, ON, MO)

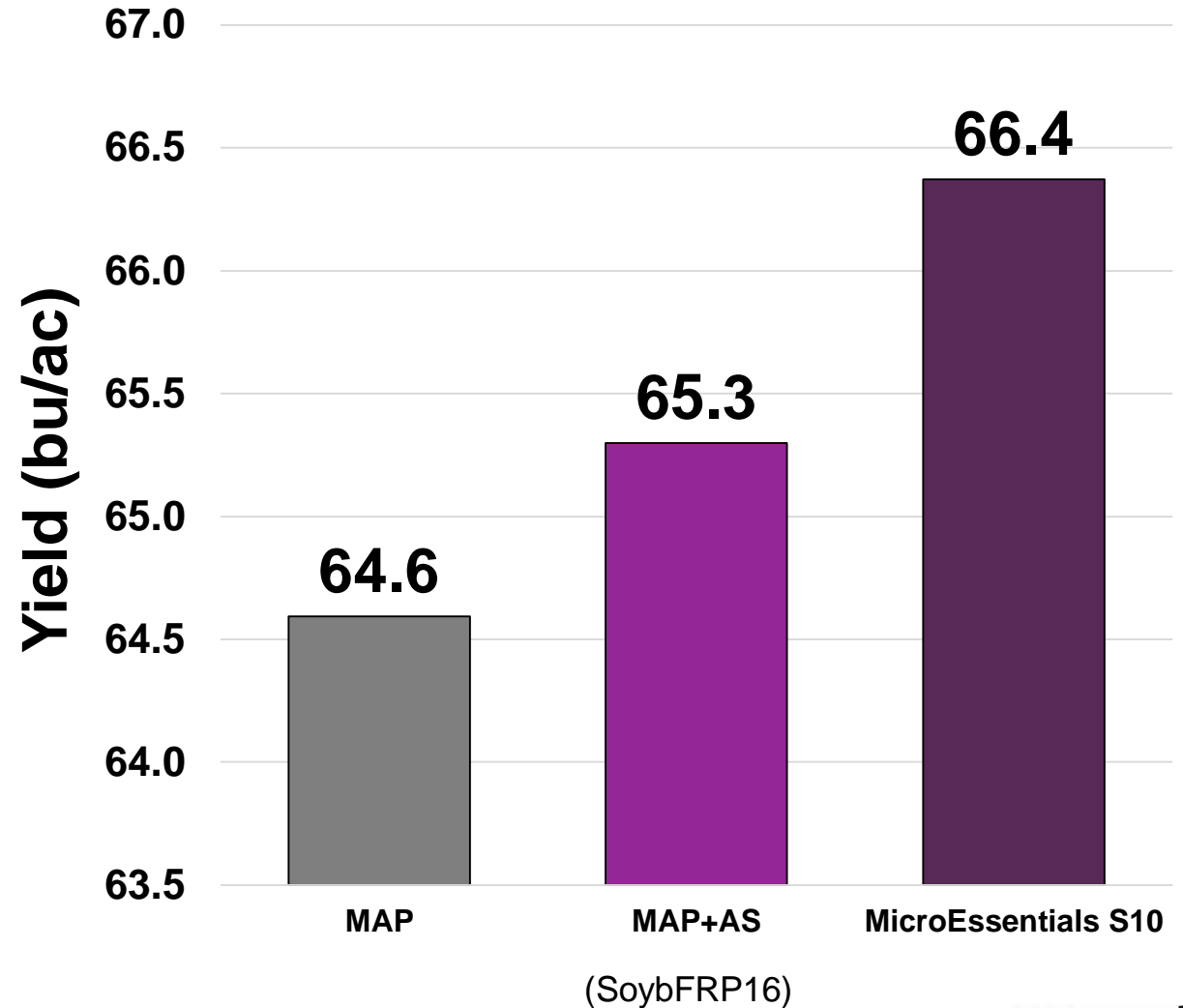
**DATA SOURCE:** Small-plot (RCBD) trials conducted by university and third-party contract researchers.

**P RATE:** 40 lbs P<sub>2</sub>O<sub>5</sub>/ac


**K RATE:** 60 lbs K<sub>2</sub>O/ac

**S RATE:** 10 lbs S/ac

**CROPPING CONDITIONS:** All trials conformed to local cropping practices.




# MICROESSENTIALS ON RICE



**AgriFacts**<sup>®</sup>

RICE

MARCH 2014



## MicroEssentials<sup>®</sup> SZ<sup>™</sup> Rice Zinc Study

**Objective**

- Evaluate the yield response of MicroEssentials<sup>®</sup> SZ<sup>™</sup> (12-40-0-10S-12n) compared to a blend of DAP (18-46-0) + AS (21-0-0-24S) + ZnSO<sub>4</sub> (0-0-0-16.5S-36Zn) applied at different zinc rates.

**Introduction**

- Zinc (Zn) deficiency is the most widespread micronutrient disorder in rice (*Oryza sativa*). Zn deficiency causes multiple symptoms that usually appear two to three weeks after planting. Plants lacking zinc remain stunted and in severe cases may die. Plants that survive may show substantial delay in maturity and reduction in yield (Figure A and B).
- Rice is very responsive to Zn application; therefore, it is critical to evaluate the effect of Zn application rates on rice yield.
- DAP + AS + ZnSO<sub>4</sub> is often used as a fertilizer blend applied to rice.

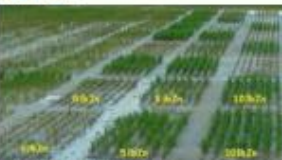


Figure A: Early-season response to zinc.


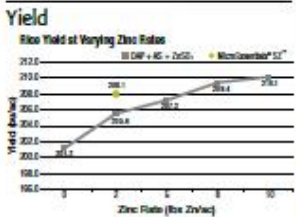


Figure B: Mid-season response to zinc.

**Yield**



**Trial Details**

**Locations and Crop Management:**

CROP: Rice (*Oryza sativa*)

YEARS: 2011–2012

LOCATIONS: 6 trials across rice-growing regions of the U.S. (AR, LA, MS).

DATA SOURCE: Field studies conducted by University of Arkansas, Louisiana State University and Mississippi State University.

EXPERIMENTAL DESIGN: Small-plot RCBD with 4 replications.

CROPPING CONDITIONS: All trials conformed to local cropping practices.

- P Rate: 80 lbs P<sub>2</sub>O<sub>5</sub>/ac
- S Rate: 20 lbs S/ac balanced across treatments
- Zn Rate: MicroEssentials SZ was applied at 2 lbs Zn/ac; DAP + AS + ZnSO<sub>4</sub> was applied at 5 different Zn rates (0, 2, 5, 8, 10 lbs Zn/ac).
- Application Timing and Method: Preplant broadcast

**Summary**

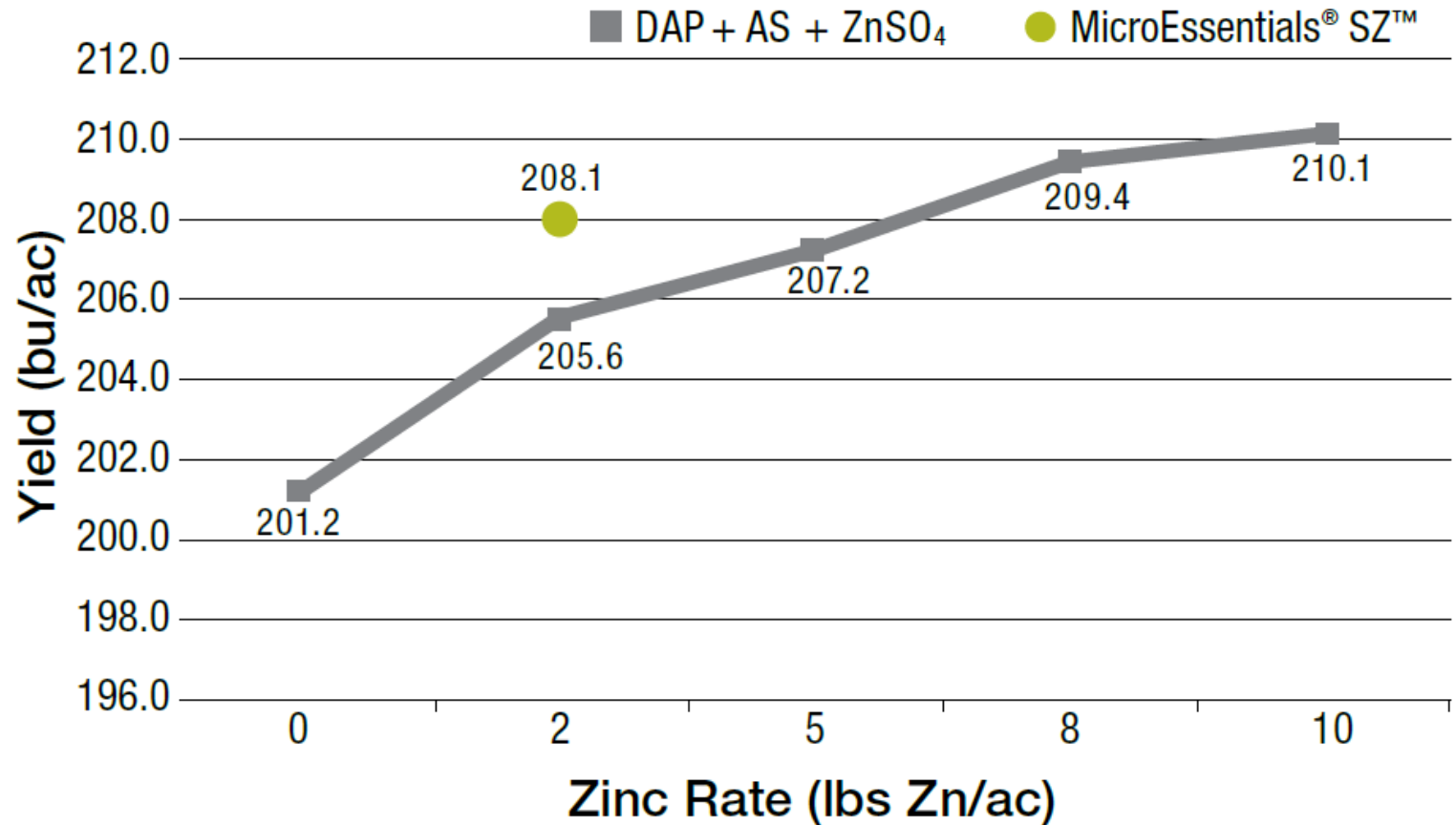
- Rice yields increased with higher rates of zinc.
- MicroEssentials SZ at 2 lbs Zn/ac demonstrated a 0.9 bu/ac higher yield than a DAP blend at 5 lbs Zn/ac. This zinc rate was 2.5 times greater than MicroEssentials SZ.
- Rice yield for MicroEssentials SZ at 2 lbs Zn/ac is statistically similar to the DAP + AS + ZnSO<sub>4</sub> blends applied at 5, 8 and 10 lbs Zn/ac.
- MicroEssentials SZ contains N, P, S and Zn fused into one nutritionally balanced granule providing uniform nutrient distribution, increased nutrient uptake and season-long sulfur availability.

**2 lbs Zn/ac from MicroEssentials<sup>®</sup> SZ<sup>™</sup> yielded statistically similar to 5, 8, and 10 lbs Zn/ac from DAP blend**

**Mosaic**

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## Rice Yield at Varying Zinc Rates



# KEY TAKEAWAYS ON SULFUR

- **Sulfur management is a system. We receive less S from “acid rain” today.**
- **Plants require more S (in part due to high yields) which needs to be available for longer for maximum grain yield.**
- **Significant University research has been done on soybean nutrition. Current data shows they stand to benefit from S, even if only 5-10 lbs S/ac.**
- **MicroEssentials has two forms of S, sulfate and elemental S, for season long availability.**



**For more information, please visit...**

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**K-Mag: [www.KMag.com](#)**

**Aspire: [www.AspireBoron.com](#)**

**MicroEssentials: [www.MicroEssentials.com](#)**



***CropNutrition.com***



