Nutrient Management for 80+ Bushel Soybean

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ILLINOIS SOYBEAN ASSOCIATION
CHECKOFF PROGRAM

One and Done!
For 80 bu Soybean

Mother Nature Needs to Cooperate

Basic Steps for High Yield Soybean

1. Field Selection/Crop Rotation – Avoid multiple years of soybean in the same field.

2. Proper Seed Selection and Seed Treatments – Inoculate the seed with *B. Rhizobium japonicum.*

3. Correct Plant Population – 130,000 to 150,000 seeds per acre? Replant <90,000 per acre

4. Plan your Weed Control Program – Use overlapping Soil Residuals and Rotate the Chemistry.

5. Test fields for SCN.

SCN Reproduction on Some Current Varieties

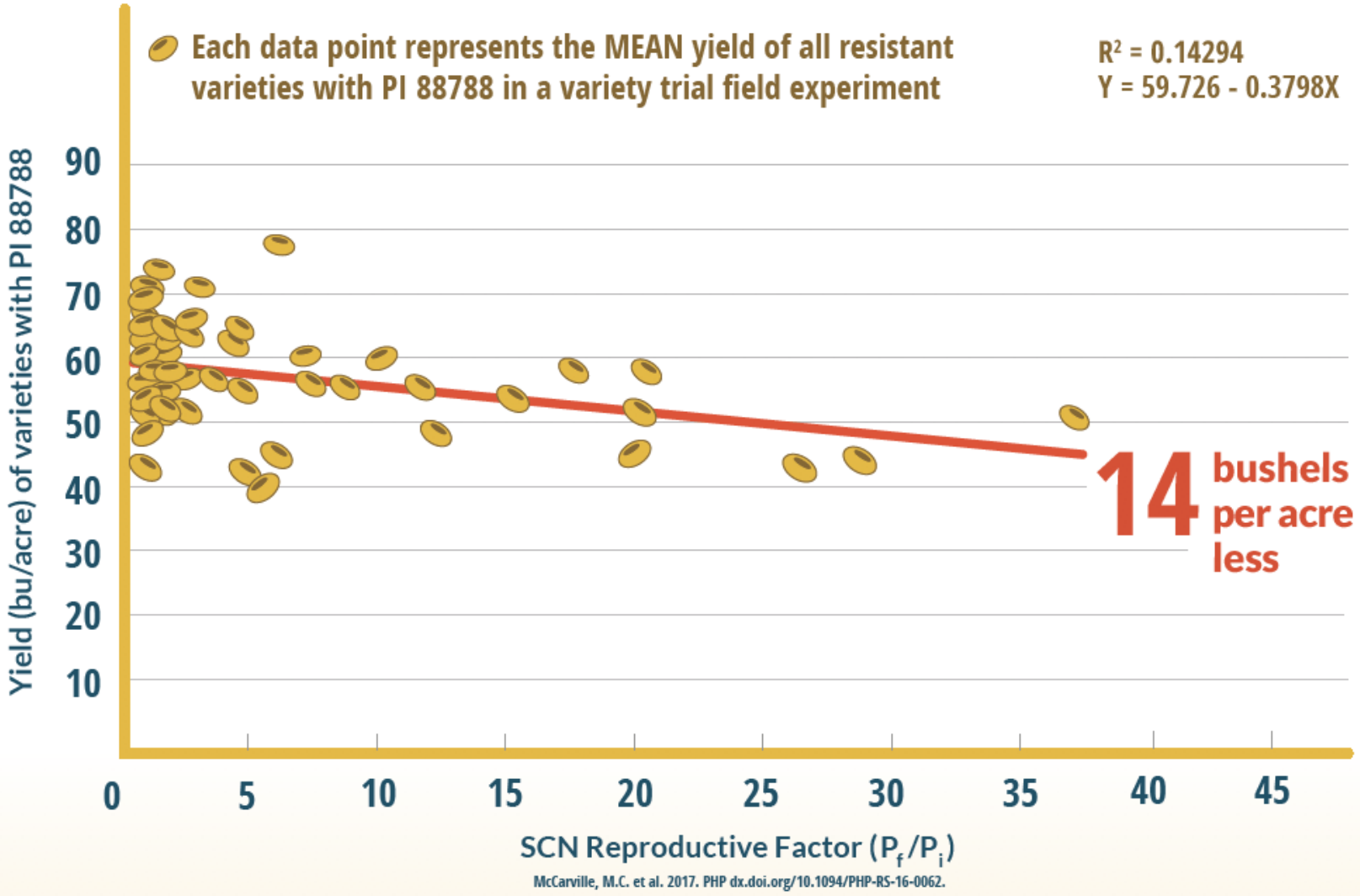
Table 7. Moorhead (WC Iowa) Glyphosate-resistant.

Brand	Variety	Relative maturity	Resistance	IDC	SCN # (eggs/100cc)[1]	SCN RF[2]	Yield (bu/acre)
NuTech	7279	2.7	PI 88788	2.8	5,075	2.1	79.6
Dyna-Gro	S26RS75	2.6	PI 88788	2.4	5,950	2.4	79.0
Kruger	K2X-2652	2.6	PI 88788	2.5	6,550	3.1	78.3
NuTech	7224	2.2	Peking	2.0	1,525	0.5	77.0
XL ®	285R4	2.8	Peking	2.4	1,100	0.5	76.6
ASGROW	AG24X7	2.4	PI 88788	2.6	3,650	1.4	75.3
NK	S30-C1	3.0	PI 88788	1.8	6,750	2.3	75.3
LG Seeds	C2441R2	2.4	PI 88788	1.8	5,950	2.6	74.9
Stine	24RE03	2.4	PI 88788	2.9	4,850	2.6	74.8
4 Star	3X240	2.4	PI 88788	2.8	4,575	1.5	74.4
NK	S28-N6	2.8	PI 88788	2.0	3,200	1.4	74.3
ASGROW	AG27X7	2.7	PI 88788	2.8	7,525	3.5	74.2
Hoegemeyer HPT	2811NR	2.8	PI 88788	2.4	5,450	3.6	74.0
Mycogen	5N245R2	2.4	PI 88788	2.4	5,075	3.1	74.0
Hoegemeyer HPT	2913NR	2.9	Peking	2.5	700	0.4	73.4
LG Seeds	C2520R2	2.5	PI 88788	2.3	6,450	3.1	73.4
Dairyland Seed	DSR-2330/R2Y	2.3	PI 88788	2.2	7,250	2.8	72.8
Legacy Seeds	LS-2437N RR2	2.4	PI 88788	2.0	5,625	2.4	72.3
Pioneer	P28T08R	2.8	PI 88788	2.2	3,025	1.6	72.1

Greg Tyklka – ISU Variety Trials. https://www.plantpath.iastate.edu/tylkalab/iowa-state-university-scn-resistant-soybean-variety-trials

AS SCN REPRODUCTION INCREASES,

yields decrease by as much as 14 bushels per acre.



McCarville, M.C. et al. 2017. PHP dx.doi.org/10.1094/PHP-RS-16-0062.

SCN Samples – Fall 2017 and Fall 2018

Sample	County	Eggs/250 cc
WC-171	Clinton	2,900
WC-271	Clinton	5,200
WC-371	Clinton	10,300
WC-471	Clinton	26,800
WC-571	Perry	45,075
WC-671	Washington	7,900
JCB-171	Effingham	500
JCB-271	Effingham	21,800
JCB-371	Effingham	33,000
WC-1081	Washington	42,240
WC-2081	Washington	16,240
WC-2181	Washington	27,040
WC-3081	Franklin	11,600
WC-4081	Randolph	94,000

Samples analyzed by the University of Illinois – Plant Clinic

SCN Samples – Fall 2017 and Fall 2018

38 bu/acre Yield in Purple Area, SCN Eggs = 42,240

High Yield Soybean Nutrient Management

1. Soil pH and Liming
2. Nitrogen
3. Phosphorus
4. Potassium
5. Sulfur – the Next Macronutrient?
6. Micronutrients – Zinc and Boron

(Don't forget the 4R's – Right Source, Rate, Time and Place)

Why is Proper Soil pH and Liming Acid Soils Important?

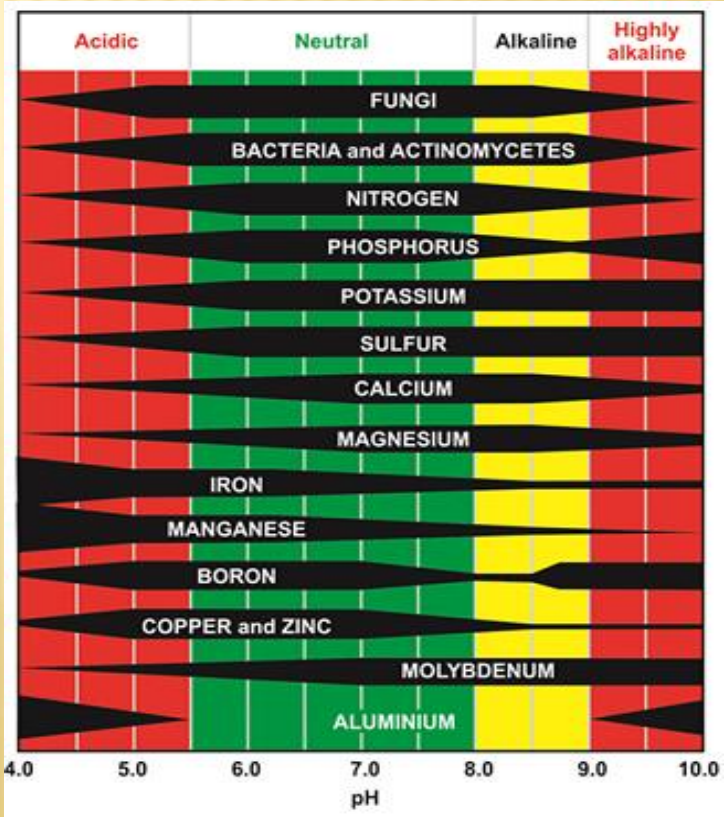
1. The performance of soil-applied herbicides can be adversely affected.

2. Reduced activity of symbiotic N fixing bacteria.

3. Availability of nutrients such as P, K and Mo is reduced.

4. Tendency for K to leach is increased.

5. Correct a possible Ca deficiency.



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Low Soil pH – Ca Deficiency and Manganese Toxicity

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Nitrogen Fertilizer for Soybean?

1. Soybeans need 4-5 lbs of N per bushel.
2. 3 lbs of which is in the seed.
3. O. M. in general releases 20-30 lbs of N per %O.M.
4. The balance is provided by the nodules.

** The nodules don't start supplying large quantities of N until about the V3-V4 stage.

** Starter fertilizers can help but do not exceed 30 lbs/acre Actual N (affects biological fixation).

Nitrogen Fertilizer for Soybean?

Soybean Yield (bu/acre)	lbs/acre N Needed	lbs/acre N from Nodules*
40	160-200	100-140
50	200-250	140-190
60	240-300	180-240
70	280-350	220-290
80	320-400	260-340

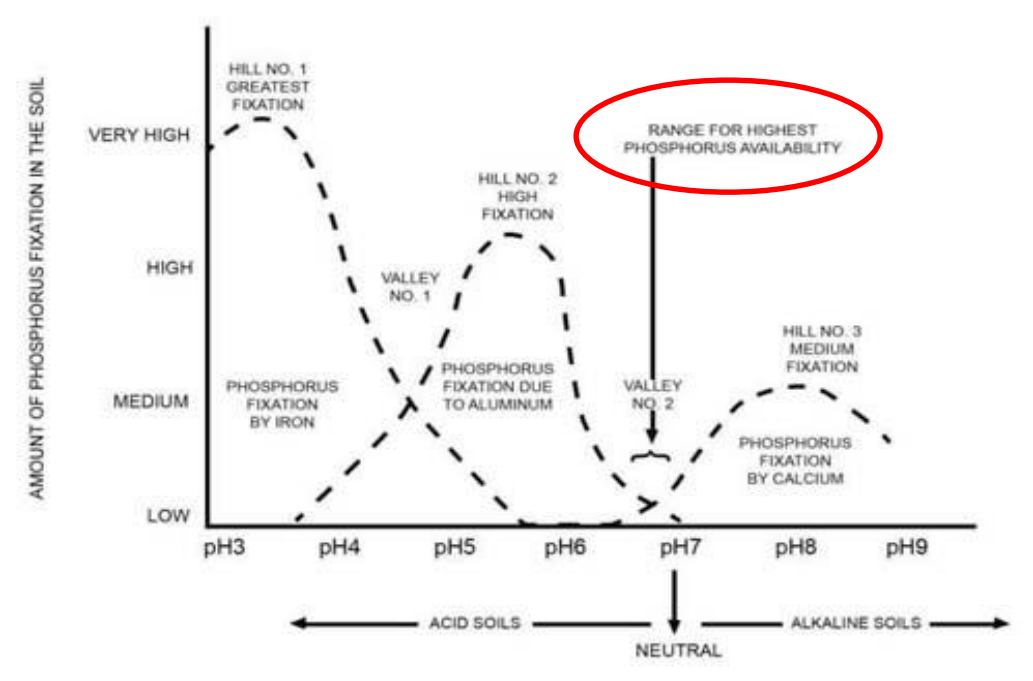
* Assumes 30 lbs N from O.M. and 30 lbs N from Starter Fertilizer.

** 2018 had excellent moisture and healthy nodules all season.

PHOSPHORUS (P)
AND
POTASSIUM (K)

P Availability is Affect by:

1. Amount and Type of Clay
2. Application Time and Method
3. Aeration and Compaction of the Soil
4. Level of Soil P & other nutrient interactions
5. Soil Moisture and Temperature
6. Soil pH (6.8-7.1)



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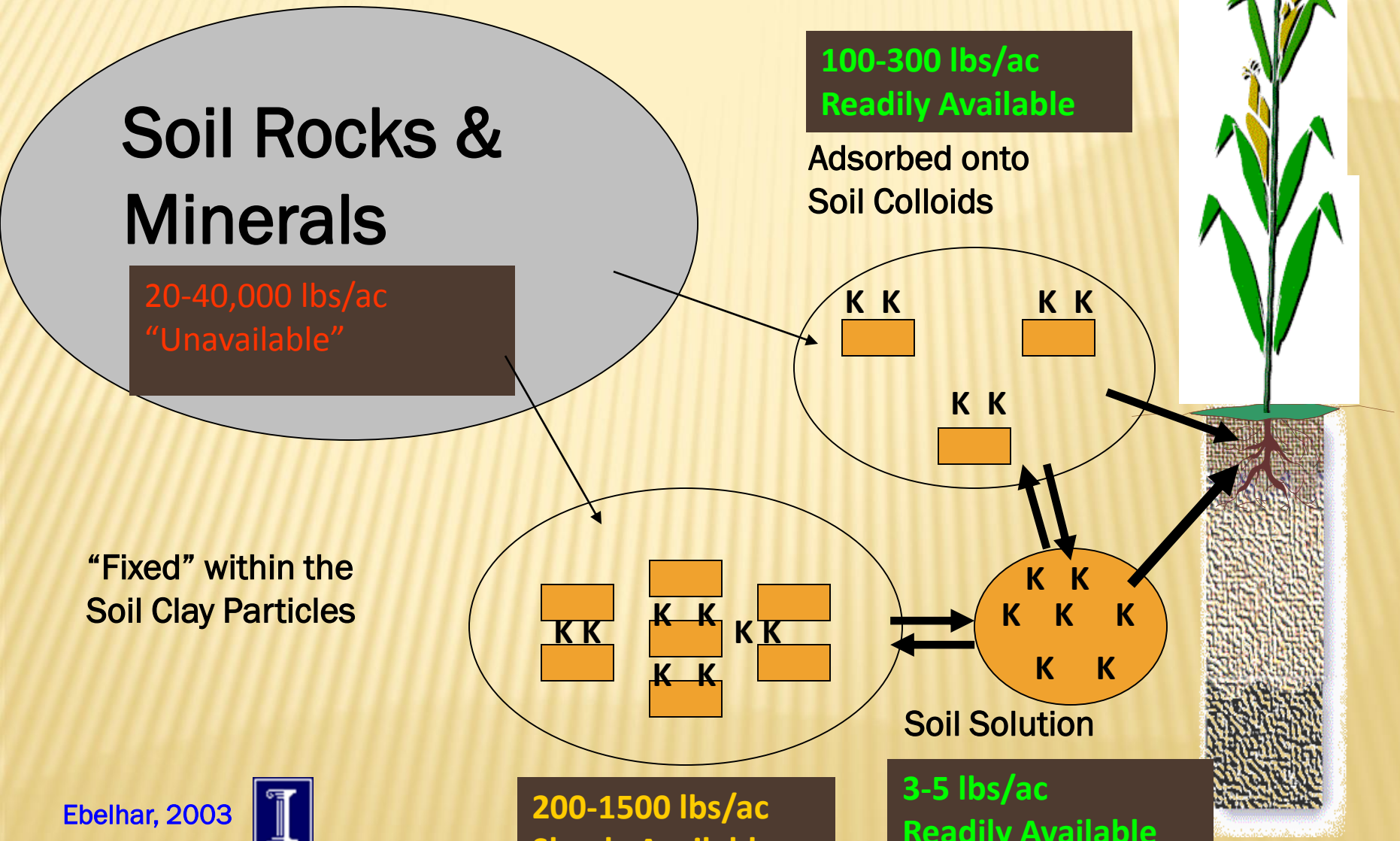
What Happens to Applied Fertilizer K?

1. It can be held in the exchangeable form (CEC).
2. Some will remain in soil solution.
3. Some will be taken up by the crop.
4. Part will be “fixed” by the clays.
5. Some may leach in very sandy or acidic soils.

*** Declining Soil Test K Values?

Forms of Soil Potassium



Ebelhar, 2003

Roots contact only
a small percentage of
all available nutrients. Therefore,
potassium fertilization is necessary
to ensure that adequate K is in the
system for plant uptake.

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K Deficiency

Photos by Wyciskalla Consulting

Building Soil Test P and K Levels

On Average, it takes:

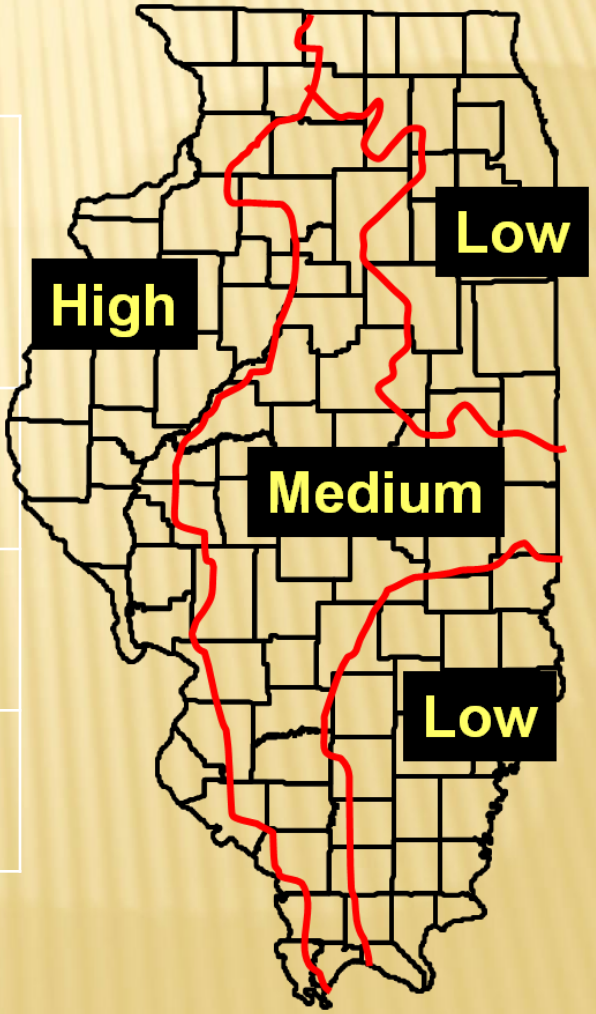
- 9 lbs P_2O_5 to change a soil test by 1 lb P/acre
  (~20 lbs/acre DAP)

- 4 lbs K_2O to change a soil test by 1 lb K/acre
  (~7 lbs/ac Potash)

Adapted from the Illinois Agronomy Handbook

Buildup Levels for Soil Test P (lbs/acre)

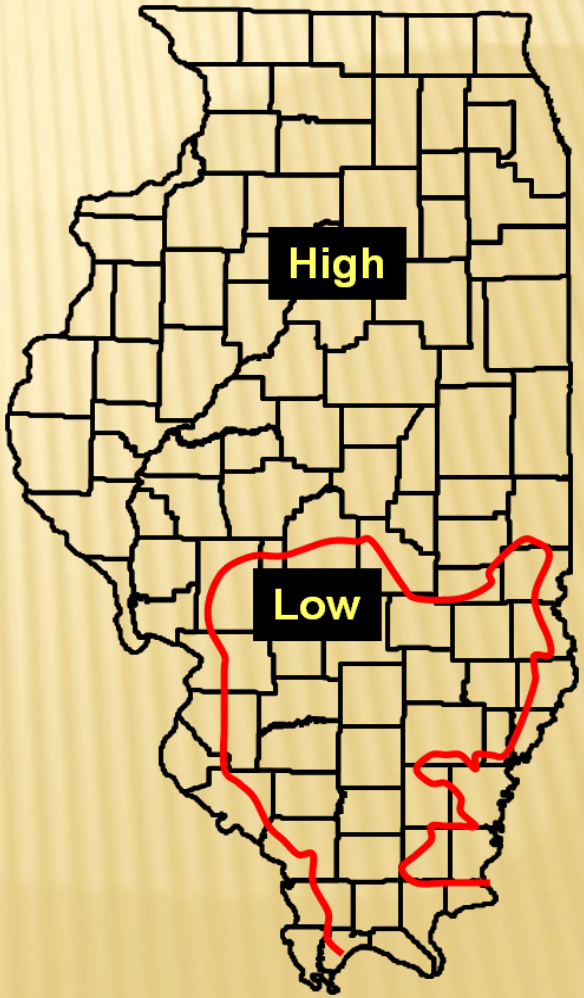
P Supply Region	Rec. Level	No Fertilizer
Low	50	>70
Medium	45	>65
High	40	>60



Adapted from the Illinois Agronomy Handbook

Buildup Levels for Soil Test K (lbs/acre)

CEC Region	Rec. Level	No Fertilizer
Low/Sands	260	>360
High	300	>400



Adapted from the Illinois Agronomy Handbook

Grain P and K: summary to date

Nutrient	No. of samples	Average value	Range 25th -75th%	Book value	% change BV to 75th%	Iowa State numbers
			----------lb P/K (oxide) per bushel----------			
Corn P	2,140	0.34	0.31-**0.37**	0.43	-14	0.32
Corn K	2,140	0.23	0.22-**0.24**	0.28	-15	0.22
Soy P	2,181	0.70	0.66-**0.75**	0.85	-12	0.72
Soy K	2,181	1.11	1.06-**1.17**	1.30	-10	1.20
Wheat P	625	0.42	0.36-**0.47**	0.60	-22	0.55
Wheat K	625	0.26	0.23-**0.28**	0.30	-8	0.27

Source: Dr. Emerson Nafziger, Illinois NREC Project

High Yield Soybean - Maintenance P and K

Soybean Yield (bu/acre)	lbs/acre DAP to Apply	lbs/acre Potash to Apply
40	74 (65)	87 (78)
50	92 (82)	108 (98)
60	111 (98)	130 (117)
70	129 (114)	152 (137)
80	148 (130)	173 (156)

Assumes 0.85 lbs/bu P_2O_5 and 1.30 lbs/bu K_2O

Assumes 0.75 lbs/bu P_2O_5 and 1.17 lbs/bu K_2O

Adapted from the Illinois Agronomy Handbook

SULFUR (S)

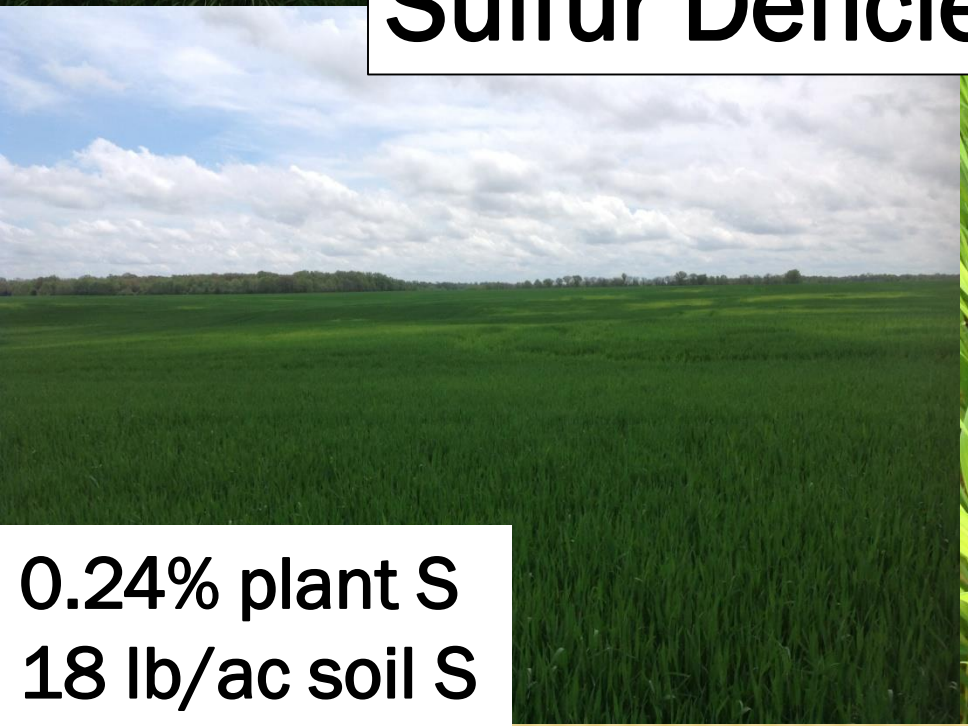
Sulfur Needs of Soybean?

On Average, it takes about 0.35 lbs S per bushel

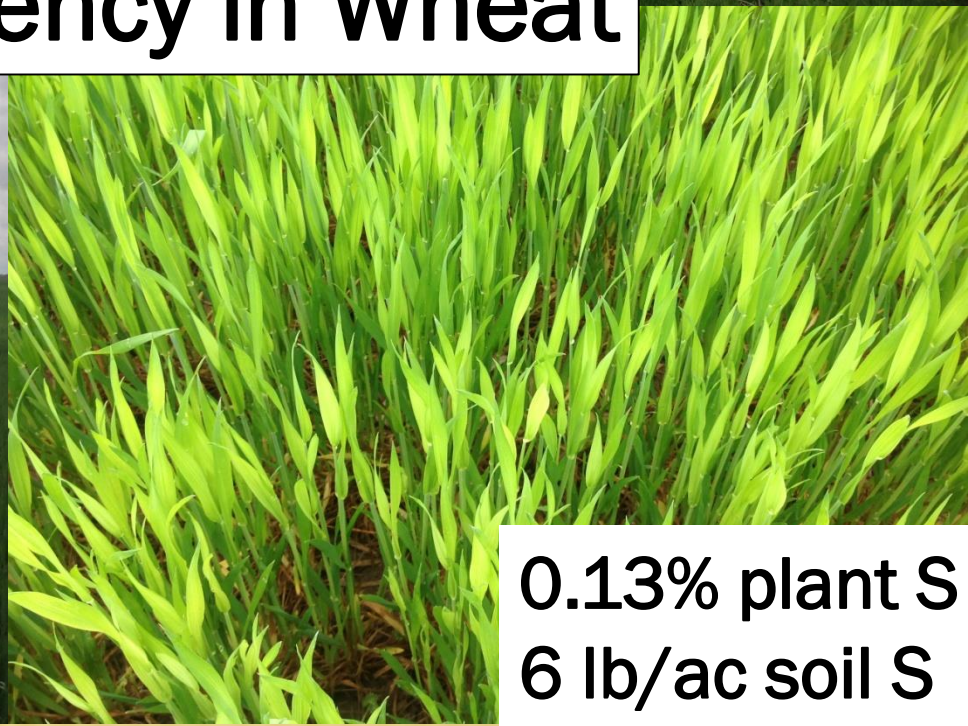
(O.M. can supply 2-3 lbs S total, annually)

Soybean Yield (bu/acre)	lbs/acre S Needed	lbs/acre 90% S	lbs/acre AMS (and N)
40	14	16	60 (13-N)
50	18	20	75 (16-N)
60	21	23	88 (19-N)
70	25	28	104 (22-N)
80	28	31	117 (25-N)
Recommended	35	39	146 (31-N)

Sulfur Deficiency in Wheat

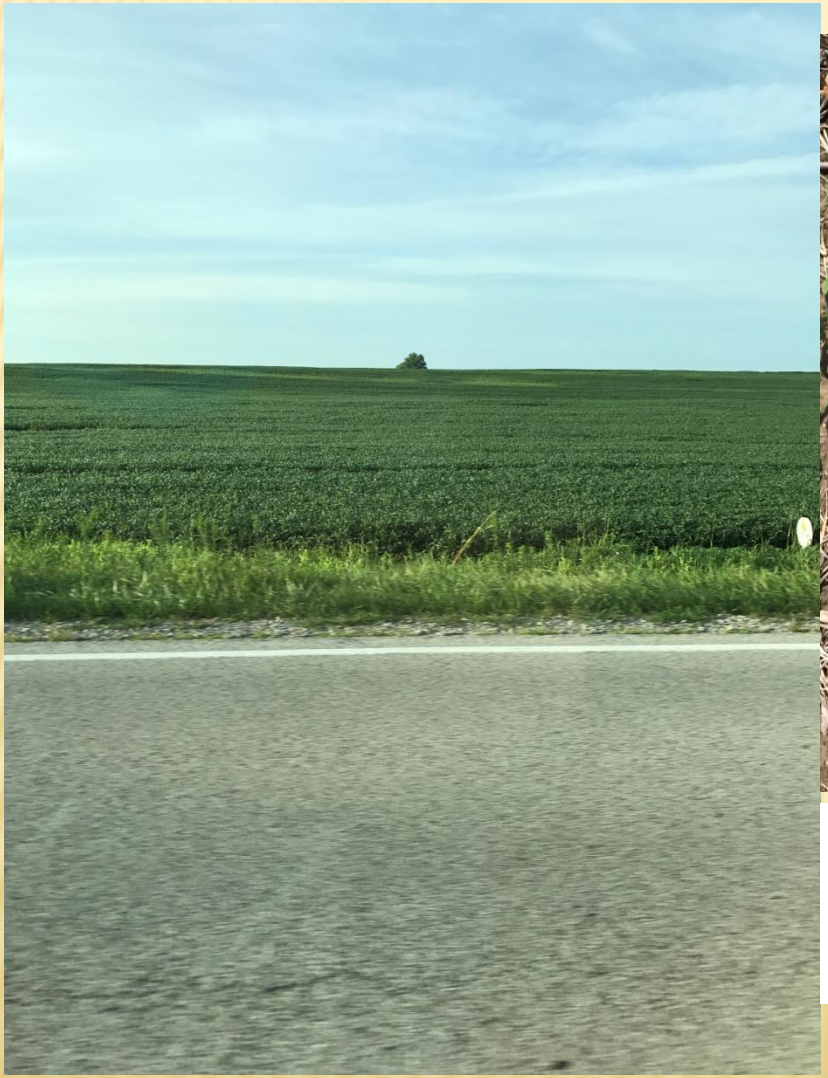


0.24% plant S
18 lb/ac soil S



0.13% plant S
6 lb/ac soil S

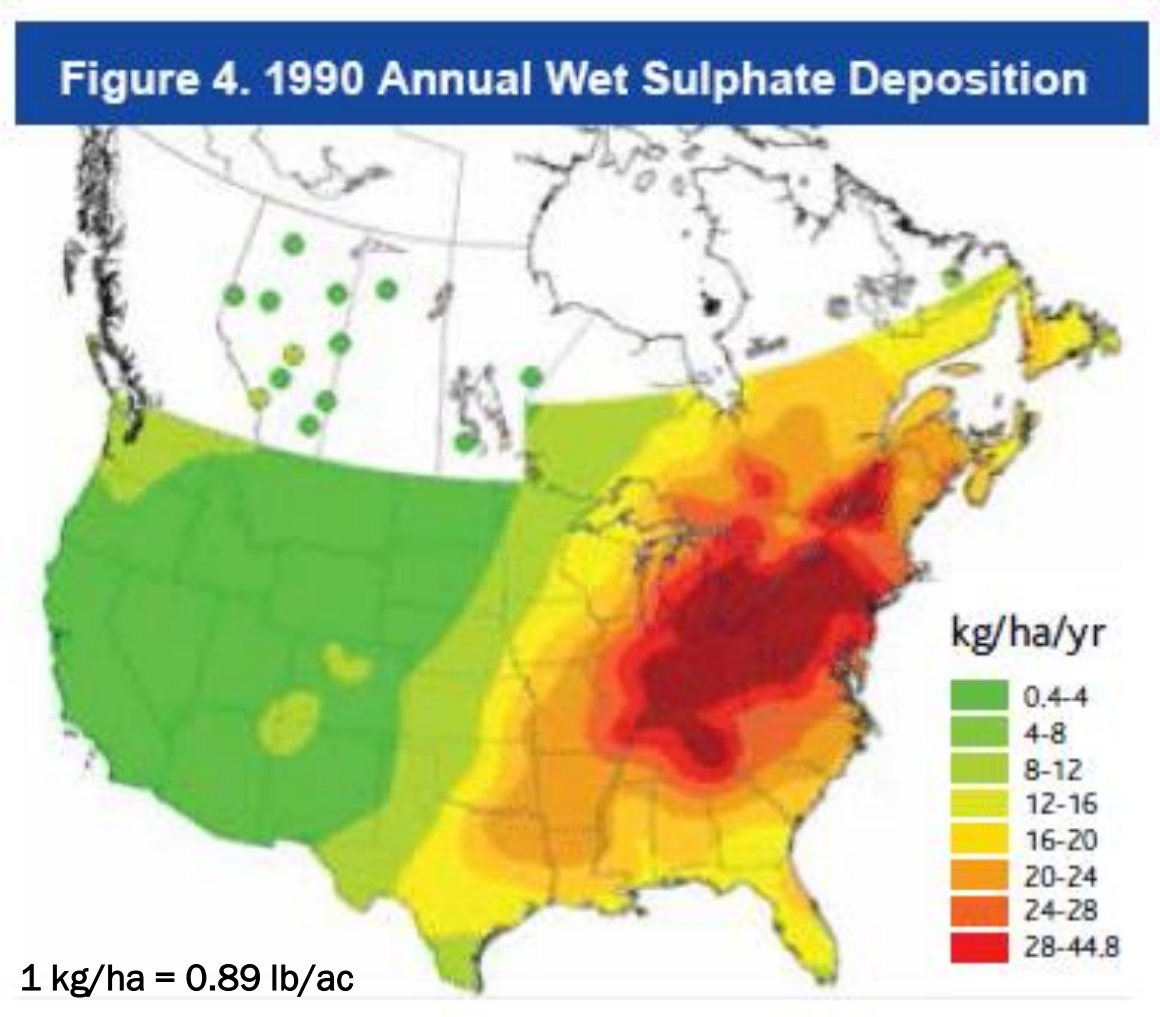
S Deficiency in Soybean



0.11% plant S
7 lb/ac soil S

Photo by Wyciskalla Consulting, 2018

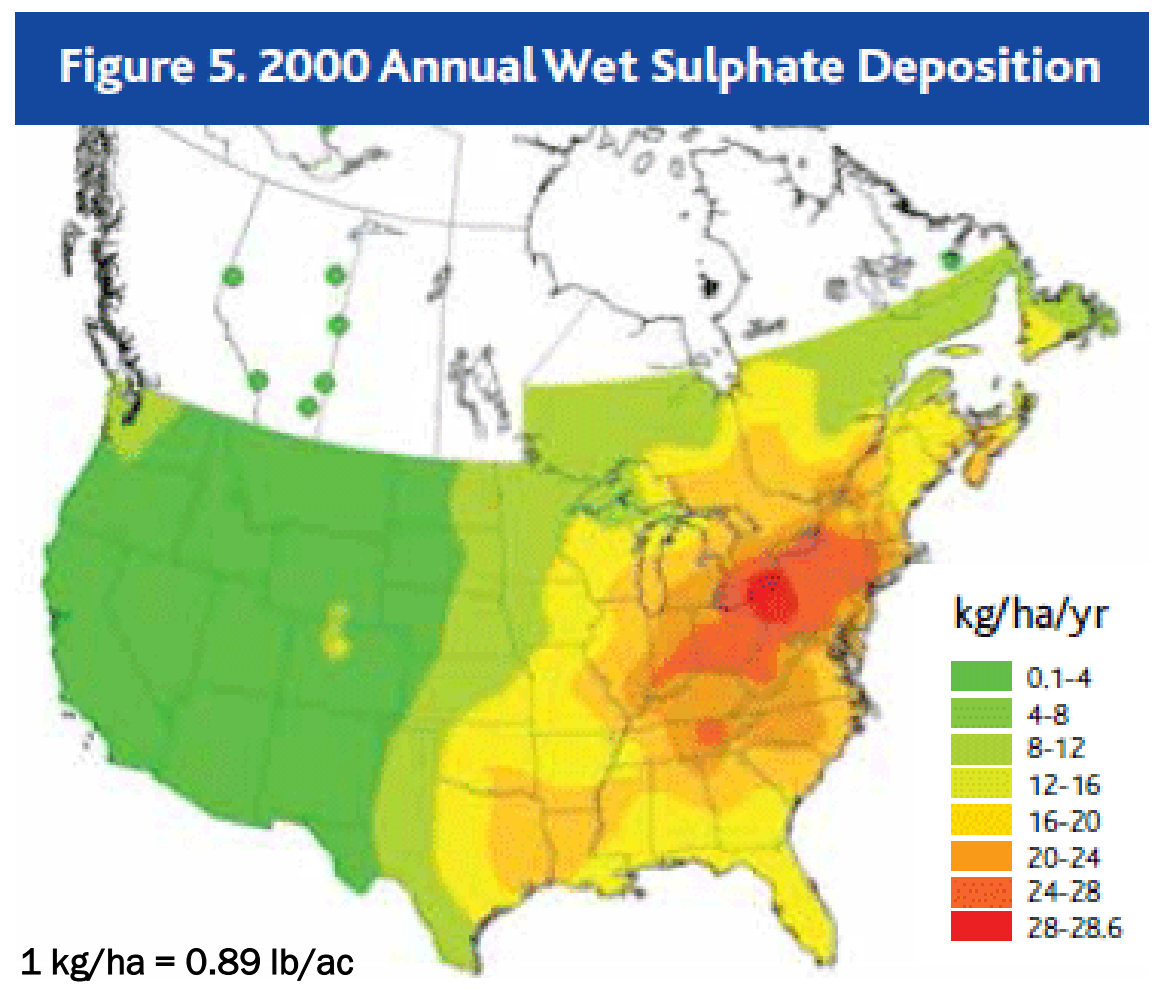
Decreased Atmospheric S Deposition



~25 lbs/ac

Source: US EPA – National Atmospheric Deposition Program

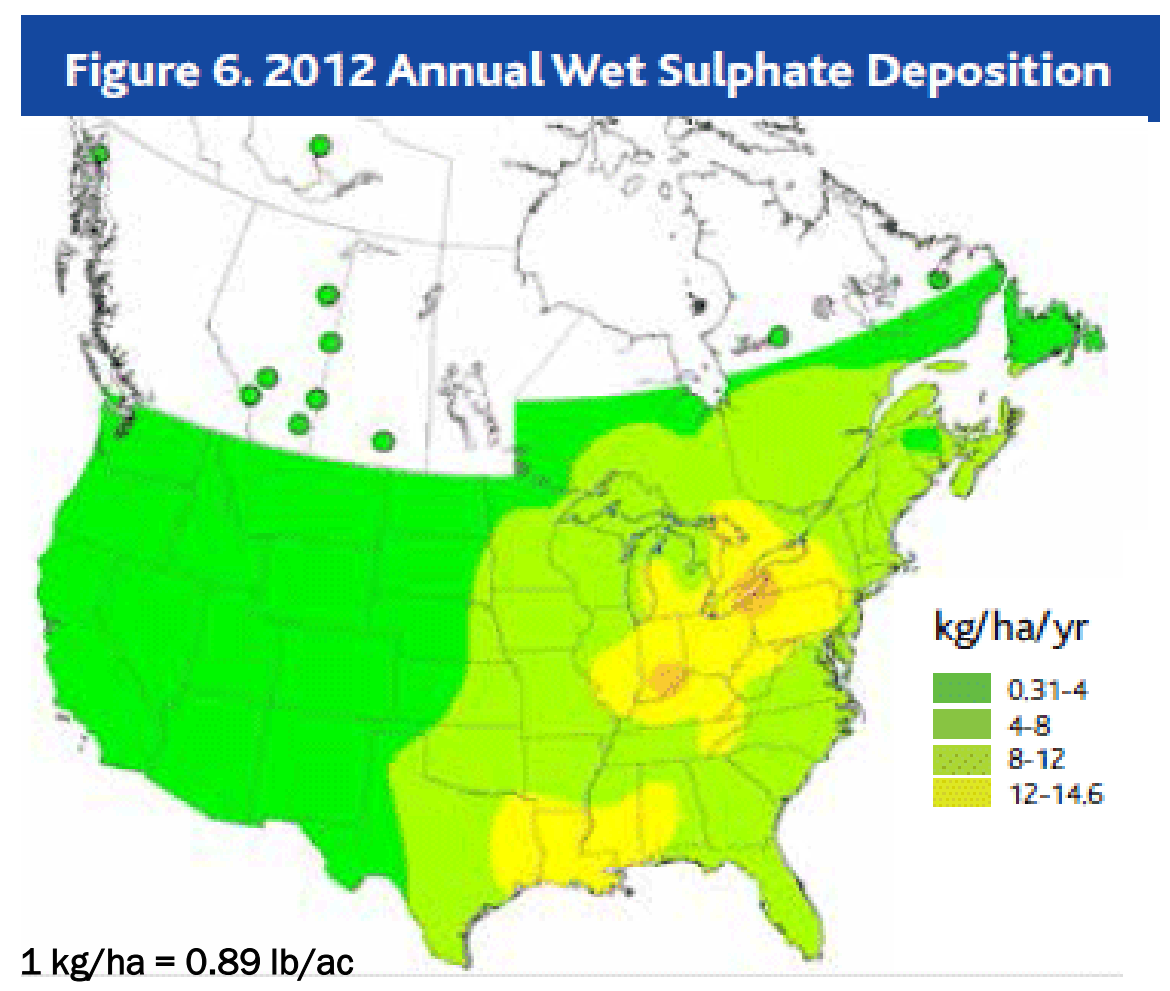
Decreased Atmospheric S Deposition



~18 lbs/ac

Source: US EPA – National Atmospheric Deposition Program

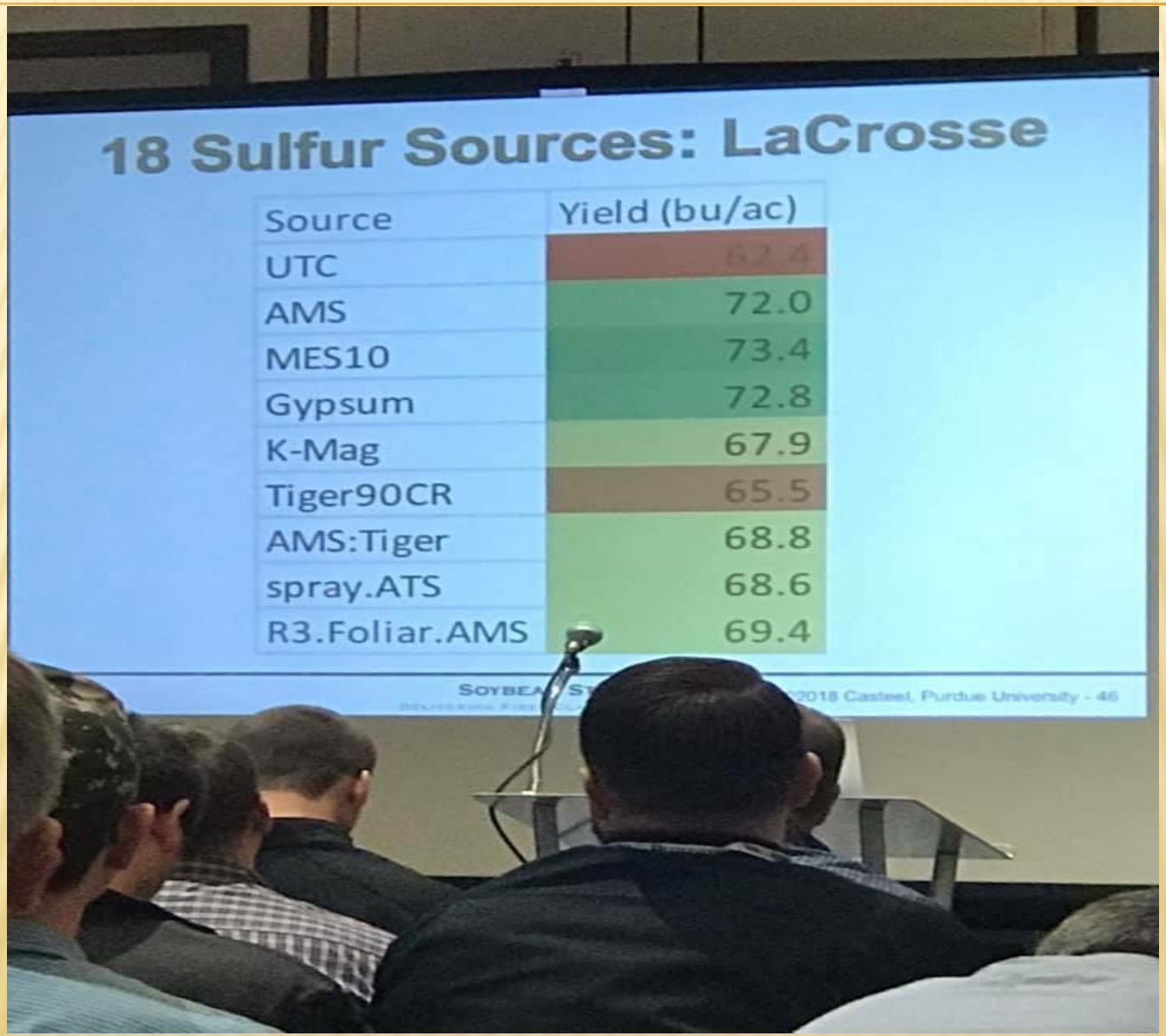
Decreased Atmospheric S Deposition



~12 lbs/ac

Source: US EPA – National Atmospheric Deposition Program

S Sources and Soybean Yield, Purdue Univ.



Example Scenario:

If a Producer applies:	200 lbs/acre DAP 150 lbs/acre Potash
Has a Soil P test	35 lbs/ac P (medium)
Has a Soil K test	180 lbs/ac K (low)

Did they supply enough nutrients for the crops?

Assumes using the U of I IAH Buildup + Maintenance Fertilization Scheme

Soil Buildup Requirement

P_2O_5 Needed = 45 lb P_2O_5 - 35 lb P_2O_5 = 10 lb P_2O_5
= (10 lb P_2O_5 x 9) divided by 4
= 23 lb P_2O_5/acre/year for the Soil (4 years)
= 50 lbs/ac DAP/year (4)

K_2O Needed = 260 lb K_2O - 180 lb K_2O = 80 lb K_2O
= (80 lb K_2O x 4) divided by 4
= 80 lb K_2O/acre/year for the Soil (4 years)
= 133 lbs/ac Potash/year (4)

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P Fertilization Example

P_2O_5 Removed = 40 bu/acre (Soybean) x 0.75 lb P_2O_5/bu
= 30 lb P_2O_5 (65 lbs/ac DAP or TSP)

= 60 bu/acre (Soybean) x 0.75 lb P_2O_5/bu
= 45 lb P_2O_5 (98 lbs/ac DAP or TSP)

= 80 bu/acre (Soybean) x 0.75 lb P_2O_5/bu
= 60 lb P_2O_5 (130 lbs/ac DAP or TSP)

These values do not take soil test levels into consideration.

K Fertilization Example

K_2O Removed = 40 bu/acre (Soybean) x 1.17 lb K_2O/bu
= 47 lb K_2O (78 lbs/ac Potash)

= 60 bu/acre (Soybean) x 1.17 lb K_2O/bu
= 70 lb K_2O (117 lbs/ac Potash)

= 80 bu/acre (Soybean) x 1.17 lb K_2O/bu
= 94 lb K_2O (157 lbs/ac Potash)

These values do not take soil test levels into consideration.

Example Scenario:

The Producer Applied — 200 lbs/acre DAP
150 lbs/acre Potash

Soybean	40 bu	60 bu	80 bu
Soil P	50	50	50
Soy P	65	98	130
TOTAL DAP/TSP	115	148	180
Soil K	133	133	133
Soy K	78	117	157
TOTAL Potash	211	250	290

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P and K Help by Contributing to:

1. A Larger Root System.
2. More Above-Ground Residue.
3. Quicker Ground Cover/Row Closure.
4. Improved Water Use Efficiency.
5. Crop Resistance to Stresses/Diseases.

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Cutting Back on Fertilizers WILL NOT:

1. Cut land taxes.
2. Cut interest rates.
3. Cut seed and pesticide costs.
4. Cut machinery costs.
5. Cut fuel costs.

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Cutting Back on Fertilizers WILL:

1. Reduce yields per unit area.
2. Mine soil nutrients.
3. Reduce crop resistance to drought, disease, insect, and other stresses.
4. Reduce crop cover and residue resulting in greater risk of erosion.
5. Reduce profits.

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Questions ???

"The soil is the mother of mankind and it will furnish him life and the material basis for happiness and comfort if he does not make too strong demands upon it."

Dr. James Thorp, Purdue Univ., 1936.