

The FRST Decision Aid for Soil Test P and K Interpretation

Soil testing and fertilizer management are at the core of modern agriculture. Most soil test correlation and calibration trials and the corresponding development of fertilizer recommendations occurred from the 1950s to 1970s. Despite many changes and advancements in agronomy and increases in crop yields, research on key soil fertility topics has not been conducted in many states. Today, the imperative of upgrading fertilizer and soil amendment recommendations is highlighted by variable on-farm economic conditions and concerns over the fate of fertilizer nutrients in the environment.

The Fertilizer Recommendation Support Tool project, or FRST, is a national initiative to modernize fertilizer recommendations by pooling expertise and soil test correlation and calibration data from across the country into an accessible decision support tool. Researchers working as a national team rather than within individual states and institutions will reduce ambiguity while optimizing soil amendment and nutrient use across state lines. FRST activities also include the improvement of soil acidity management and liming recommendations. The FRST tool and data generated by FRST activities are expected to augment existing recommendations with the potential to enhance soil and natural resource management, increase return on soil amendment investment by growers, and reduce excess nutrient losses to the environment.

The FRST Project involves land grant institutions, multiple branches of the USDA,

non-profit organizations, and private industry participation in a collaborative effort guided by three objectives:

- developing a community of practice focused on soil fertility
- preserving soil test correlation and calibration data in a relational database
- developing a decision tool to provide consistent soil test interpretations.

The FRST Project team developed a web-based decision aid backed by a relational database (Fact sheet #8) to facilitate soil test correlation. Correlation determines whether a relationship exists between soil test values for the nutrient of interest and crop yield response to fertilization with that nutrient.

Correlation model selection and method for determination of the critical soil test value (CSTV) were developed as a collaborative effort of FRST Project participants. The CSTV is the soil test value where 95% of the maximum relative yield is produced without fertilization with the nutrient of interest. The decision aid was beta-tested by FRST members, collaborators, stakeholders, and an advisory panel before the release of v1.0 to the public on April 8, 2024 (<https://frst.scinet.usda.gov/Tool>).

The decision aid currently supports soil test correlation for phosphorus (P) and potassium (K), and work is underway to include sulfur (S). An interactive map shows the counties of all trials in the database. Users can select counties on the map to query the database for

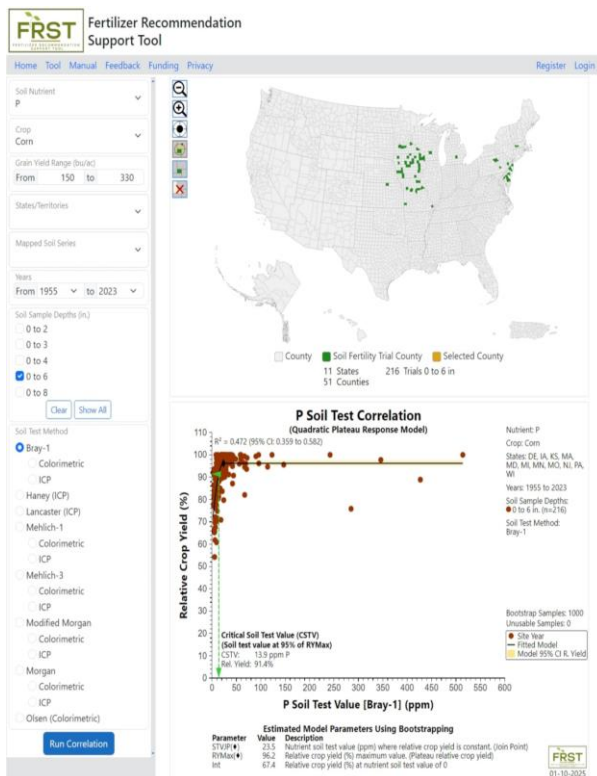


Figure 1. The Fertilizer Recommendation Support Tool Project Decision Aid (version 1.5) soil test correlation (partial) output for trials based on the selections in the left dropdown menu. pane.

trial information, filter data using criteria using dropdown menus and selections (Figure 1), or use a lasso tool to group counties of interest for correlation analysis. Filter options include nutrient (P or K), crop, yield range, soil type, year, sampling depth, and soil testing method. The counties highlighted on the map change as filter criteria are selected.

Once criteria are set, the tool can execute soil test correlation by fitting a quadratic-plateau model. The FRST output includes the soil-test and relative-yield correlation scatter plot (Figure 1), a histogram of maximum yield distribution across site-years, and a list of trials included in the correlation. Trial results and selected metadata can be reviewed in this list. The scatter plot provides correlation components, including the goodness of fit (R^2) and CSTV.

Users of the FRST decision aid can evaluate trial results across states, soils, crop yields, and years. This enables correlation from robust datasets, which may strengthen correlation relationships and facilitate assessments that are less influenced by bias rooted in professional judgment and preference for fertilization strategy, model selection, and relative yield calculation.

The FRST decision aid serves as a resource for scientists, agronomists, and farmers for developing science-based fertilizer recommendations and evaluating the potential yield benefit and return on investment of fertilizer recommendations. During the first six months, almost 1,500 users interacted with the FRST webtool and we anticipate growth in tool utilization. Continued additions to the database and refinement of the decision aid are ongoing processes to maintain relevance and functionality for stakeholders.

Thanks to the individuals providing data, time, and effort to develop the FRST decision aid and to our funders, USDA-NRCS (grants 69-3A75-17-45 & NR233A750011G016), USDA-ARS (grant 58-8070-8-016), and agInnovation (State Agricultural Experiment Stations) via Hatch Funds provided by the National Institute of Food and Agriculture, U.S. Department of Agriculture for the National Research Support Project 11 (NRSP11).

For more information, visit soiltestfrst.org.

For more detailed information on the FRST Decision Aid, please see:
TBD – paper is in review

Authors: M. Bourns (Univ. of Arkansas), G. Buol (NC State Univ.), L. Gatiboni (NC State Univ.), J. Spargo (Penn State Univ.), M. Yost (Utah State Univ.), N. Slaton (Univ. of Arkansas), & D. Osmond (NC State Univ.) January 2025