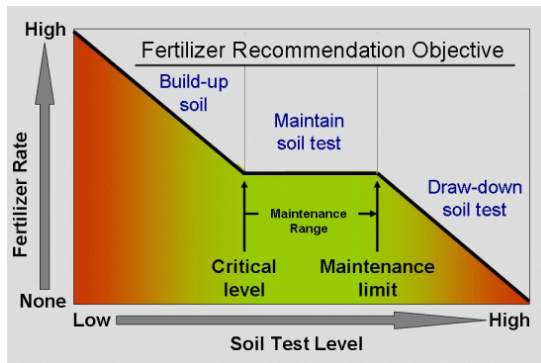
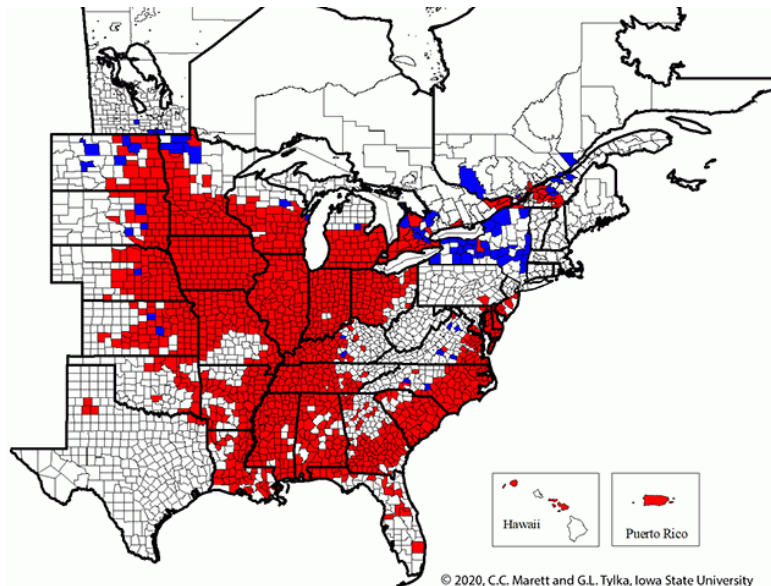


AGVISE Demonstration Project Update



Vitosh et al. (1995)



- Agvise Seminars
- January 7-9, 2025
- Brent Jaenisch, Ph.D.



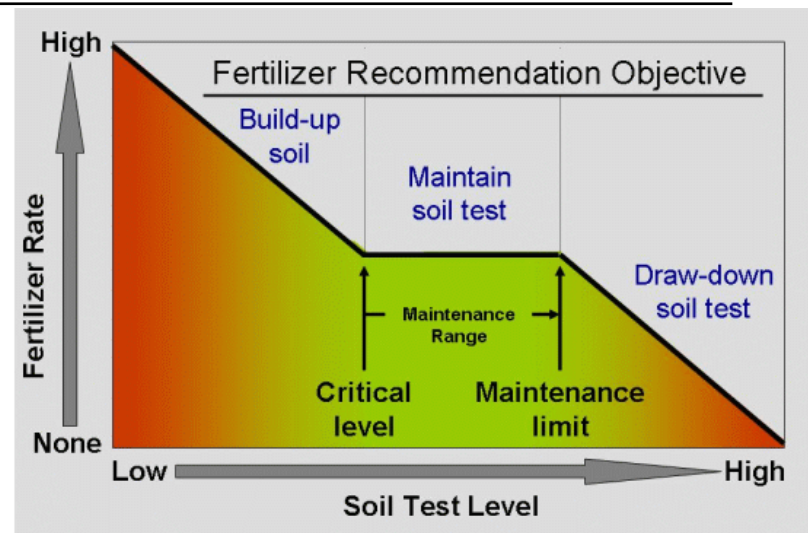
Outline

- Increasing soil test P and K values
- Decreasing soil pH with elemental sulfur
- 2024 SCN egg counts
- Summary

Background – Why build soil test P and K values?

Olsen soil test P category	Expected time P fertilizer will increase corn grain yield	Expected yield without P fertilizer
Very Low (1-3 ppm)	87%	87%
Low (4-7 ppm)	83%	90%
Medium (8-11 ppm)	27%	98%
High (12-15 ppm)	13%	99%
Very High (>15 ppm)	7%	99%

SOURCE: Kaiser, D. E., Fernandez, F., & Coulter, J. (2020). Fertilizing corn in Minnesota. Regents of the University of Minnesota. Available online: <https://extension.umn.edu/crop-specific-needs/fertilizing-corn-Minnesota> (accessed on 26 December 2024). Fertilizing corn in Minnesota.



Questions from growers about P

- Can you actually increase soil test phosphorus on high pH and calcareous soils?
 - We know high pH and calcium carbonate do increase phosphorus fixation.
- How much P does it actually take to move these soil test numbers in our upper Midwest soils?

Questions from growers about K

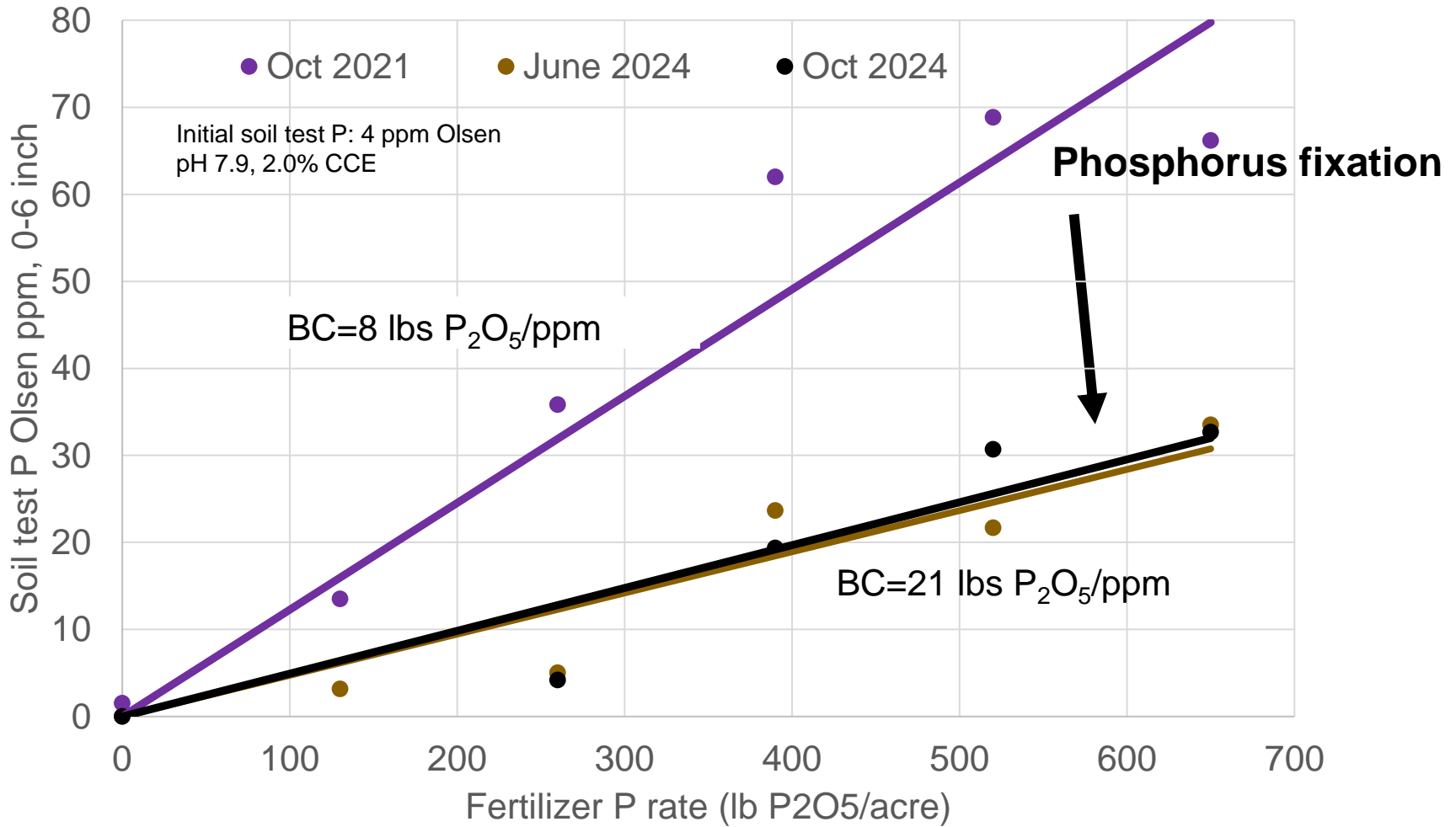
- Are you able to increase potassium saturation (%K) or base cation saturation ratios?
 - We know soils with high clay content have higher K buffering capacity.
 - We know soils with high pH, calcium carbonate, or salinity have inflated CECs and screwy BS calculations.
 - We know %K saturation is not important for soil potassium availability or crop uptake, so why do we still keep getting these questions?
- How much K does it actually take to move these soil test numbers in our upper Midwest soils?

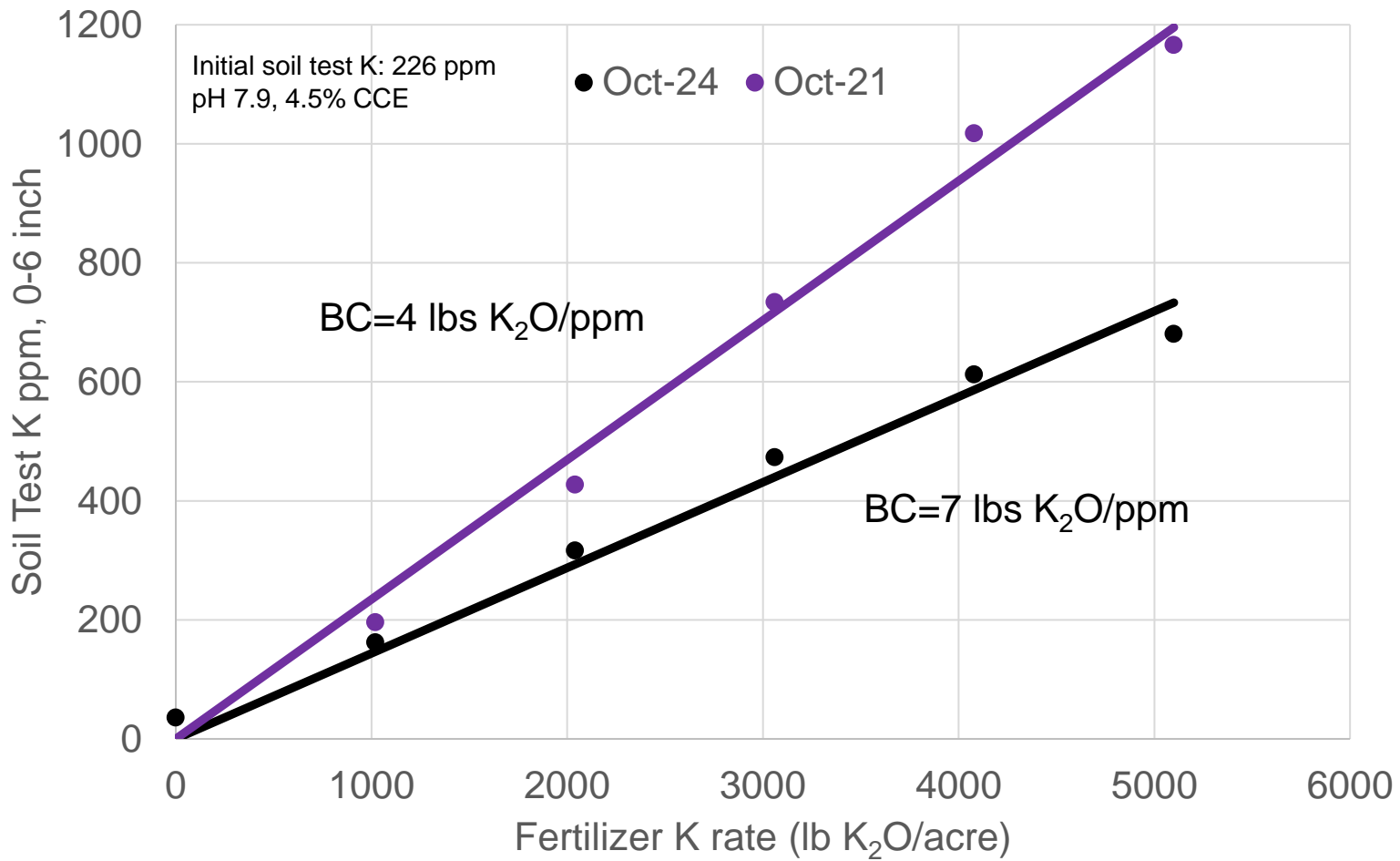
Long-term phosphorus and potassium fertilizer rate trial

- **Site:** Northwood, ND
 - Bearden silty clay loam
 - Soil pH: 7.9
 - Carbonate: 4.5% CCE
 - Initial soil test OP: 4 ppm
 - Initial soil test K: 226 ppm
 - Initial %K: 1.1%
- **Treatments:**
 - 0 to 1,250 lb/acre MAP (11-52-0)
 - 0 to 8,500 lb/acre potash (0-0-60)
 - rototilled to 6 inches after application

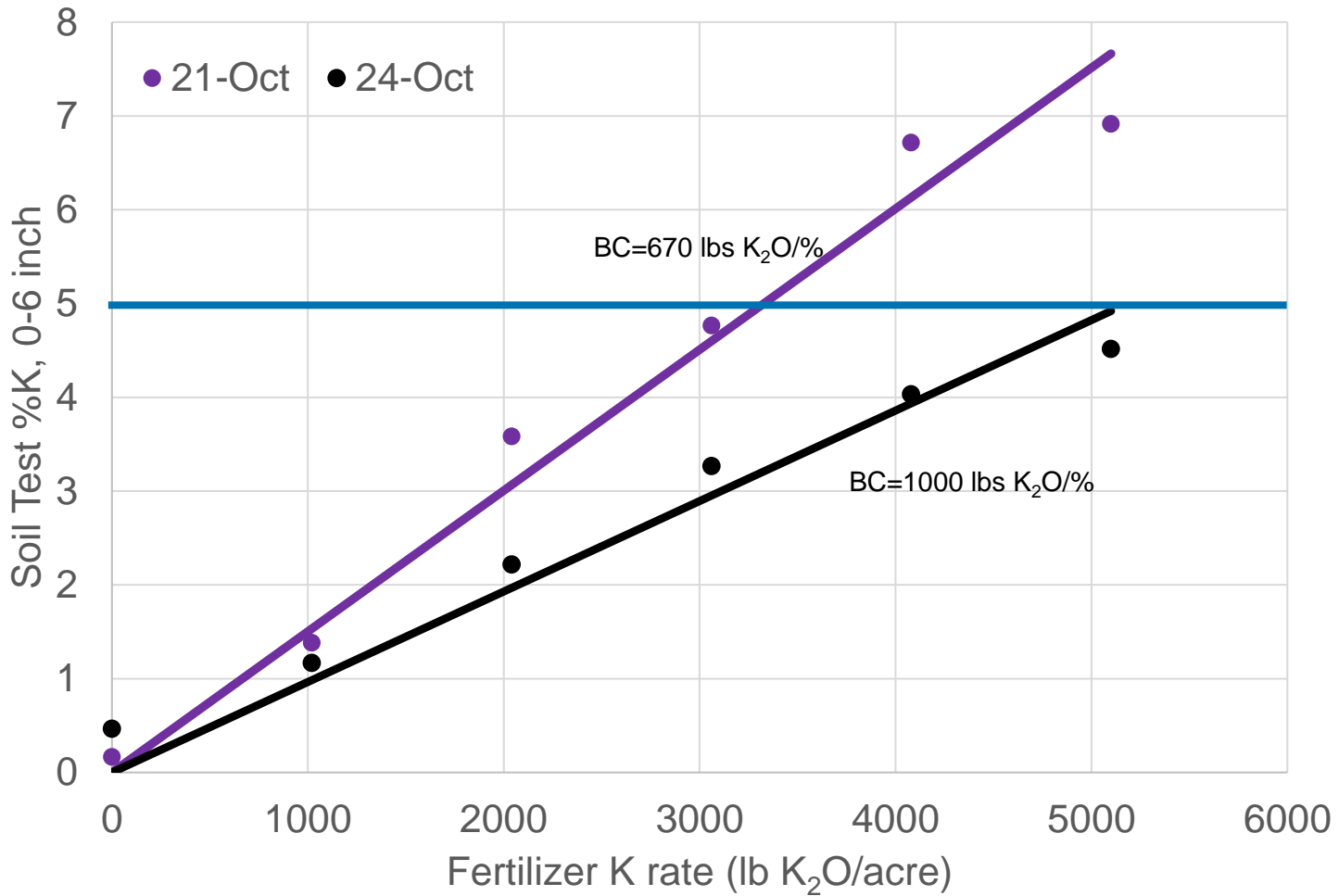


Trial initiated: September 1, 2021





Not sure what the “real” number is???



Soil buffering capacity, so far

Soil buffering capacity (building factor) describes how much added nutrient (fertilizer) is required to increase the soil test level. Factors include soil pH, soil texture, mineralogy, carbonate, and others.

Bearden silty clay loam, pH 7.9, 4.5% CCE.

Parameter	General range	Unit	Oct. 2021 (2 months)	Oct. 2024 (38 months)
Soil test P (Olsen)	15-20 lb/ 1 ppm	P ₂ O ₅	7.2 lb/ppm	21.0 lb/ppm
Soil test K	5-10 lb/ 1 ppm	K ₂ O	4.2 lb/ppm	7.0 lb/ppm
K saturation	soil dependent	K ₂ O	660 lb/%	1000 lb/%

Quick observations

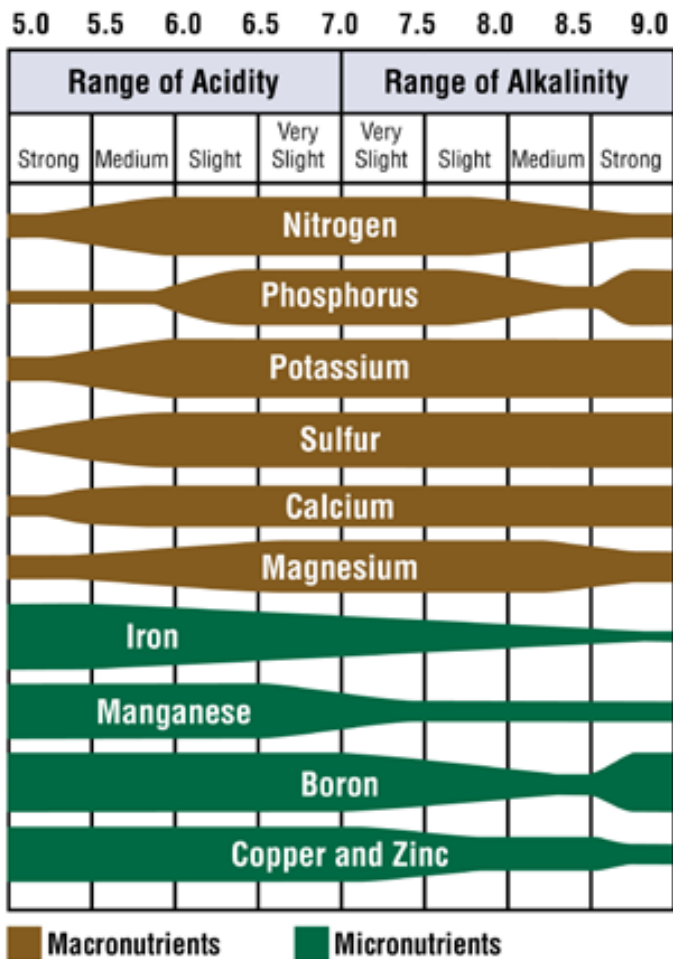
Phosphorus

- Soil test P increased quickly from “fresh” P
- Phosphorus fixation is occurring and decreasing soil test P

Potassium

- Soil test K increased with increasing rate
- %K increased to 4-8% when high rates of K were applied
- 100 years worth of K

Soil pH



Purdue Extension publication ID - 179



Atrazine carryover at pH > 6.8

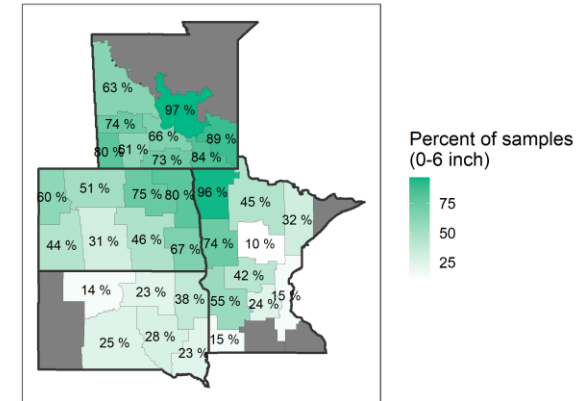


Purdue Extension publication ID – 2018.13

Is there an easy way to lower high pH?

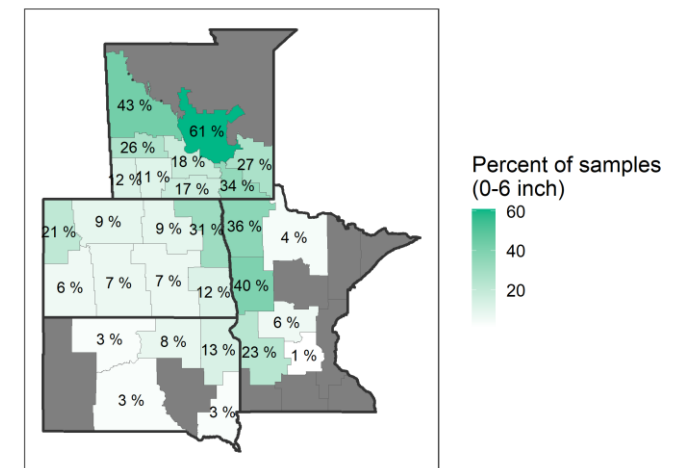
- Soils in the Northern Great Plains often have soils with high pH (>7.3)
 - Soils with free calcium carbonate (CaCO_3) will have a pH buffered around 8
- Soil pH controls availability of plant nutrients
 - Lowering soil pH may increase nutrient availability
- Elemental sulfur often marketed as an “easy solution” to reduce pH

Soil samples with soil pH above 7.3 in 2024



Data not shown where n < 100
AGVISE Laboratories, Inc.

Soil samples with calcium carbonate above 5.0 % CCE in 2024



Data not shown where n < 100
AGVISE Laboratories, Inc.



Soil Acidity Produced by N and S Fertilizers

Fertilizer Source	Soil Reaction	CaCO ₃ Equiv.
Anhydrous ammonia	$\text{NH}_3 + 2\text{O}_2 \rightarrow \text{H}^+ + \text{NO}_3^- + \text{H}_2\text{O}$	3.6
Urea	$(\text{NH}_2)_2\text{CO} + 4\text{O}_2 \rightarrow 2\text{NO}_3^- + 2\text{H}^+ + \text{CO}_2 + \text{H}_2\text{O}$	3.6
Diammonium phosphate	$(\text{NH}_4)_2\text{HPO}_4 + \text{O}_2 \rightarrow 2\text{NO}_3^- + 3\text{H}^+ + \text{H}_2\text{PO}_4^- + \text{H}_2\text{O}$	5.4
→ Elemental sulfur	$2\text{S} + 3\text{O}_2 + \text{H}_2\text{O} \rightarrow 2\text{SO}_4^{-2} + 4\text{H}^+$	7.2
Ammonium Sulfate	$(\text{NH}_4)_2\text{SO}_4 + 4\text{O}_2 \rightarrow 2\text{NO}_3^- + 4\text{H}^+ + \text{SO}_4^{-2} + \text{H}_2\text{O}$	7.2

CaCO₃ equivalent: lbs. CaCO₃ required per lbs. N applied to neutralize acidity in the fertilizer

SOURCE: Adams, 1984, Soil Acidity and Liming, No. 12, p. 234 ASA

The science behind lowering pH with elemental sulfur

- High pH soils have “free lime” (CaCO_3)
- Free lime must be neutralized before pH can be reduced
- When S^0 is applied to soil, it is oxidized by soil bacteria (*Thiobacillus*). Thus, forming sulfuric acid



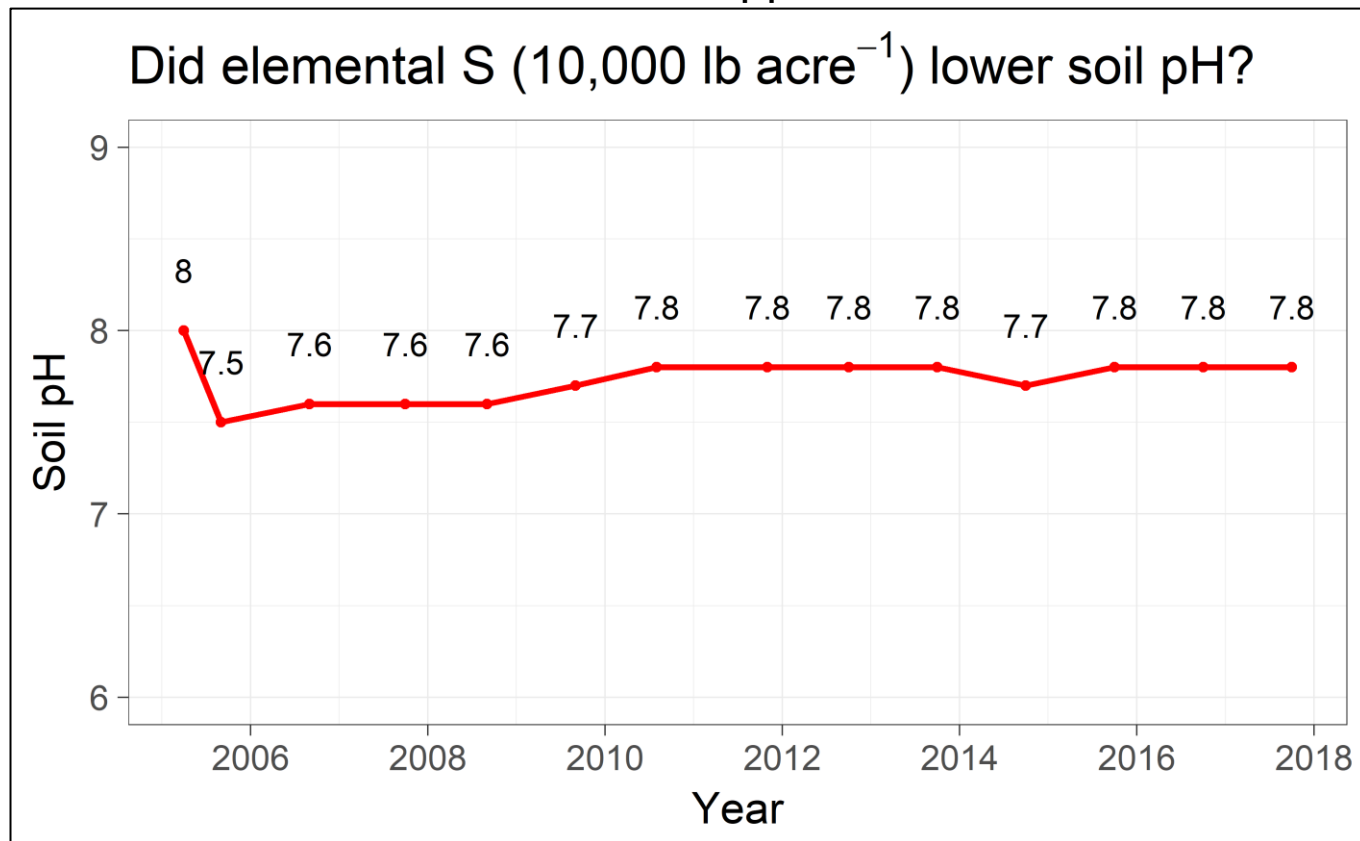
- Sulfuric acid produces H^+ ions, which can neutralize free lime in the soil
- Any other form of sulfur fertilizer (e.g. gypsum) is in the sulfate form of sulfur and CAN NOT neutralize free lime

I only need about 100 lb/A elemental sulfur, right?

AGVISE Demonstration 2005-2017

Soil had 1.5% CCE, starting pH was 8

Elemental S applied in 2005

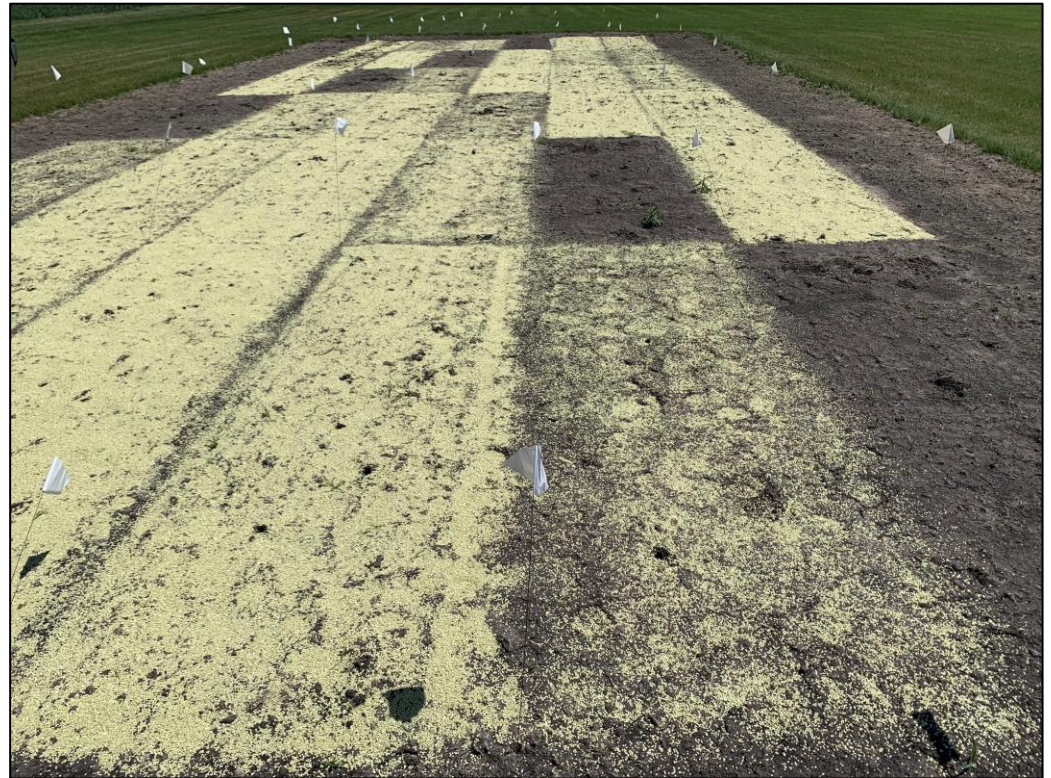


Again starting in 2020, with higher rates!

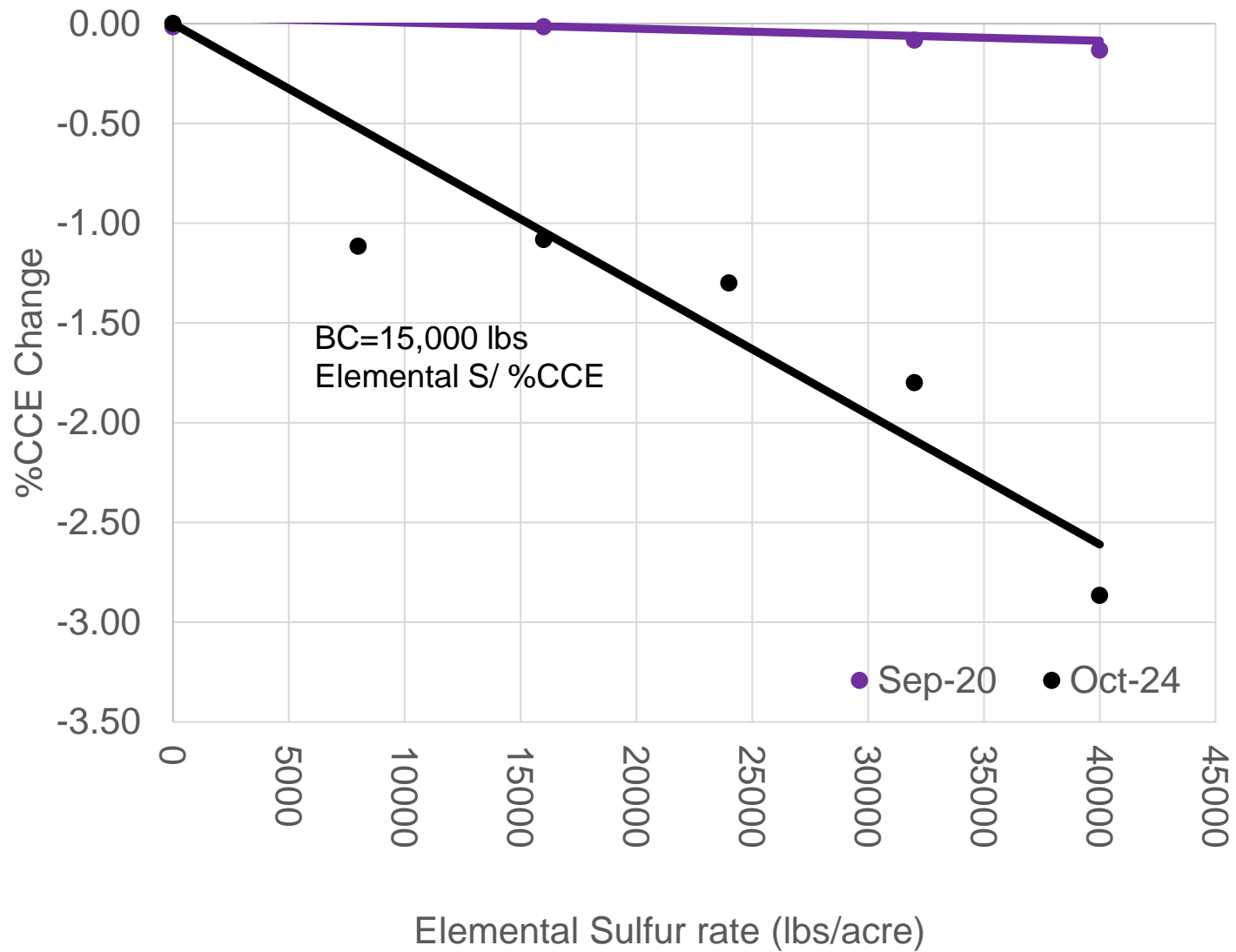
Objective: evaluate long-term effectiveness of elemental S as a soil amendment to reduce soil pH on a calcareous Northern Plains soil.

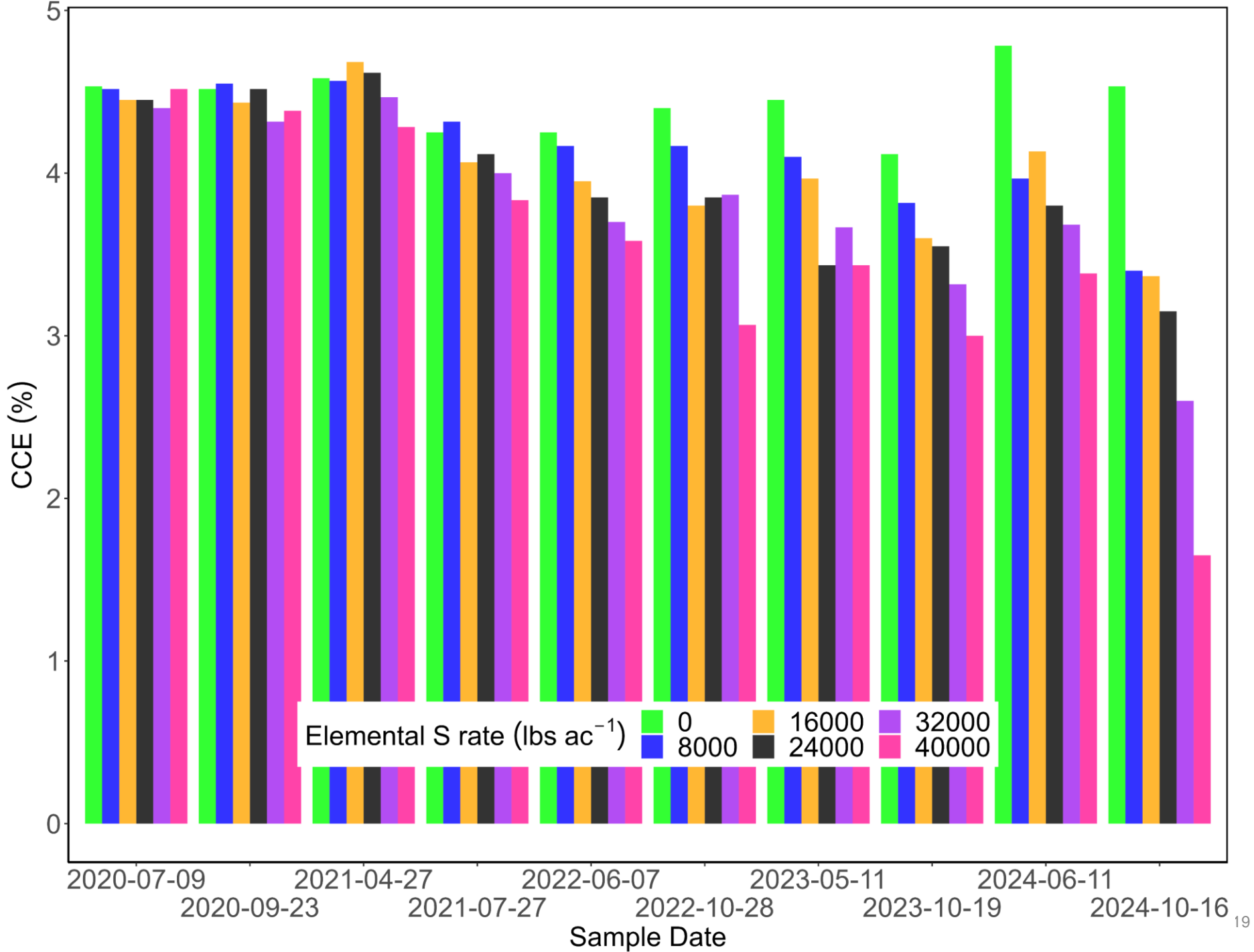
Site: Northwood, ND
Bearden silty clay loam,
soil pH 8.0,
average **CCE: 4.5%**

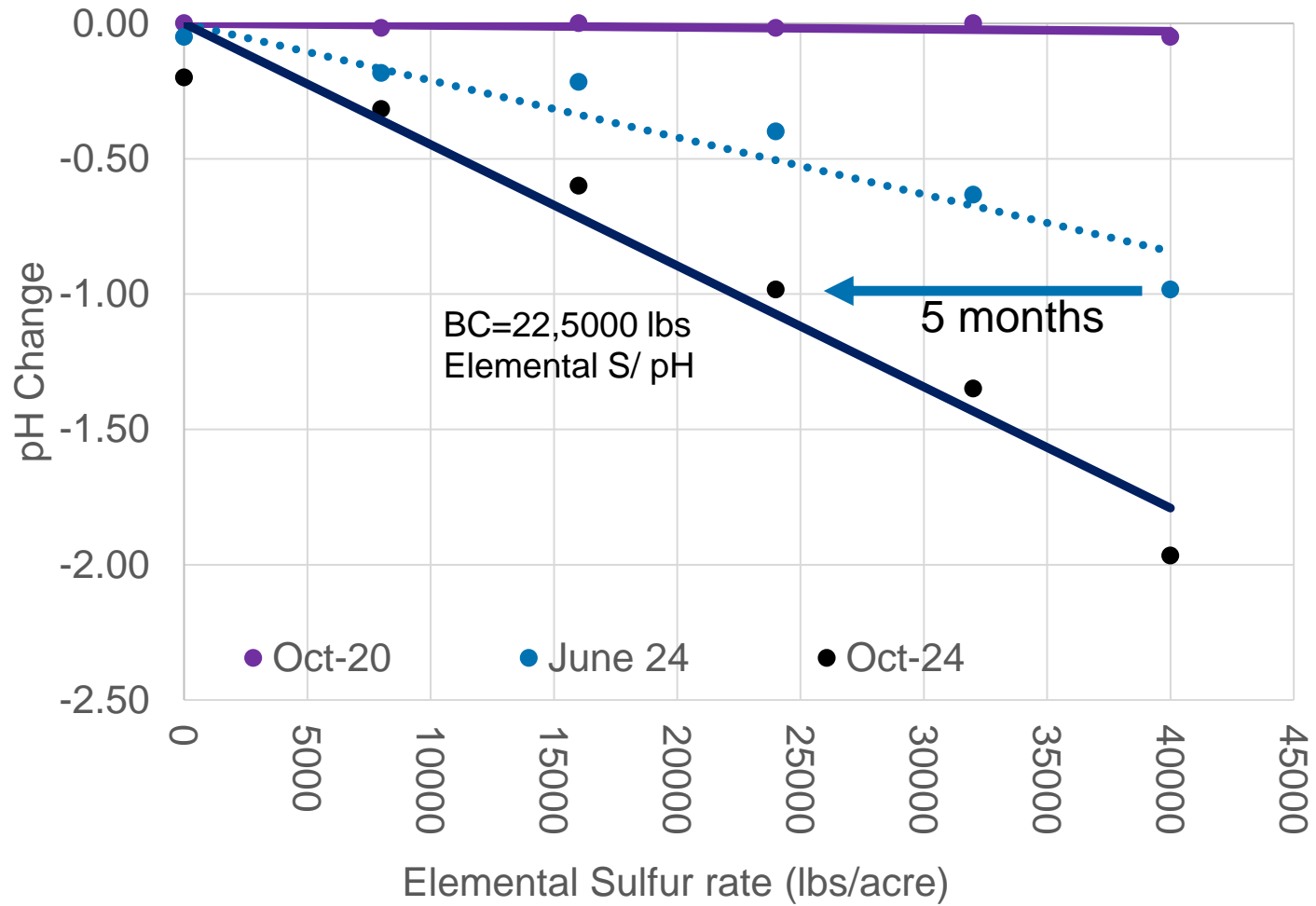
Treatments: 0 to 40,000
lbs/A elemental sulfur, tilled
to 6" after application

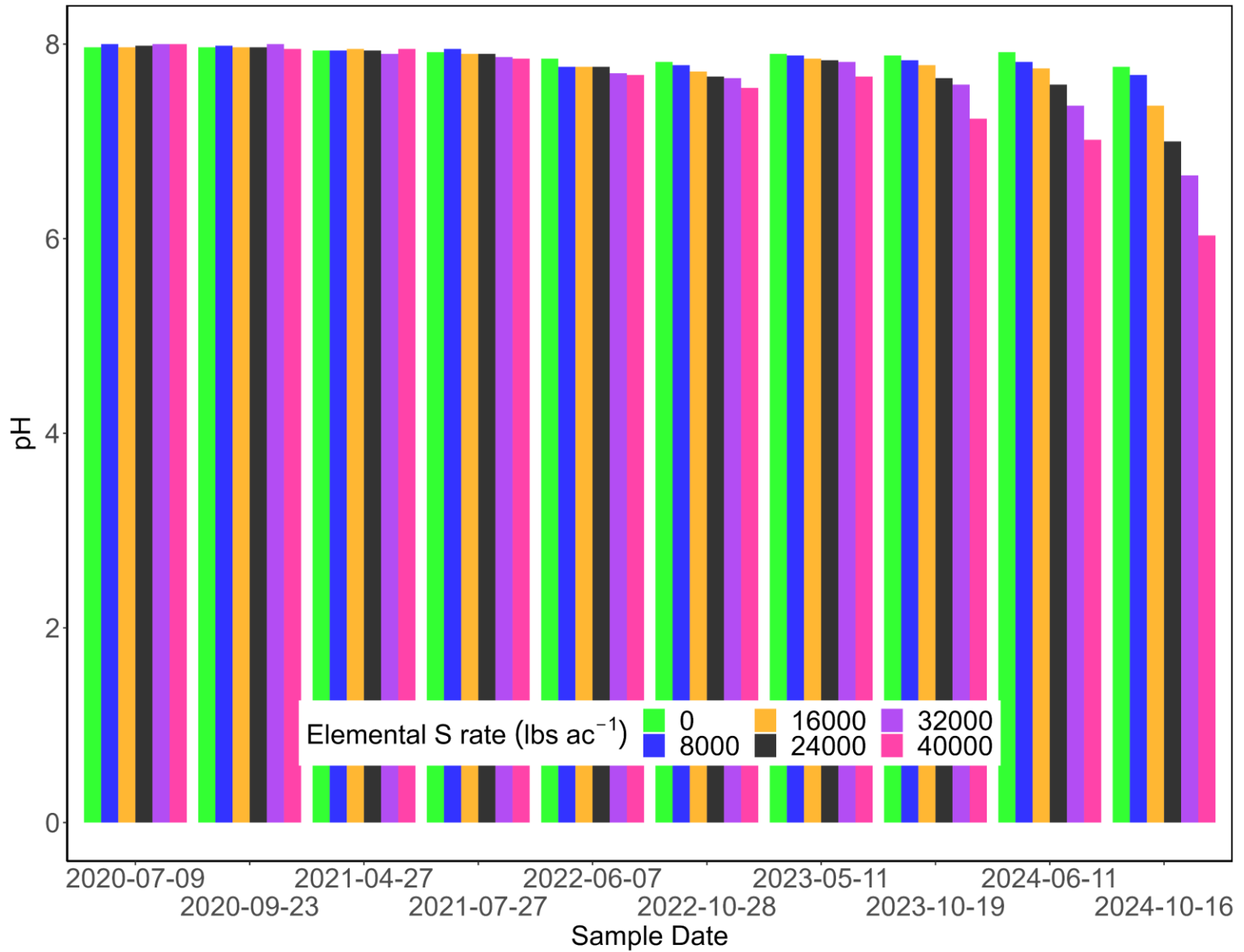


It takes about 3.2 tons elemental sulfur/acre to neutralize 1% CCE in soil









Conclusion

- The process that turns elemental sulfur into sulfuric acid is biology driven.
 - Dry conditions: 2020 – 2021, 2023
 - Wet conditions: 2022 and 2024

There is no quick, easy solution to reducing soil pH in the northern Great Plains/Prairie Provinces

SCN in Soybeans

Introduction-SCN

- Annual losses of \$1.5 billion
- Main source of resistance is PI 88788
 - 95% contain this resistance
- Capacity to survive long term without soybeans
- First reported
 - MN-1978
 - SD- 1995
 - ND-2003
 - Manitoba-2019



IOWA STATE UNIVERSITY

Extension and Outreach

Greg Tylka Professor

Integrated Crop Management

Dr. Greg Tylka is a professor in the Department of Plant Pathology and Microbiology at Iowa State University with extension and research responsibilities for management of plant-parasitic nematodes. The focus of Dr. Tylka's research program at Iowa State University is primarily the soybean cyst n...

Income in SCN-infested Fields Can Be \$200 Per Acre Less With PI 88788 Than With Peking Resistance

January 9, 2020

The results of a field experiment conducted in 2019 with the soybean cyst nematode (SCN) in southeast Iowa were dramatic and alarming. The data illustrate what likely could occur in SCN-infested fields throughout the state in future years.

Soybean varieties in Iowa

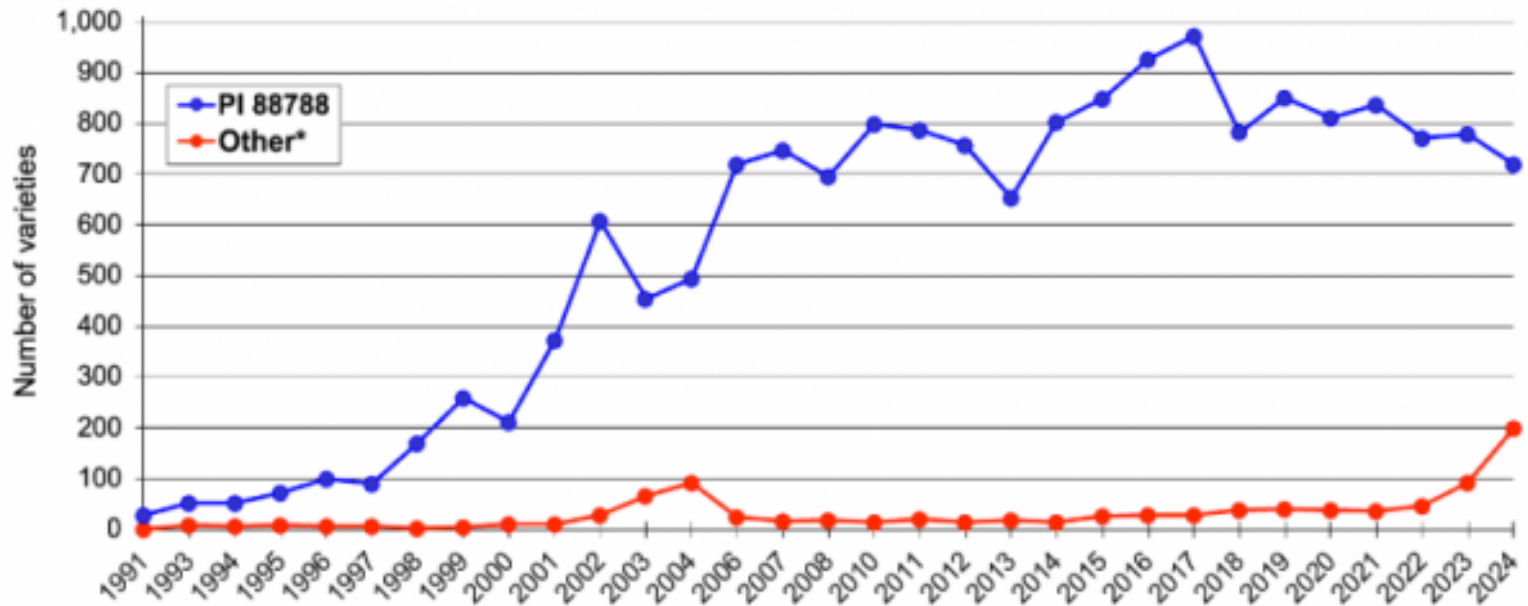
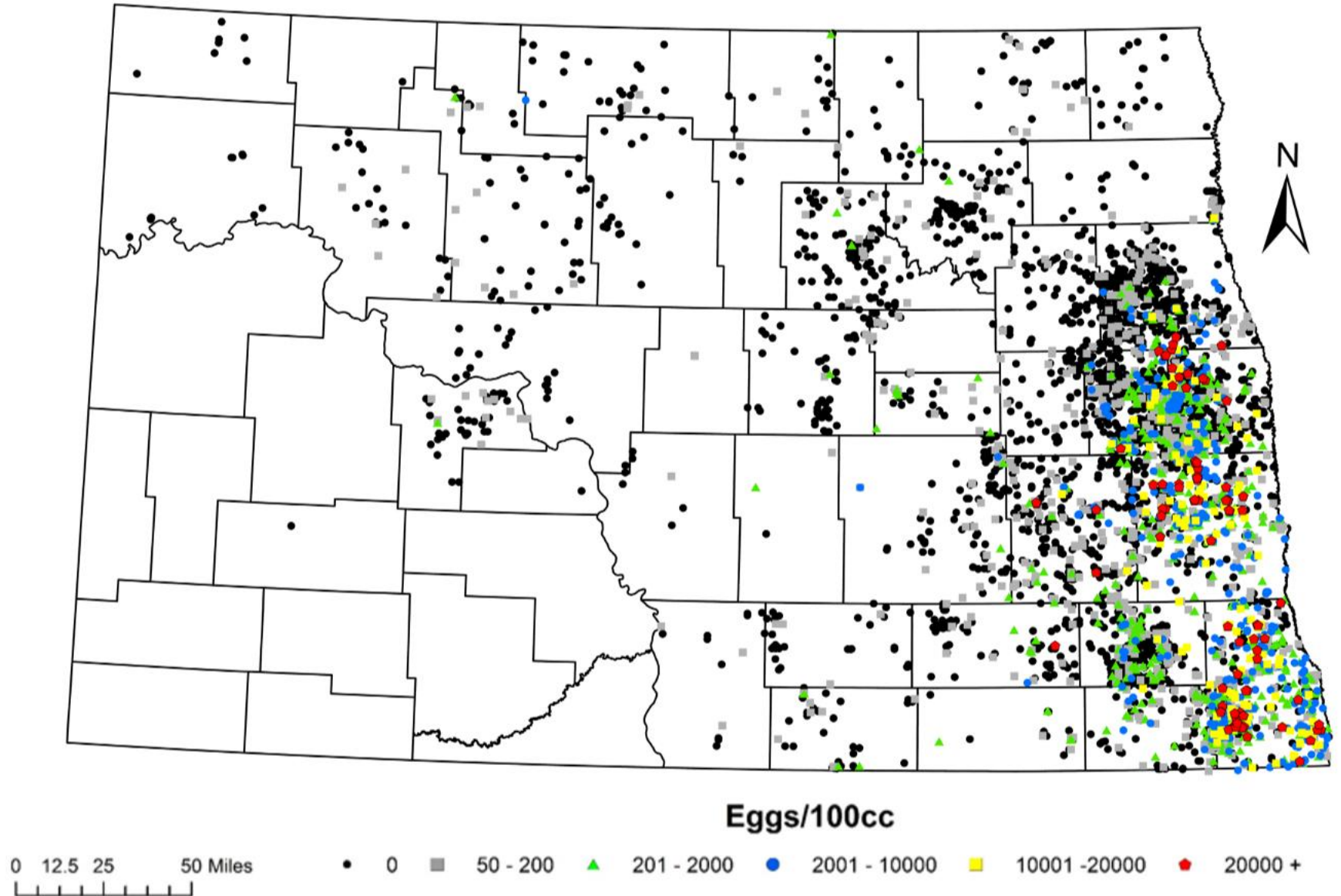
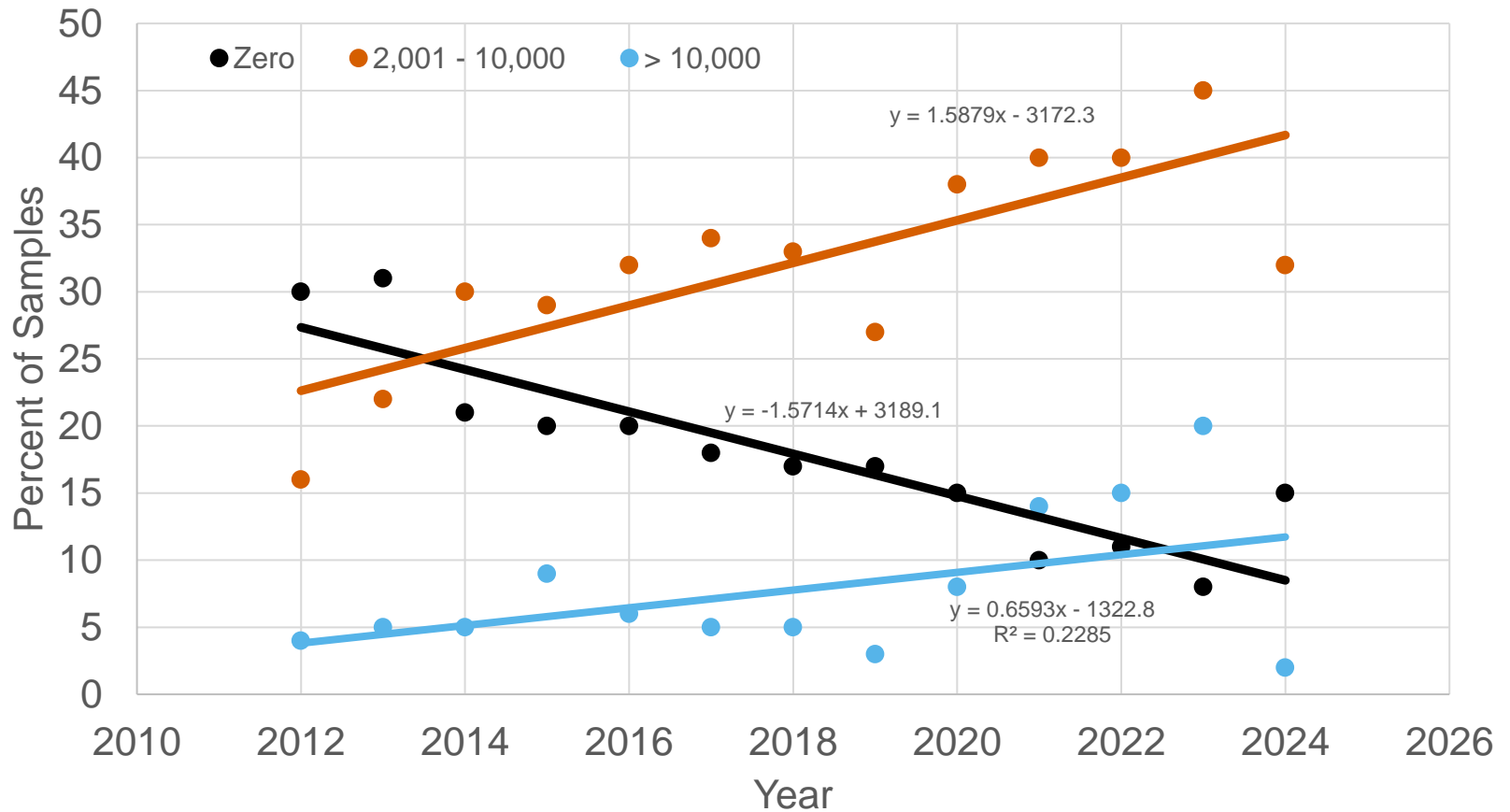


Figure 2. Number of SCN-resistant soybean varieties available for Iowa, by resistance genetics 1991 to 2024.

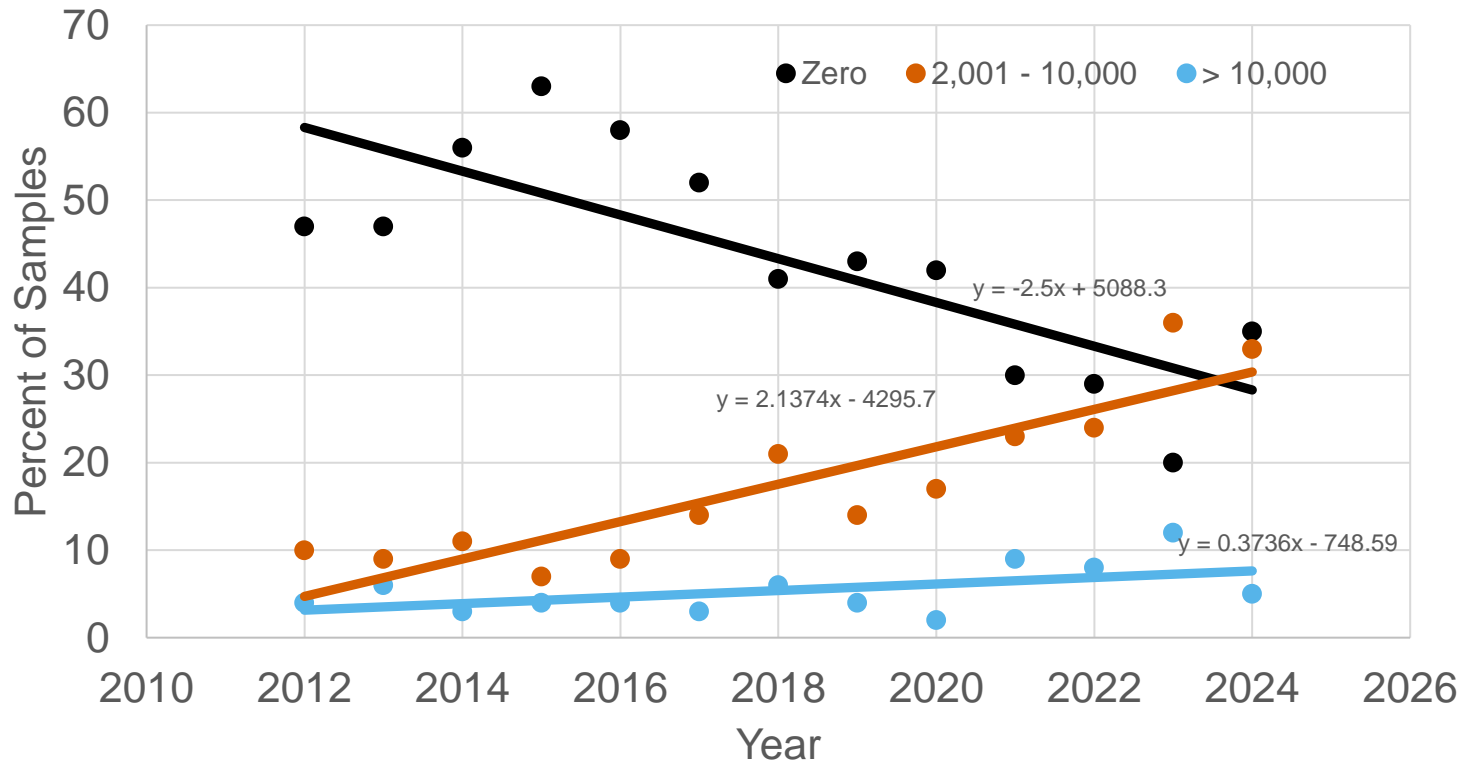
SCN Survey 2013-2023



Minnesota SCN Egg Counts



North Dakota SCN Egg Counts



Summary

- SCN reproduction
 - Dry and hot years: increases
 - Wet years: decreases
- Why – don't really know
- SCN eggs still need to be measured and managed

Going Forward: Start/Continue Sampling for SCN



SCN Sampling Program

Got questions?
We'll help you dig for answers.


North Dakota
Soybean Council
Our World Is Growing.

www.ndsoybean.org





SCN
Soybean Cyst Nematode
Management
GUIDE

SCOUTING AND SOIL TESTING FOR SOYBEAN CYST NEMATODE.

What's your number?
Take the test.  Beat the pest.
The **SCN** Coalition™
Funded by the soybean checkoff

TWO WAYS to scout for SCN.

- 1** Dig roots and look for females. (Dig, don't pull.) 
- 2** Collect soil samples for testing. 

Questions



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