Minimum Dataset and Metadata Guidelines for Soil-test Correlation and Calibration Research

Soil testing and fertilizer nutrient management are at the core of modern agriculture. The majority of soil test correlation and calibration trials and development of fertilizer recommendations occurred from the 1950's to 1970's. Despite many changes and advancements in agronomy and increases in crop yield, little soil fertility research has been conducted in the last several decades. Today, the imperative of upgrading soil test fertilizer recommendations is highlighted by global supply chain disruptions and concerns over the fate of fertilizer nutrients in the environment.

The Fertilizer Recommendation Support Tool, 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 nutrient use across state lines through the development of the FRST. Users will select specific conditions, such as soil, crop, geographic region, and soil test extractant, to provide tailored soil test recommendations that are expected to save farmers millions of dollars annually while reducing excess nutrient losses to the environment.

In support of transparent, science-based fertilizer recommendations, the FRST project sought to establish a core set of information for field-based soil-test phosphorus and potassium fertility trials (e.g., soil test correlation and calibration studies). The FRST project collaborators volunteered to serve on the minimum dataset committee, which worked for two years. This committee developed and vetted a robust set of factors for the minimum dataset, which included information on soil sample collection and processing, soil chemical and physical

Table 1. Summary and examples of required and recommended data and metadata.

	Required data		Recommended data	
Category	**Items**	**Examples**	**Items**	**Examples**
	#		#	
Soil sample collection and processing	9	soil core number per composite, composite sample inference space, & core sample depth	5	Soil core diameter, drying duration, & analyzing laboratory name and location
Soil chemical and physical properties	6	organic matter, pH, and soil test phosphorus, potassium, calcium, & magnesium	19	Soil texture, bulk density, & cation exchange capacity
Crop, soil, and nutrient management metadata	26	County/state, nutrient source, application date, cultivar, planting date, irrigation & previous crop	17	GPS coordinates, previous year fertilization, pest management, & plant population
Experimental design and data	8	Block number, experimental design, & yield means	9	Treatment *P*-values & replicate yield data,

properties, trial metadata about the production system (metadata is data that provides information about other data) and field management, and the experimental design and statistical analyses (Table 1).

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. The template is available at the FRST website (https://soiltestfrst.org/resources/). The template was tested by 13 researchers who performed soil test correlation and calibration research in 2021. The expectation is that soil fertility researchers will use this template so that a consistent suite of data and metadata are collected, added to the FRST database, and published in journals. Collecting a consistent suite of data allows researchers, agricultural practitioners, and farmers to have access to all available soil fertility trial data and metadata that crosses state boundaries on which to develop critical soil test values and crop fertilization guidelines. The emphasis of the minimum dataset is to encourage scientists to record and report the invaluable metadata that enhances the reuse of the soil test fertility data. We realize the minimum dataset is not static and expect that it will need continual reevaluation as the science of soil testing evolves.

For more details, including metrics that are recommended and required see: Slaton, N. A., Lyons, S. E., Osmond, D. L., Brouder, S. M., Culman, S. W., Gatiboni, L. C., Hoben, J., Kleinman, P. J. A., McGrath, J. M., Miller, R. O., Pearce, A., Shober, A. L., Spargo, J. T., & Volenec, J. J. (2022). **Minimum dataset and metadata guidelines for soil-test correlation and calibration research**. Soil Science Society of America Journal, 86, 19– 33. https://doi.org/10.1002/saj2.20338

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For more information, visit soiltestfrst.org.

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