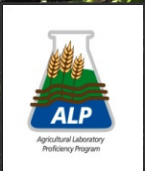


# FRST Lime Project Update

Robert Miller,  
Former Professor Colorado State University  
ALP Program Technical Director,  
Windsor, CO

February 23, 2023





# Soil pH methods, Mid-Atlantic Region

## Measurement of active acidity, ISE



1) pH (1:1) H<sub>2</sub>O

2) pH (1:1) 0.01 M CaCl<sub>2</sub>

$$\text{pH (1:1) H}_2\text{O} = \text{pH (1:1)}_{\text{CaCl}_2} + 0.4$$



\* Soil pH by the salt method has increased in recent decades to address low ionic strength soil slurry solutions and improve precision.

# Soil BpH methods, Mid-Atlantic Region



## Measurement of reserve acidity

- 1) **Adams Evans BpH**<sup>1</sup>  
(mimic replacement Moore-Sikora)
- 2) **SMP BpH**<sup>2</sup>  
(mimic replacement by Sikora)
- 3) **Mehlich BpH<sub>mod</sub>**



<sup>1</sup> Moore-Sikora BpH method was developed in 2008 mimic Adams Evans to replace hazardous chemical reagents of the method, limited adoption.

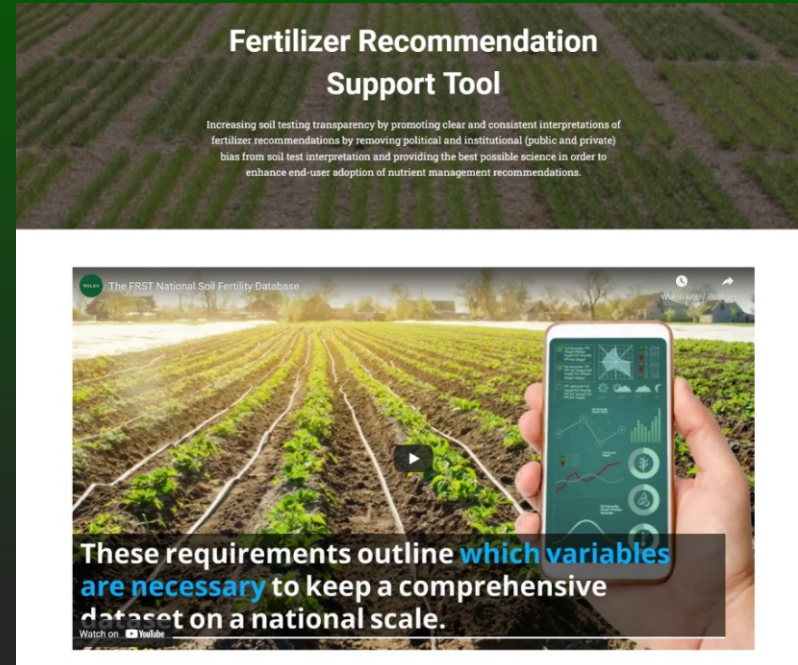
<sup>2</sup> The Sikora BpH method was developed in 2002 mimic SMP to replace hazardous chemical reagents of the SMP method, has been widely adopted.

# FRST Project

The FRST (Fertilizer Recommendation Tool) was initiated in 2016 to develop promote clear and consistent soil testing interpretations of fertilizer recommendations for nutrient management, and act as a catalyst for innovation.

The FRST project team is comprised of university and government researchers across the US. Initially FRST has focused on P and K soil test calibration and recommendations. Additional projects have focused on soil sampling and a SOP for conducting P and K calibration research.

In January 2022 established the FRST Lime Project.



[soiltestfrst.org](https://soiltestfrst.org)

# FRST Lime Project Team

Brian Arnall	Oklahoma State University
Steve Culman	Washington State University
Luke Gatiboni	North Carolina State University
David Hardy	North Carolina Dept of Agriculture
Joseph Heckman	Rutgers University
Sindhu Jagadamma	University of Tennessee
Clain Jones	Montana State University
John Jones	University of Wisconsin
Emileigh R Lucas	University of Maryland
Quirine Ketterings	Cornell University
Jay Lessl	University of Georgia
Andrew Margenot	University of Illinois
Robert Miller	Colorado State University
Amber Moore	Oregon State University
Stephanie Murphy	Rutgers University
Rao Mylavarapu	University of Florida
Bryan Hopkins	Brigham Young University

John Spargo	Penn State University
Nathan Nelson	Kansas State University
Deanna Osmond	North Carolina State University
Rasel Parvej	Louisiana State University
Tim Pilkowski	USDA-NRCS
Manbir Rakkar	Montana State University
Ed Rayburn	West Virginia University
Dorivar Ruiz Diaz	Kansas State University
Kurt Schroeder	University of Idaho
Amy Shober	University of Delaware
Frank Sikora	University of Kentucky
Nathan Slaton	University of Arkansas
Jared Spackman	University of Idaho
Haiying Tao	University of Connecticut
Gurpal Toor	University of Maryland
Matt Yost	Utah State University
Hailin Zhang	Oklahoma State University
Shannon Alford	Clemson University

# FRST Lime Project

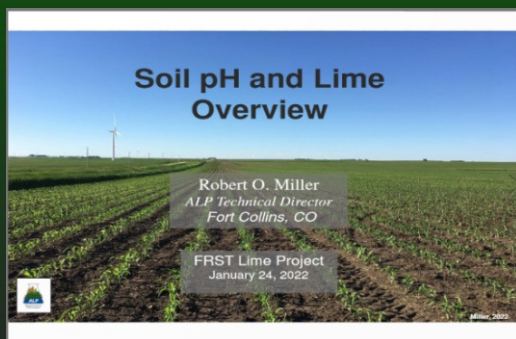
The FRST Lime Project team has monthly meetings with the initial goal establishing a knowledge base line of soil acidity. The project has generated six mini seminars on the measurement of soil pH and Buffer pH, and is developing a national research project to address soil acidity and lime recommendations.

Monthly recordings of Lime project meetings will be uploaded to the FRST project: <http://www.soiltestfrst.org/>

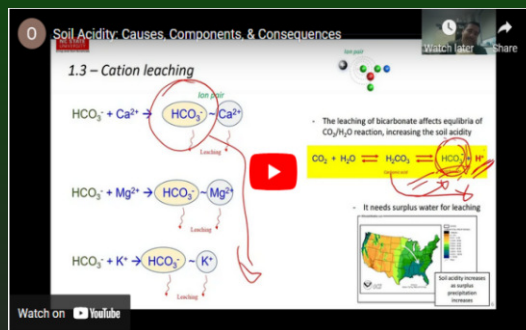


# FRST Lime Project: presentations

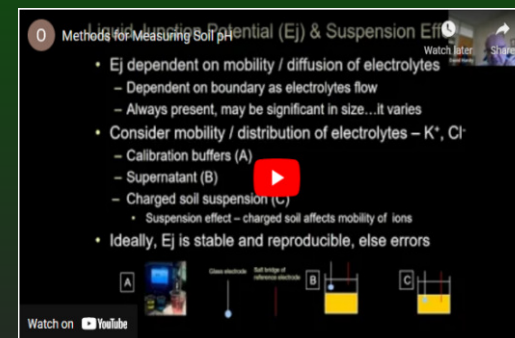
## pH overview



## Soil acidity



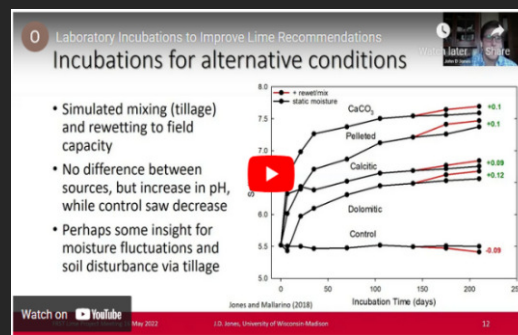
## Soil pH methods



## Soil BpH method



## Lime incubation



## Lime calibration



[soiltestfirst.org/lime/](http://soiltestfirst.org/lime/)

# FRST Lime Project objectives



1. Identify current US soil pH and buffer methods and lime recommendations and identify inconsistencies.



2. Discuss and plan development unified soil lime recommendation(s) for North America.

3. Establish a multi-year research project to assess soil acidity and generate new lime recommendations through lab analysis, incubation studies and field validation.

4. Develop grant support through industry, government and commercial interests to generate new soil lime recommendations.

5. Develop state-level extension programs to educate agronomists, consultants and practitioners on soil acidity and lime recommendations.



# FRST Lime: Obj #1 survey of recommendations

Proficiency data for pH and BpH data for six ALP soils was submitted to 32 LGU labs for lime recommendations.

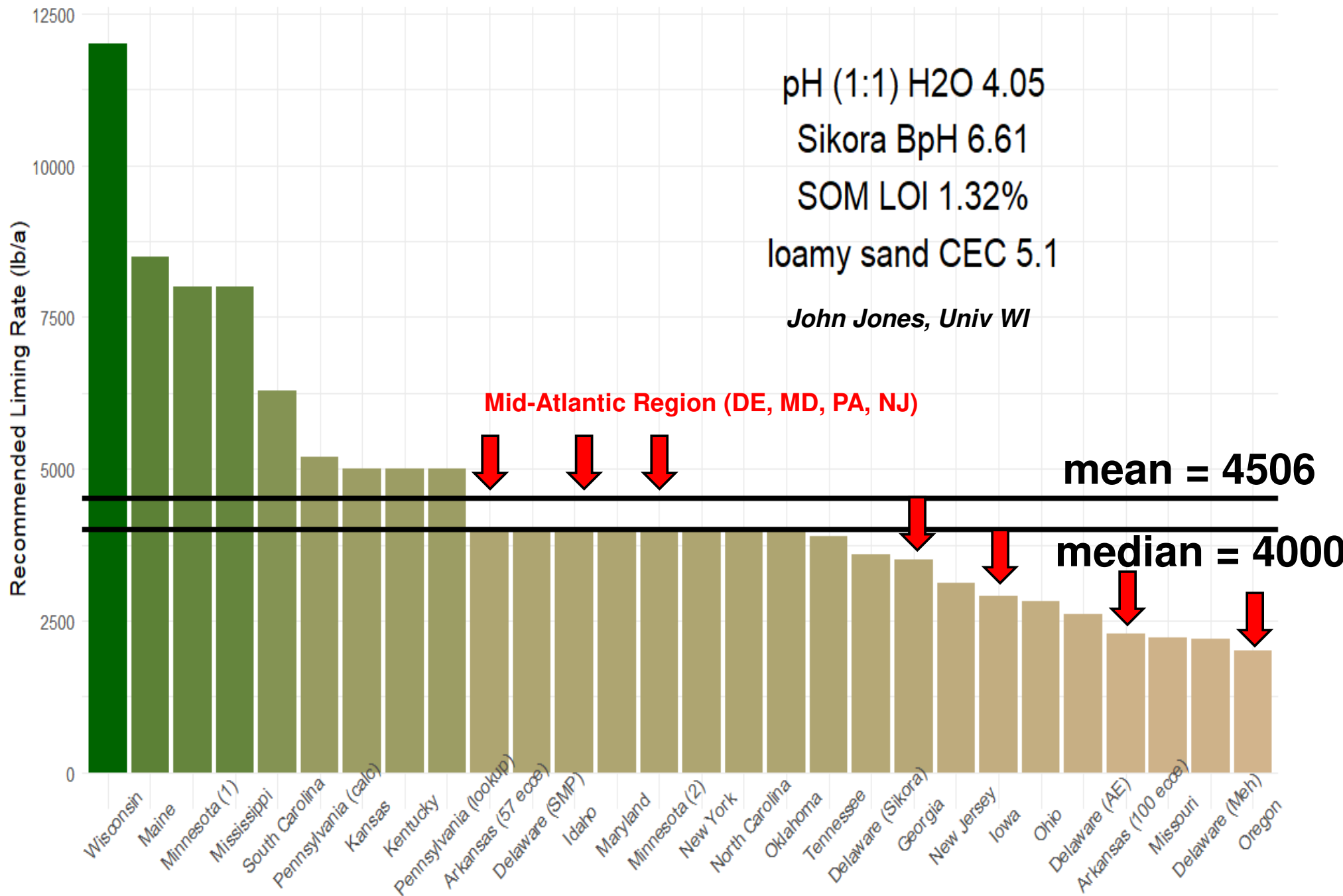
Soil pH ranged 4.05 – 5.89. Sikora BpH ranged 5.90 - 6.90. AE BpH 6.98 – 7.59. Soil clay ranged 7 - 31%.

Recommendation based on 0-6" soil depth, target pH 6.50 and 100% ECCE.

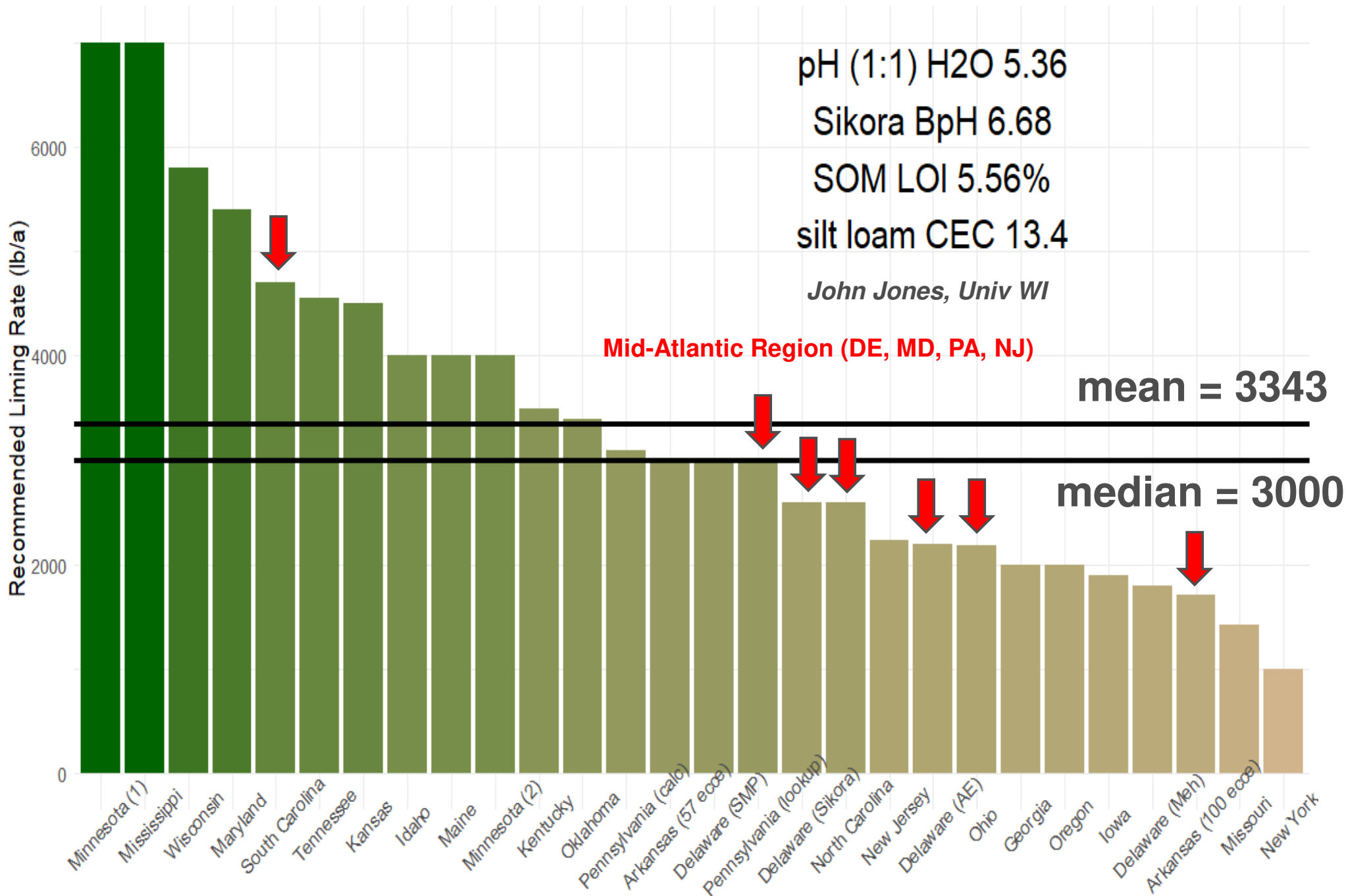
ALP Soil ID	pH <sub>1:1</sub> H <sub>2</sub> O	AE BpH	CEC cmol kg <sup>-1</sup>
SRS-2113	4.05	7.52	5.1
SRS-2102	4.23	7.28	6.6
SRS-1614	4.60	6.98	18.4
SRS-1903	5.36	7.43	13.4
SRS-1604	5.52	7.59	12.3
SRS-2115	5.84	7.46	12.7

*John Jones, Univ WI*

# Soil SRS-2113

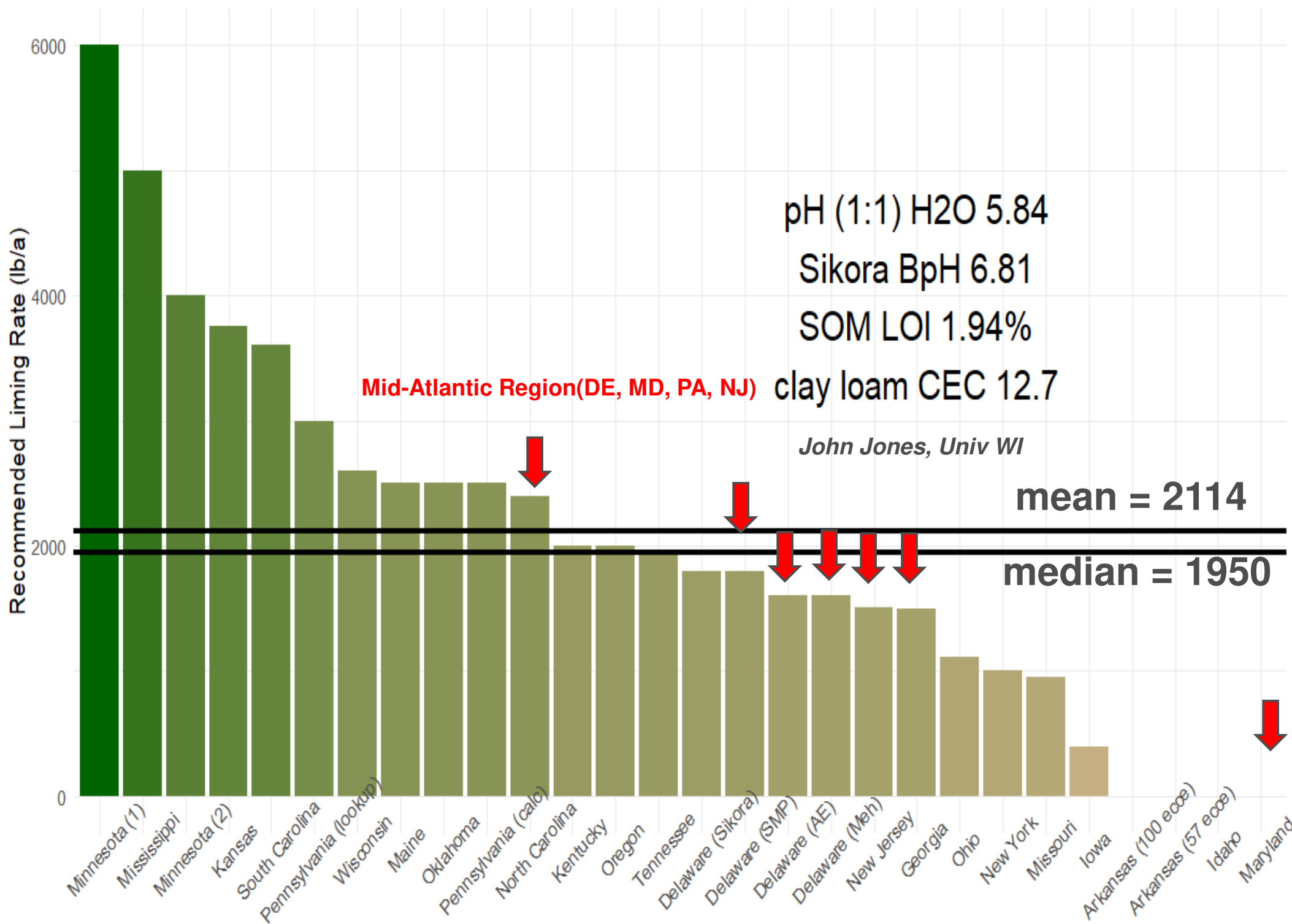


# Soil SRS-1903

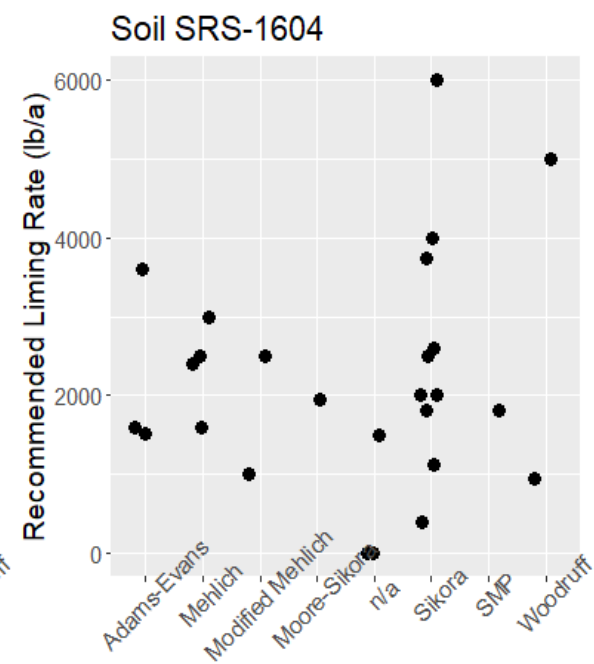
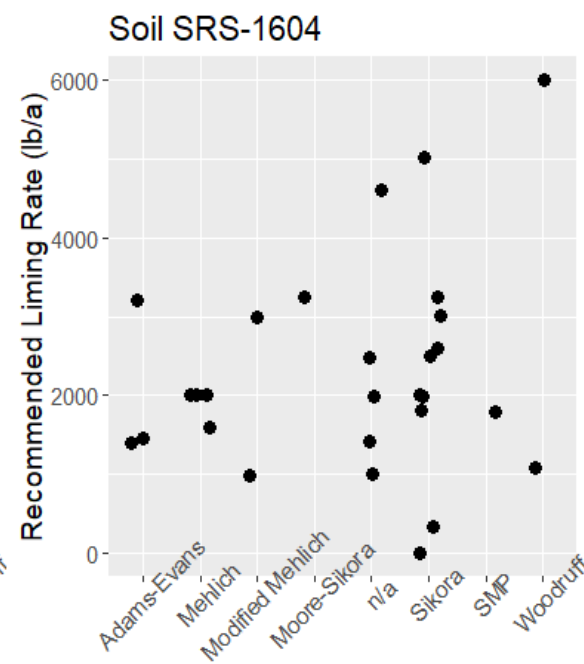
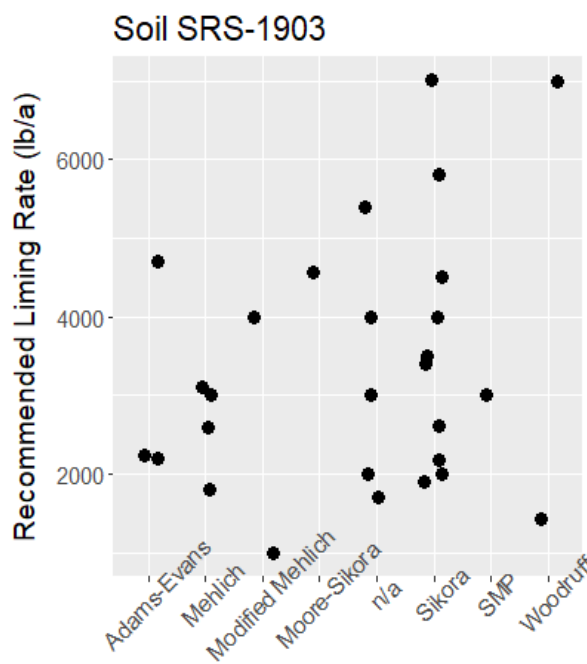
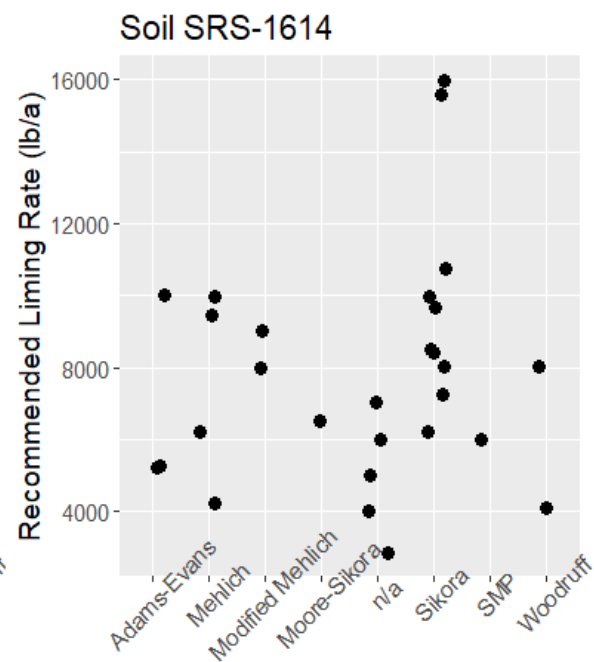
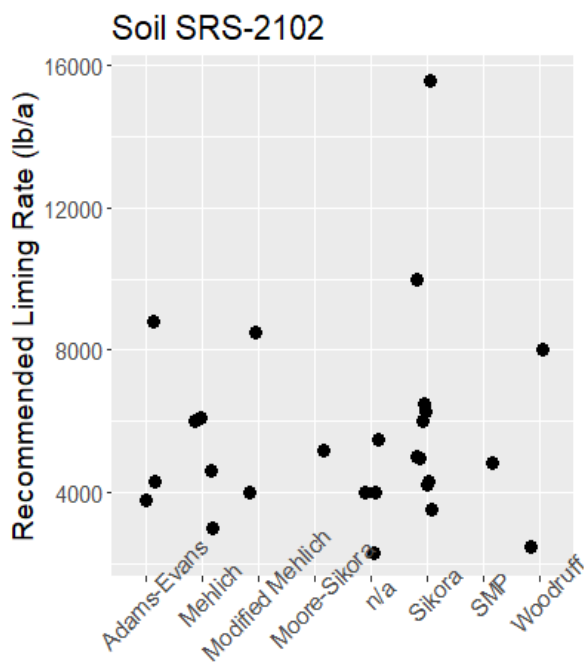
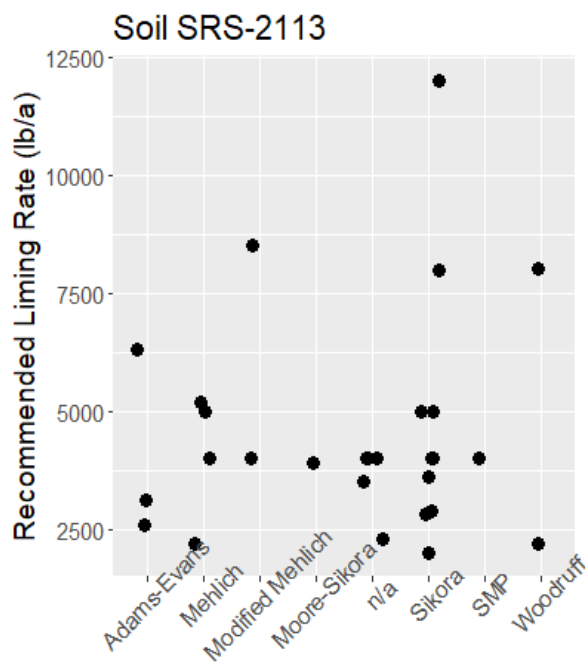




# Soil SRS-2115



John Jones,  
Univ WI



# Lime Rec survey summary



- Mid-Atlantic lime recommendations were generally consistent for the loamy sand texture soil (SRS-2113). pH 4.05, ranging 2500 - 4000 lbs/ac ECCE, with a median of 4000 lbs/ac.
- Liming recommendations for the silt loam (SRS-1903). pH 5.36 indicated a majority of Mid-Atlantic recommendations were 2200 - 3000 lbs/ac ECCE, with one of 4800 lbs/ac.
- It should be noted LGU lime recommendations from the survey were developed on soils within each state over the past 50 years and based on unique specific state and temporal calibrations.



# FRST Lime: Obj #2 incubation study

Collect 120 soils across the US representing major soil physiographic units across the four major soil regions (WERA-102, SERA-6, NEC-67 NECRA-13). Soils ranging in  $\text{pH}_{(1:1) \text{ H}_2\text{O}}$  4.0-6.4, loamy sand to clay loam, CEC, SOM and mineralogy. **In progress**

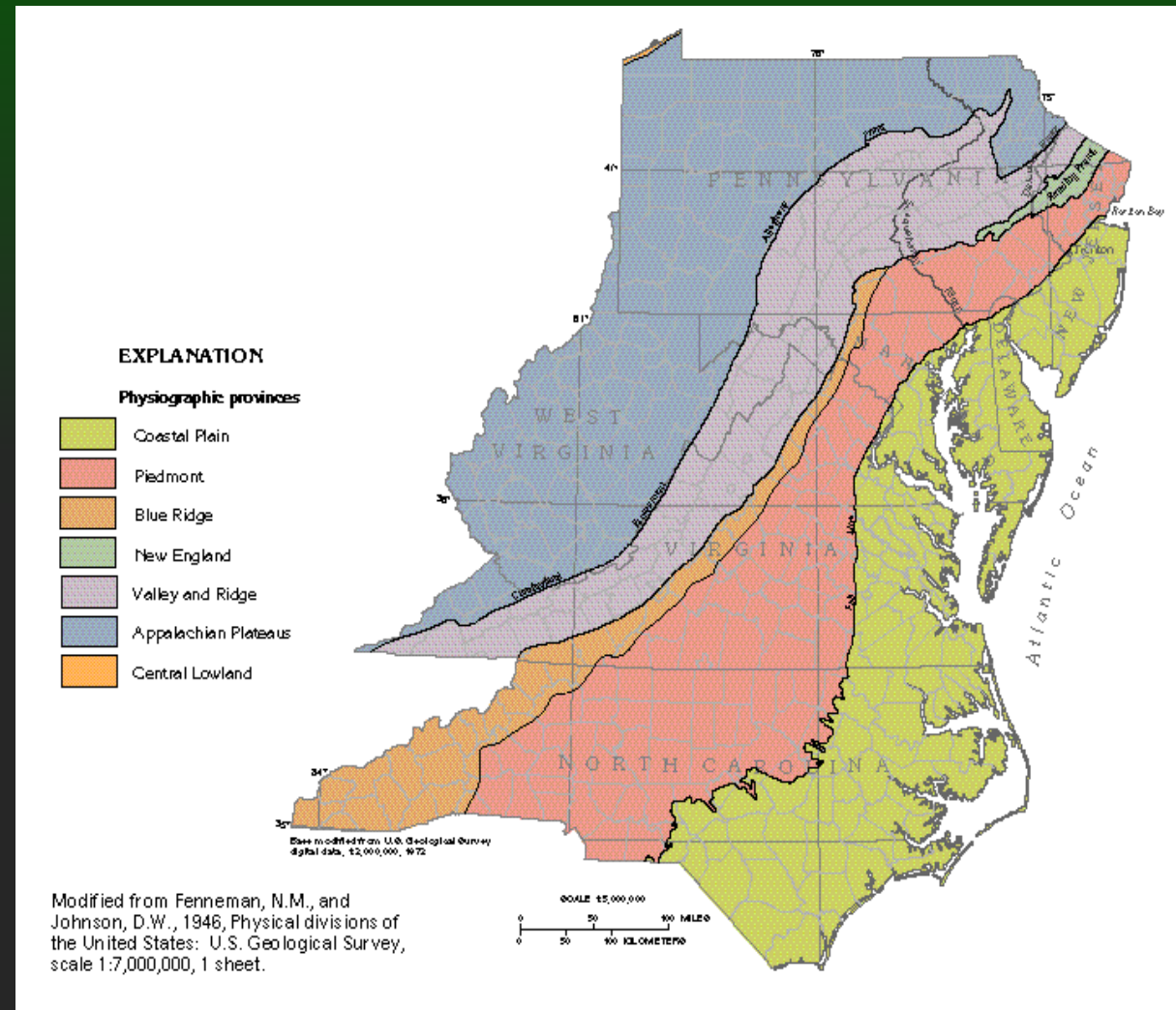
Soil acidity is independent of soil type or location.



# FRST Lime soils

Collect soils representing the primary physiographic units of the Mid-Atlantic: Coastal Plain, Piedmont, Valley Ridge and Appalachian Plateau.

Focus on agronomic soils which ranged in: pH 4.0 – 6.40, SOM content, CEC and texture.



# FRST Lime: Incubation study    In progress



- Collected 120 soils across US based on physiographic unit. Meta data to include, depth, GPS, soil map unit, crop and fertilizer history.
- Soil analysis: pH (2 methods), BpH (5 methods), M3 analytes, SOM, SOC, CEC, texture, titratable acidity, and exch Al.
- Lime incubation study: 7 rates of lime application, source  $\text{Ca}(\text{OH})_2$ , equilibration, and assess impact of lime on pH and  $\text{NO}_3\text{-N}$ .
  - Pilot study to evaluate alkaline source and time



# FRST Lime Project: Incubation study



Develop lime recommendation algorithms based on each of the four primary buffer pH methods (Sikora, Adams Evans, Modified Mehlich and Sikora-2). Pilot lime incubation study is in progress.

Evaluate the potential of mult-linear regression model for estimating lime recommendation based on routine measured soil parameters: pH cations and SOM.

Verify lime recommendation algorithms on 12 new soils.

# FRST Lime Project: support

The FRST project initial support through a USDA grant and is funding lime project soil collections for the incubation research.

Additional support will be needed to complete soils analysis, incubation research and data analysis.

Support will be sought from the fertilizer industry, lime manufacturers and commodity workgroups.



# Thank you for your time and attention

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**Txt: 970-217-2572**

