What you need to know about the national fertilizer recommendation team called **FRST**

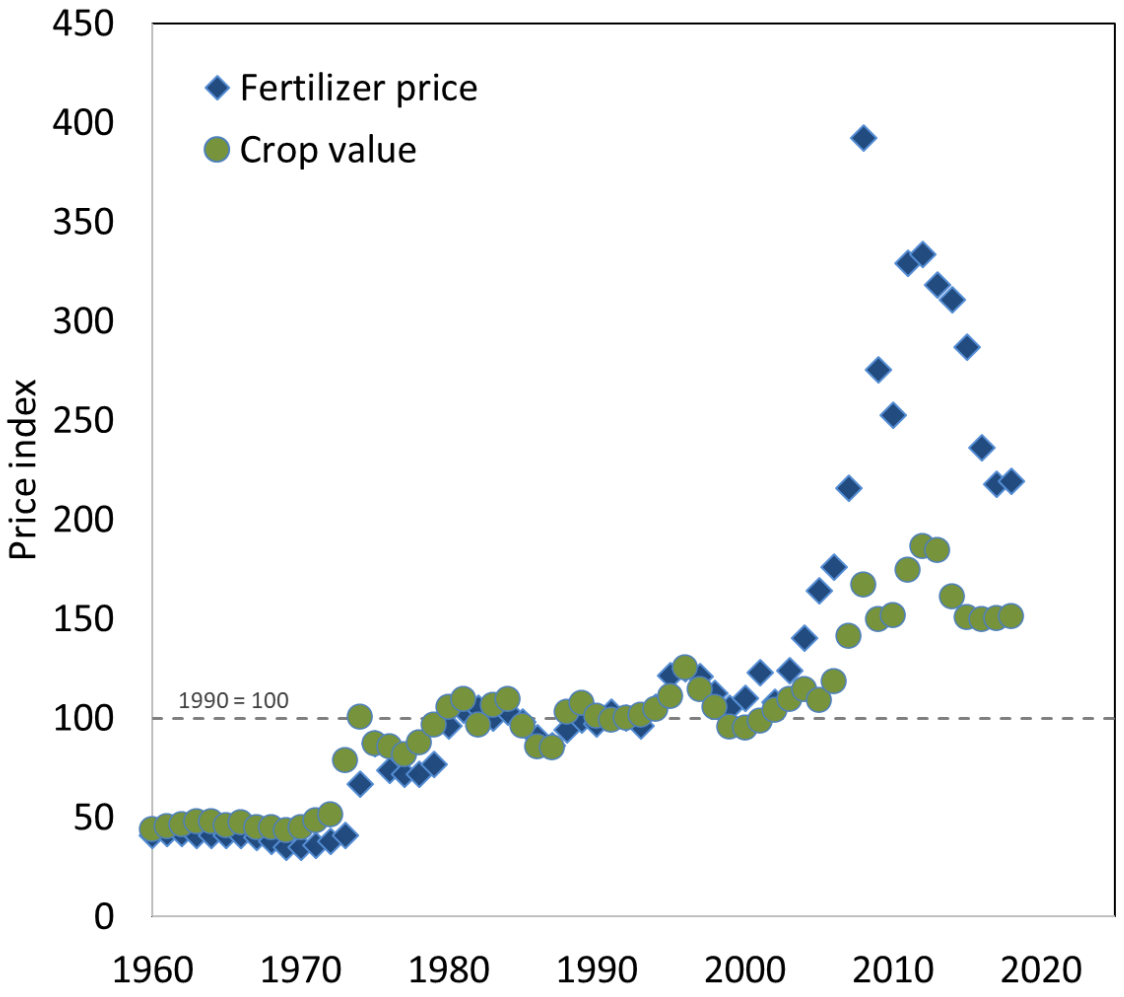
2025 Western Nutrient Management Conference

Matt Yost, Nathan Slaton, John Spargo, Daniel Kaiser, Luke Gatiboni, and Deanna Osmond

FRST
FERTILIZER RECOMMENDATION SUPPORT TOOL

Getting it right is more important now than ever

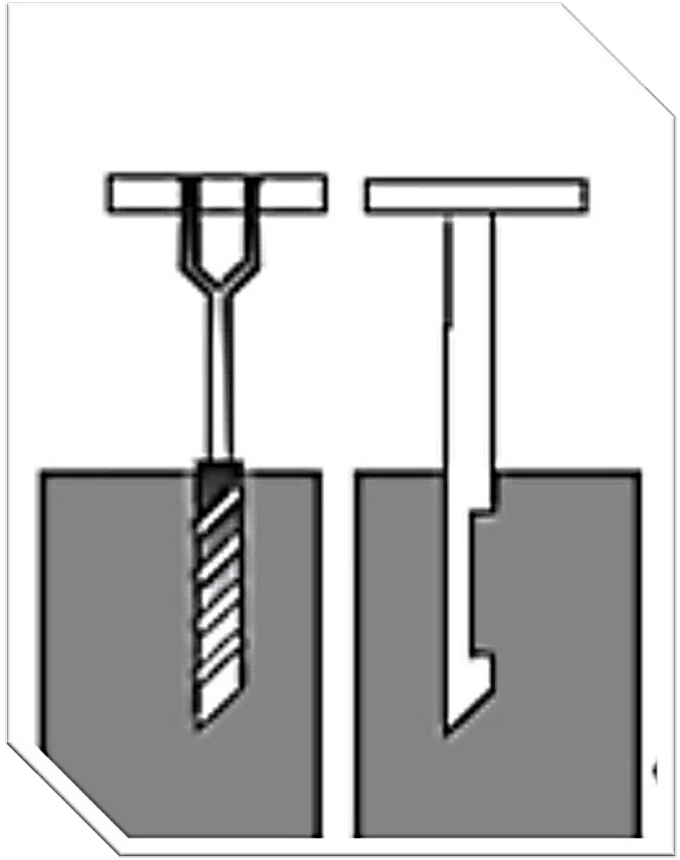
Cost of fertilizer rising faster than the value of crops – **about 1/3 of production costs**



(Summarized from USDA-ERS data)

Soil fertility testing serves as the foundation of nutrient management in modern agricultural production systems.

When methods, interpretations, & recommendations are based on local field calibration, provides valuable information needed to develop a sustainable soil fertility management program.

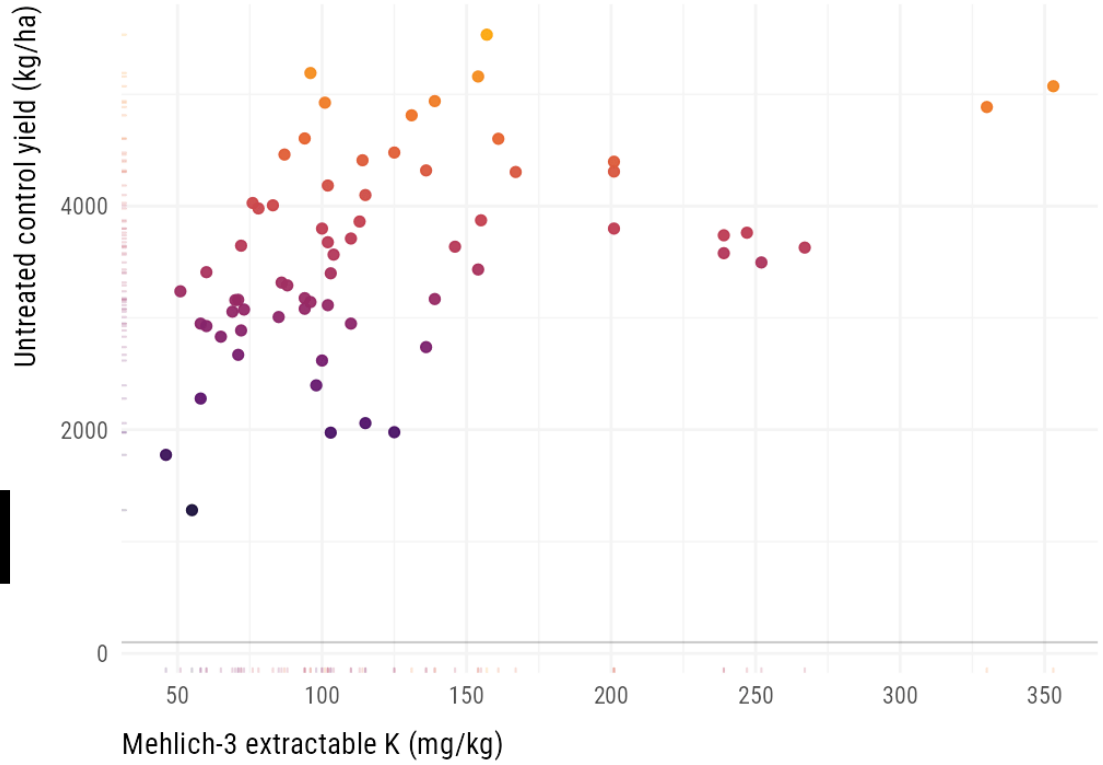


Soil Tests = Recommendations

What is CSTV?

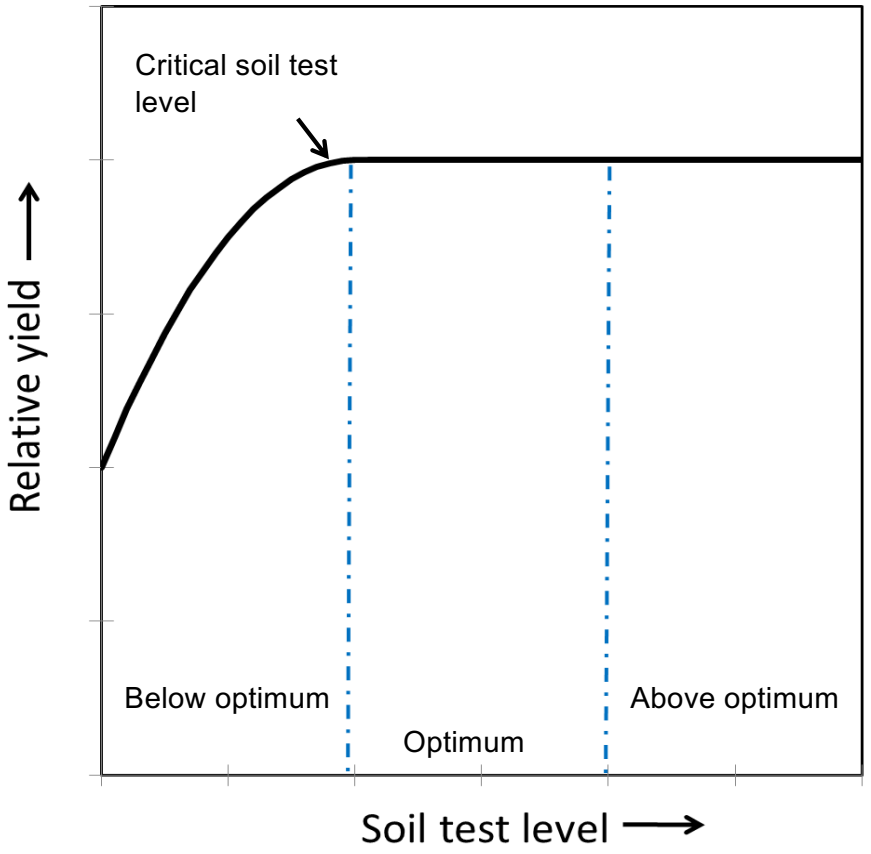
Step 1 – Extract nutrients from soils

Step 2 – Convert yield to relative yield



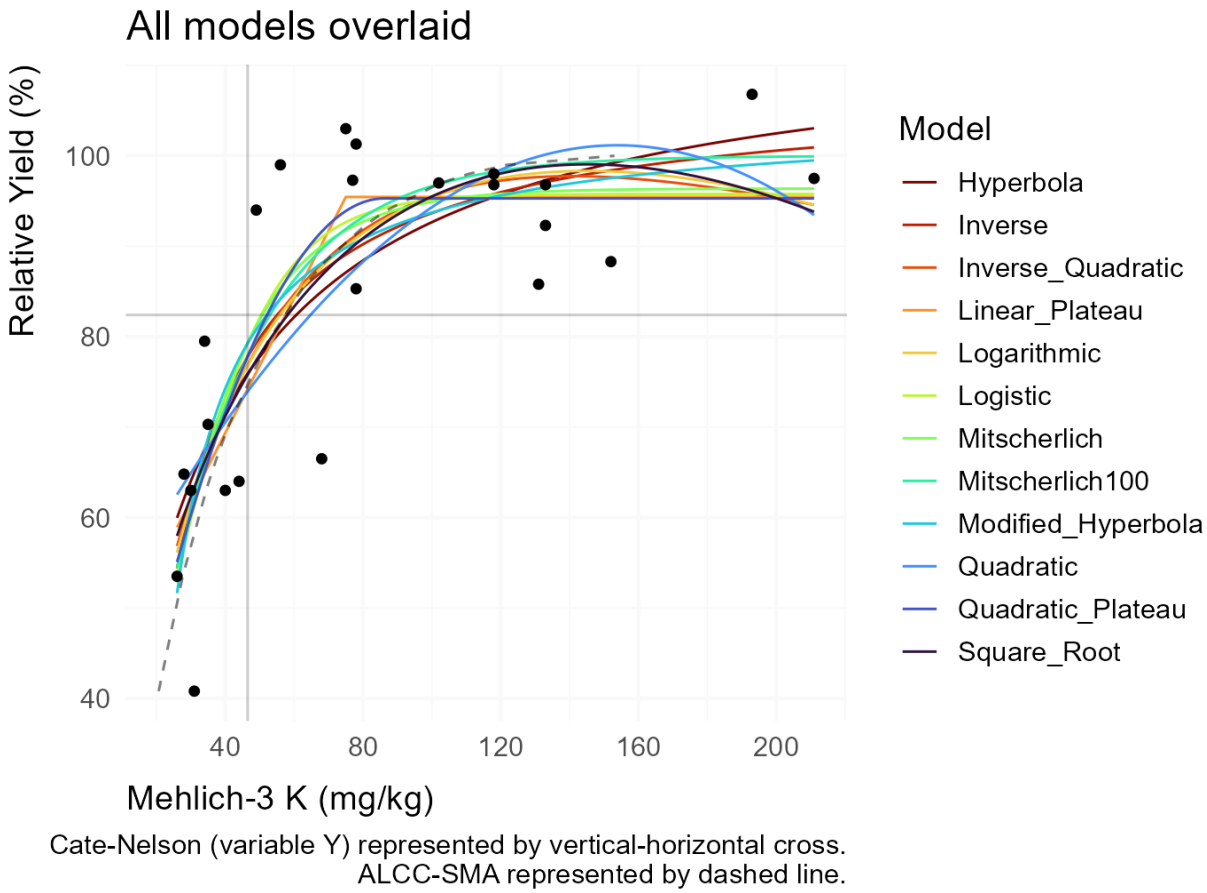
Austin Pearce

Step 3 – Soil test vs. relative yield



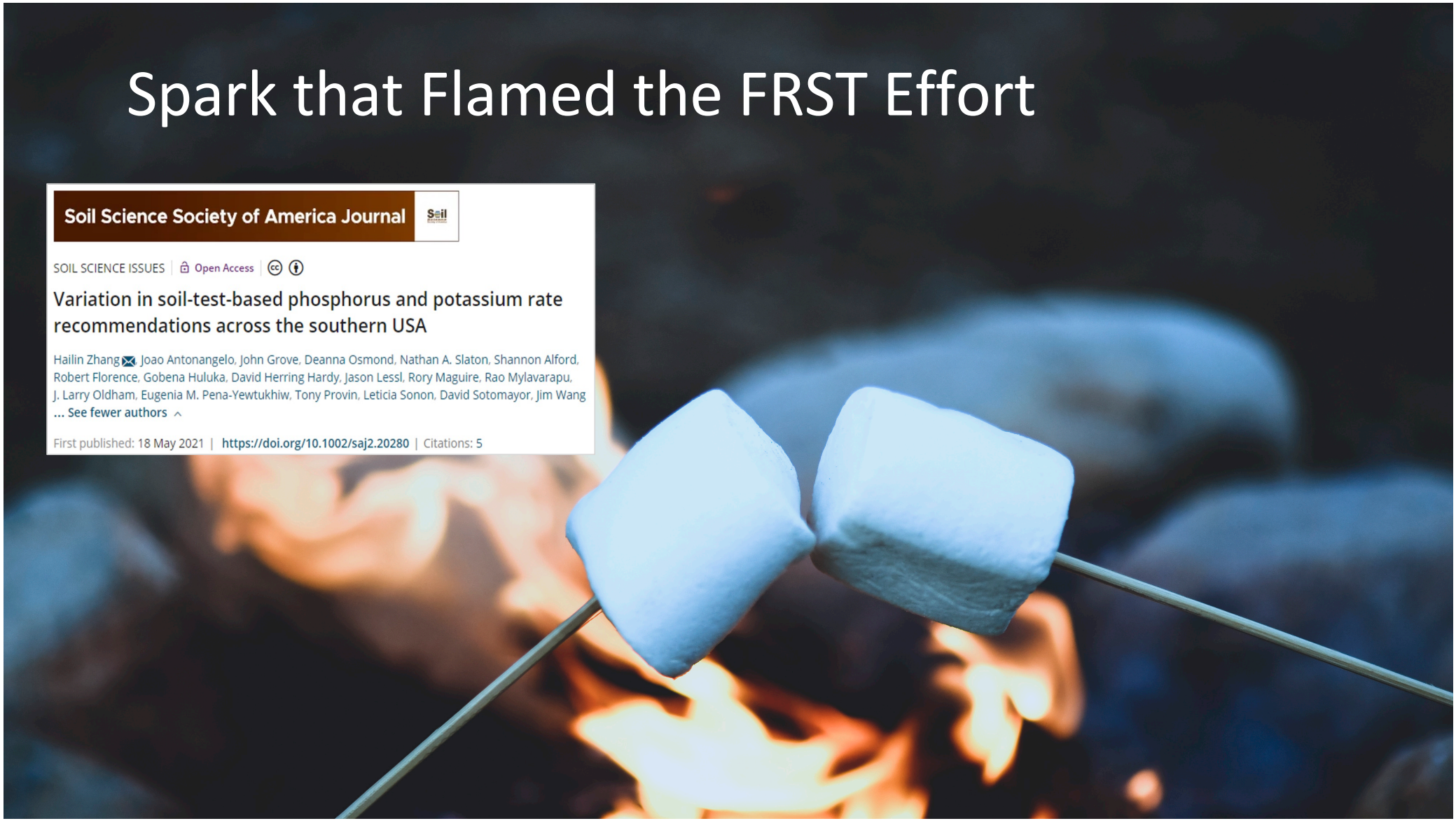
Generalized relationship between soil test level and crop response to nutrient applied

Step 4 – model to determine CSTV



Austin Pearce

Spark that Flamed the FRST Effort



Soil Science Society of America Journal

SOIL SCIENCE ISSUES | Open Access

Variation in soil-test-based phosphorus and potassium rate recommendations across the southern USA

Hailin Zhang, Joao Antonangelo, John Grove, Deanna Osmond, Nathan A. Slaton, Shannon Alford, Robert Florence, Gobena Huluka, David Herring Hardy, Jason Lessl, Rory Maguire, Rao Mylavarapu, J. Larry Oldham, Eugenia M. Pena-Yewtukhiw, Tony Provin, Leticia Sonon, David Sotomayor, Jim Wang
... See fewer authors

First published: 18 May 2021 | https://doi.org/10.1002/saj2.20280 | Citations: 5

Fertilizer Recommendations Support Tool (FRST)

Goals

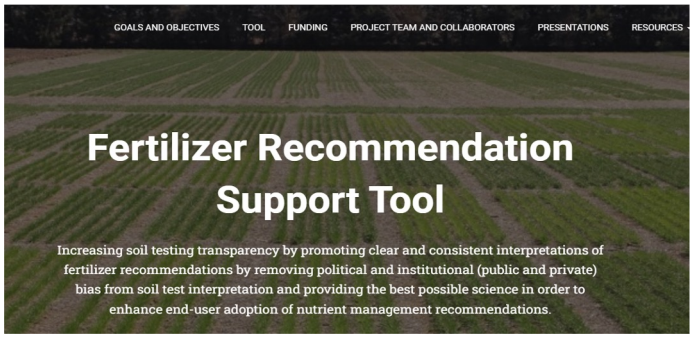
Increase the transparency of soil test evaluation and remove bias

Enhance end-user awareness, confidence, and adoption of soil-test-based recommendations

Provide a collaborative environment for improving soil-test-based recommendations

Provide information that can be used

to augment existing recommendation systems



FRST collaborators

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Javed Iqbal	University of Nebraska
Sindhu Jagadamma	University of Tennessee
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Teferi Tsegaye	USDA-ARS
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Forbes Walker	University of Tennessee
Jim Wang	Louisiana State University
Charles White	Penn State
Stephen Wood	The Nature Conservancy
Frank Yin	University of Tennessee
Matt Yost	Utah State University


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FRST project activities

Current and Ongoing

- Develop and maintain the FRST database
- Support state-level trials
- Evaluate soil sampling depth influence
- Develop model(s) for calibration of P and K rates
- Develop model(s) for frequency of response to fertilization
- Add S to FRST tool
- Survey liming methods
- Calibrate lime rate recommendations
- Survey stakeholders to determine how soil test data is used
- Evaluate fertilizer recommendation strategies and terms used by land grant institutions

Completed

Survey soil fertility faculty on current soil fertility practices and recommendations

Compare P and K fertilizer recommendations in the southern US

Develop minimum dataset for soil test correlation & calibration research

Determine models for FRST soil test correlation

Determine the most appropriate relative yield calculation for FRST

Build and release FRST tool

FRST project activities

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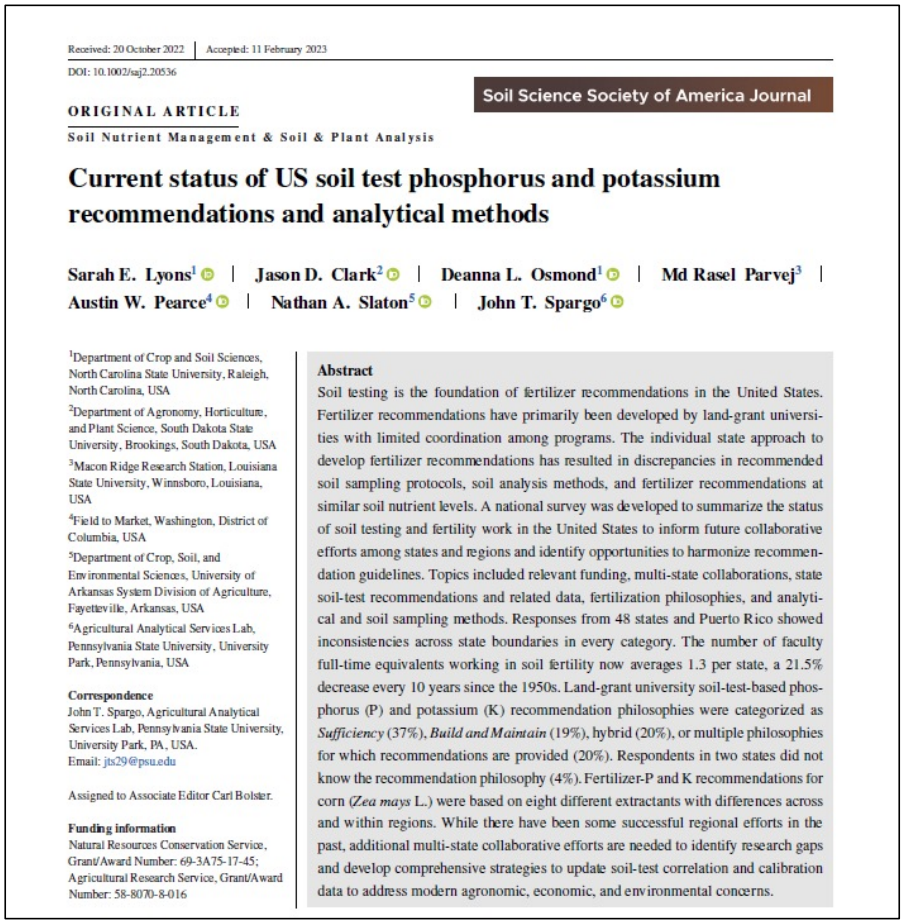
Survey of soil test P and K recommendations and methods

Objectives

Gain a better understanding of the status of soil testing across the U.S. to inform collaborative efforts among states & regions & identify opportunities to harmonize recommendation guidelines.



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Soil Science Society of America Journal

ORIGINAL ARTICLE

Soil Nutrient Management & Soil & Plant Analysis

Current status of US soil test phosphorus and potassium recommendations and analytical methods

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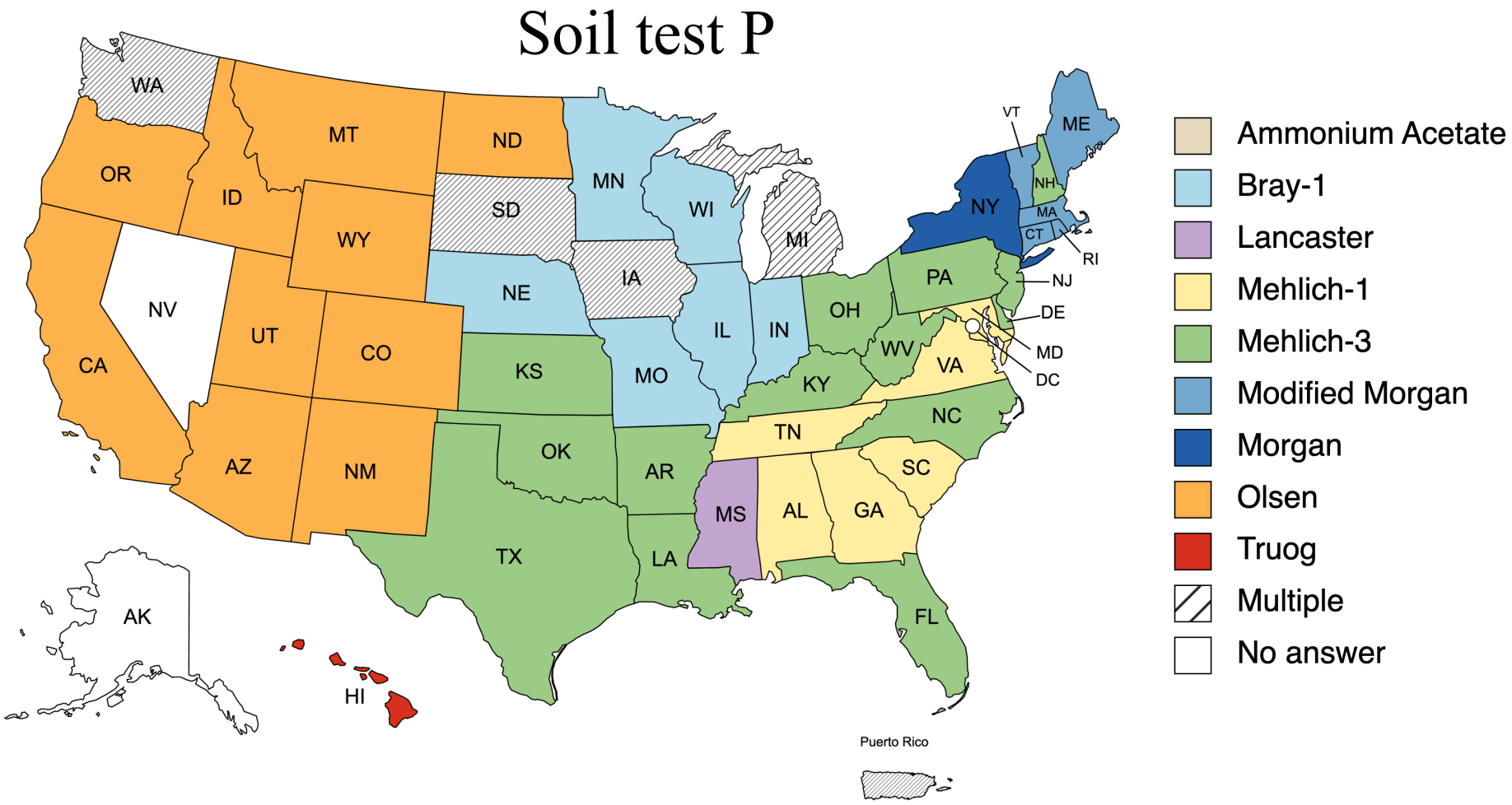
Abstract

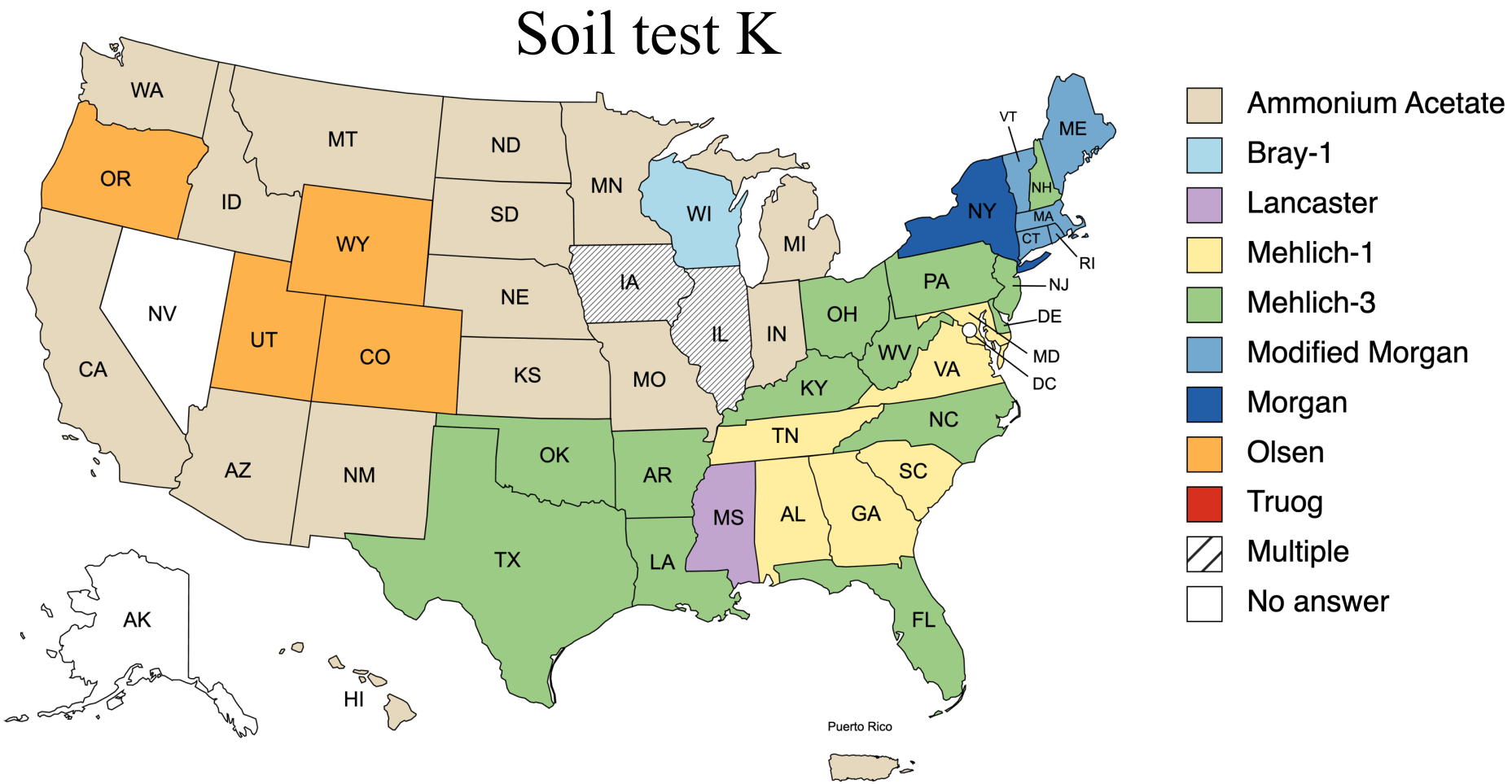
Soil testing is the foundation of fertilizer recommendations in the United States. Fertilizer recommendations have primarily been developed by land-grant universities with limited coordination among programs. The individual state approach to develop fertilizer recommendations has resulted in discrepancies in recommended soil sampling protocols, soil analysis methods, and fertilizer recommendations at similar soil nutrient levels. A national survey was developed to summarize the status of soil testing and fertility work in the United States to inform future collaborative efforts among states and regions and identify opportunities to harmonize recommendation guidelines. Topics included relevant funding, multi-state collaborations, state soil-test recommendations and related data, fertilization philosophies, and analytical and soil sampling methods. Responses from 48 states and Puerto Rico showed inconsistencies across state boundaries in every category. The number of faculty full-time equivalents working in soil fertility now averages 1.3 per state, a 21.5% decrease every 10 years since the 1950s. Land-grant university soil-test-based phosphorus (P) and potassium (K) recommendation philosophies were categorized as *Sufficiency* (37%), *Build and Maintain* (19%), hybrid (20%), or multiple philosophies for which recommendations are provided (20%). Respondents in two states did not know the recommendation philosophy (4%). Fertilizer-P and K recommendations for corn (*Zea mays* L.) were based on eight different extractants with differences across and within regions. While there have been some successful regional efforts in the past, additional multi-state collaborative efforts are needed to identify research gaps and develop comprehensive strategies to update soil-test correlation and calibration data to address modern agronomic, economic, and environmental concerns.


COMPLAINTS
GRATITUDE

Survey of soil test P and K recommendations and methods



Survey of soil test P and K recommendations and methods



Survey of soil test P and K recommendations and methods

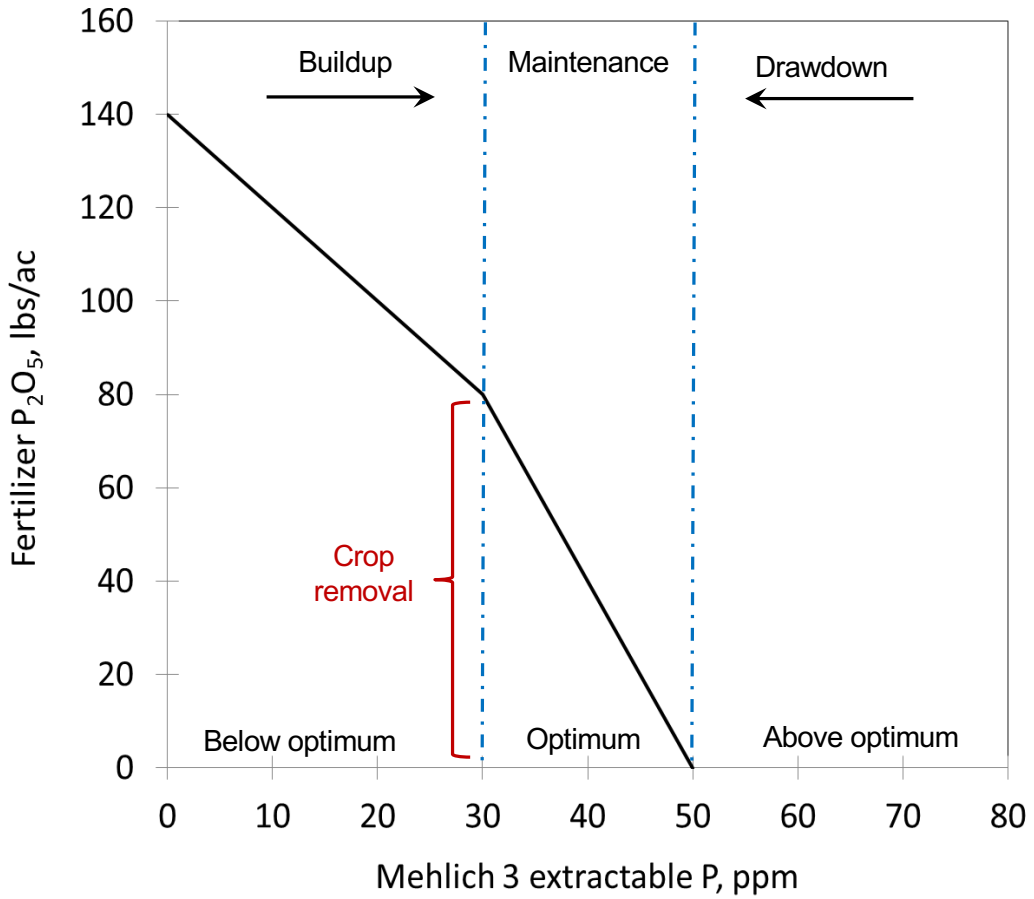
Recommendation philosophy

Build & maintain approach
(feed the soil)

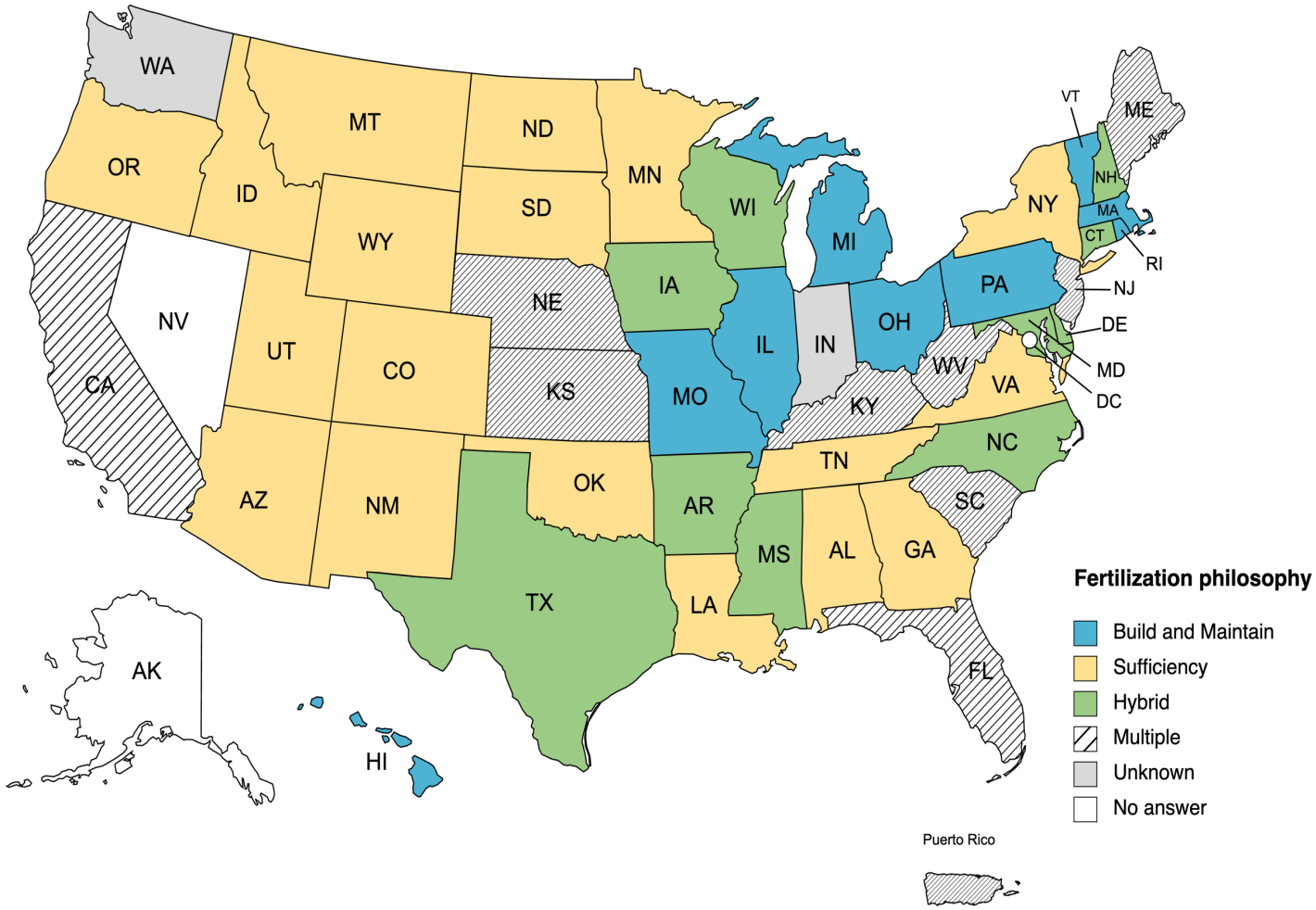
- Build soil test levels to optimum range over several years then replace nutrients removed by crop

Sufficiency approach
(feed the crop)

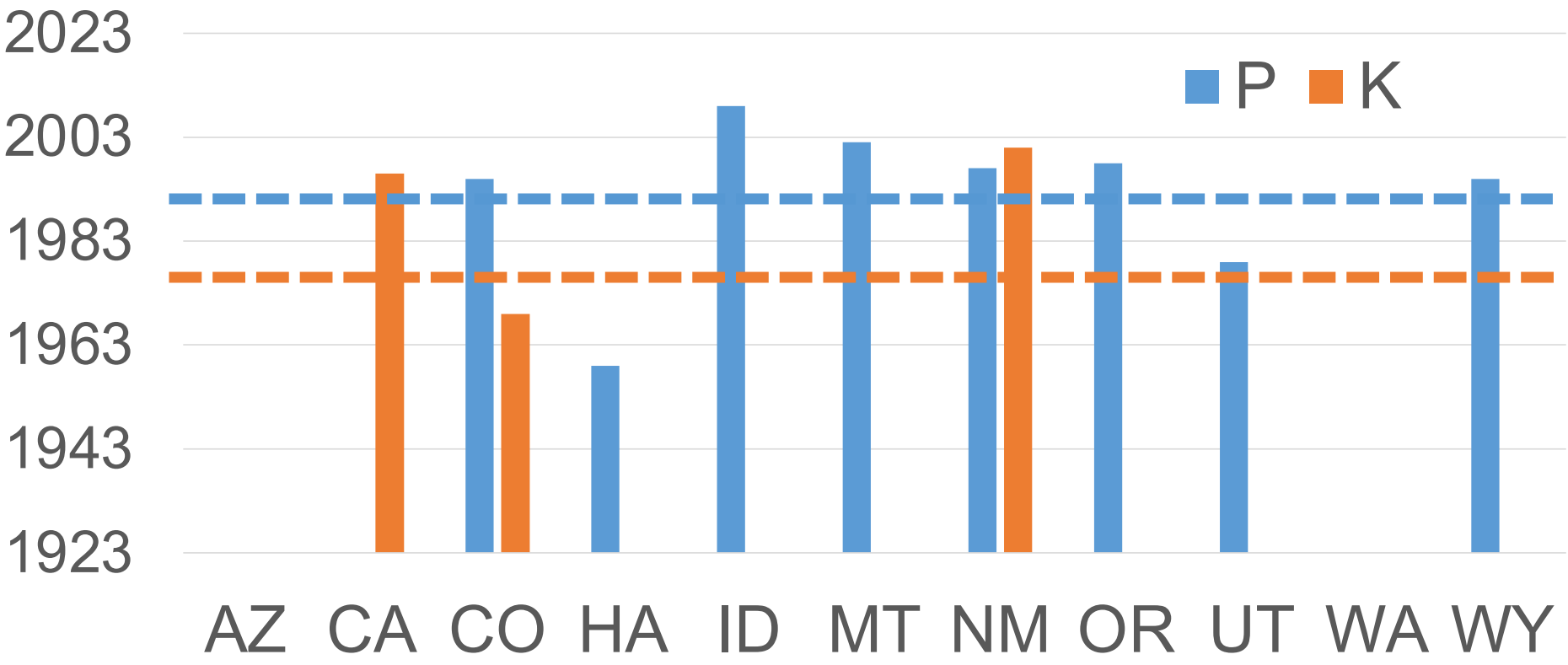
- When soil test level is below optimum, apply only enough nutrients to meet crop needs



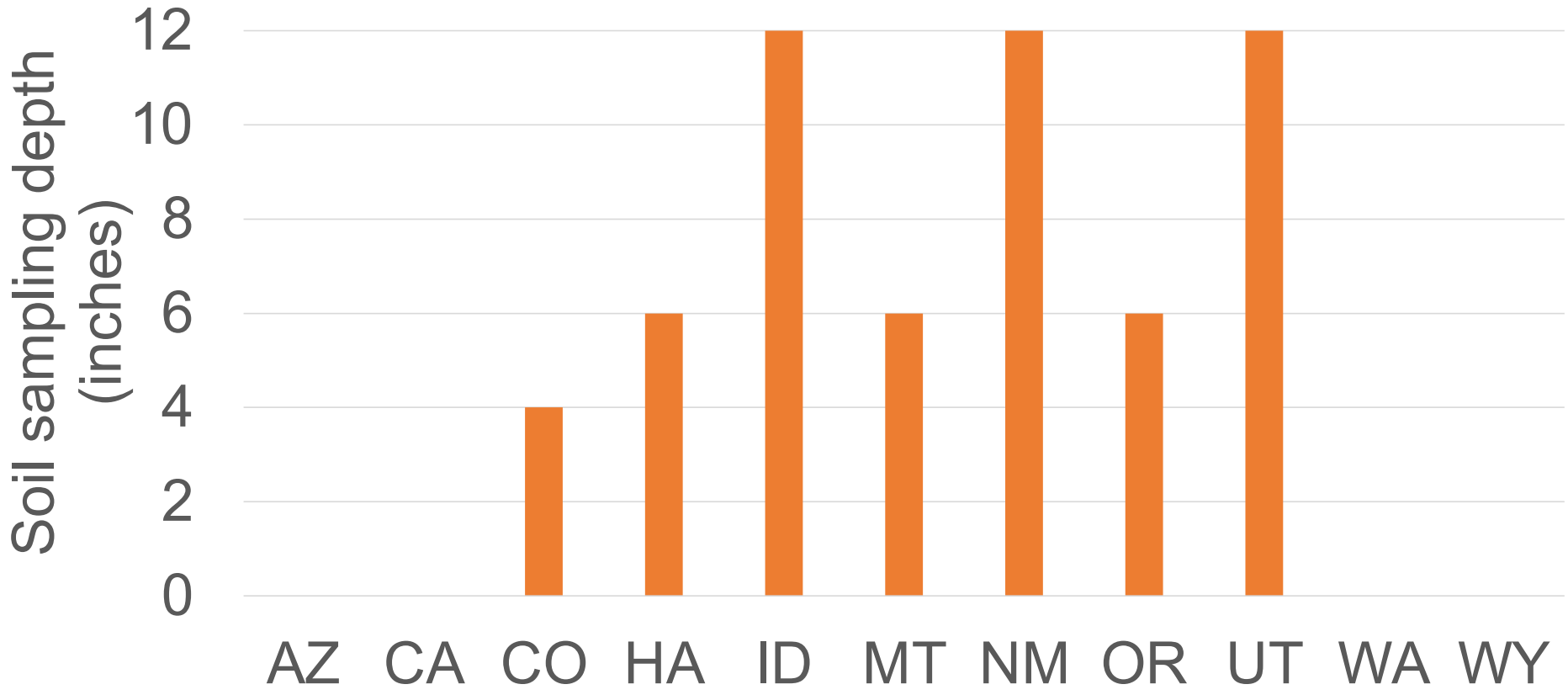
Survey of soil test P and K recommendations and methods



What year was the current soil test value field correlation established and/or last validated?



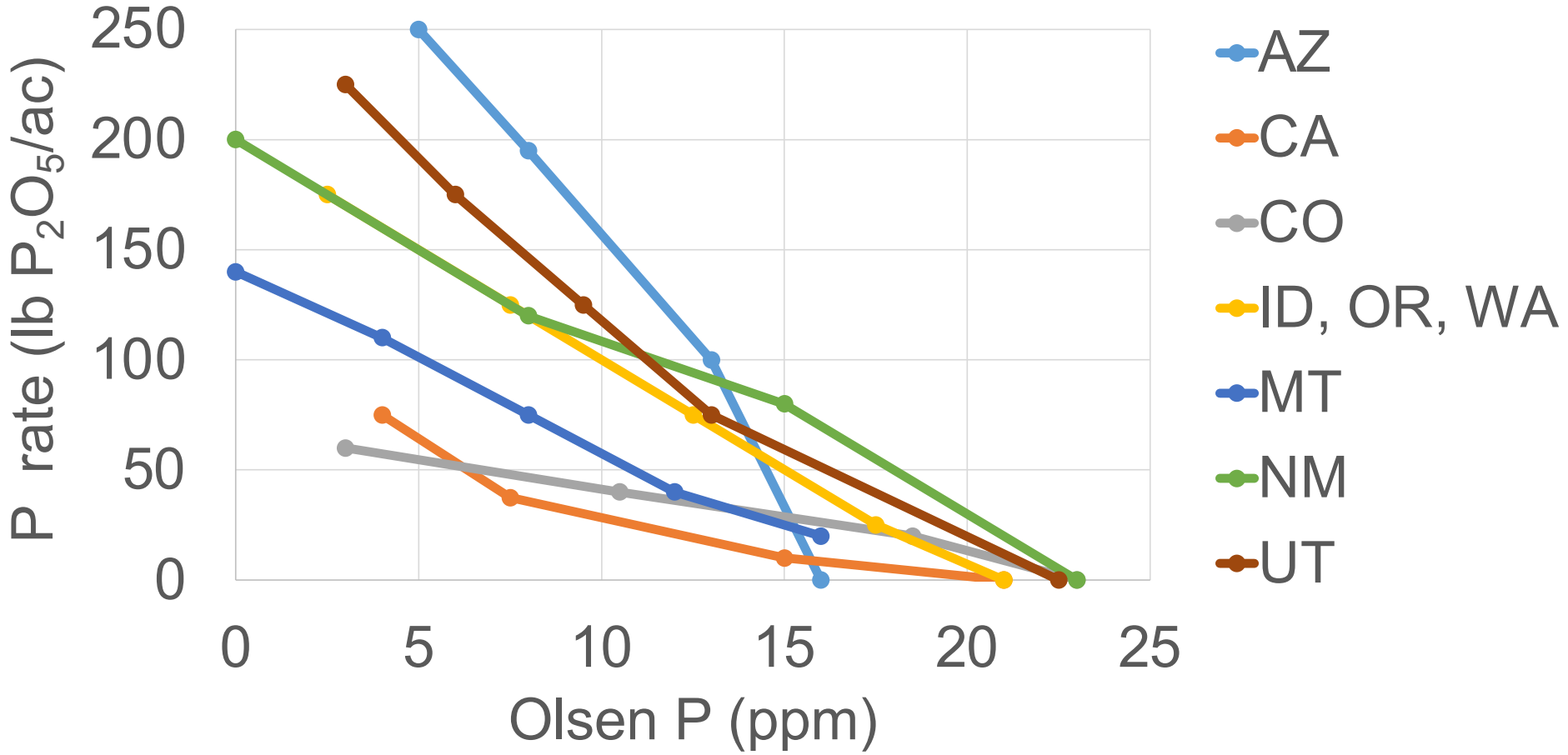
SOIL SAMPLING DEPTH



CRITICAL SOIL TEST VALUES - P

State	Alfalfa	Corn Silage	Grass Hay	Potato	Wheat
	---------- Olsen P (ppm) ----------				
Arizona	15	.	.	.	13
California	20	6	17	.	.
Colorado	22	15	22	29	14
Idaho	22	10	10	20	12
Montana	20	20	20	20	20
Nevada	.	.	.	.	.
New Mexico	23	23	23	31	23
Oregon	20	15	30	.	20
Utah	15	15	15	30	15
Washington	20	20	15	20	16

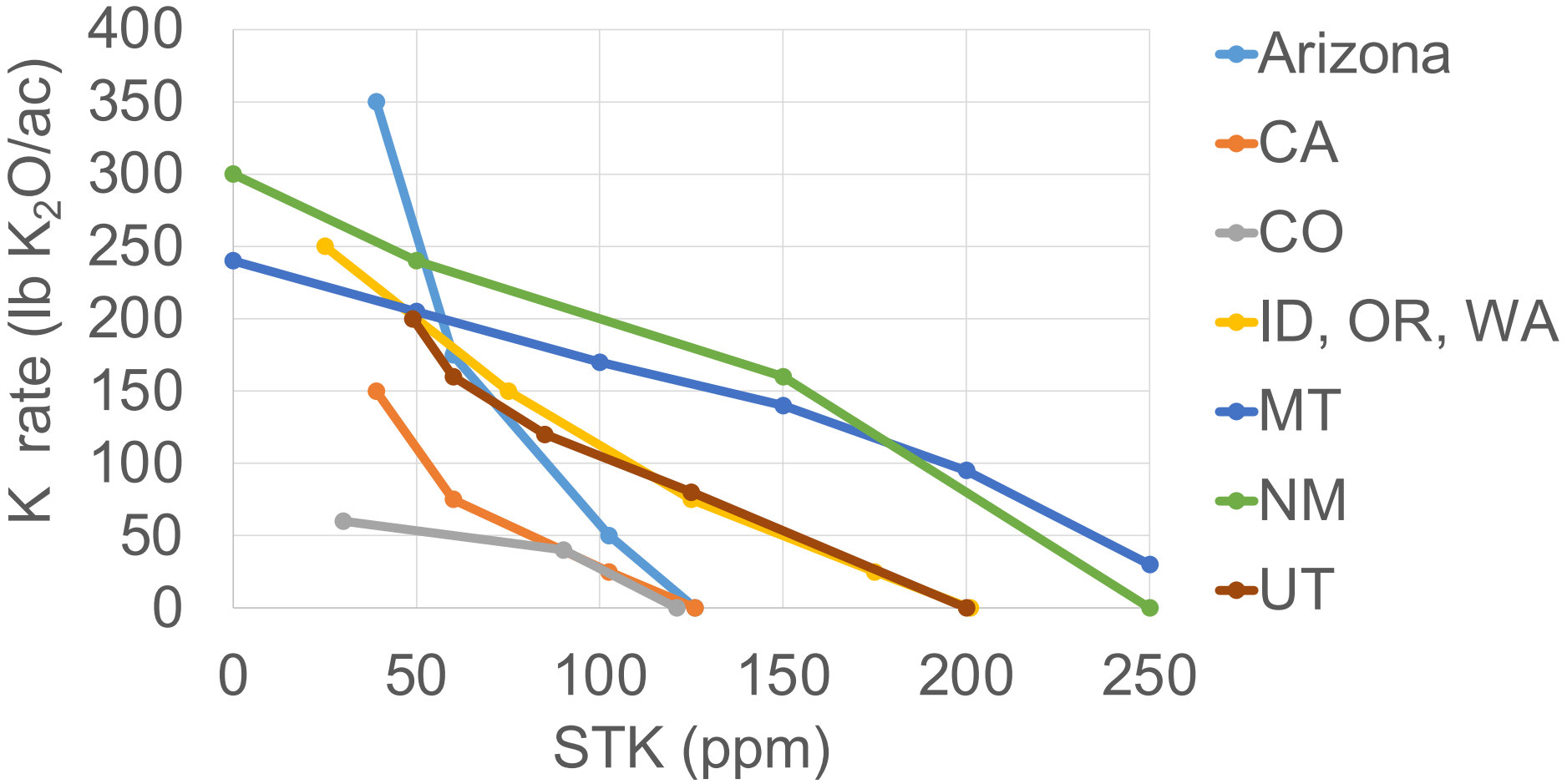
ALFALFA P RECOMMENDATIONS



CRITICAL SOIL TEST VALUES - K

State	Alfalfa	Corn Silage	Grass Hay	Potato	Wheat
	---------- Olsen or NH4OAc K (ppm) ----------				
Arizona	125	.	.	150	.
California	125	.	125	125	.
Colorado	120	120	120	180	60
Idaho	200	120	110	175	75
Montana	300	300	300	300	300
Nevada	.	.	.	.	.
New Mexico	250	250	250	350	250
Oregon	200	150	200	.	100
Utah	150	150	150	120	150
Washington	200	150	150	240	90

ALFALFA K RECOMMENDATIONS

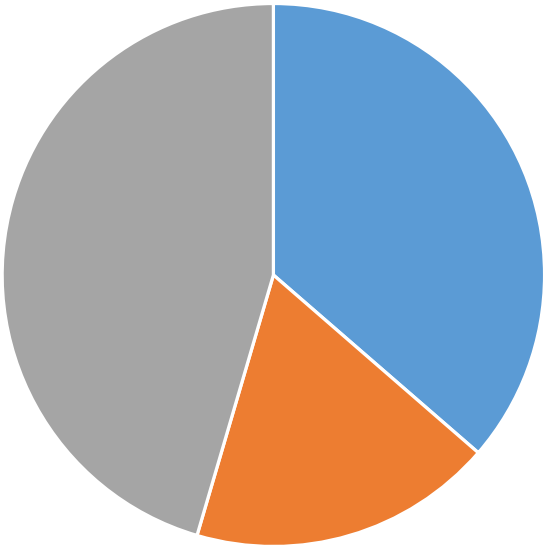


CRITICAL SOIL TEST VALUES - S

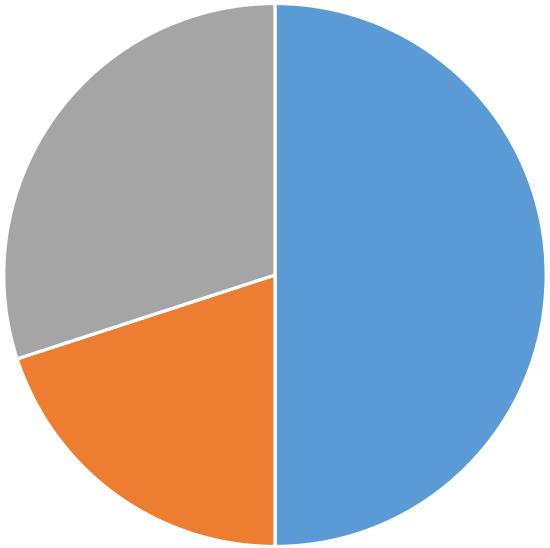
State	Alfalfa	Corn Silage	Grass Hay	Potato	Wheat
	---------- S ppm ----------				
AK, AZ, CA, HI, MT, NV, NM	.	.	.	.	.
Colorado	8	8	8	.	.
Idaho	10	8	10	15	10
Oregon	15	.	.	.	10
Utah	8	8	8	8	8
Washington	10	.	10	2	8

SULFUR TRENDS

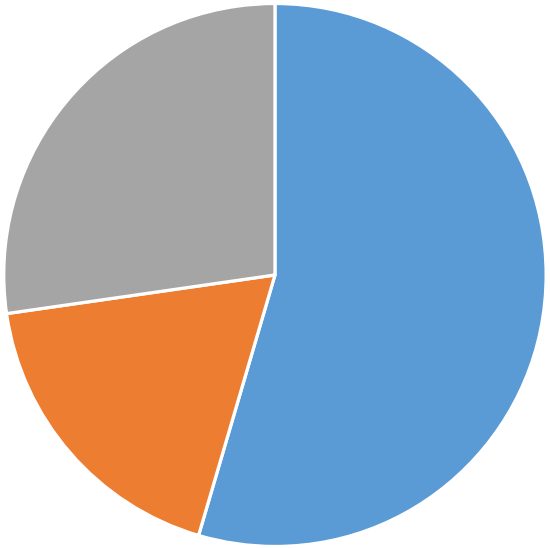
More S response?



Test for it?



Recent trials?



No Yes Unsure

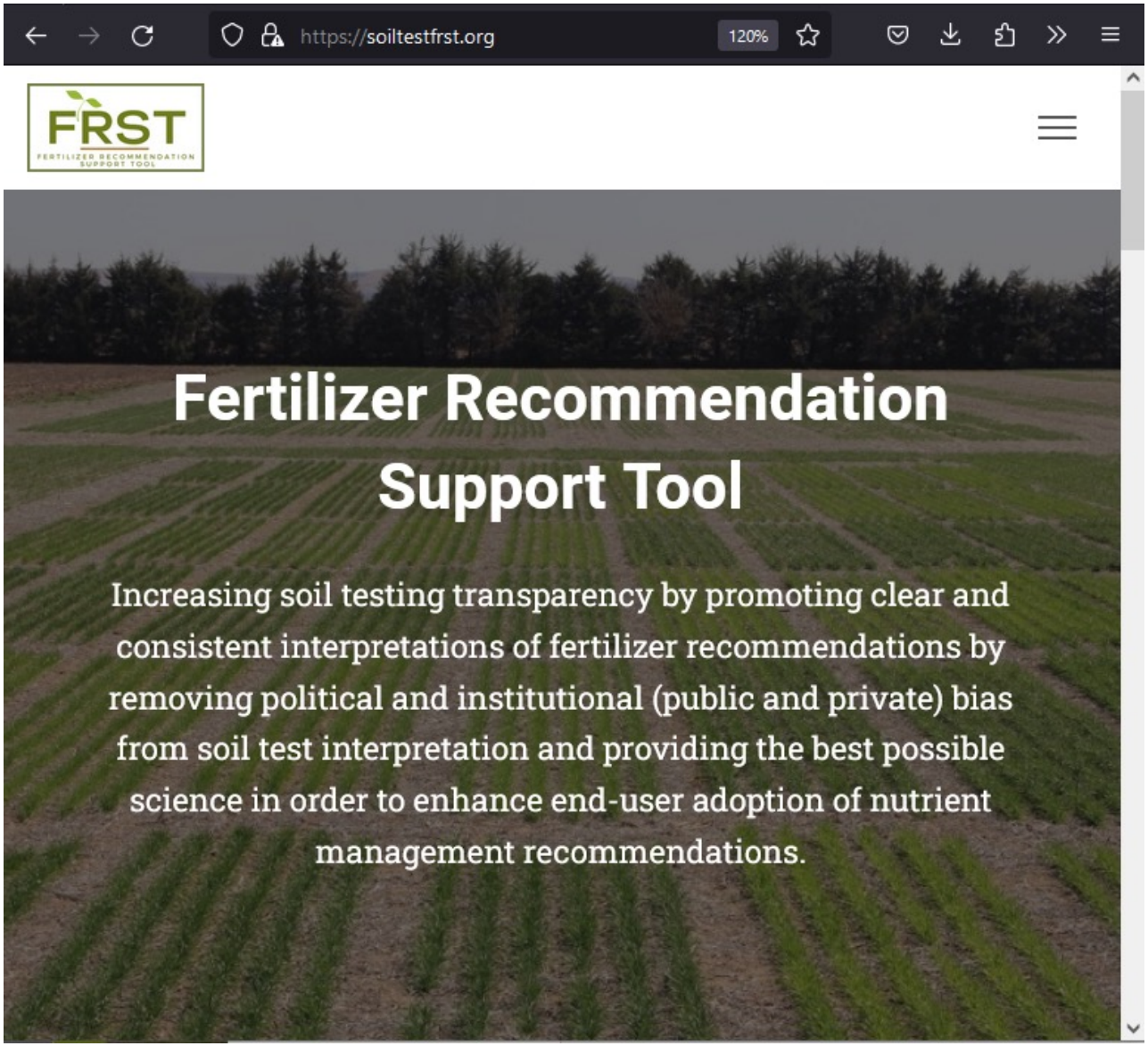
OPPORTUNITES

- Find, review, and certify background calibration data that built recommendations so updates are science-based.
- CSTV and recommendations that are tailored to each crop (removal rates) and region.
- Common and correlated methods for extractants, soil sampling depth, approach.
- Fill in the missing gaps for many states/crops.
- More regional coordination in recommendations – **include industry data**.

soiltestfrst.org

Web-based platform that generates soil test correlations based on user-selected criteria, including crop, year, location, soil classification, and sampling depth.

Launched - April 2024



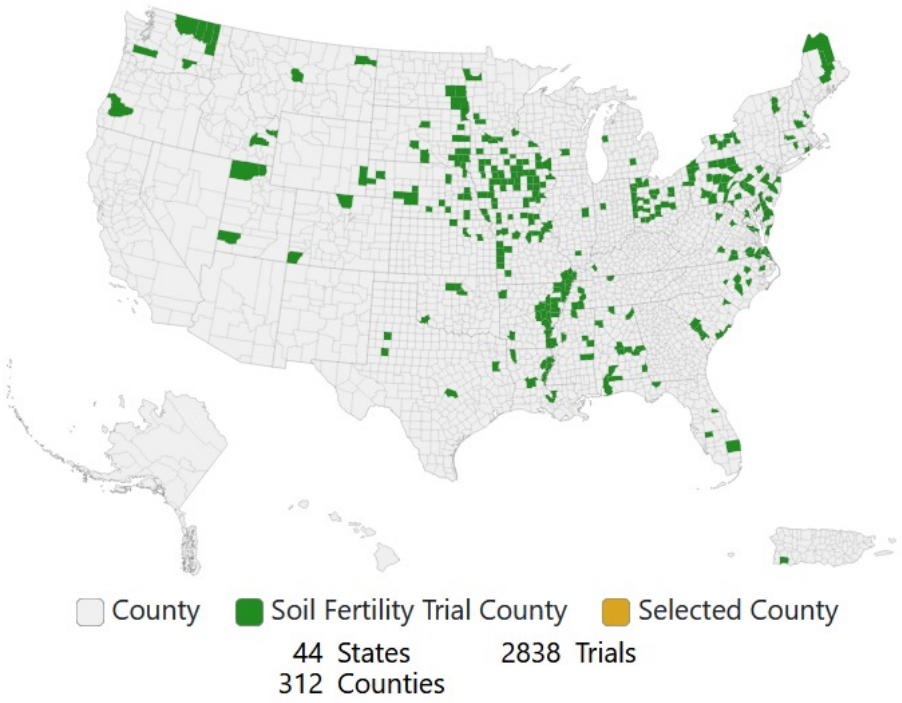
FRST database inventory, 1 February 2025

P trials: 1408 observations

- 39 states represented
- Corn: 703 trials in 26 states
- Soybean: 459 trials in 15 states
- 83% of data from corn & soybean trials

K trials: 1313 observations

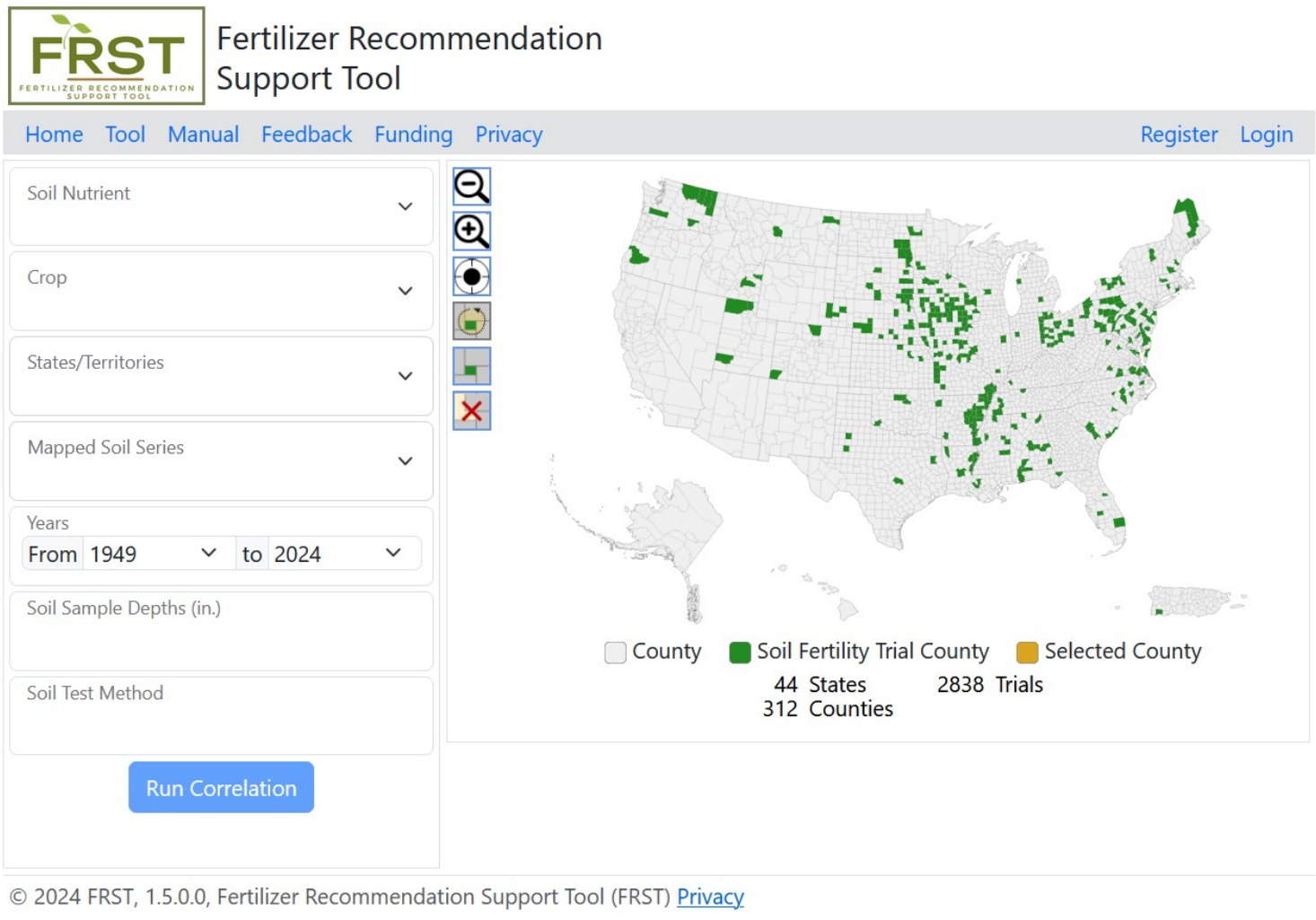
- 30 states represented
- Corn: 616 trials in 22 states
- Soybean: 373 trials in 17 states
- 75% of data from corn & soybean



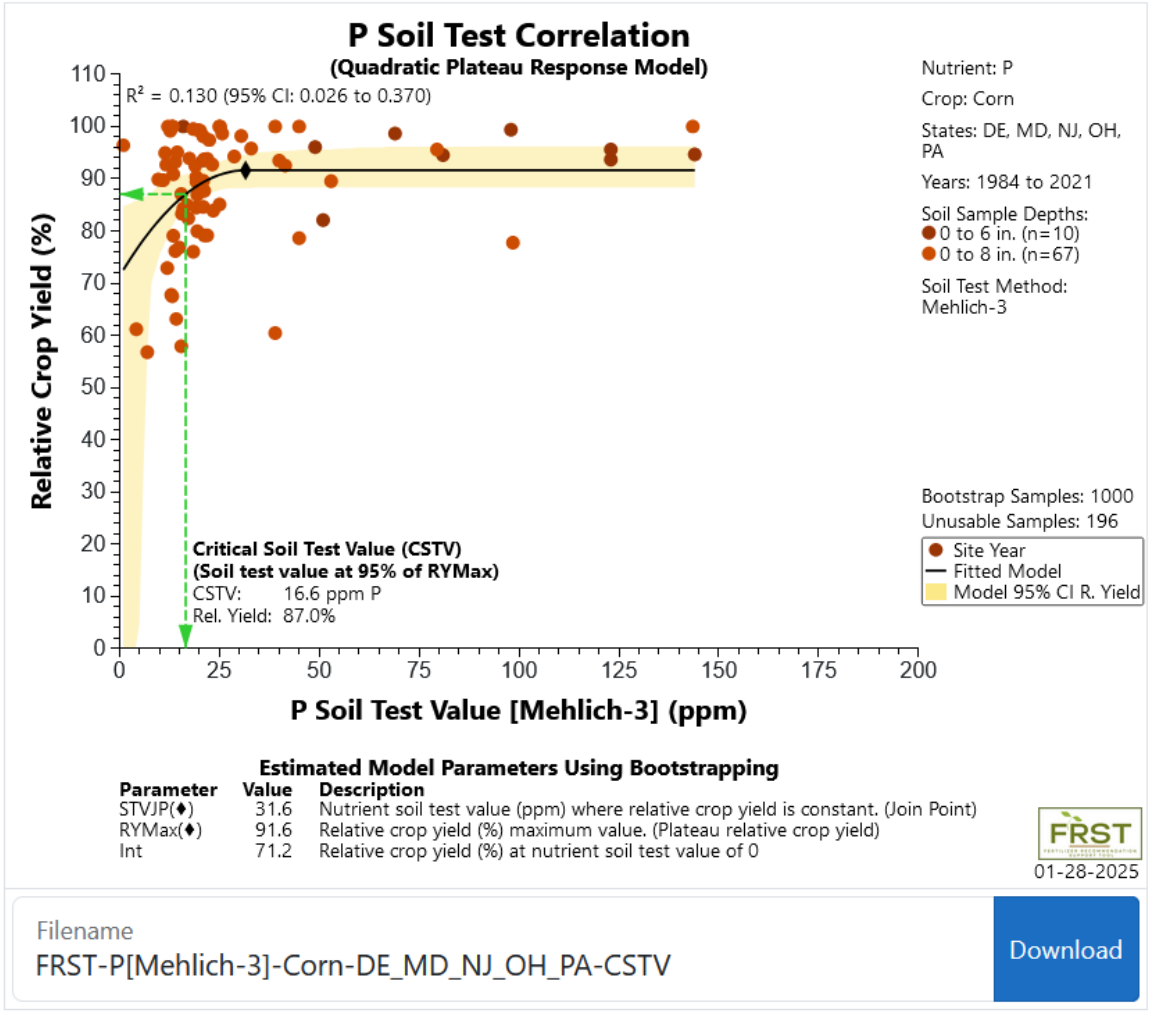
❖ Funding from USDA-NRCS and OCP-NA to support additional trials nationwide.

❖ Continuing to collect data from legacy trials for underrepresented crops and regions.

The FRST, v1.5.0.0



The FRST, v1.5.0.0

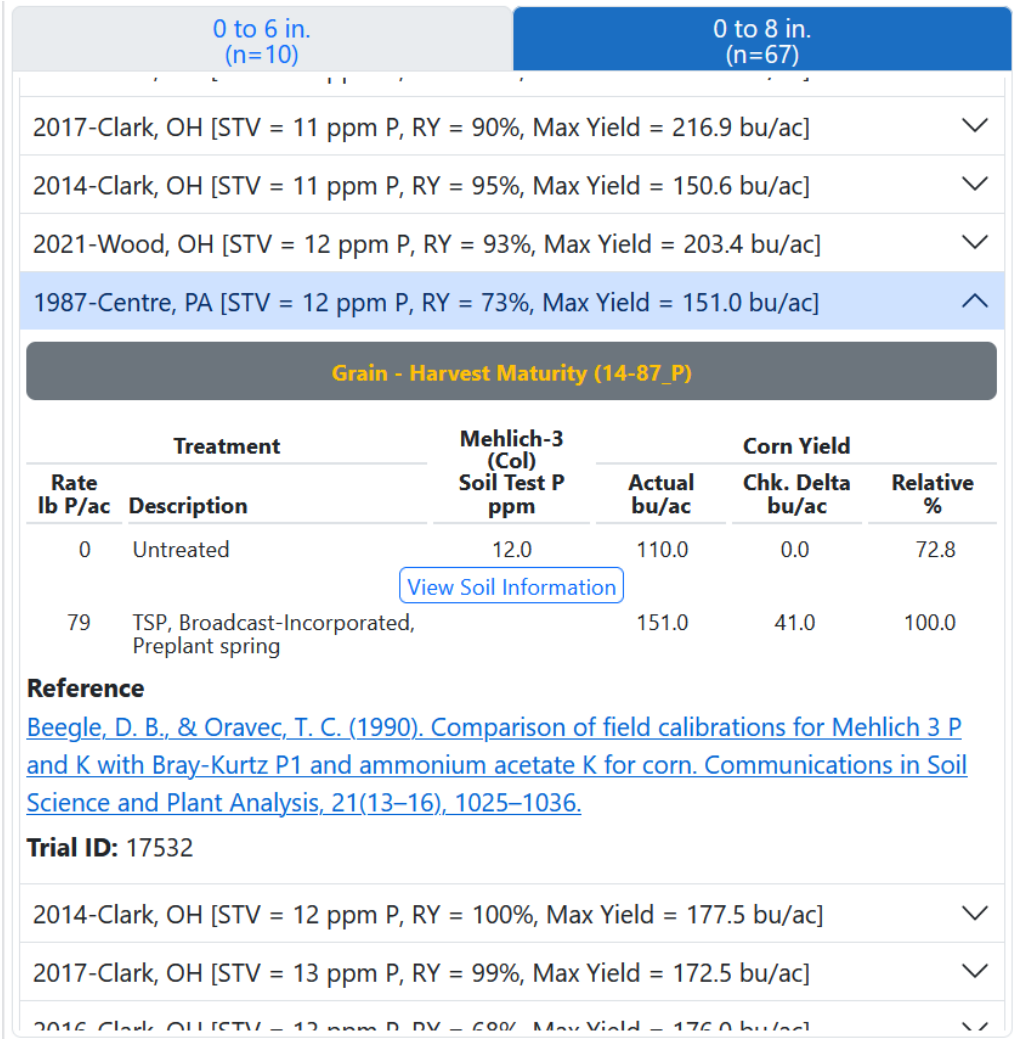


Quadratic plateau curve with 95% CI (bootstrapping 1,000 reps)

Model R^2 with CI

Critical soil test value (CSTV) with CI

The FRST, v1.5.0.0



Site year data for each trial within the queried dataset

Adding Existing and New Data - PKS

The minimum dataset committee determined that some information was essential and was therefore called "required" data, while other information would be useful, especially for data sharing, and was categorized as "recommended" data. A simple-to-use Excel template with color coded data entry fields that helps to distinguish between required and recommended information has been developed to facilitate data collection and reporting (**FRST Data Submission Template**). The template was tested by 13 researchers who performed soil test correlation and calibration research in 2021. The expectation is that soil fertility researchers

	C	D	E	F	G	H	I
1	**Trial ID**	**Nutrient of Interest**	**Country**	**State**	**Nearest City**	**County**	**Latitude (decimal degrees)**	**Longitude (decimal degrees)**	**Nearest NOAA Weather Station ID**
2	EXAMPLE	P	USA	NC	Apex	Wake			USC00310212
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Thank You

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