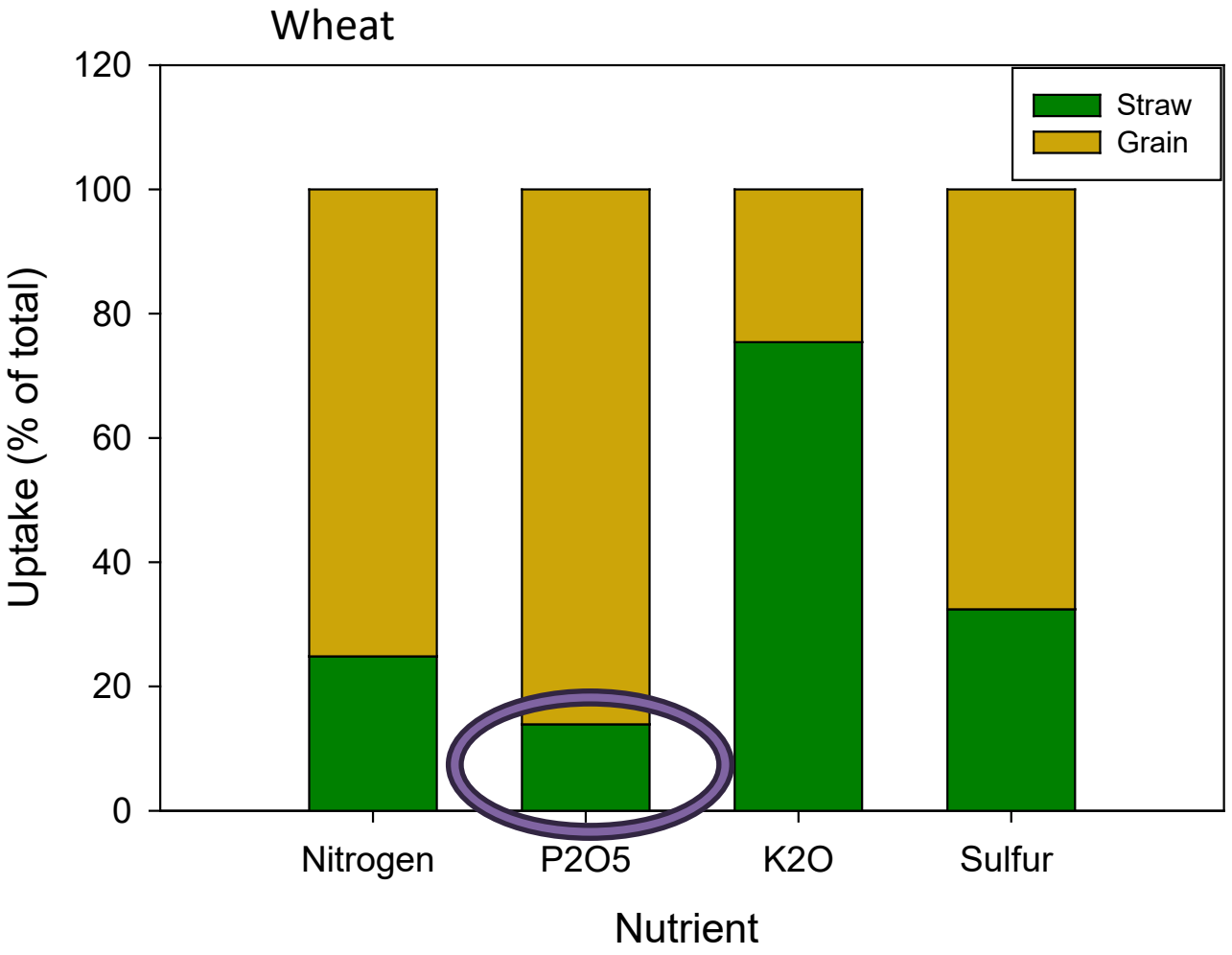
Phosphorus management, sulfur, and pH

Dorivar Ruiz Diaz

Overview

- Phosphorus for corn, soybean and wheat
  - Crop response
  - Soil test methods and critical values
- Sulfur in corn and wheat
- Soil pH considerations

Nutrient uptake and partition between grain and residue



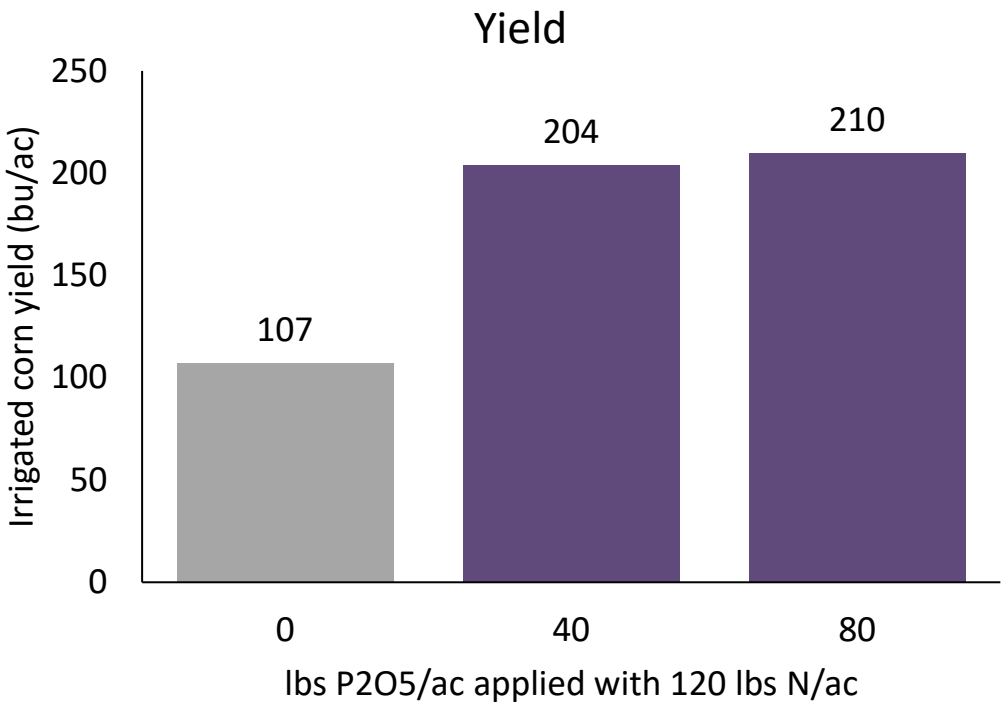
Grain nutrient removal

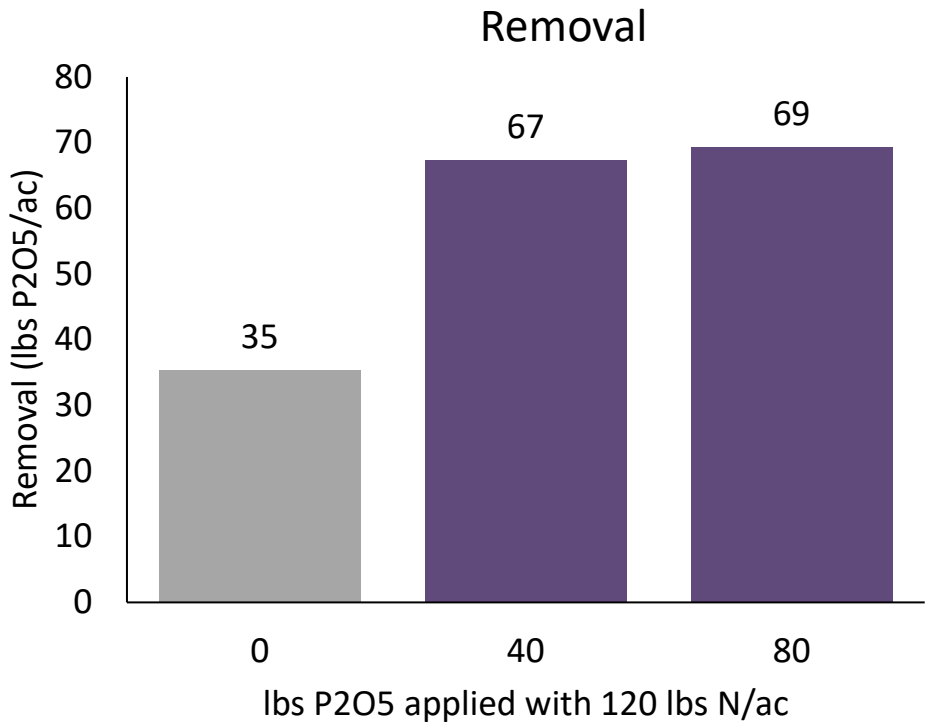
Crop	P_2O_5 (lb/bu)	K_2O (lb/bu)
Corn	0.33	0.26
Sorghum	0.40	0.26
Wheat	0.50	0.30
Soybeans	0.80	1.40

Ruiz Diaz, 2010

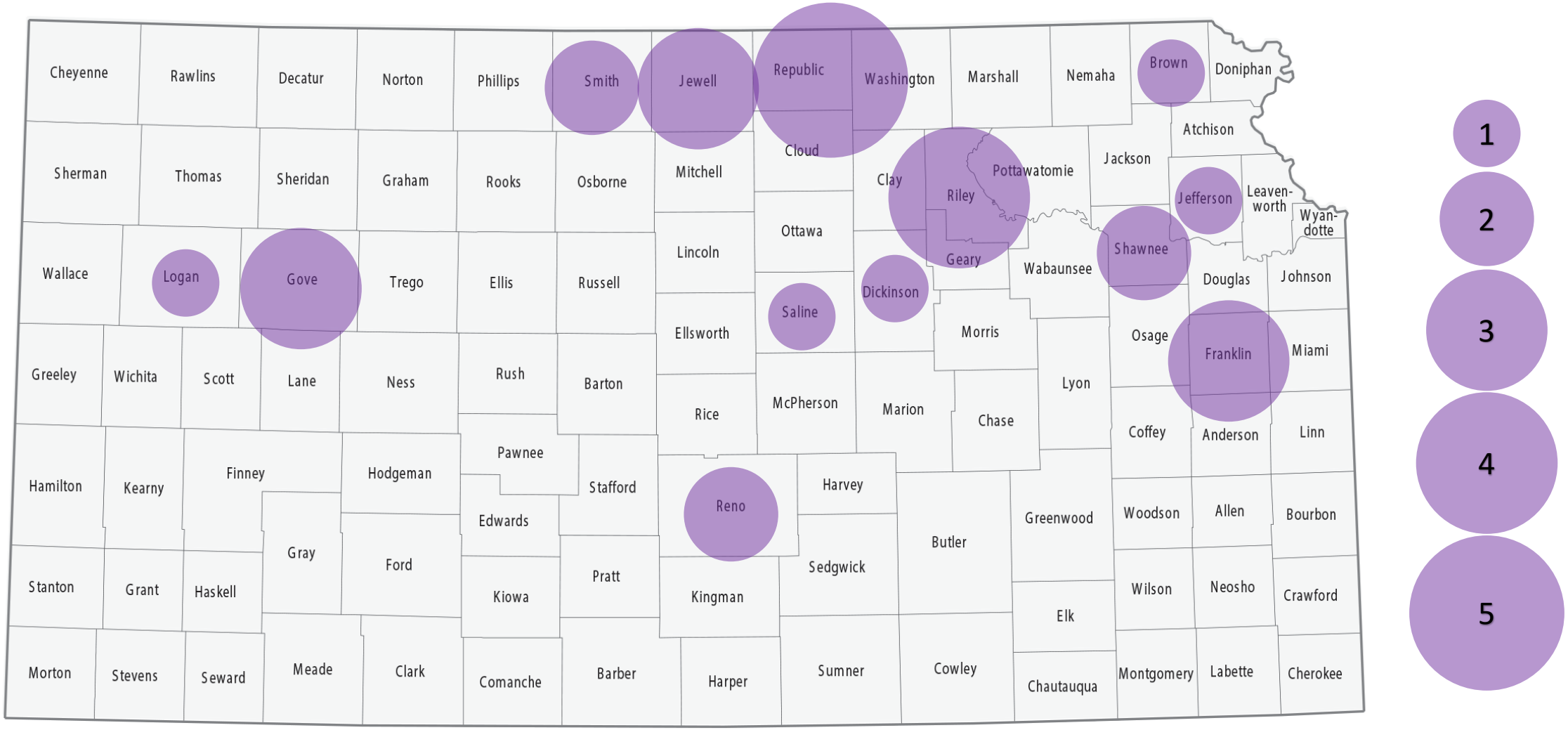
P released from the mineral fraction ?

- Long-term study at Tribune
  - Zero P was applied to the control for 63 years
  - 2-3 ppm STP the 0P control





Corn P response: Total of 30 sites across Kansas during 2021-2023



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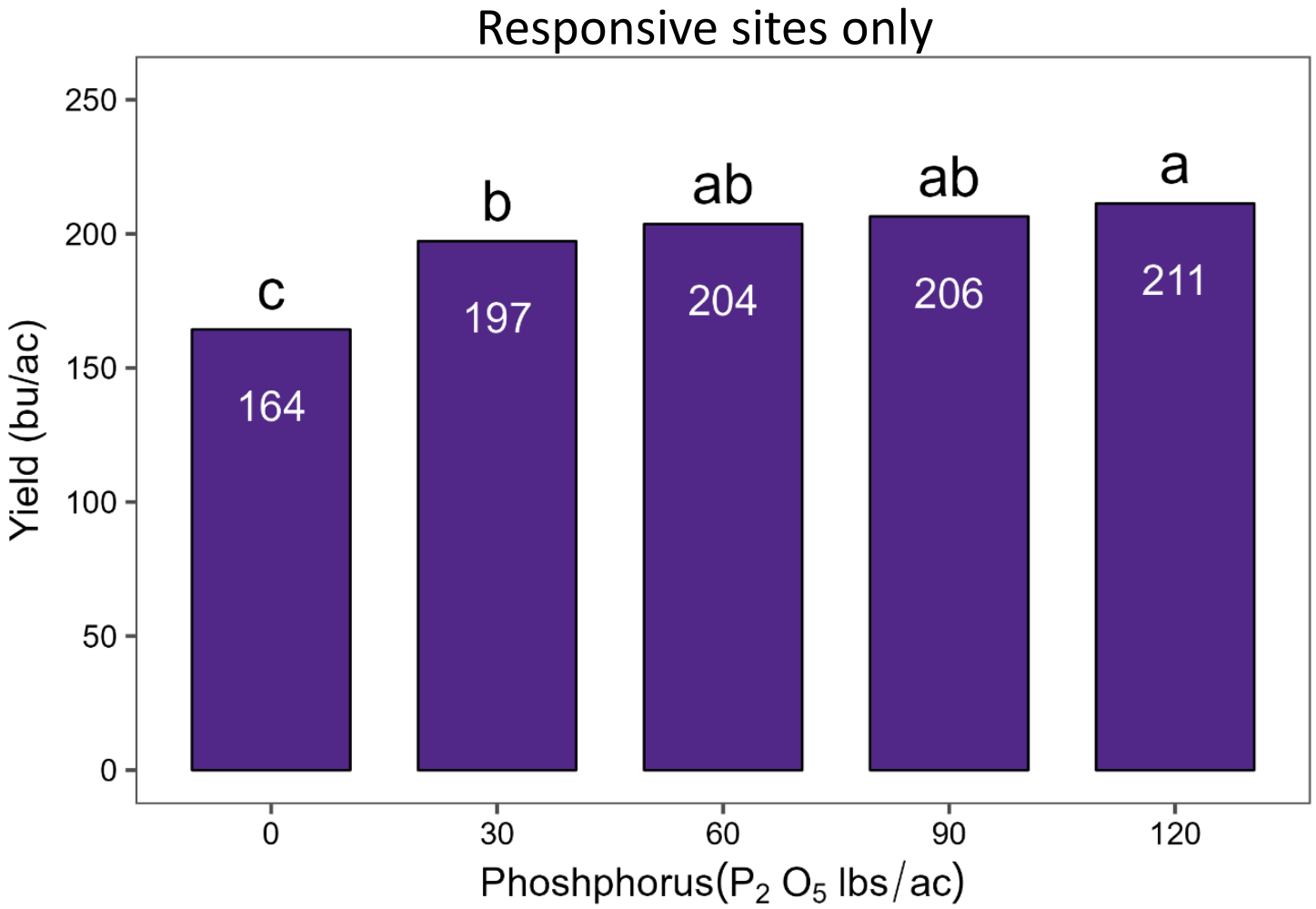
Corn Yield response to P fertilizer rates



30 sites, 2021-2023

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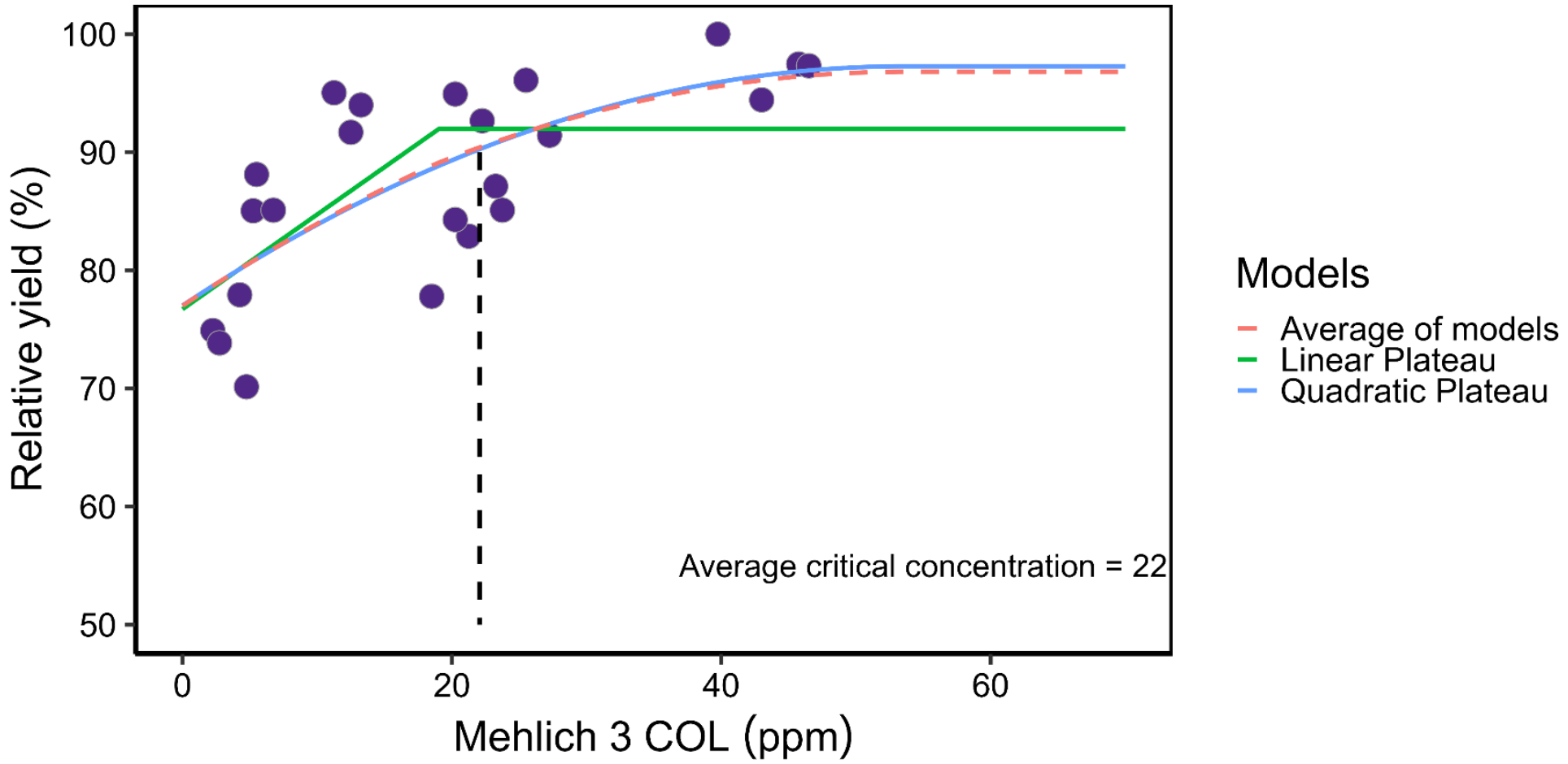
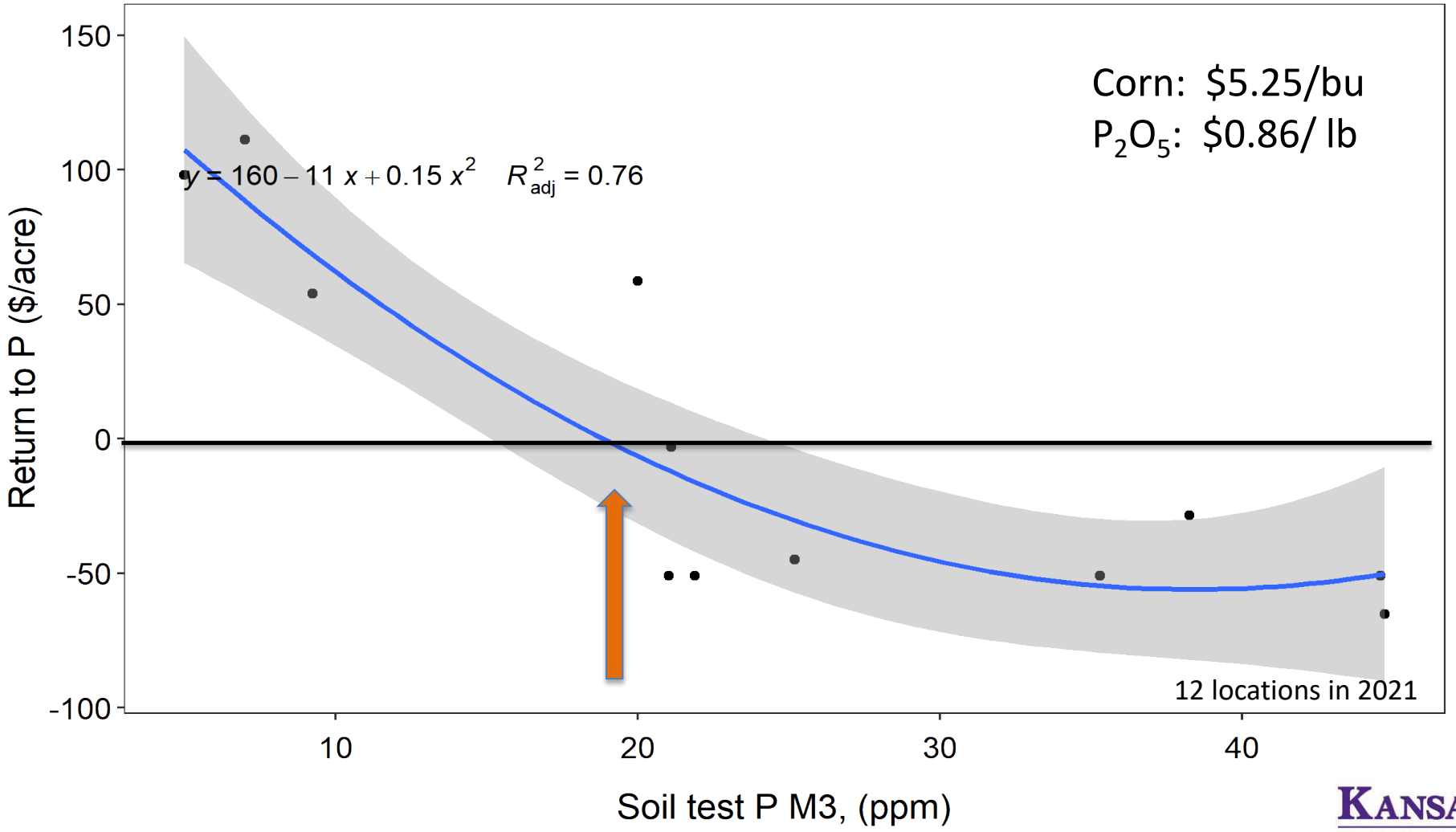
Corn: Critical soil test value using Mehlich 3

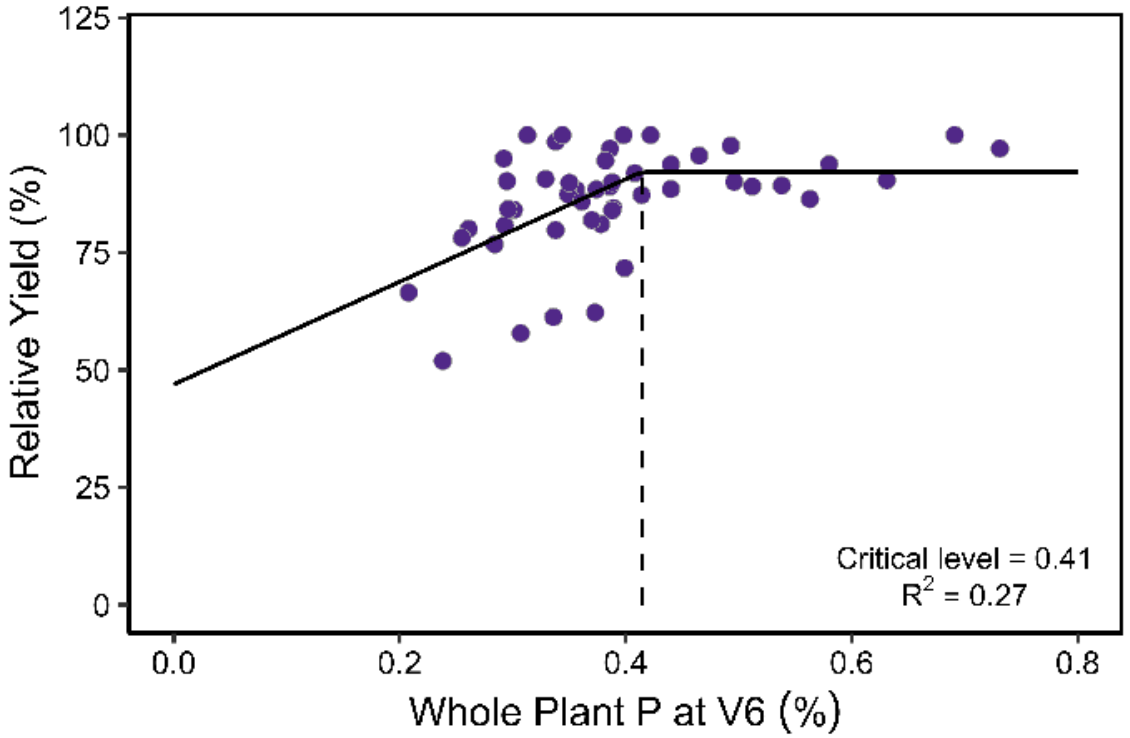


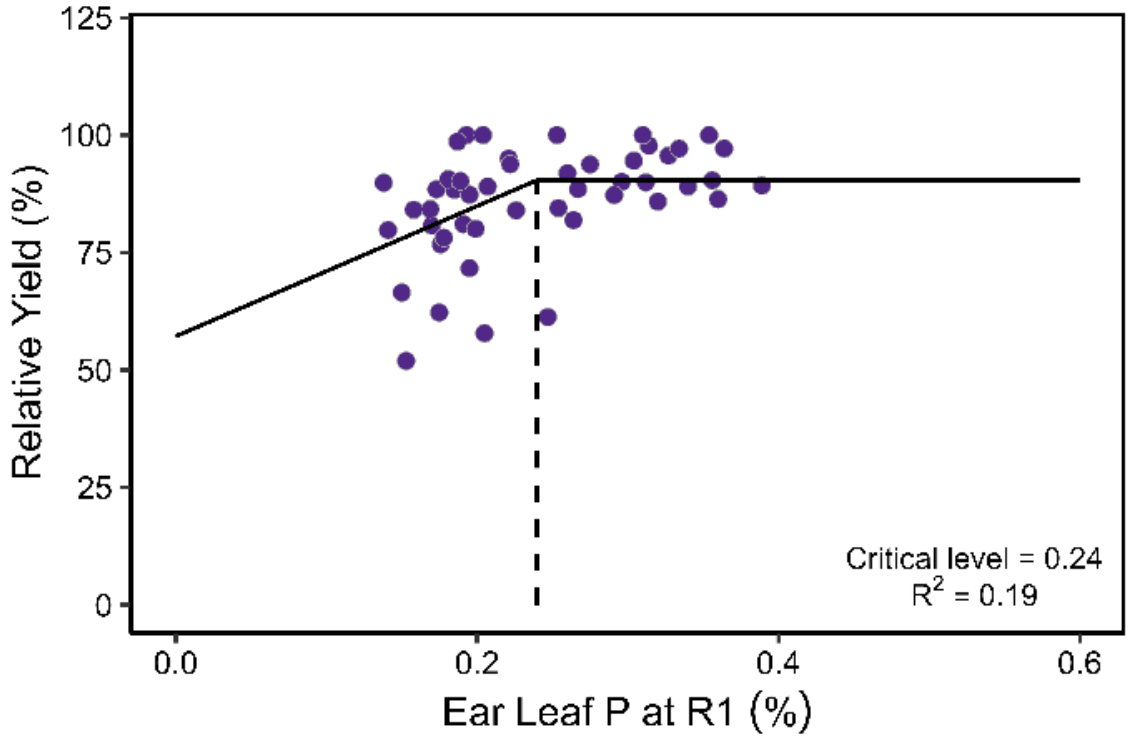
30 sites, 2021-2023

$ return to 60 lbs of P_2O_5 in the year of application in corn

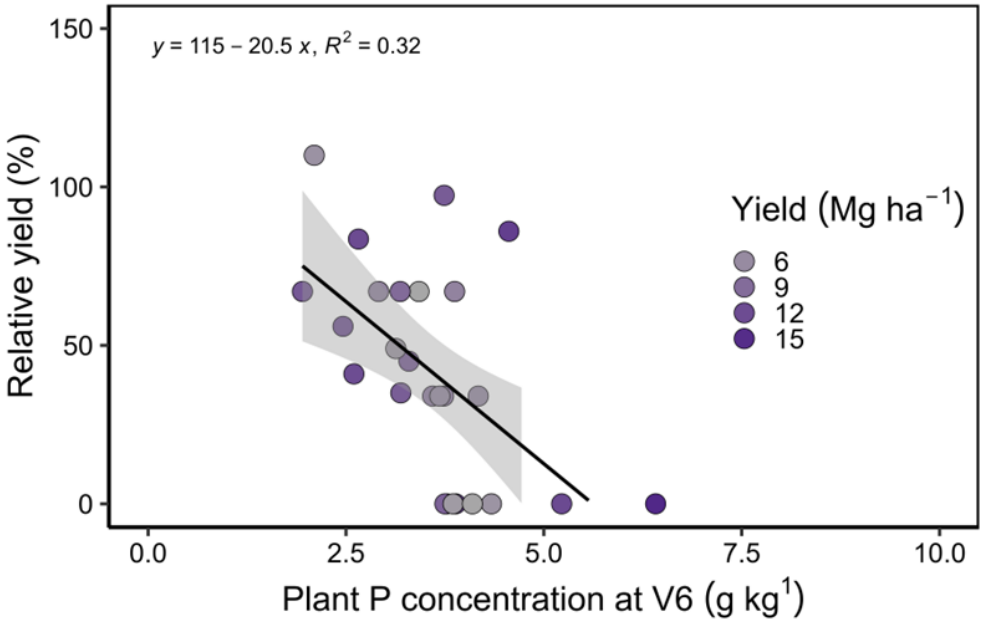


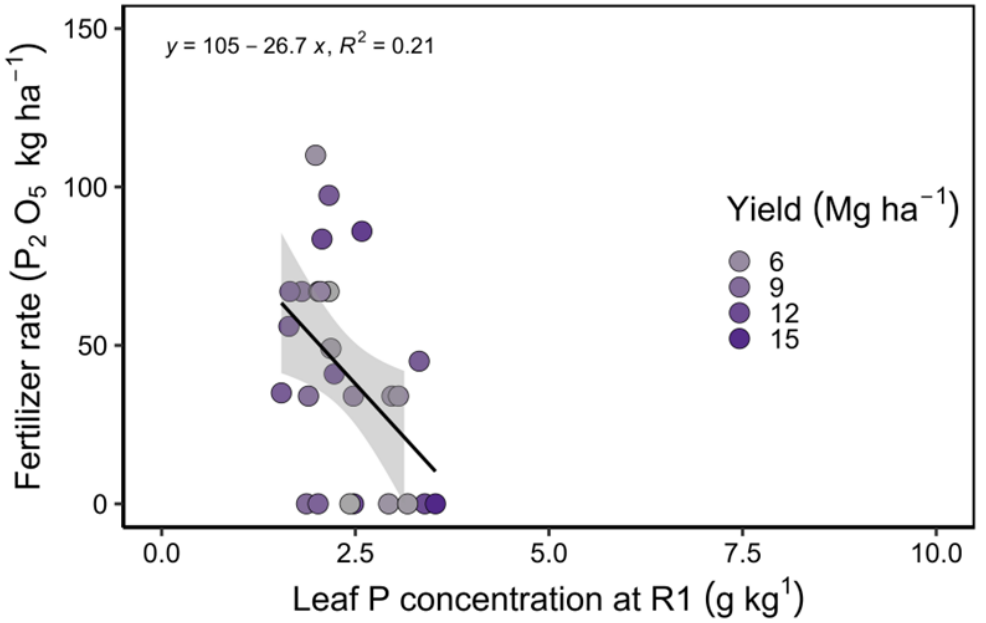
Corn: Relationship between relative yield and tissue concentration





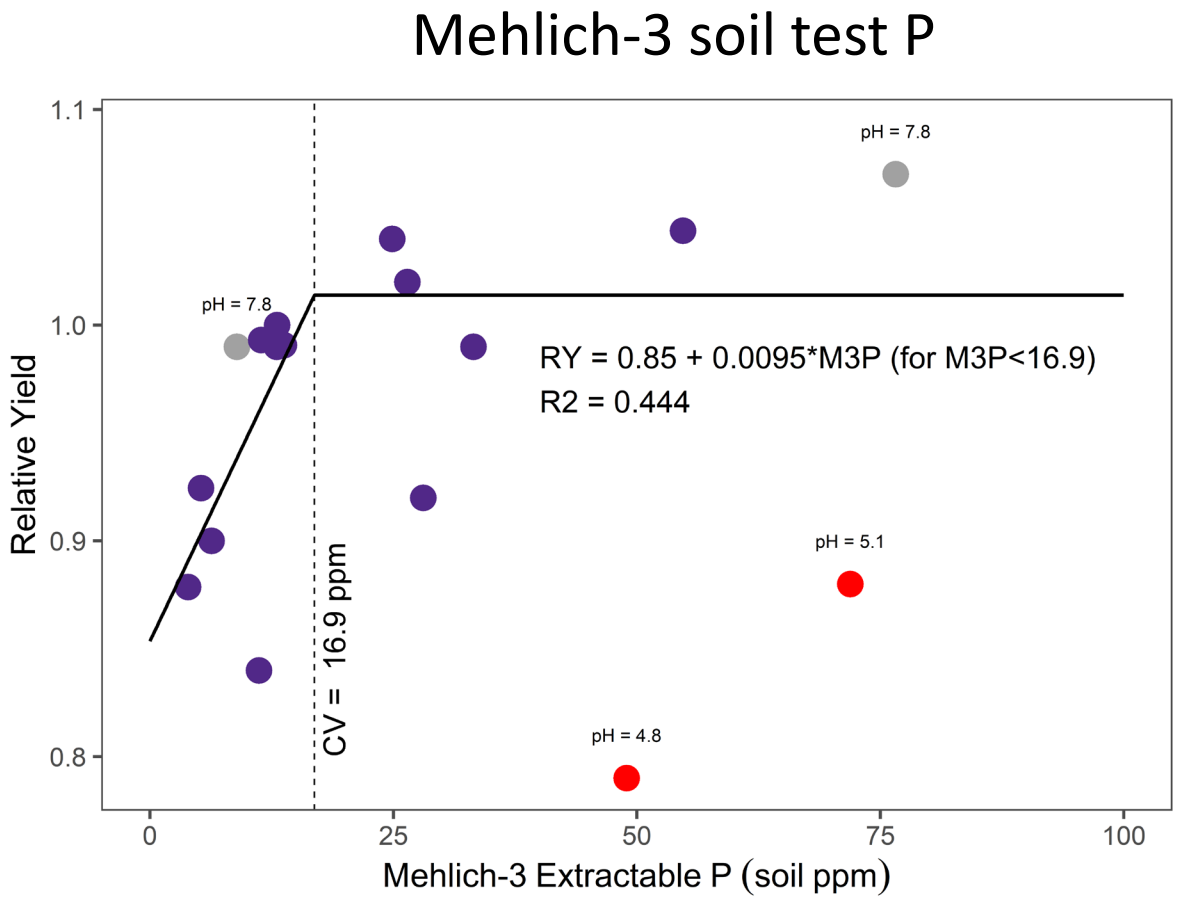
Corn: Response to fertilizer rate and tissue concentration





26 sites

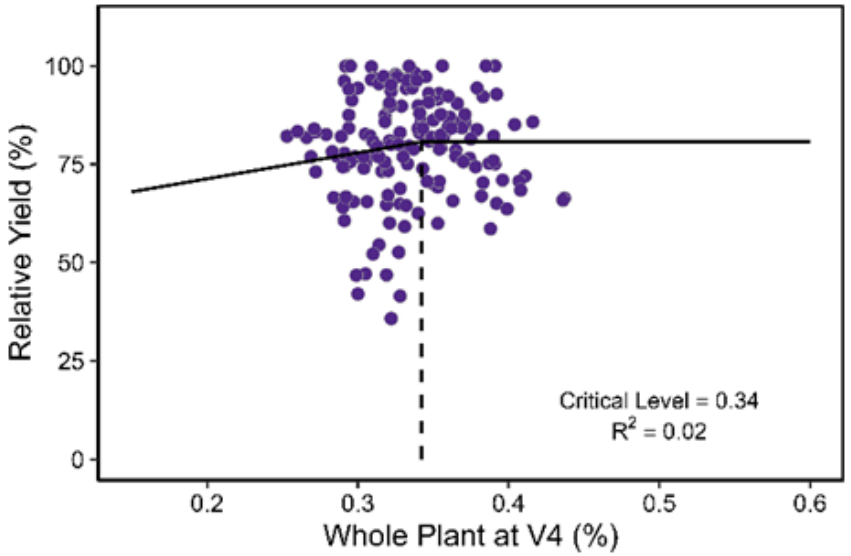
Soybean: response and soil test phosphorus

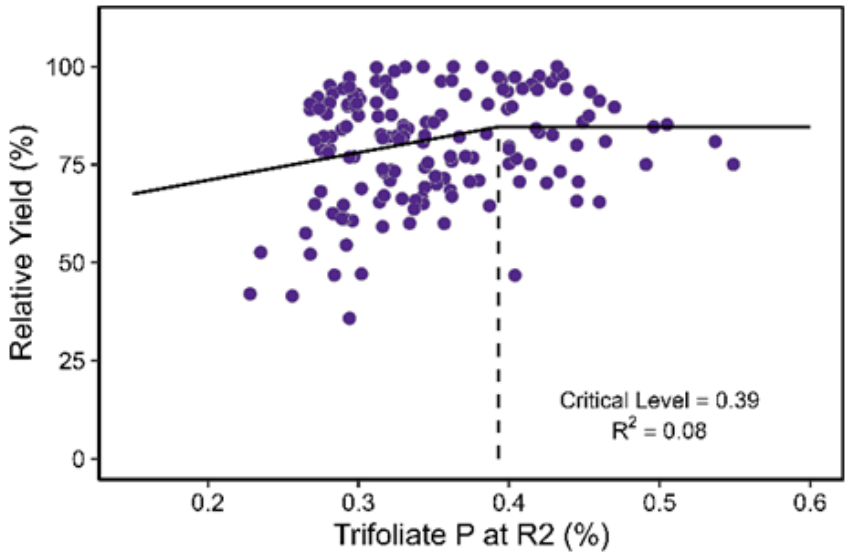


Critical value: 17 ppm

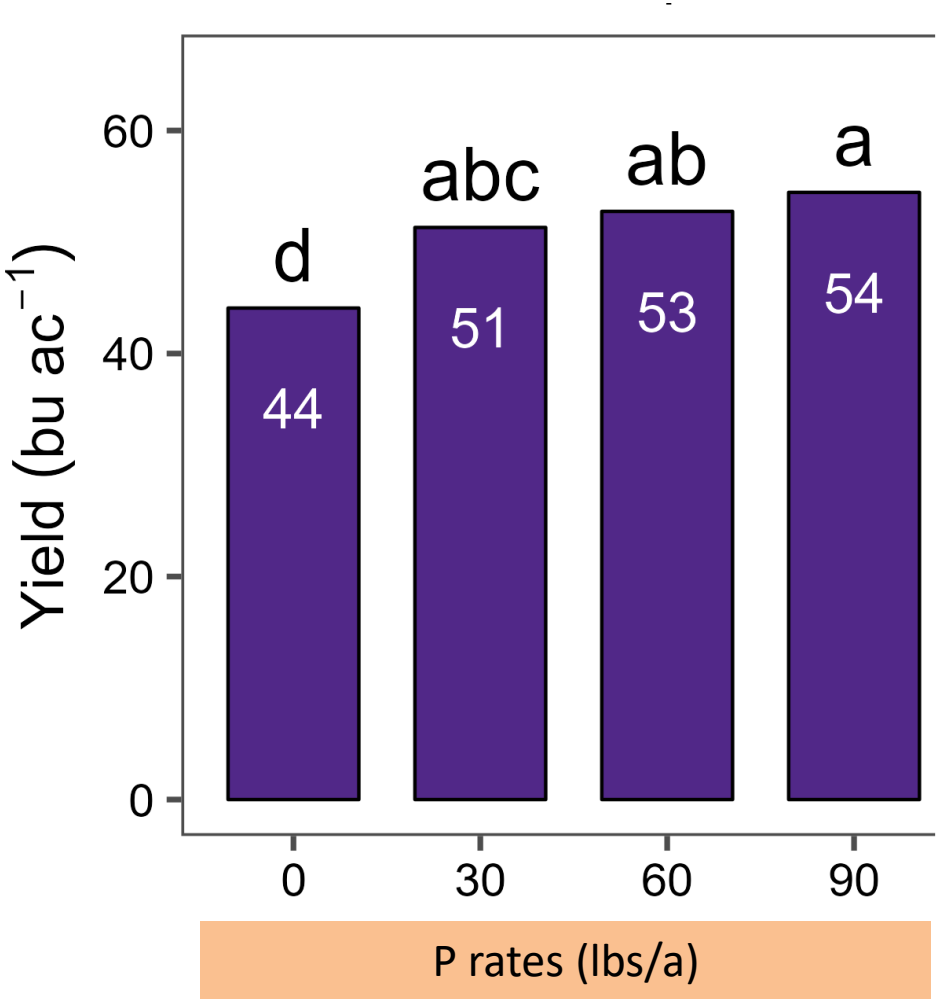
18 locations 2019-2021

Soybean: Relationship between relative yield and tissue concentration





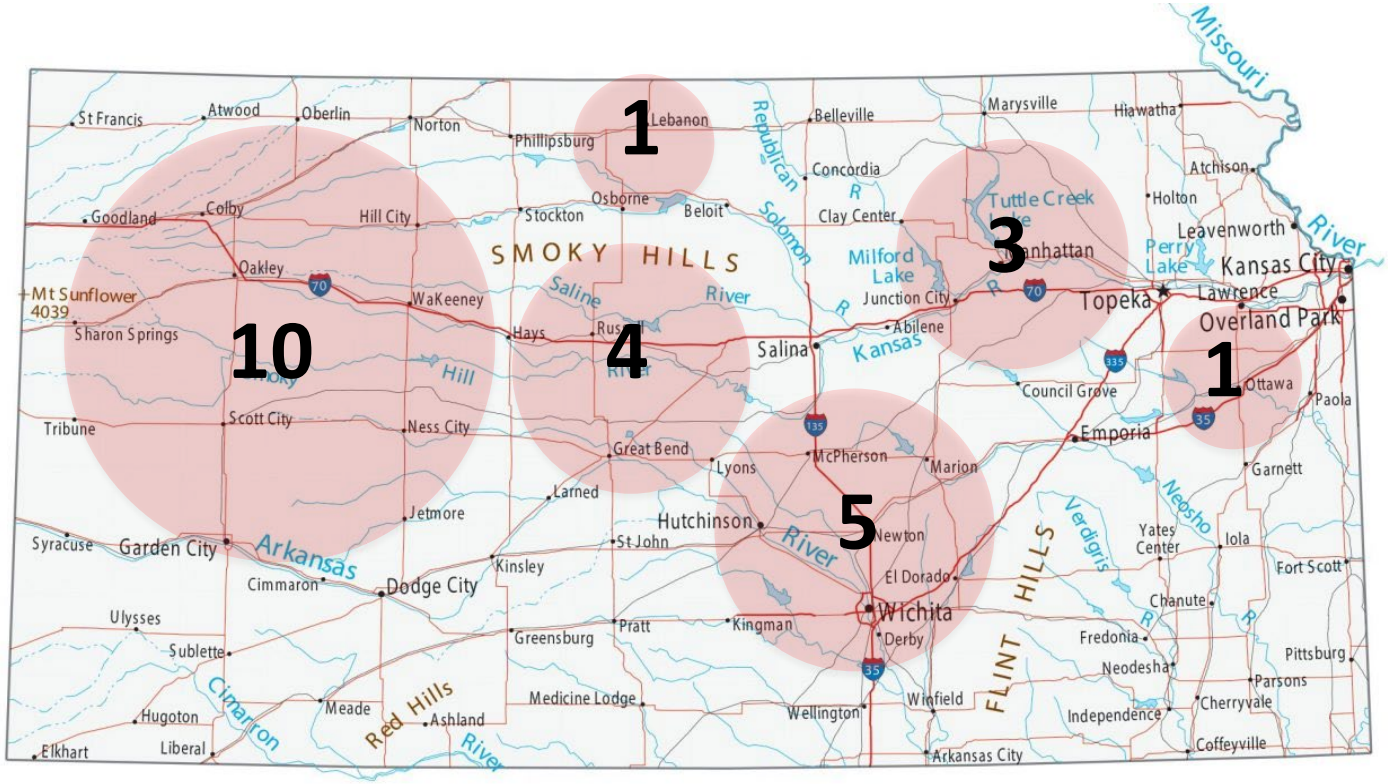
Soybean yield response to direct P application vs residual



Average of 6 locations 2022-2023

Phosphorus in wheat

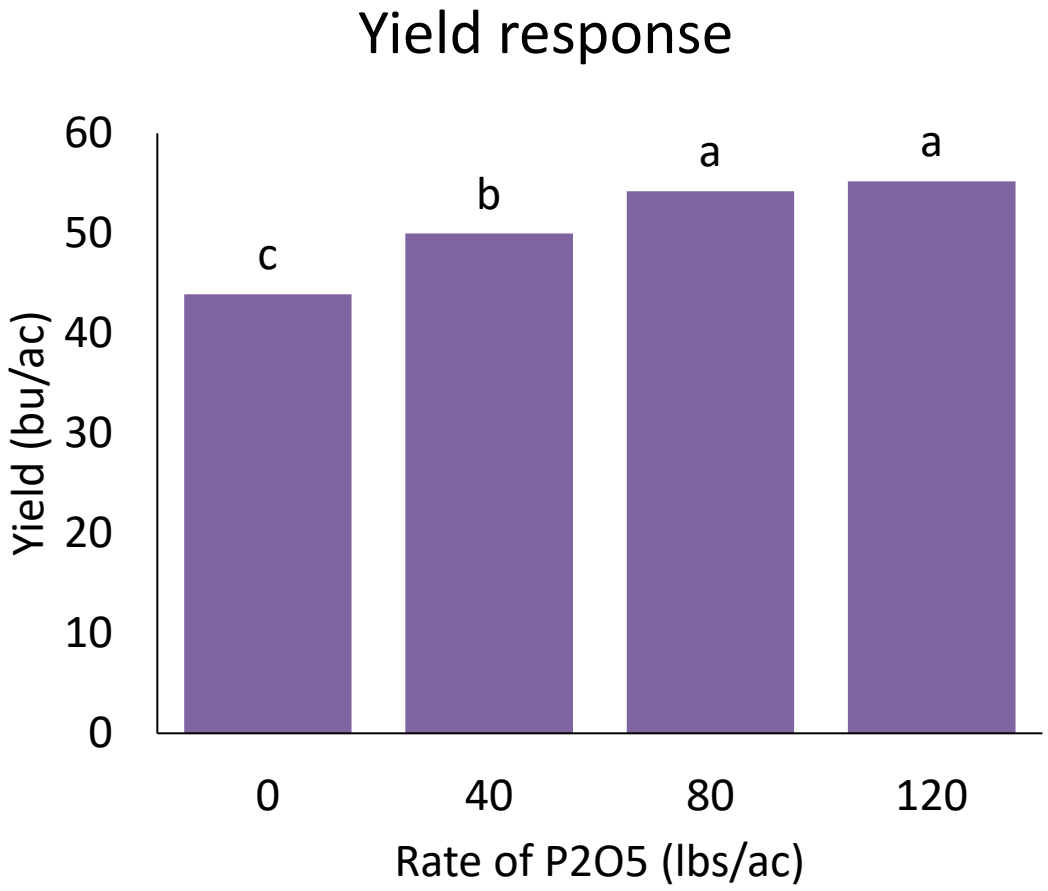
- 24 locations in two years (2019 and 2020)
  - 18 Farmer's field
  - 6 University

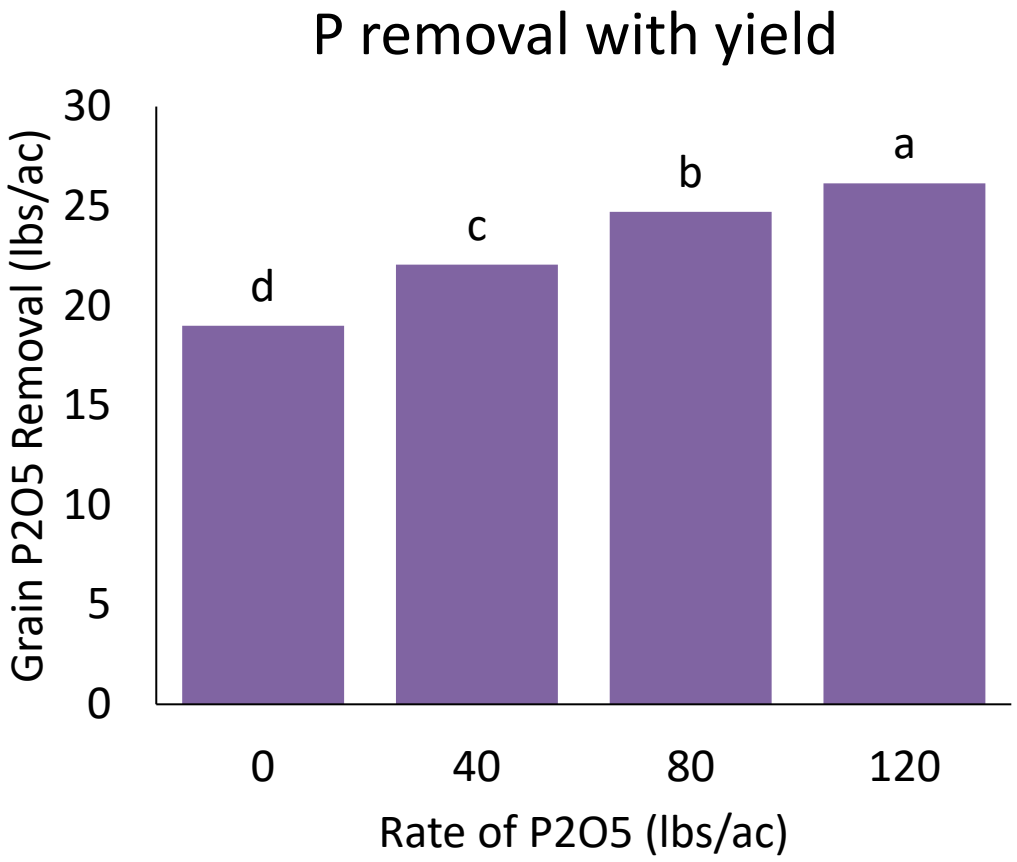


Wheat response to phosphorus

N **N + P** **N** **N + P**

Average wheat response across locations





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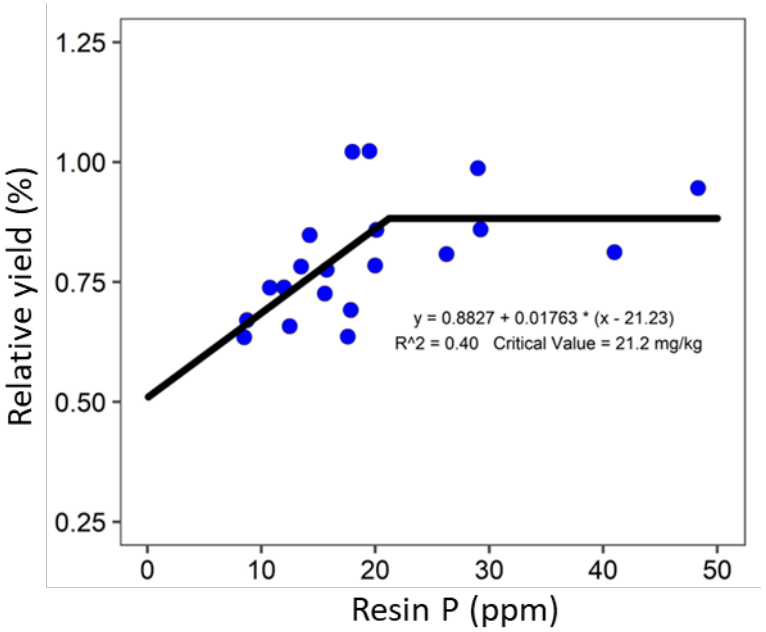
Different soil test methods and critical soil test levels in wheat

STP Method	Critical value (ppm)
Mehlich-3 COL	25
Bray-1	26
Olsen	12
H3A	26
Resin	20
Mehlich-3 ICP	36



24 sites across Kansas 2021

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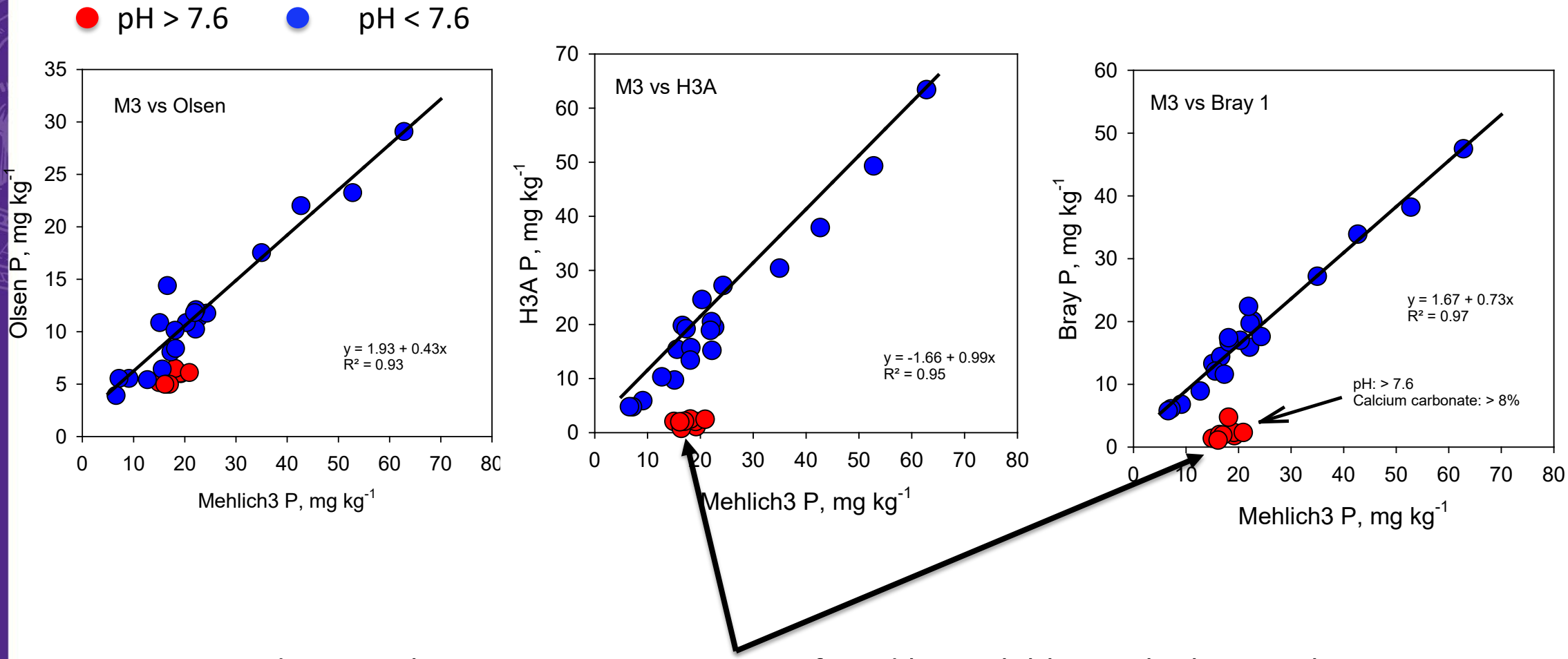
Common soil test methods

- Not all soil test methods are suitable for high pH soils

Bray -1	Developed for acidic soils, pH<7
H3A (Haney)	Uses weak organic acid extractant
Mehlich-3	Developed to be the ‘universal’ extractant
Olsen	Developed for high pH soils

Common soil test methods



- H3A and Bray soil tests not representative of readily available P in high pH soils
- **Request Olsen or Mehlich-3**

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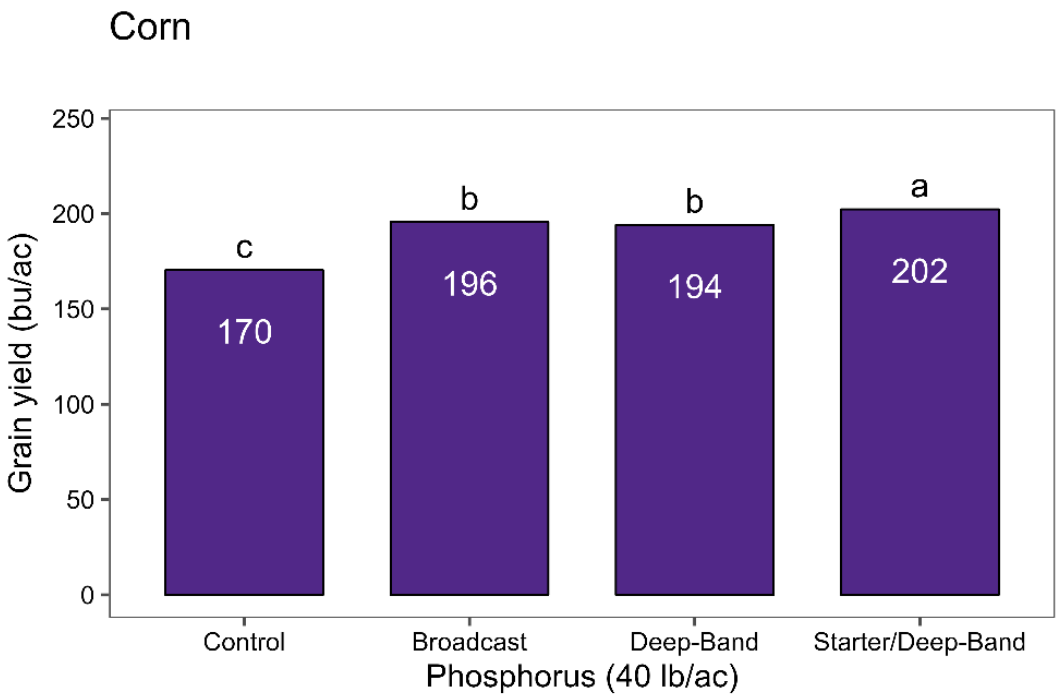
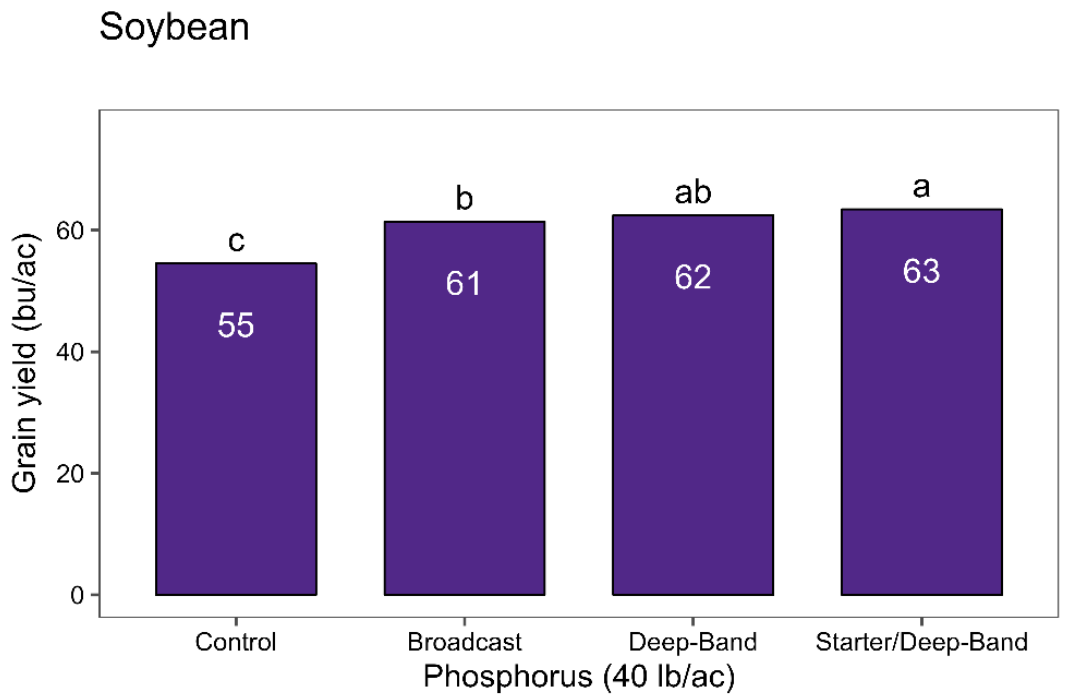
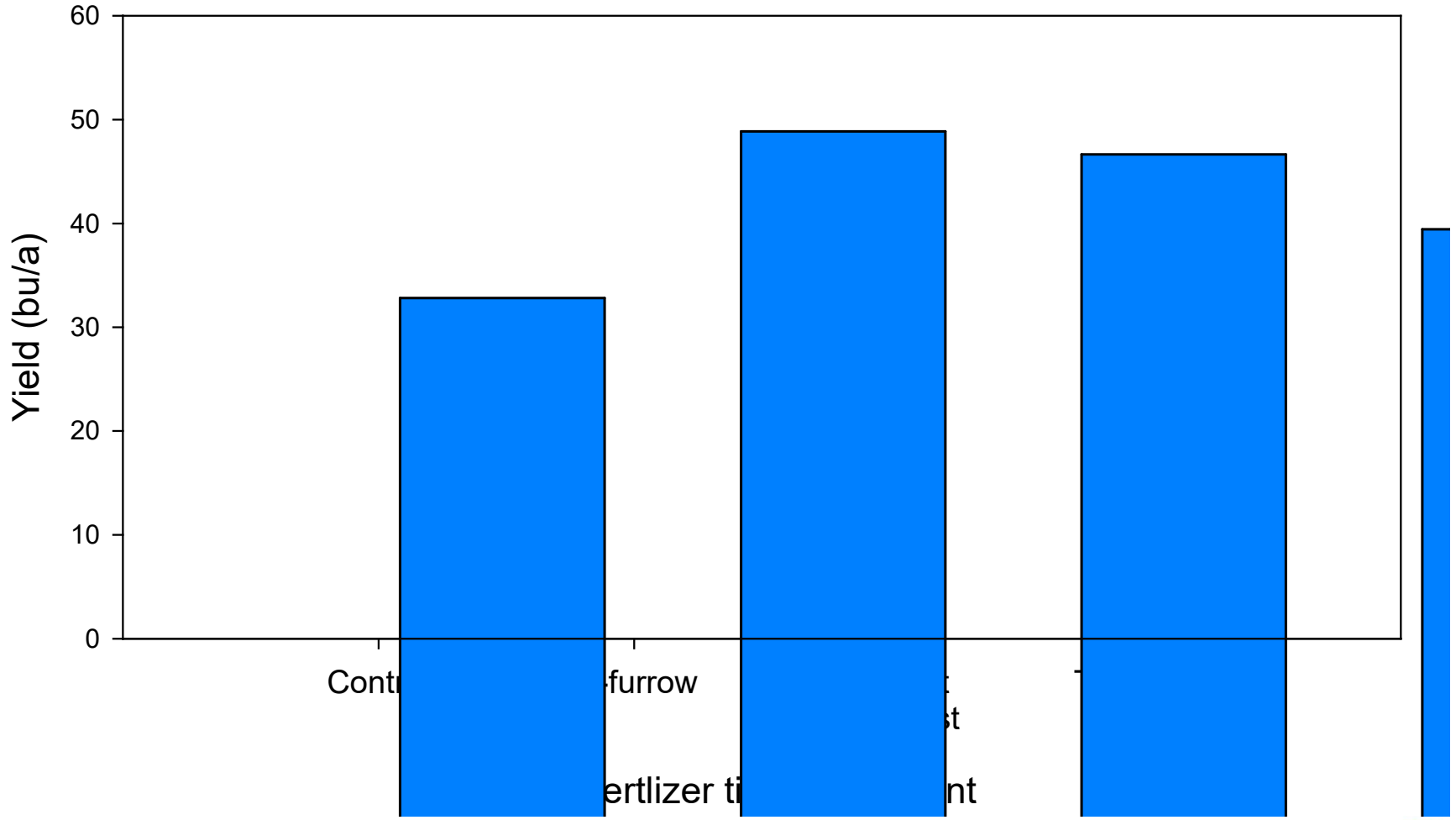
Phosphorus fertilizer placement – Scandia (17 year)





Fertilizer placement and time for wheat, 40 lbs of P2O5 using TSP



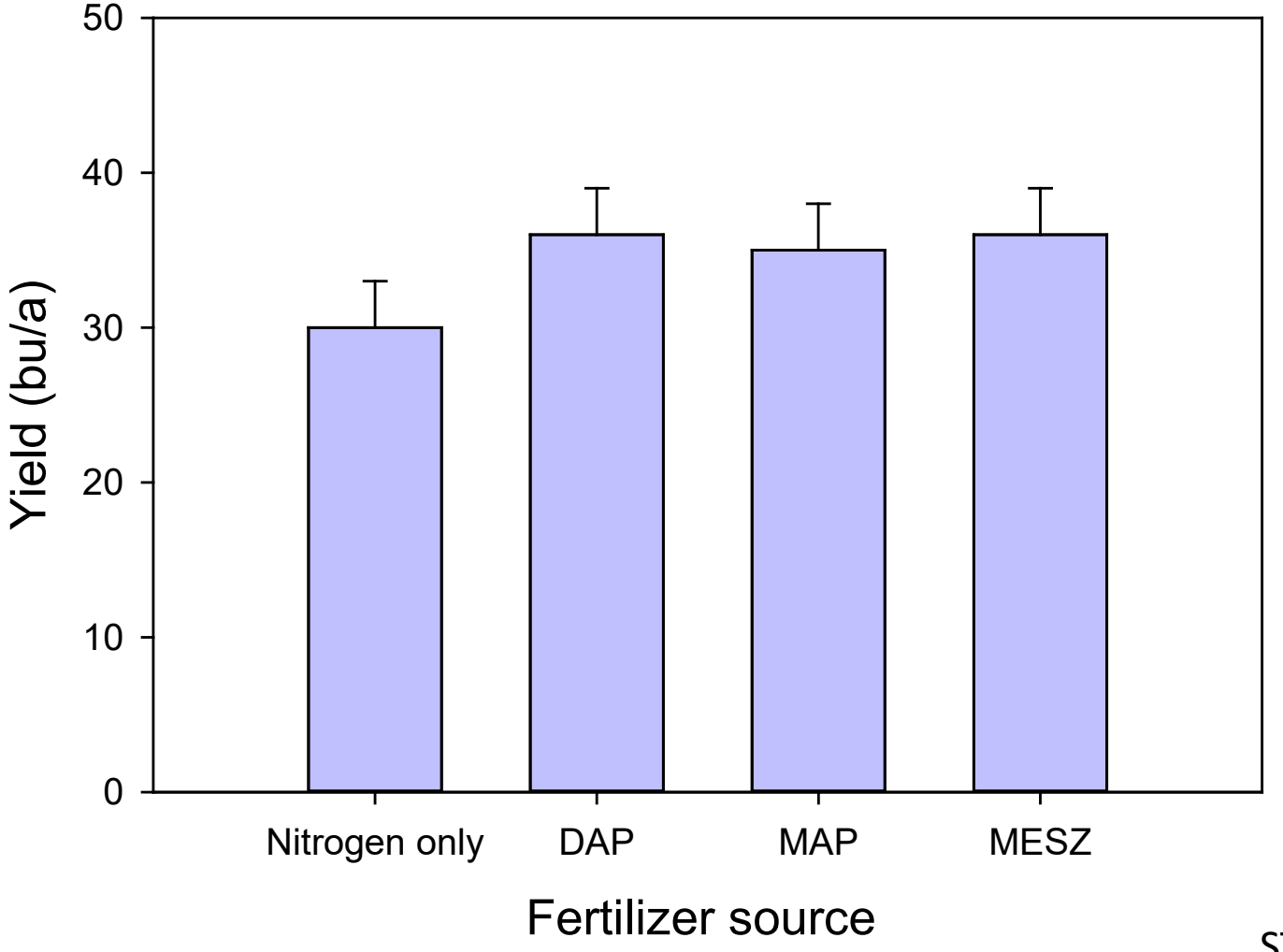
Average of 6 locations 2021-2022

Safe in-furrow fertilizer rates

- Safe rates of N + K2O in medium-fine textured soil (note: **no** urea)

Row Spacing (in)	N + K2O (lbs/acre)
30	8
20	12
15	16
12	20
10	24
6-8	30

40 lbs of P2O5 with different fertilizer sources in wheat



STP=7-22

Lebanon, Wilsey and Sabetha, 2018

Sulfur response and diagnostic tools for corn in Kansas

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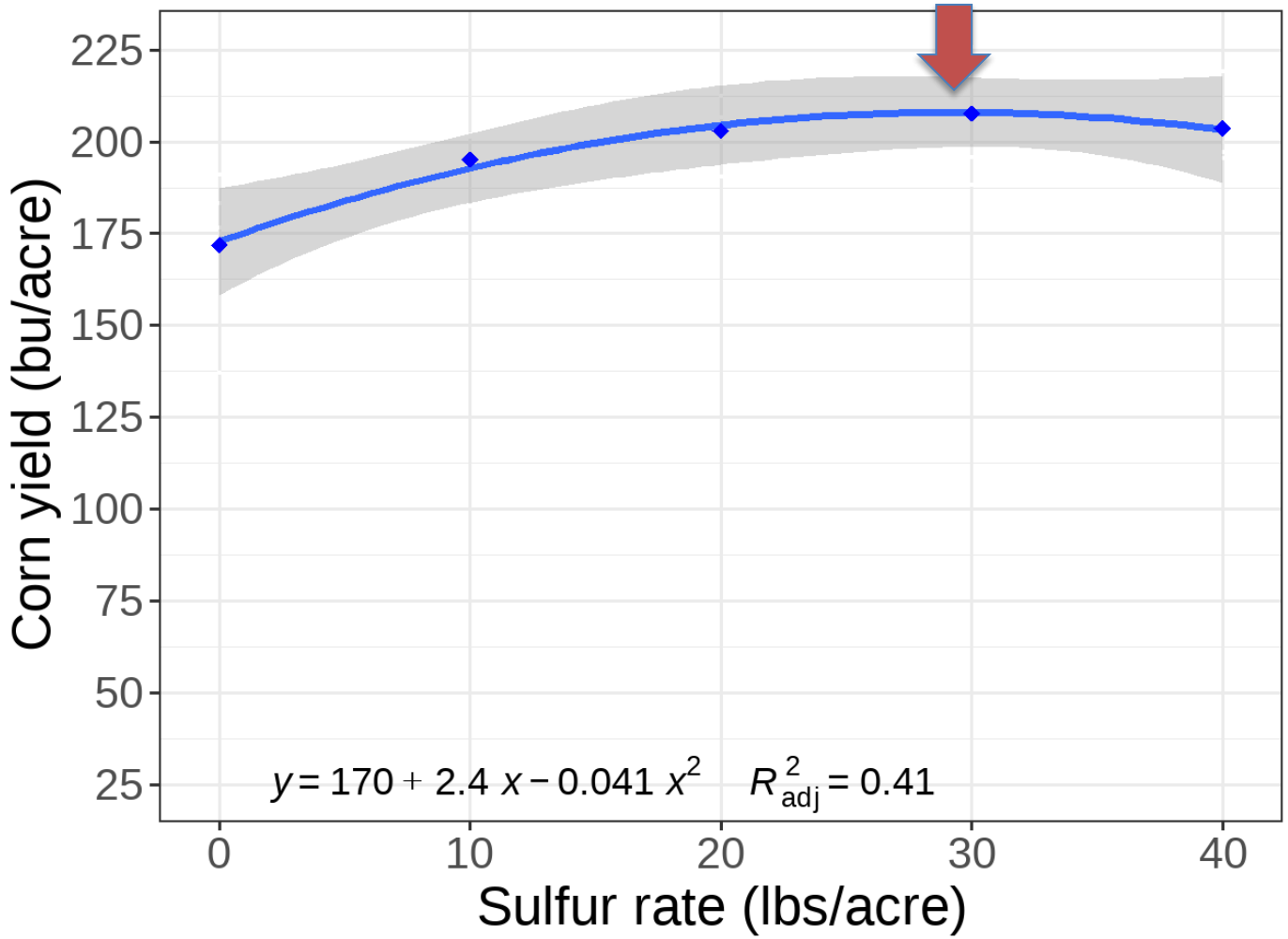
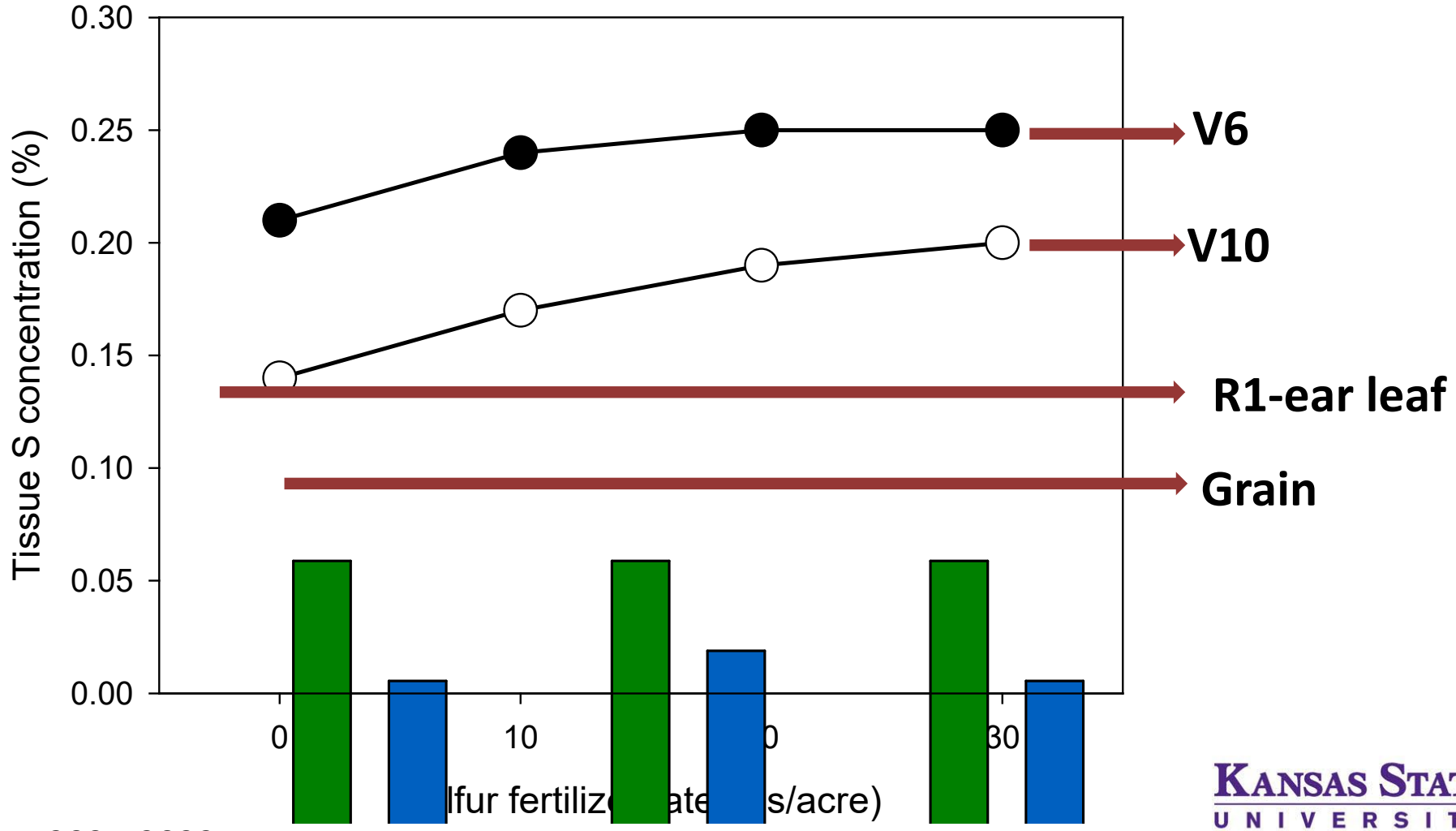
Responsive locations to sulfur



Agronomic optimum sulfur rate = <u>29 lbs/a</u>

4 responsive site-years 2021-2022

Corn tissue sulfur and S fertilizer rate by growth stage



4 responsive site-years 2021-2022

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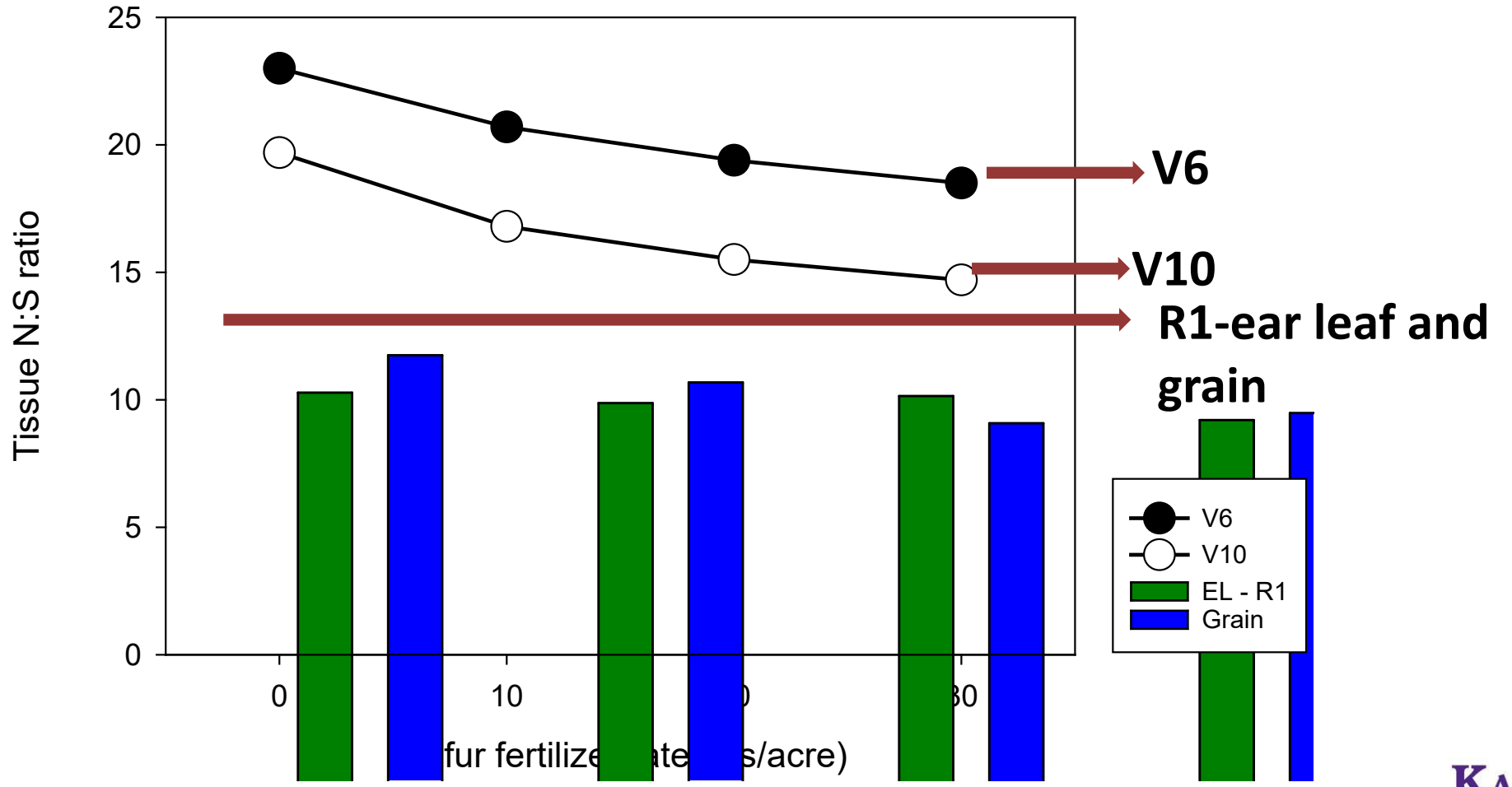
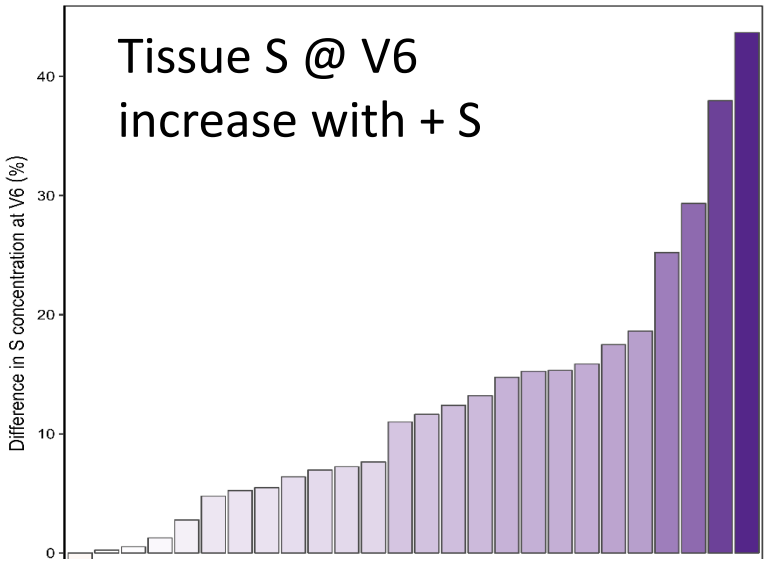
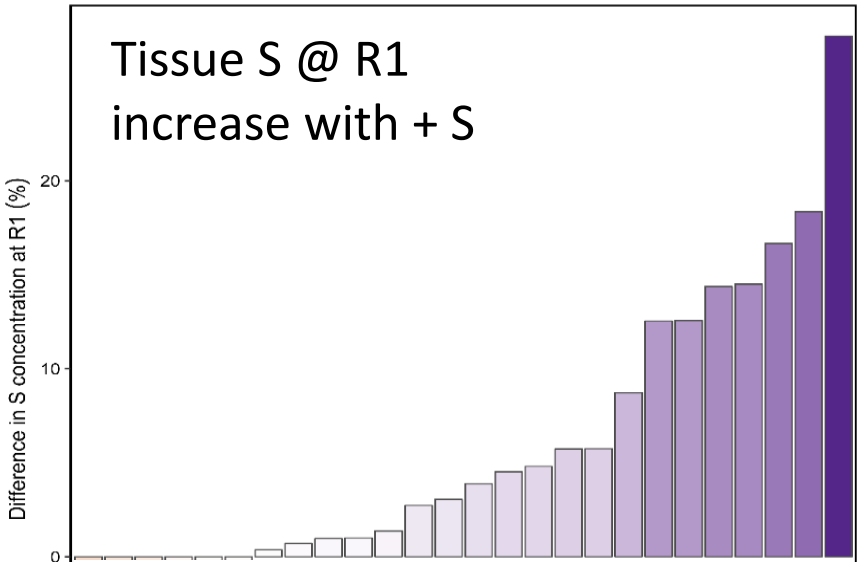
N:S ratio in corn tissue and S fertilizer rate by growth stage

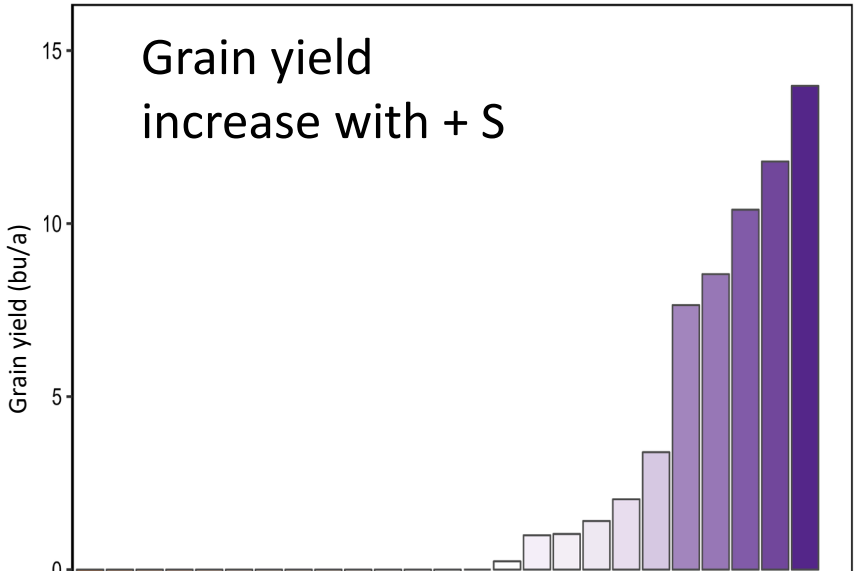


4 responsive site-years 2021-2022

Change with sulfur fertilizer application (40 lbs S/a) - 26 locations

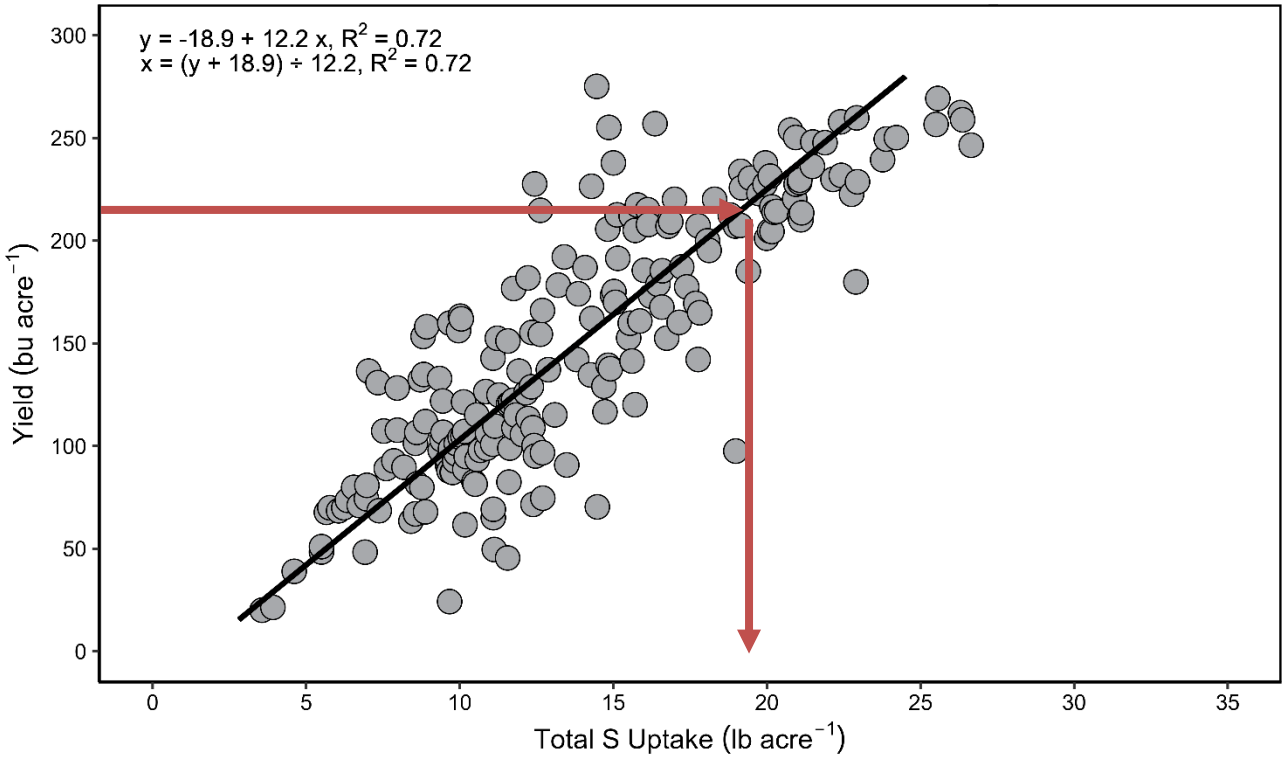






26 locations 2021-2022

Corn whole plant S uptake at R6 (stover + grain) vs yield



220 bu/a corn take up
~ 19 lb S/a

26 locations 2021-2022

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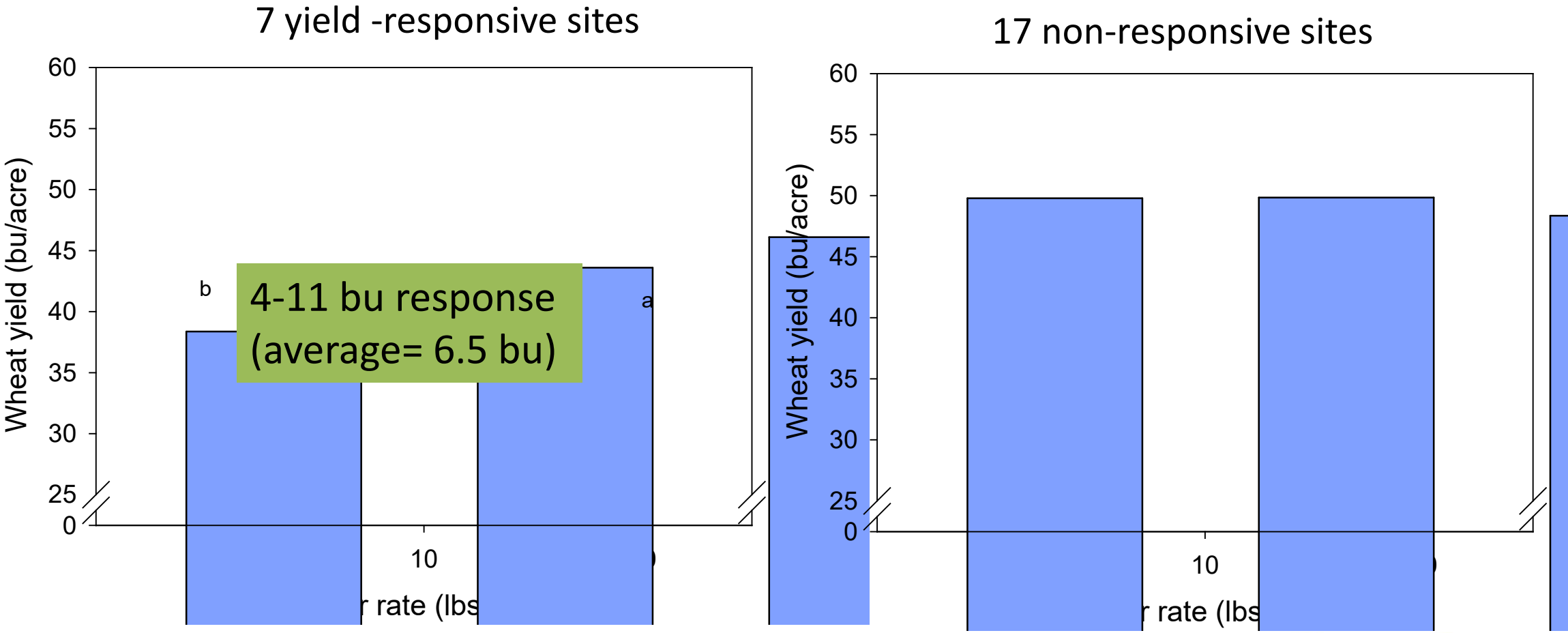
Wheat yield response to sulfur across 24 locations in Kansas



24 locations in 2019-2021

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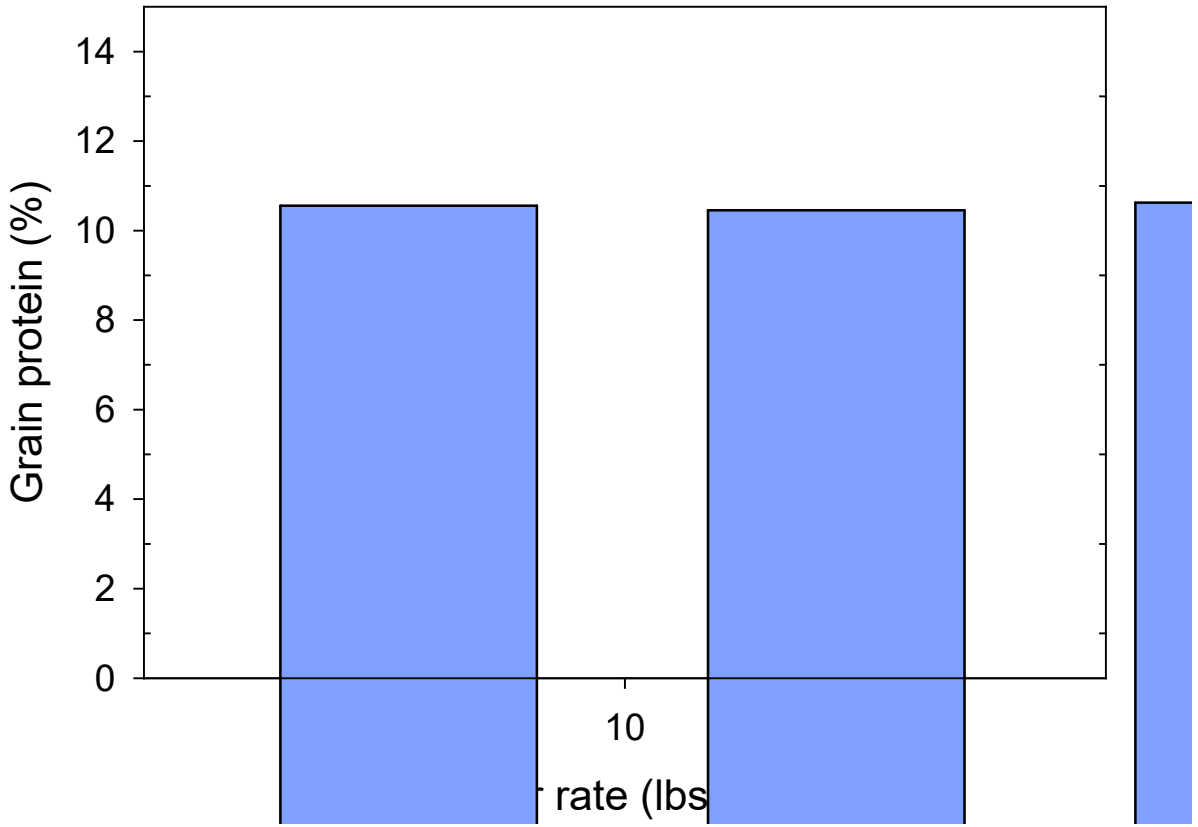
Protein response to sulfur across responsive locations

7 responsive sites



24 locations in 2019-2021

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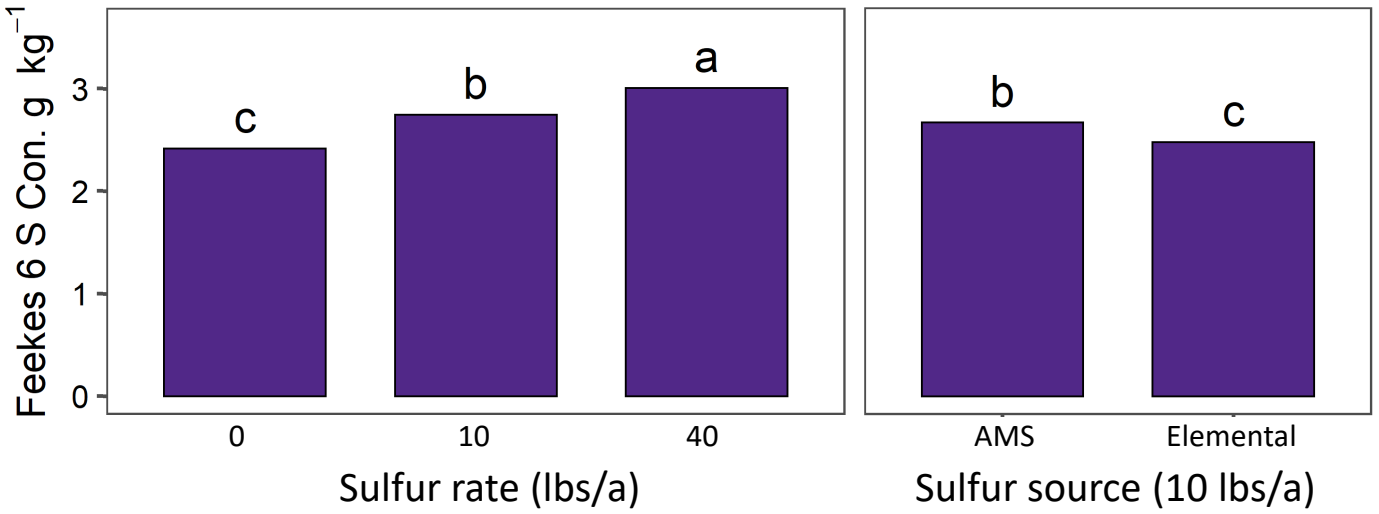
Wheat response to sulfur rate and source across locations



24 locations in 2019-2021

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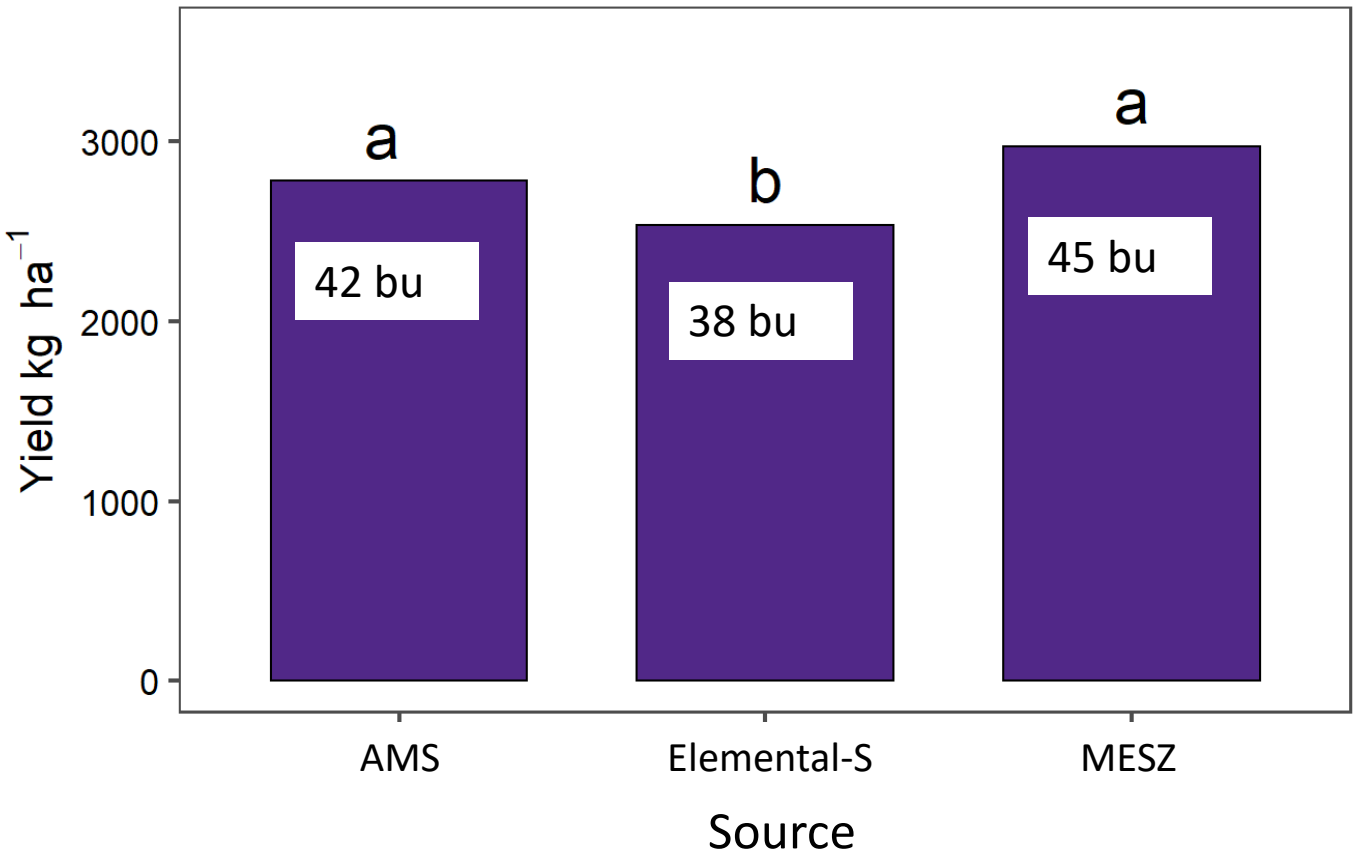
Fall-applied sulfur source for wheat and dryer environments



40 lbs of S + 40 lbs of P2O5

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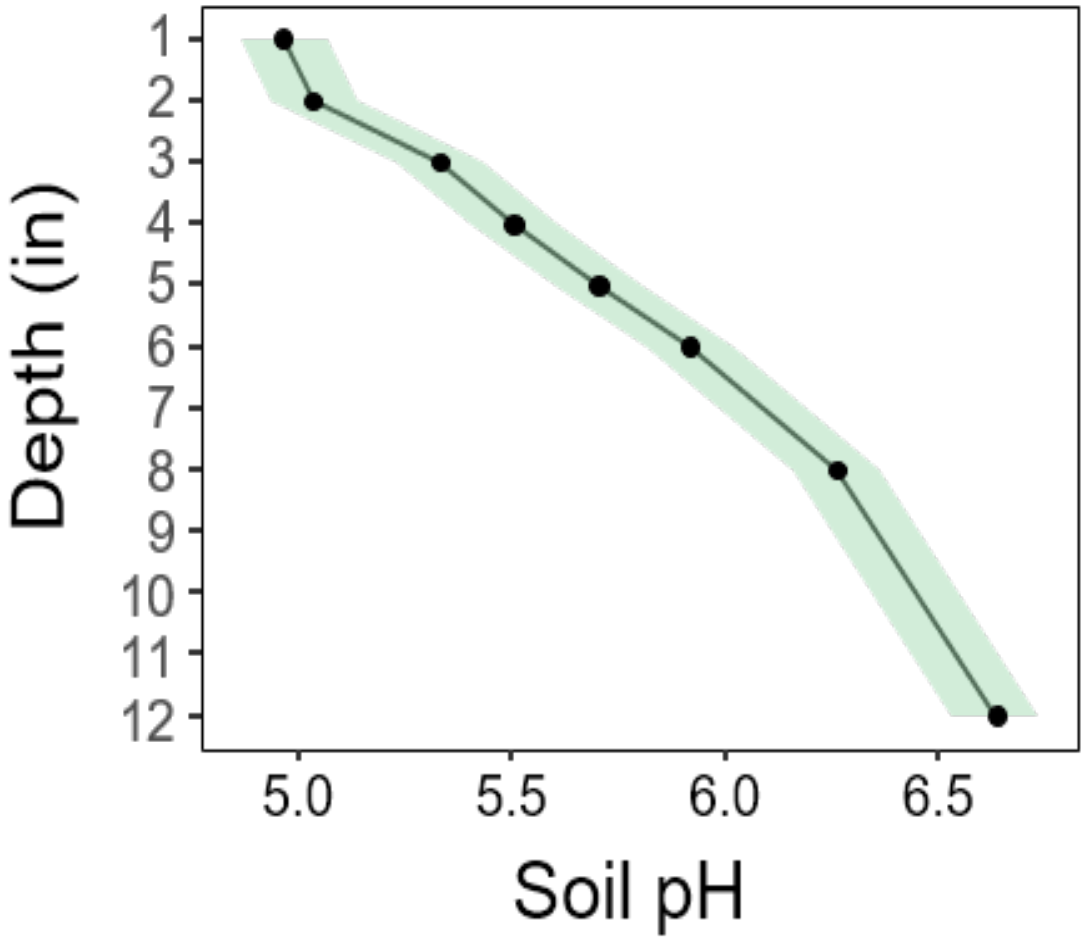
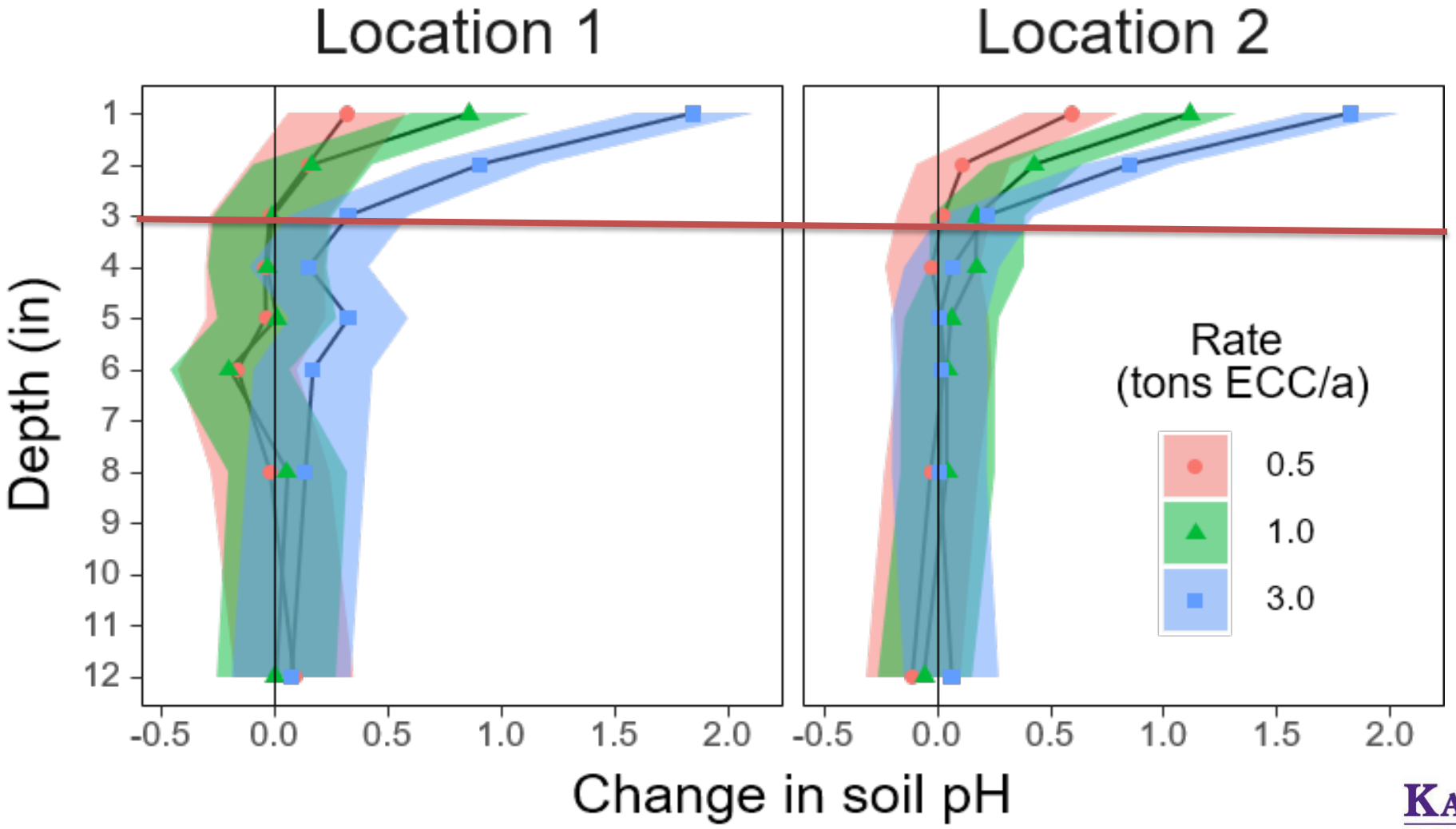
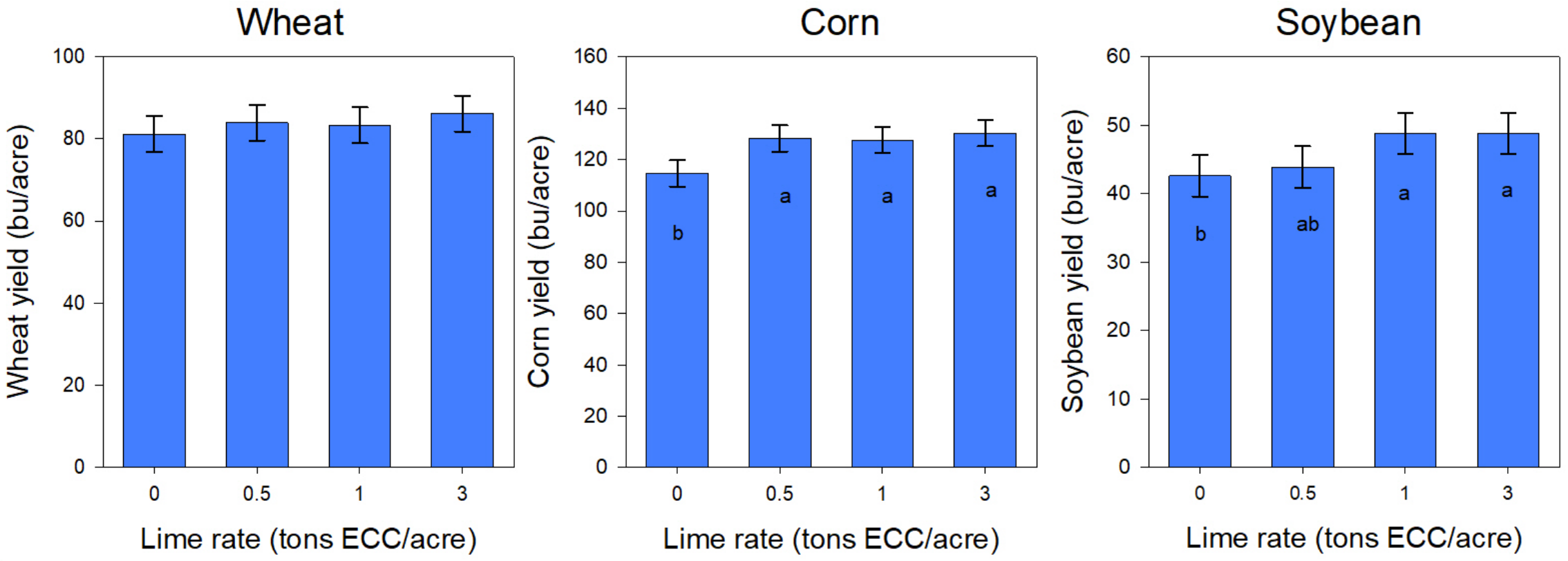
Surface soil acidification and lime application in no-till



Changes in soil pH with surface lime application



Yield response to surface lime application for wheat, corn and soybean



Crop rotation in this order: wheat, corn, soybean (2017-2019)

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Thank you!

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