Corn Response to Sulfur

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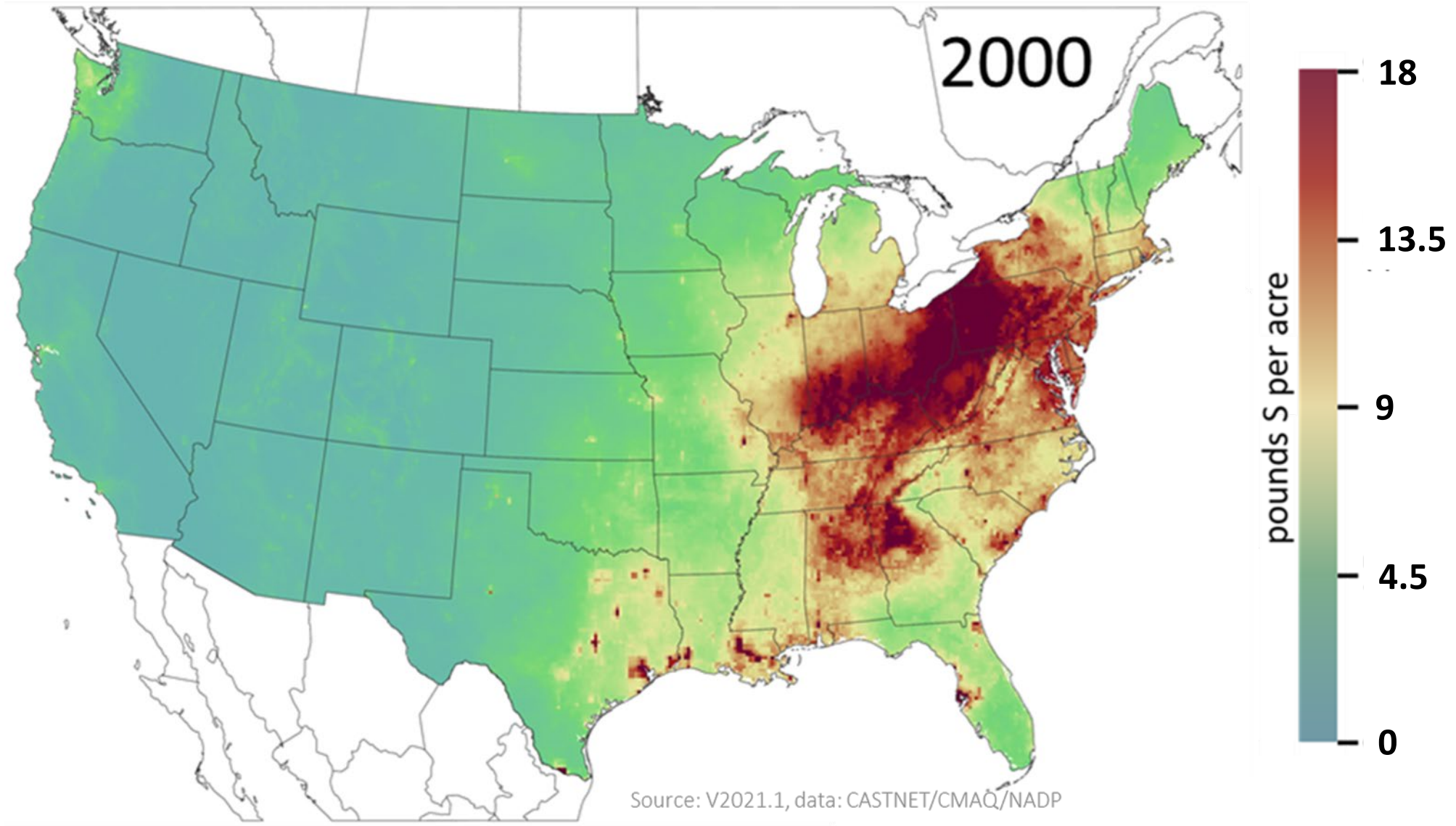
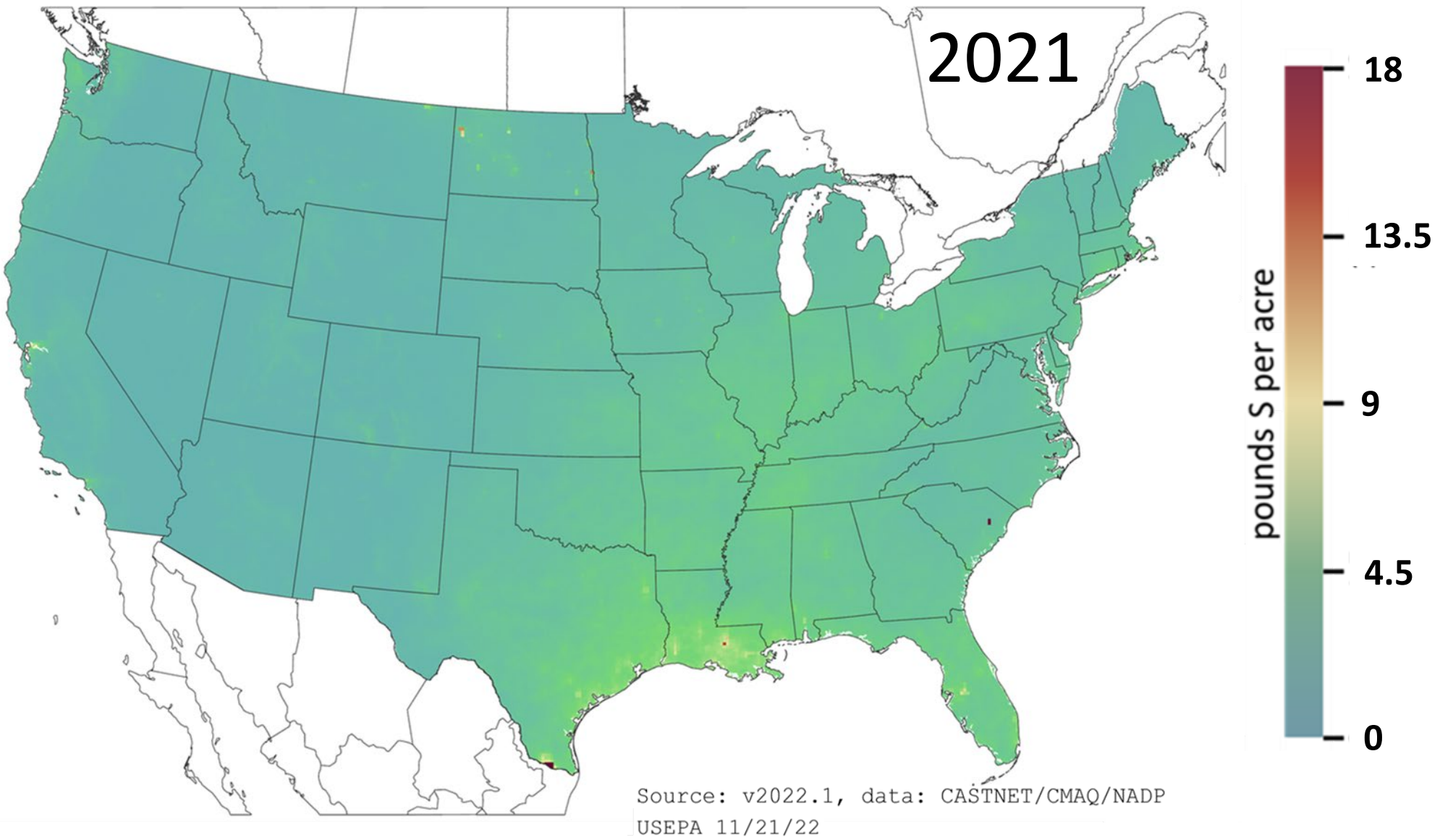
Plenty of free sulfur from the air in the past!



Not anymore!


2021
18
13.5
9
4.5
0
pounds S per acre
Source: v2022.1, data: CASTNET/CMAQ/NADP
USEPA 11/21/22

Other sources of S for plants

- Mineralization of S in soil organic matter and crop residues
- Some retained SO_4-S, especially in soils with acid subsoils
- Residual sulfur from processing rock phosphate to make phosphorus fertilizers

Conditions likely favoring S deficiency

- Sandy, low organic matter soils
- Cold, excessively wet or dry, no-till fields, C/C, heavy residues
- ***Soil S supply varies with depth and time (transient deficiency)***
- No phosphorus fertilizer applied recently

Large-plot (field-scale) response trials

- Whole field trials ranging from 30 to 80+ acres
- Individual plots ranging from 30 to 60+ feet wide by length of field
- Facilitated by use of commercial farming equipment and precision ag technology – applicators/yield monitors/etc.
- Use of mapping software and GIS to design trials and work with spatial data

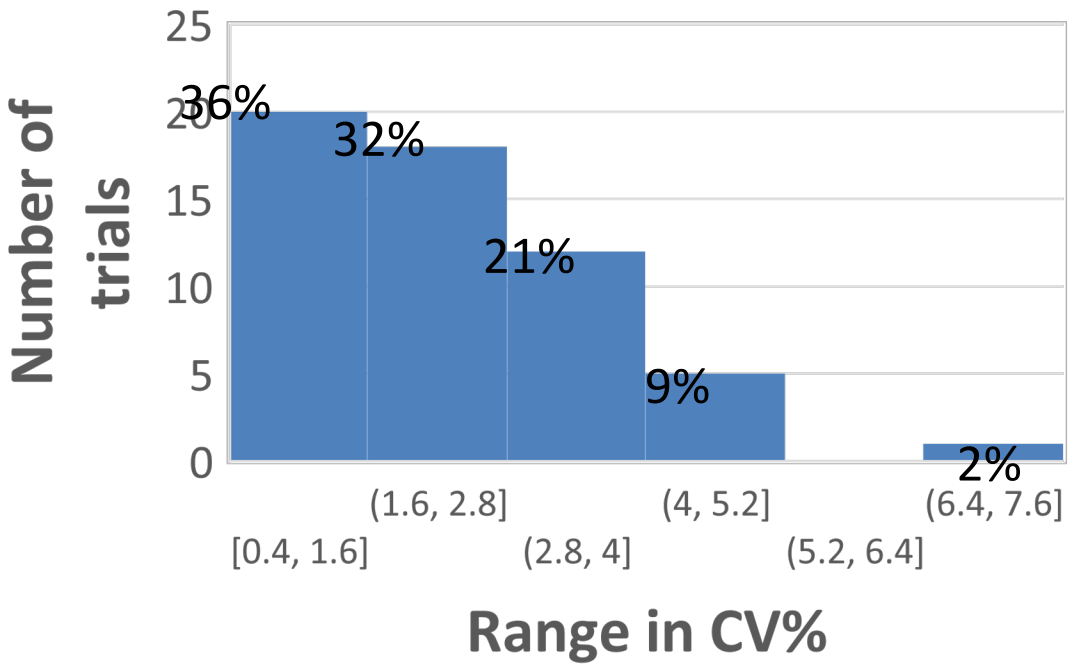
Photo: Bob Nielsen

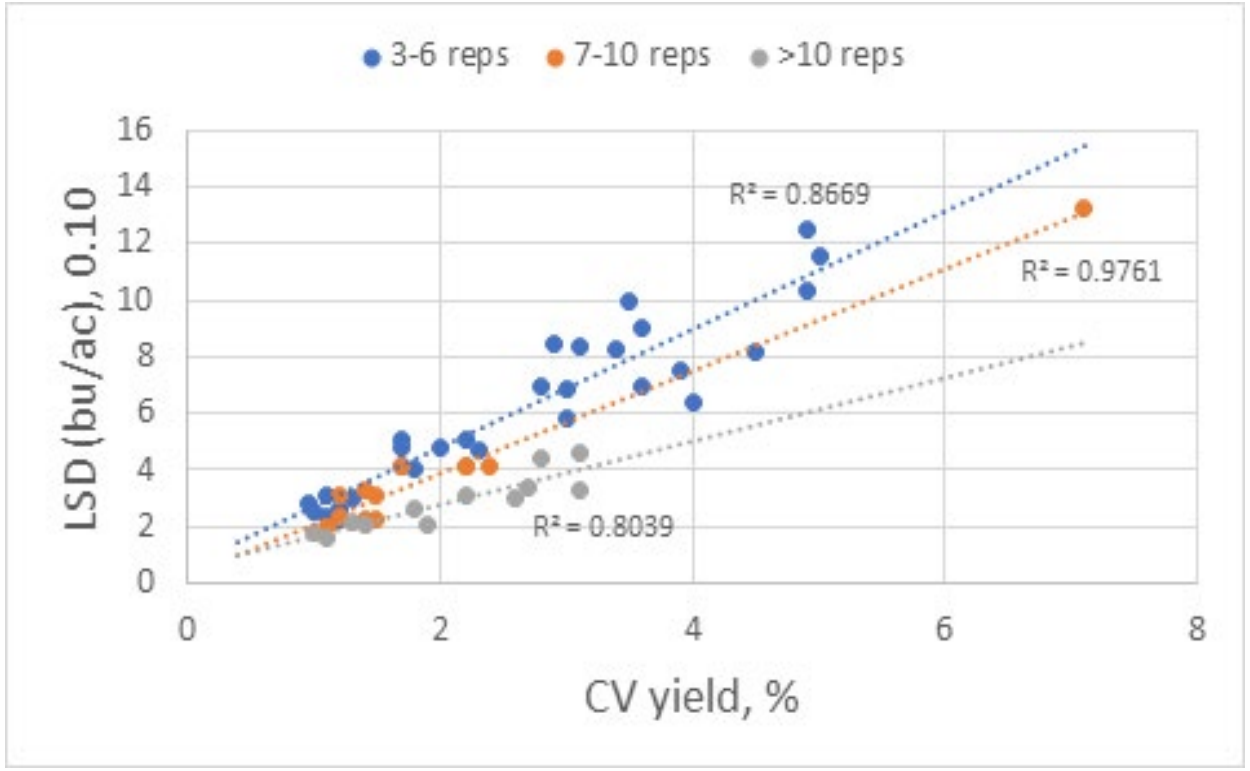
Simple S timing/rate trials or ± S to determine corn response to S fertilization

- Starter and/or sidedress S
- S rates – 0-30 lb S/a
- Usually ATS in liquid N
- Some residual studies

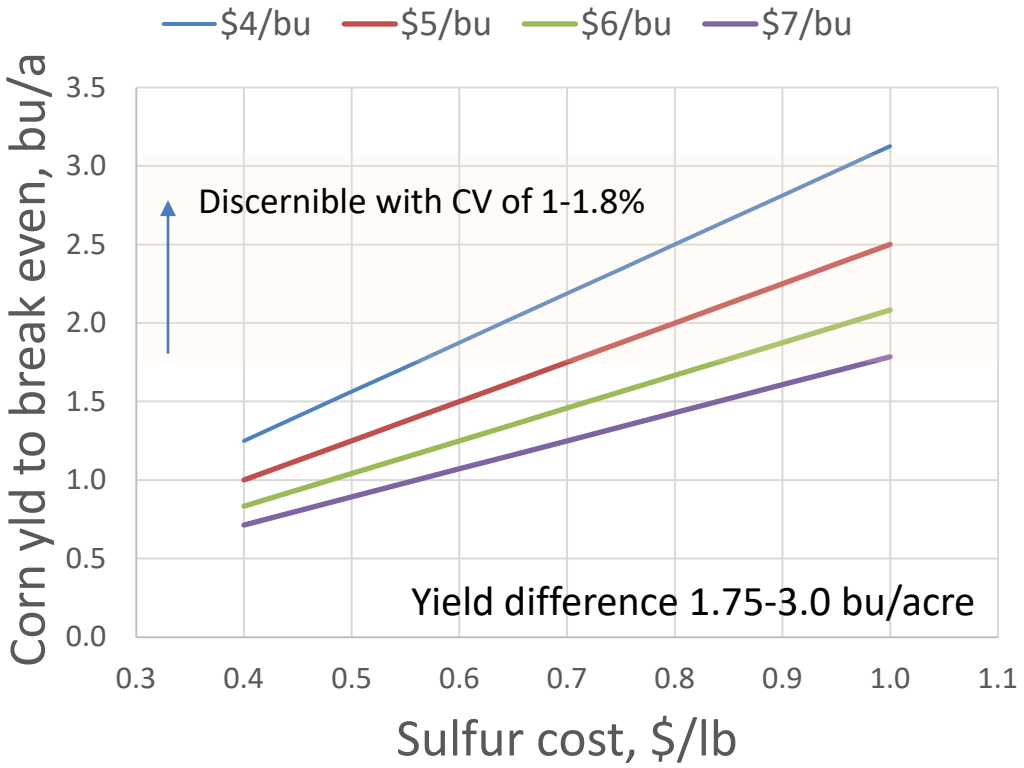

Photo credit: Bob Nielsen, Purdue Univ.

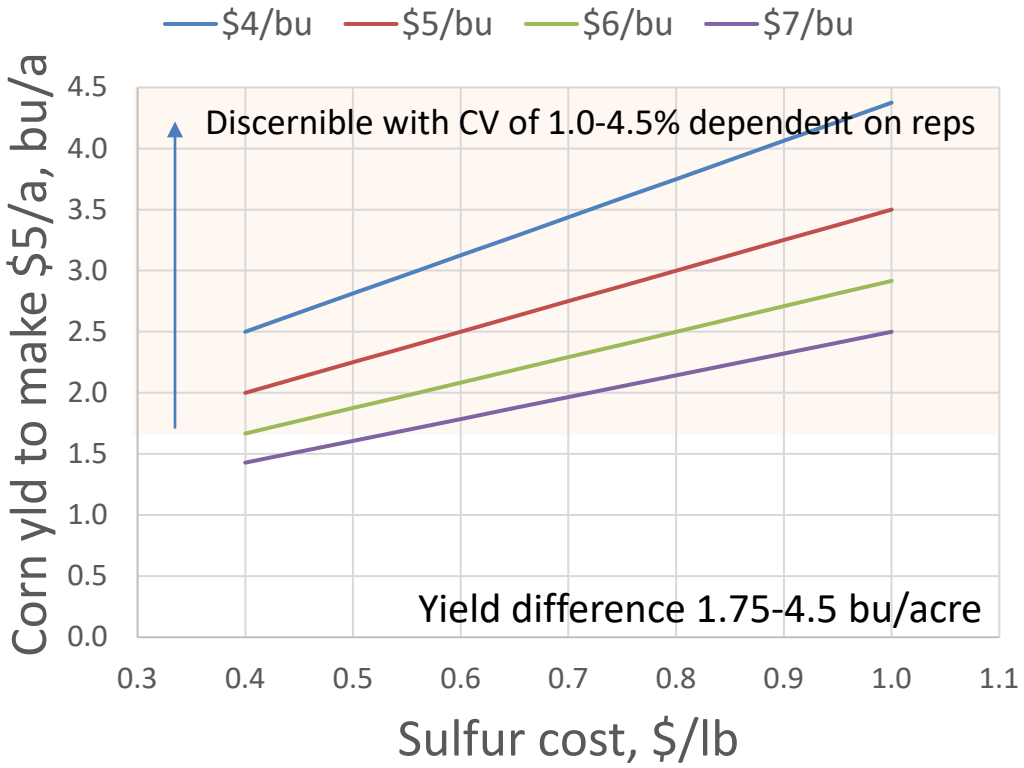
Large plot strip trials have low variability and can detect reasonably small differences in yield





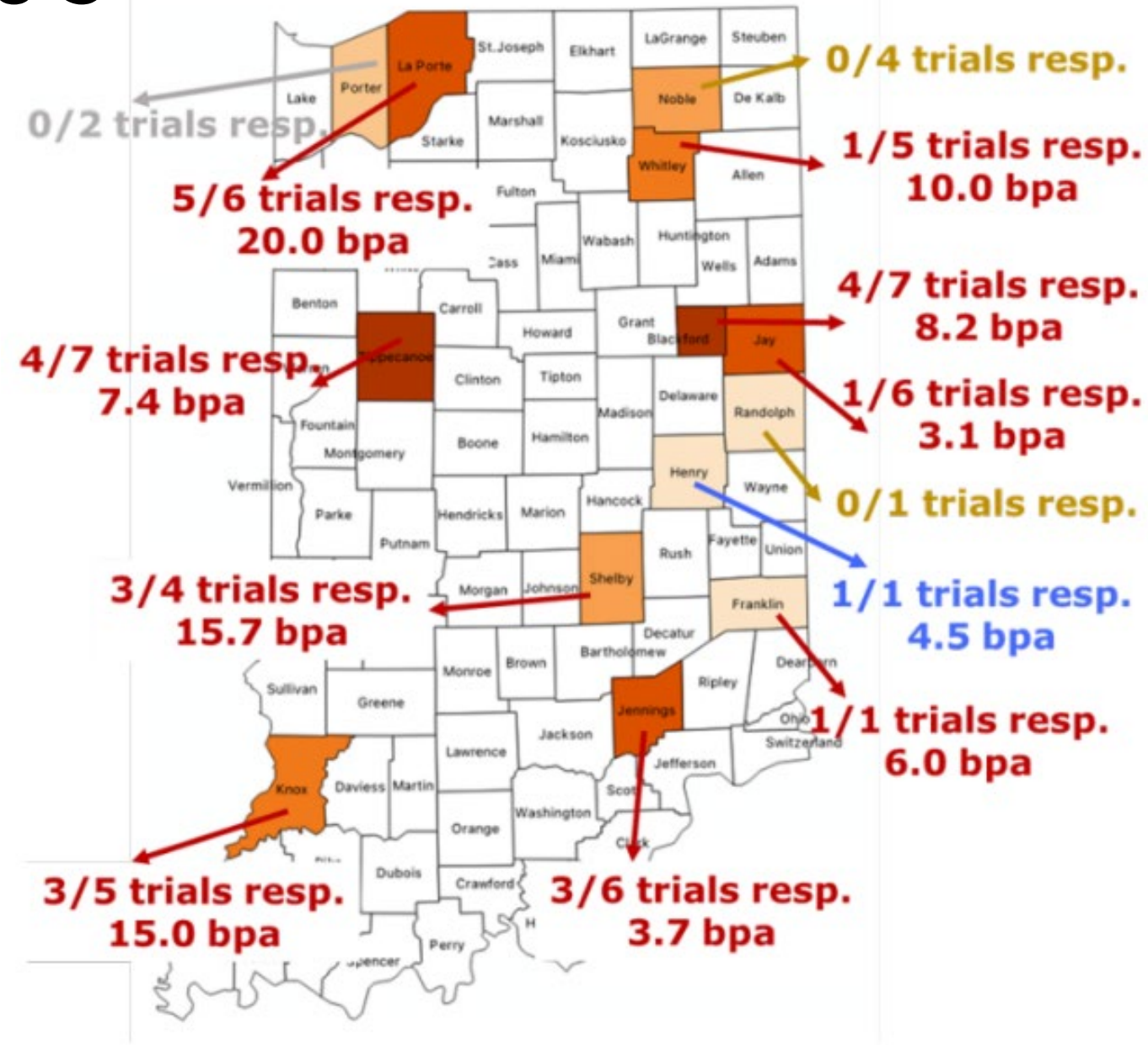
Low variability is needed to detect meaningful yield differences especially with low-priced input and high-priced grain





Corn yield response to S fertilization

- Sulfur application increased yield in 26 of 55 trials (47%), 3 to 34 bu/a
- The lowest rate of S in each trial was sufficient (5-30 lb S/acre)



Largest and most consistent responses to S occurred on a sandy soil in northern Indiana

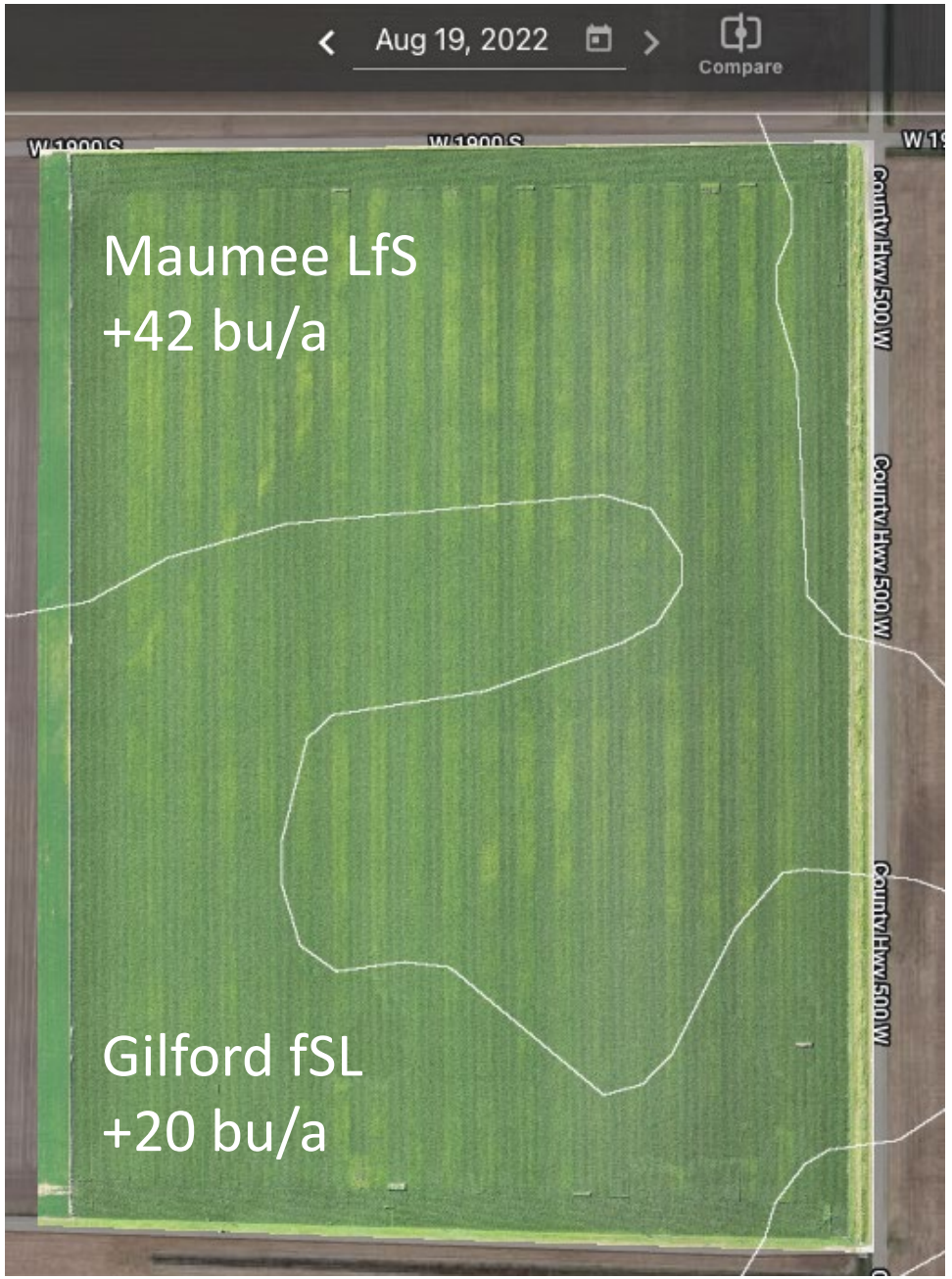
Fert. S	2017	2018	2019	2020	2021	2022
	---------- Grain yield, bu/acre ----------					
No S	217	181	179	217	179	171
+S	233	202	194	221	195	204
Diff.	**+16**	**+21**	**+15**	**NS**	**+16**	**+33**

Rice Farm, LaPorte Co.; Gilford fSL, Maumee LfS,

Greater response on sandier lower OM soil within field

S fert.	Gilford fSL 2.7% OM 4 ppm SO_4-S 75% sand	Maumee LfS 1.9% OM 9 ppm SO_4-S 81% sand
No S	190	159
+S	210	201
Diff.	**+20**	**+42**

2022 – LaPorte Co.



Corn response to S was unexpected on a prairie soil

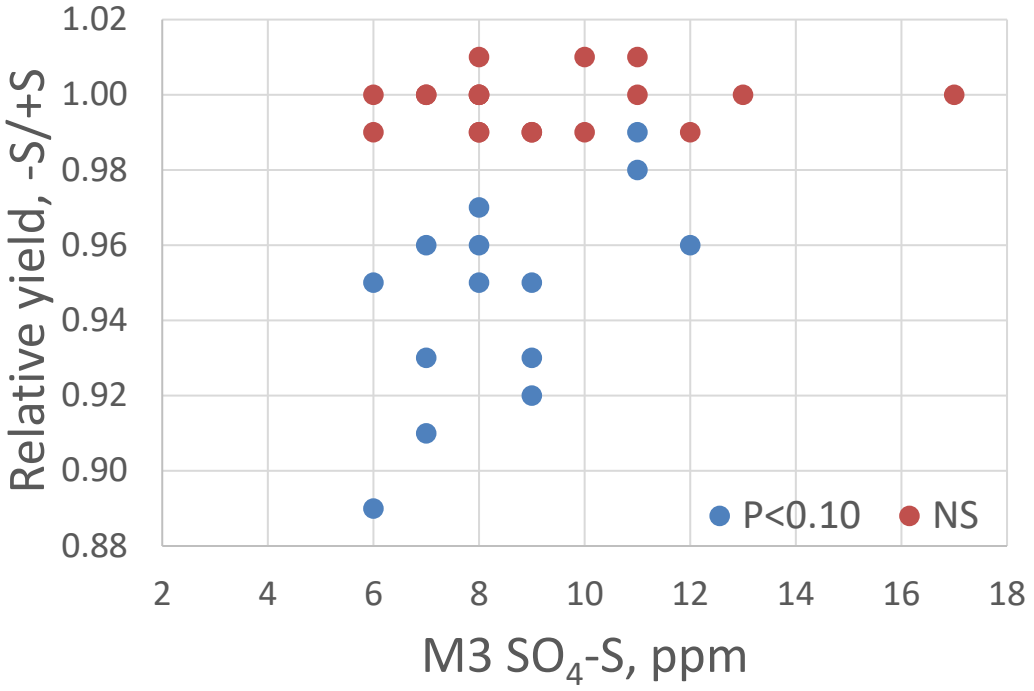
	4.1% OM, 19% sand	4.0% OM, 24% sand 8 ppm SO_4-S	3.4% OM, 16% sand 8 ppm SO_4-S
S rate, lb/ac	**C/S 2021**	**C/S 2022**	**C/C 2022**
0	202	207	188
10		214	197
15	212	213	196
20		214	196

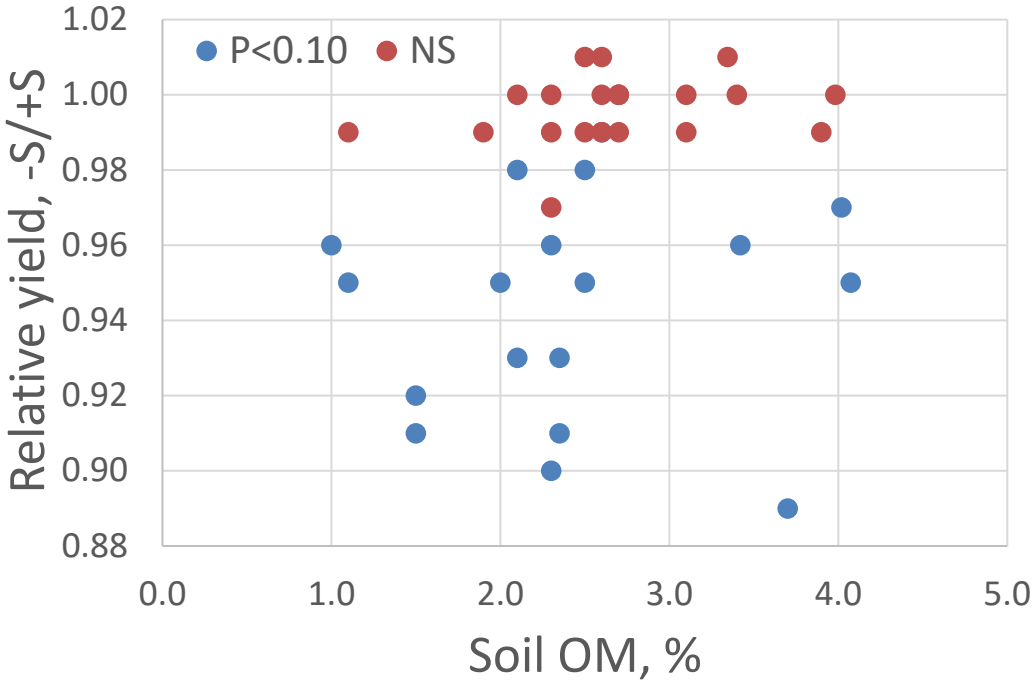
Chalmers SiCL - ACRE, Tippecanoe Co., 35% clay

Potential predictors/confirmation of sulfur deficiency

- Soil properties – SO_4-S, OM, clay, sand
- Plant tissue S and N:S prior to SD (limited) and earleaf

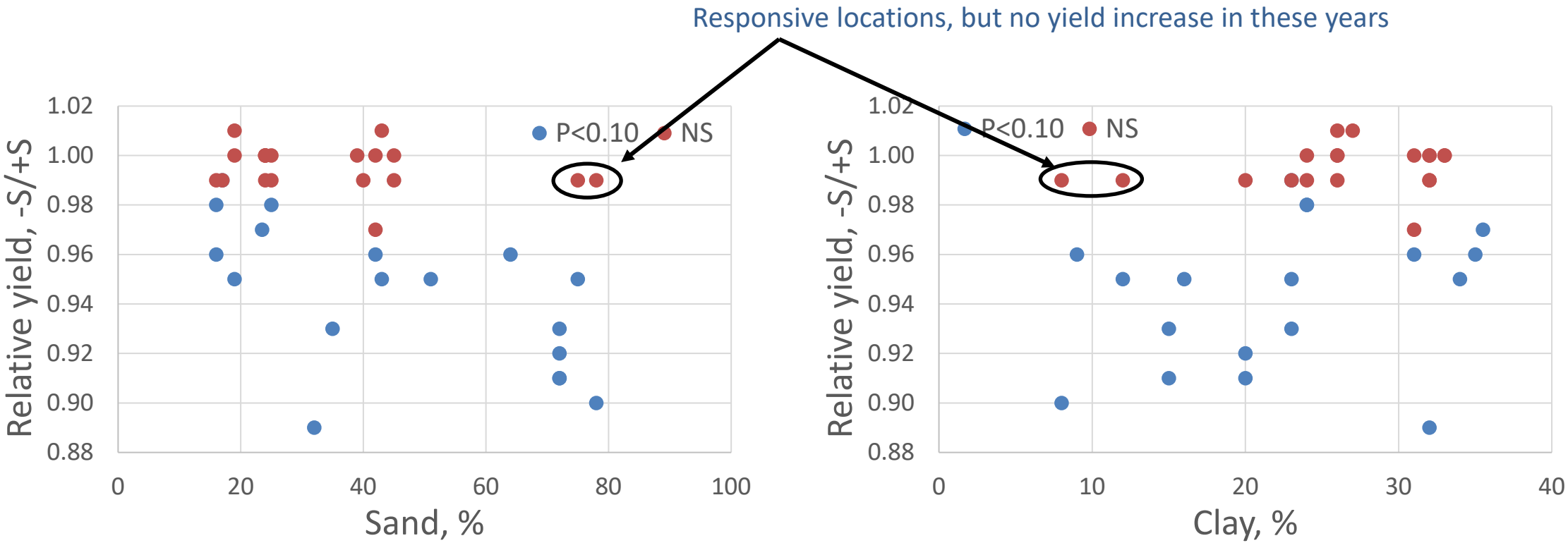
Sulfate-S and soil OM do not separate responsive from non-responsive sites well





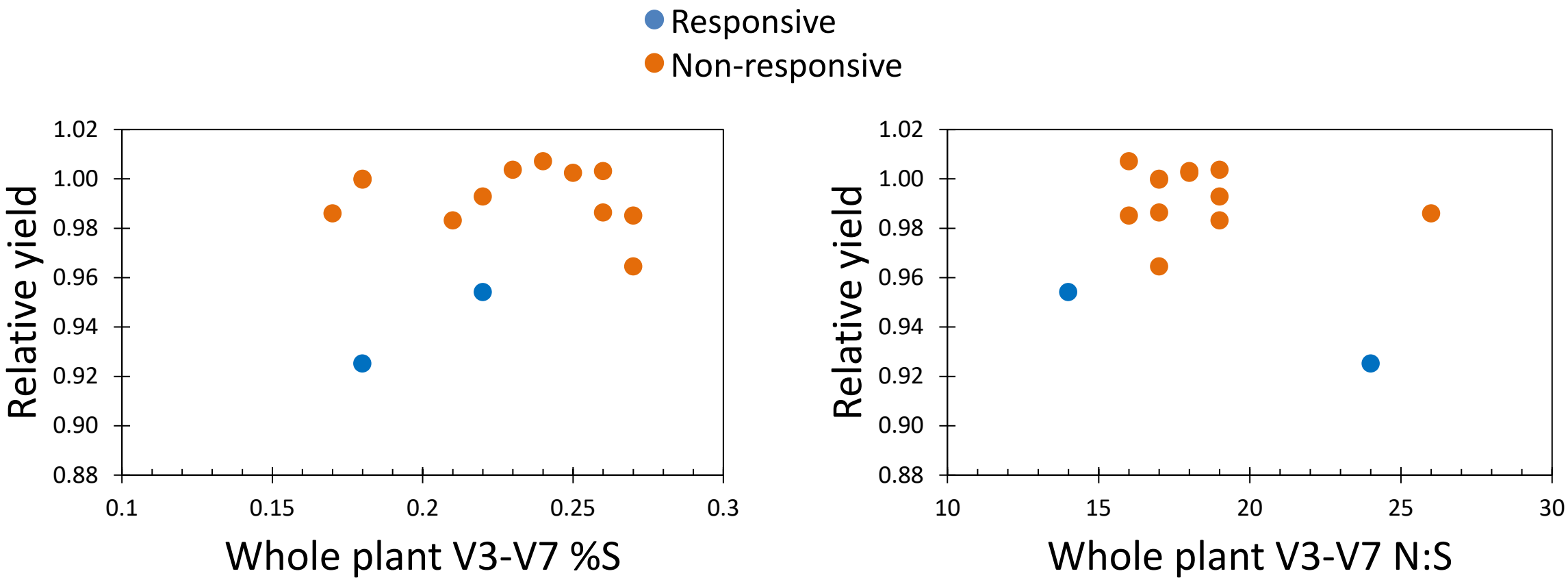
Greater yield reduction without S on soils with lower initial SO_4-S

Lightest-textured soils more responsive to +S

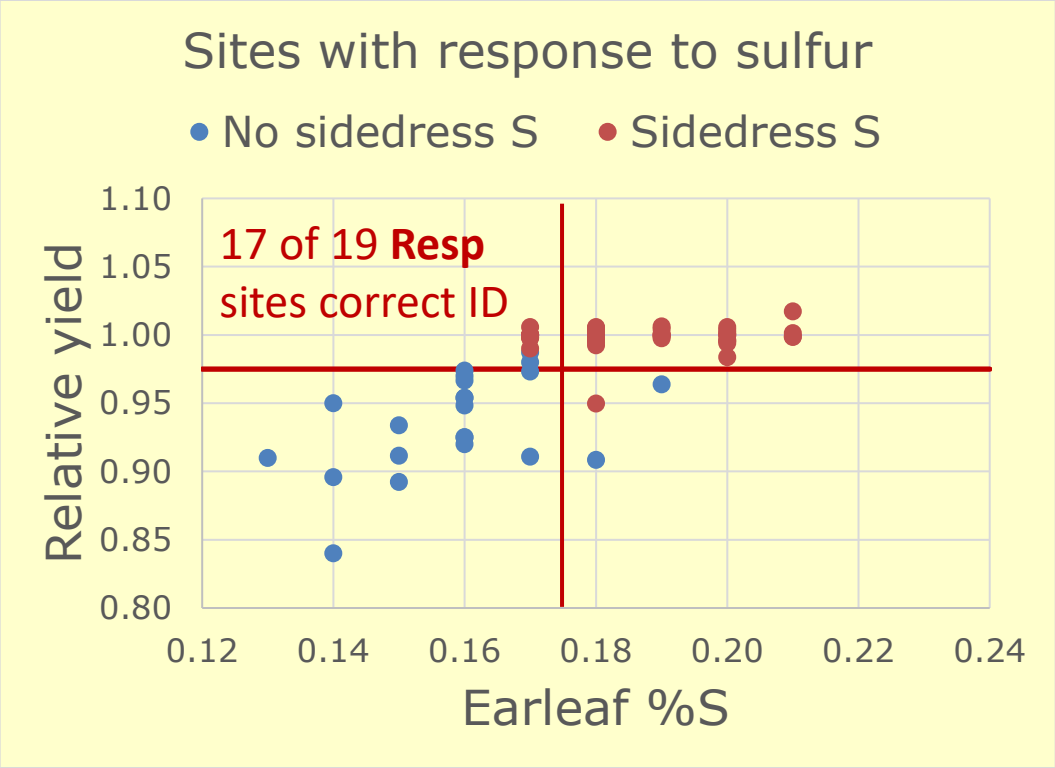


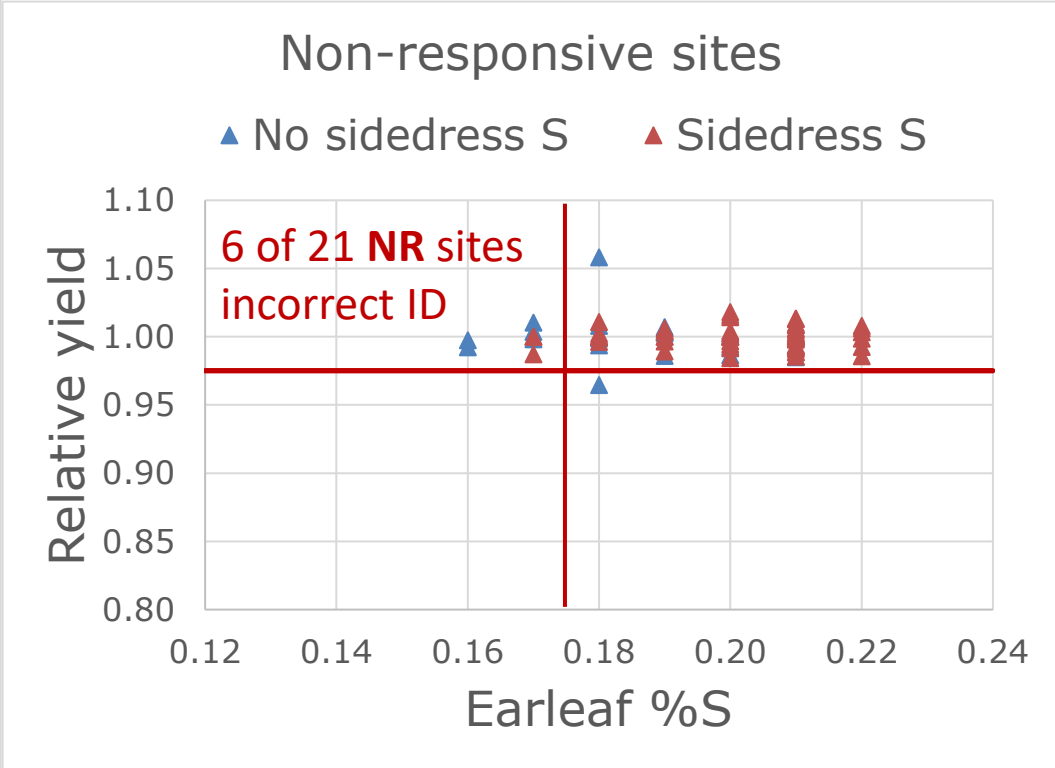
Two locations with highest sand and lowest clay content have greatest yield reduction without S

Limited whole plant data at sidedress time



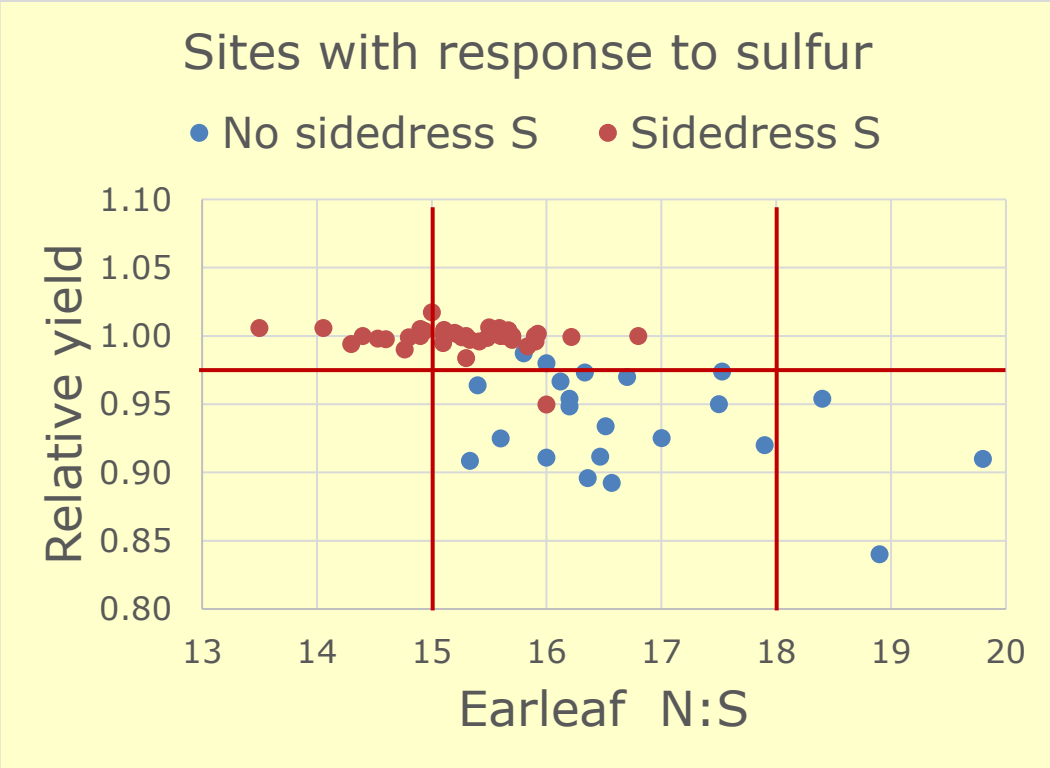
Earleaf S as indicator of deficiency

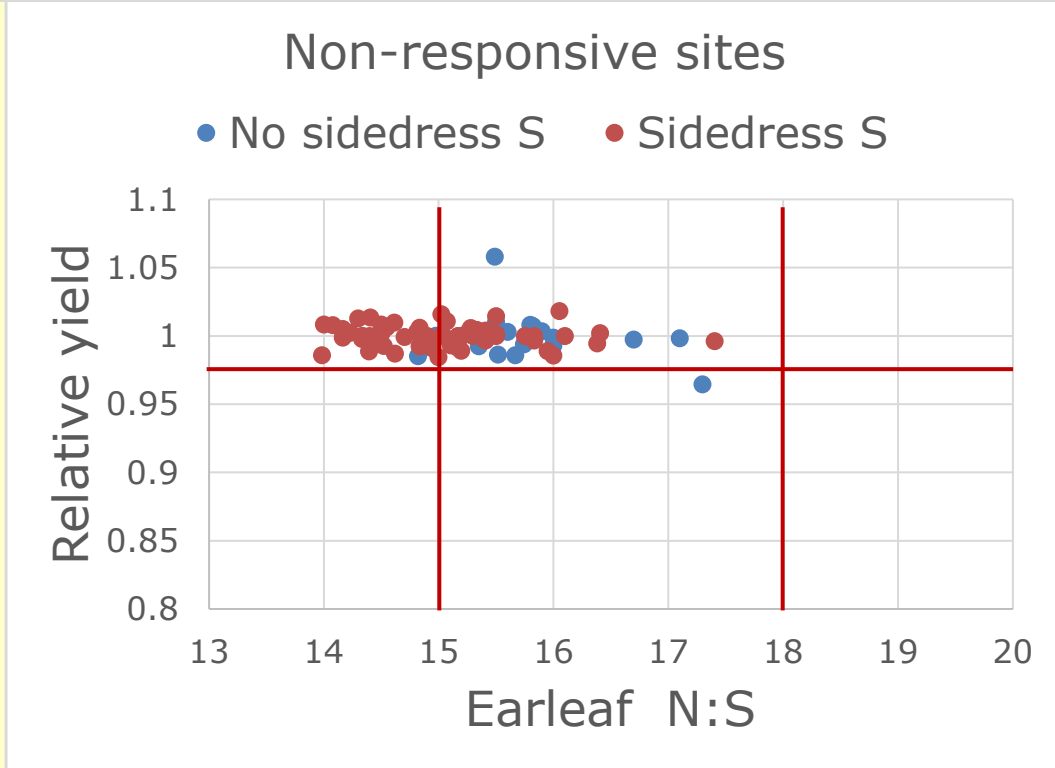




<0.15 currently considered “low”, may appear normal but probably will be responsive to fertilization

Earleaf N:S not as good as %S as indicator of S deficiency





Corn response to S was unexpected on a prairie soil

Chalmers SiCL, 3.5% OM

S rate, lb/ac	C/S 2021	C/S 2022	C/C 2022
0	202	207	188
10		214	197
15	212	213	196
20		214	196

ACRE, Tippecanoe Co.

Tillage can affect sulf

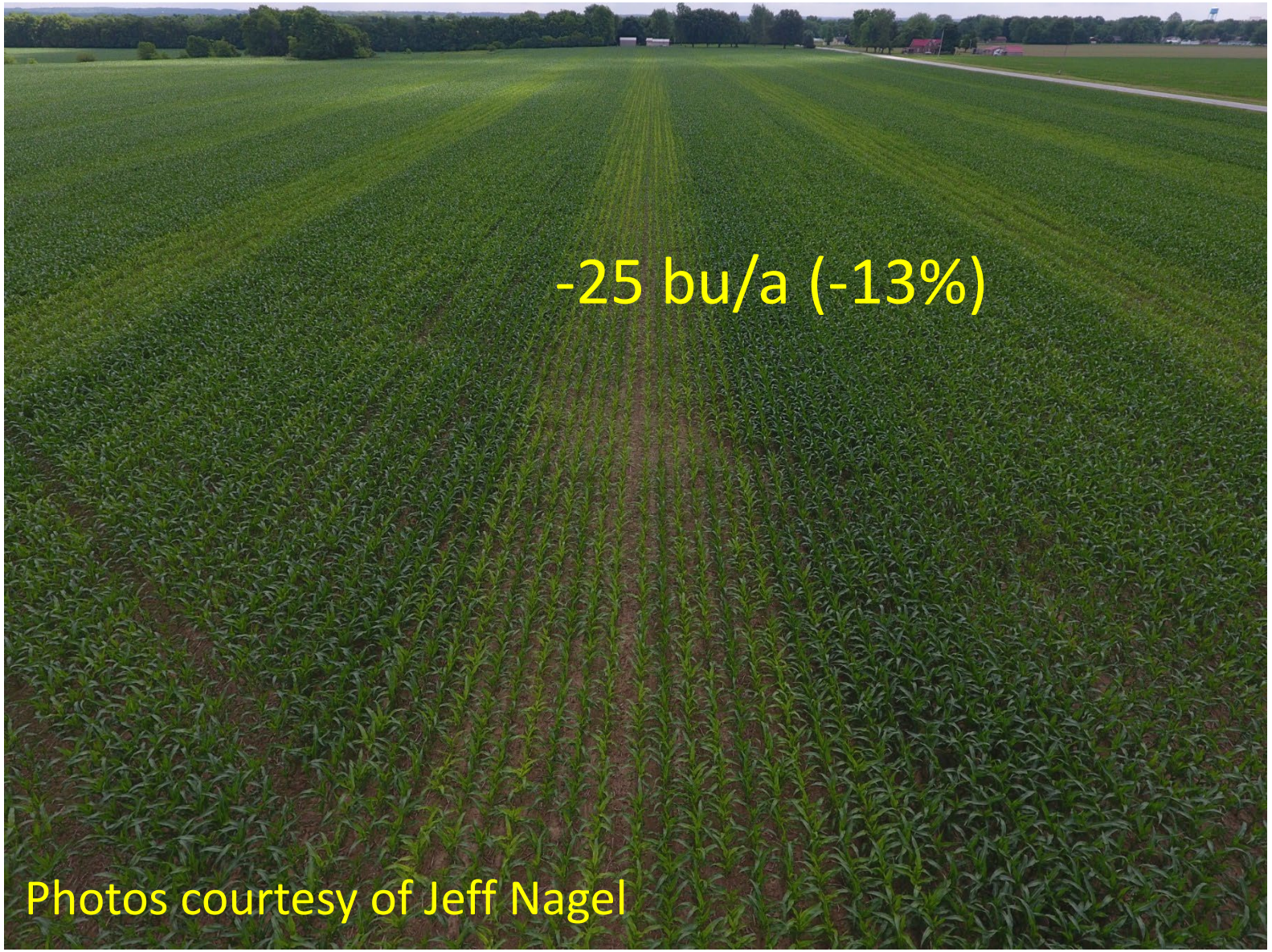
Potential S contribution of P fertilizers

Fertilizer	# samples analyzed	sulfate-S concentration		sulfate-S applied at 70 lb P_2O_5/acre
		range	average	pounds S per acre
MAP	256	0.9-2.7%	1.8%	1.2-3.6
DAP	247	0.9-3.3%	1.8%	1.4-5.0
TSP	14	1.4-1.9%	1.6%	2.1-2.9
10-34-0	15	0.5-0.9%	0.6%	0.3-0.5†

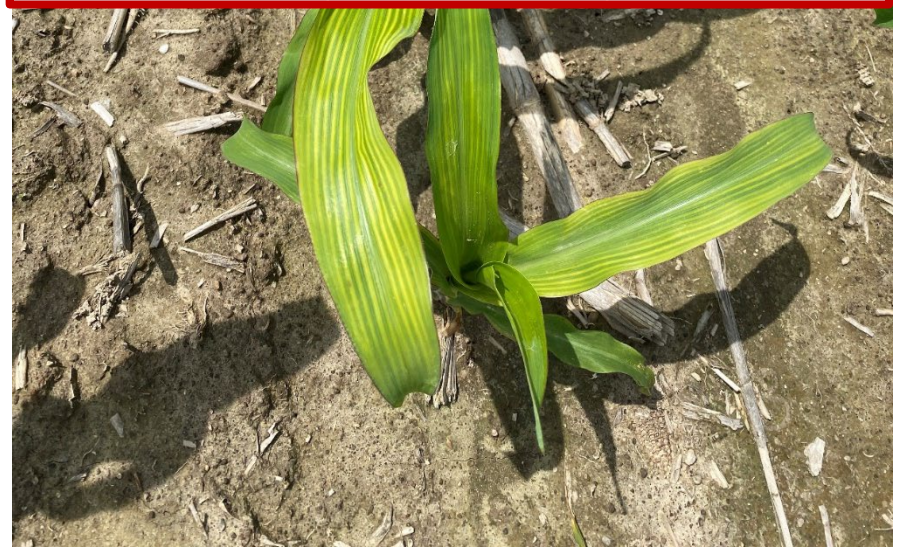
†Based on 5 gal/acre, which applied 20 lb P_2O_5/acre.

Data thanks to: Office of Indiana State Chemist

MAP contributes to S supply



Nutrient	Good	Bad
N	4.14	4.74
S	0.26	0.20
N:S	16:1	24:1
P	0.36	0.32



Carryover of S from one season to the next?

Photos: Bob Nielsen, Purdue Univ.

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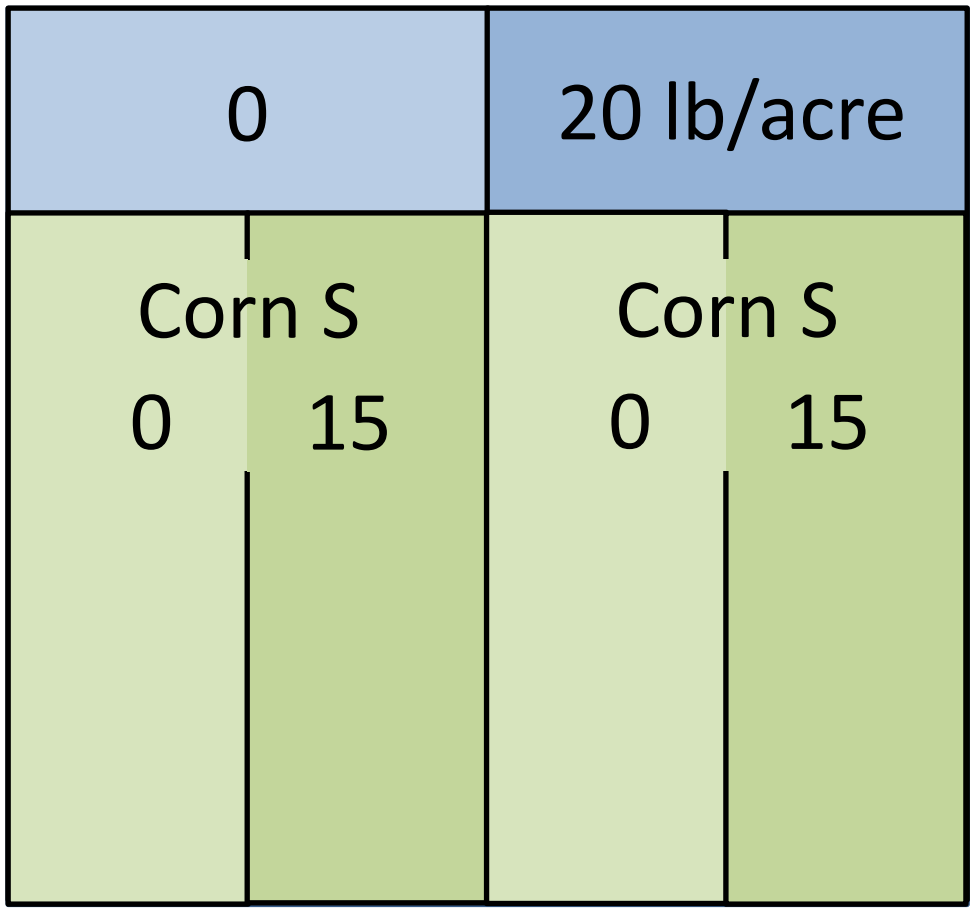
Does S applied to soybeans impact next year's corn crop?

Sulfur applied to soybean



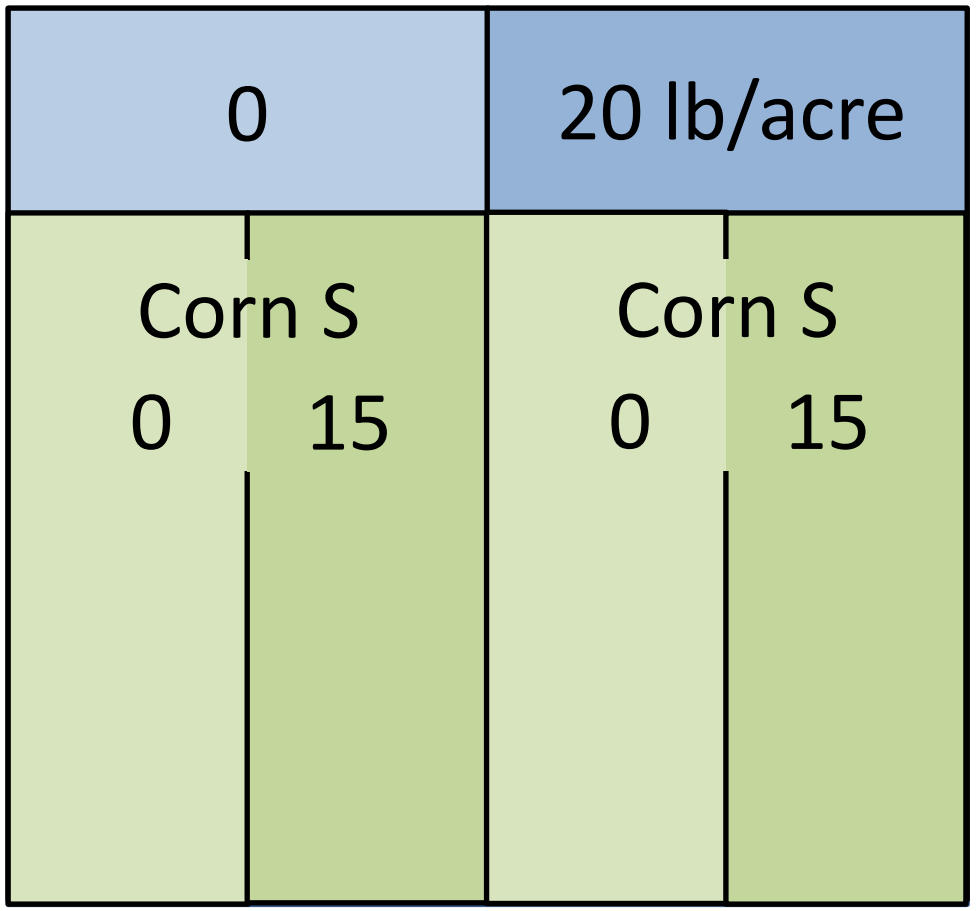
2 of 3 S deficient sites responded this way

2021 S rate, lb/acre	2022 S rate, lb/acre	Yield, bu/acre
0	0	197
0	15	213
20	0	213
20	15	214

Blackford Co.; Blount, Pewamo, Glynwood

Does S applied to soybeans impact next year's corn crop?

Sulfur applied to soybean



At 1 S responsive site S applied to soybean was not enough

2021 S rate, lb/acre	2022 S rate, lb/acre	Yield, bu/acre
0	0	217
0	15	225
20	0	222
20	15	229

Summary

- Soils with more than 50% sand are more likely to respond to S fertilizer
- Low soil SO^4-S and sandy texture increase magnitude of S response
- Soil OM (1-4%) not a good indicator of response or magnitude of response
- Earleaf %S at R1 below 0.18% was a good separator of responsive from non-responsive sites


QUESTIONS?
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