SOIL TEST CALIBRATION WORK IN SOUTHERN USA

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Introduction

Sound soil test calibration is essential for successful fertilization program and crop production. It is essential that the results of soil tests be calibrated against crop responses from applications of the plant nutrients in question as it is the ultimate measure of a fertilization program. An accurate soil test interpretation requires knowledge of the relationship between the amount of a nutrient extracted by a given soil test and the amount of plant nutrients that should be added to achieve optimum yield for each crop. Calibrations are specific for each crop type and they may also differ by soil type, climate, and the crop variety.

In the southern USA, calibration work was started some 80 to 90 years ago (Table 1) to provide a basis for fertilizer recommendation based on a soil test. With the changes in plant genetics, crop management, nutrient sources, production technology, and the advent of modern and more accurate soil testing methodology, soil fertility extension specialists recognized the need to reexamine the existing soil testing and recommendation systems for most nutrients. As the survey also shows, many of the early calibration studies were limited in scope, and there were often hampered by availability of funds. Furthermore, any fertilization program today and in the future should be cognizant of its impact on the environment. Although soil test calibration data is indispensable to the economic viability of farms and environmental quality, there is very little recent national or regional emphasis on soil test calibration research.

General information on the status of soil test calibration was gathered from southern states through a survey questionnaire that includes information on the starting date of calibration studies, current program, funding, and human resource involvement. A summary of responses provides soil fertility specialists, extension personnel, and the decision makers on the status of soil test calibration programs in the southern region of the US. It is also hoped that soil test calibration studies should be conducted as a joint effort among state universities. The use of soil testing for regulatory or environmental purposes requires a concerted and coordinated regional

effort. This regional activity must address the need for reliable calibration data, but must include the extension of this information to the public.

The Survey

Question**: *In what year was your state's soil test calibration first established?***

The earliest soil test calibration survey in the southeastern states was initiated some 80-90 years ago in Florida and Kentucky, respectively. Although Alabama is reported to have established its soil test calibration program in 1953, some calibration experiments began in 1929 that were conducted in six locations of which five are still in existence. The state of South Carolina is reported to have its soil calibration program established in 1938. Soil testing in North Carolina began in 1940 but extensive trials were held only in 1949 and thereafter. Also, Arkansas began its soil testing and fertilizer research in the 1940s but a formal soil testing program was established and funded only in 1953. The other states in the southeast did not begin their calibration studies until after the Second World War. In Mississippi, the first soil testing calibration work was conducted by J.D. Lancaster and J.L. Anthony following the World War II and a soil testing laboratory started its operations in 1952 under the management of Ivan Miles. Texas initiated its soil test calibration in 1946 but was not funded actively until 1976. Although there is no record of previous calibration works in Tennessee, the first soil testing laboratory was established in 1948. Georgia and Oklahoma were the last two states to have established their soil test calibration programs. In Georgia, JB Jones began a sustained effort to establish such a program about 1969. The establishment of Oklahoma's soil test calibration program began between the late 60s and early 70s but the exact year is unknown.

Question: ***Is there an active process to conduct updated soil test correlation/calibration research? How is it funded?***

All states recognized the importance of soil test correlation/calibration work and expressed the desire to extensively pursue this endeavor if funding becomes available. Alabama has some on-going soil test calibration work, but the uncertainty of sustained funding could jeopardize the

future of this program. Some calibration work has been in place in Arkansas that is funded through fertilizer fees and grants from other commodity boards like rice and soybeans. The expenditure of this money is overseen by the Arkansas Soil Testing and Research Advisory Board. The state of Kentucky is currently active in calibration work, by the Pre Sidedress Nitrate test and optical sensors. They also have P research but only on new products with very little being done with potassium. Kentucky's primary funding is from outside funding sources, with a minimal amount from state appropriation. Limited work is ongoing in some states (New Mexico, Tennessee, Texas) but they lack coordination and organization due to insufficient funding. Most of the work is done through the soil testing lab in conjunction with external project funds, e.g., water resource protection project in Texas. Some states indicated specific calibration work such as phosphorus in citrus (Florida), lime recommendations (North Carolina), and inorganic fertilizers on rice (Mississippi). Although Georgia's calibration program started in the 60s, it had dwindled significantly with time until just recently when field calibration studies focused on vegetables. Oklahoma maintains long term fertility plots and new trials are initiated with emphasis on precision nutrient management. South Carolina is in the process of reviewing and updating recommendations after a newly hired fertility specialist came on board. Tennessee does not have any ongoing calibration work owing to lack of financial support.

Question: ***Is there a need for more correlation/calibration studies in your state? Please specify.***

All states expressed a strong desire to pursue calibration studies in order to update recommendations based on soil tests. New calibrations are needed because of new plant genetics, nutrient sources, crop management, environmental concerns, and laboratory and field advancement in technology and machinery. The common sentiment among researchers and extension specialists is the lack of funding. With rising costs of nitrogen fertilizers, all states recognized the need to improve nitrogen recommendations. Arkansas indicated that it has a good database for soybean, wheat, and rice response to P and K fertilization, but needs calibration on cotton, grain sorghum, forages, and fruit and vegetable crops. In Mississippi, soil test calibration was an emphasis of the Experiment Station from 1948 to 1986, but the program slowly lost funding following retirements. The state recognized the critical need for soil test correlation/calibration in response to changes in plant genetics, crop management, nutrient

sources, and environmental concerns. A similar pressing need to update fertilizer recommendations was identified in Georgia. Consistent with other states, Florida is facing budgetary constraints, with current funding prioritized on water quality research. Kentucky recognizes the need for potassium studies because soil test levels are declining in some areas and cropping systems. As yields continue to increase and cropping systems become more grain intensive, the need for up-to-date fertilizer recommendations are essential to maintain productivity and economic return while minimizing agriculture's environmental impact. New Mexico has few short term calibration experiments but recognized that their water extract for potassium lacks calibration with crop performance. North Carolina expressed a need for calibrating starter fertilizers on crops such as corn, cotton, vegetables, and turf especially in soils testing high in P. The state is also in the process of validating sulfur recommendations. For crops new to the area, calibration is needed as well. For example, canola is newly introduced in Oklahoma. More studies are also needed for no-till and reduced tillage systems. South Carolina has just begun updating their soil fertility recommendations. Due to changes in hybrids/varieties, cropping systems and growing environmental concerns, Texas has been pressing for calibration studies, especially on P, K, S and all micronutrients.

Table 1. Summary of responses by various states on soil test calibration survey.

Question	Reply
In what year was your state's soil test calibration program first established?	AL: 1953 but the oldest soil test calibration experiments began in 1929 at 6 locations. Five are still in existence with the seventh in longleaf pines. AR: Although no official date is known, soil testing and fertilizer research have been conducted in Arkansas since, at least, the 1940's. A soil testing program was established and funded in 1953. GA: not sure but JB Jones began a sustained effort about 1969 FL: approximately 80 years ago (as per the gurus) KY: Excerpt from p. 107 in "College of Agriculture. University of Kentucky, Early and Middle Years 1865-1951. author: H. Allen Smith." : In 1910 A.M. Peter reported on methods of analysis of plant food elements in soils, "We think we have decided upon a method of determining small quantities of potassium in soil solutions which will give satisfactory results." MS: Soil testing calibration work began following War World II, conducted by J.D. Lancaster and J.L. Anthony. Soil testing laboratory began operations in 1952 under management by Ivan Miles NM: unknown NC: Soil testing began in 1940. I do not know the specific year that calibration studies began in NC; however, extensive trials were held in 1949 and thereafter. OK: It was established in the late 60' and early 70'. Exact year is unknown. SC: 1938 TN: First lab established in 1948. (Not sure what happened before then!) TX: Initiated in 1946, but has not been actively funded since 1976.

Is there an active process to conduct updated soil test correlation/calibration research? How is it funded?	AL: yes, some ongoing, lack of funding could jeopardize future AR: There is still some calibration/correlation going on that is funded through the above-mentioned fertilizer fees. Grants from other commodity (Rice, Soybean, etc…) boards within Arkansas are also used for correlation/calibration research. The expenditure of this money is overseen by the Soil Testing and Research Advisory Board. GA: just started, delay due to lack of funding FL: some on P soil test for citrus KY: Yes, especially in the area of N in terms of PSNT, optical sensors, and new products. There has been some P research as well but this has only been on new products. Very little has been done with K. Funding comes from various sources. Very little if any has been hard money. MS: rice nutrient management using inorganic fertilizers NM: work being done but not coordinated NC: lime recommendations for specific crops OK: long-term soil fertility plots maintained; new trials are initiated as needed emphasis is on precision nutrient management research and extension lately SC: Recommendations are in the process of being reviewed and updated where possible by a newly hired fertility specialist. The position is temporary, hourly, and paid through lab revenue. TN: no active process (due to lack of funding) TX: No organized process, due to lack of funding. Most work is being done through the soil testing lab utilizing external funds obtained for other project, e.g. water resource protection.

Is there a need for more correlation/calibration studies in your state? If yes, please specify.	AL: There is always a need. Will it happen? Not likely. There is no funding! AR: Yes, up-to-date correlation data is needed on many crops like cotton, corn, grain sorghum, forages, and fruit and vegetable crops. Arkansas has a good database for soybean, wheat, and rice response to P and/or K fertilization, but more data is needed to complete the process. This correlation process should be continuous to keep recommendations up-to-date as production practices and soils change with time. GA: Yes, we especially need work on vegetable crops. FL: Yes indeed. The need for soil test-crop response calibration studies cannot be over-emphasized. However, there are not any research dollars to increase crop productivity by improving soil fertility and productivity. Resources are primarily to look at the water quality aspects. KY: Yes, potassium soil test levels appear to be declining in some areas and cropping systems. As yields continue to increase and cropping systems become more grain intensive, I think that the need for up-to-date fertilizer recommendations are essential to maintain productivity and economic return while minimizing agriculture's environmental impact. MS: Soil test calibration was an emphasis of the Experiment Station from 1948 to 1986, then deemphasized following retirements. Since that time changes in plant genetics, crop management, nutrient sources, and environmental concerns have led to a critical need for soil test correlation/calibration. NM: Yes. Several one-year studies exist but nothing over time and no correlations completed with water extracted K that the state lab analyzes for. NC: Yes. We need to further develop calibration studies for soils testing high in P where starter fertilizers are used in crops such as corn, cotton, and vegetables. Additionally, studies with turf production are needed. Currently we are validating S recommendations. OK: Yes. New crops, such as canola, need new calibration. Validations are needed for crops already with recommendations to accommodate genetic manipulation and other advancement. More works are also needed for no-till and reduced tillage systems. SC: Yes. A soil fertility specialist is needed to update and maintain soil fertility recommendations. TN: Yes. Current interest in improving nitrogen recommendations. Need to revisit nitrogen response functions with respect to economics. TX: Absolutely, due to changes in hybrids/varieties, cropping systems and growing environmental concerns. In Texas, work is needed on P, K, S and all micronutrients.

Is there a state-managed soil-testing program? If yes, who runs it and how is it funded?	AL: Yes, operated by Auburn University, funded entirely by fees for service ($8 for routine analysis) AR: Yes. It is run by the University of Arkansas Experiment Station. Our program is free to the public. It is funded by the State through the collection of a special fee associated with fertilizer sales. GA: Yes, UGA Ag & Env. Services Lab, funded partially by state dollars, partially by user fees. FL: Yes, Univ. of Florida-IFAS Extension Soil Testing Lab Diagnostic analysis for state and county faculty is free; all other users must pay a per-sample fee that partially funds the lab. KY: Yes, we have two University run soil testing labs. Funding for the lab comes from user fees, fertilizer tonnage tax, and some state funded salaries. None of the lab money is used for calibration research except that soil test results are free for UK researchers. MS: The Mississippi State University Extension Service operates a soil testing laboratory that is funded by user fees and legislatively appropriated funds. NM: No, but there is a soil testing laboratory on the NMSU campus available to homeowners and farmers paid for at their expense. NC: NC Department of Agriculture and Consumer Services. Soil testing is free to producers, and therefore by the state. Waste and plant tissue is paid for by the users. OK: Yes, Oklahoma Cooperative Extension Services. Charges for soil, plant and water testing at state lab are similar to commercial labs; state has little support for this program SC: Yes. Clemson University. Funded from State appropriation and user fees. TN: Yes. It is overseen by the University of Tennessee Agricultural Extension Service, funded by the University of Tennessee and the fees that are charged for testing. TX: Yes. Dr. Tony Provin; partially state funded, mainly funded through payments for analyses.

How many faculty FTEs are dedicated to soil fertility research and extension in your state?	AL: If you really stretched it, about 1.0 FTE spread out among about 6 faculty. AR: Equivalent to 1.7 FTE GA: About 1.5 counting the new soil test calibration person just hired. FL: Soil fertility programs have taken on the new Nutrient Management name. Although there are about 20 FTEs working in the nutrient management area around the state, none of them is conducting any of the classical soil fertility research studies. All of them are working on water quality aspects of nutrient impacts. There are two faculty members with major extension appointments on the main campus, and four faculty off-campus with varying FTEs in extension. However, there is no traditional soil fertility extension program in the state. All the programs primarily emphasize water quality aspects only. KY: Approximately 1.0 Research, 3.5 Extension (including soil fertility and manure management). MS: 1 Soil Testing Administration, 1 Soil Fertility/Nutrient Management Extension NM: 1.0 Research, 1.0 Extension NC: 3.5 Research; 2.6 Extension OK: 1.0 Research; 1.0 Extension SC: not sure TN: A total of 5.7 FTE's for soil science. About 1.5 to 2.0 would be dedicated to soil fertility research - Hugh Savoy (soil fertility and soil testing), Forbes Walker (environmental soils, manure and nutrient management) TX: Approximately 2 FTEs, which includes parts of 8 positions – 5 Research and 3 Extension.