History of Soil Testing in North Carolina

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The history of soil testing as provided by the N.C. Department of Agriculture and Consumer Services divides roughly into two parts. Prior to 1973, the Soil Testing Division (as it was then called) operated with an important, but relatively limited, mandate: to test soils and make fertilizer and lime recommendations. After 1973, the Agronomic Division (as it has subsequently been known) began to fulfill a broader mission. At present, the division provides not only soil testing, but also nematode assay, plant tissue analysis, waste analysis, solution analysis, and a statewide field services advisory program.

The Soil Testing Division: 1939–1972

The Soil Testing Division was established in 1938 to analyze soils and make site- and crop-specific fertilizer and lime recommendations. Work began in July 1939 when I. E. Miles was named the division's first director. After converting some downtown Raleigh office space into a makeshift laboratory, Miles and his staff of six full-time and seven part-time employees began soil testing in early 1940. The staff also began a concerted effort to educate state residents about the new service. Particular attention was devoted to cooperating with fertilizer dealers, educators and other agricultural agencies.

Throughout the early years, the division worked closely with farmers and agricultural leaders to verify the efficacy of its fertilizer and lime recommendations. Analytical procedures were updated repeatedly so that recommendations would be tailored to new farm management practices and crop varieties. Modern farmers owe a large debt to the division's early employees, whose careful evaluations and painstaking refinements helped build the foundation of practical knowledge upon which N.C. agriculture continues to flourish.

The service grew rapidly. With promotional assistance from the N.C. Extension Service and the Soil Conservation Service, the division analyzed 65,000 samples in 1940; 22,000 in 1944; 42,000 in 1947; and 85,000 in 1949. By the early 1950s, state farmers

were using more fertilizer, and using it more efficiently, than any other farmers in the nation. Such efficiency can be attributed, in large part, to the leadership efforts of directors Werner L. Nelson (1948) and Dr. J. W. Fitts (1950).

Although farmers were the primary benefactors of soil testing, the state agricultural experiment station, highway department and even federal agencies relied on the division for technically precise information about soil chemistry. Scientists interested in establishing soil testing programs in other states and nations came from as far away as South America, India and China to spend weeks, or even months, in North Carolina studying the program and looking for ways to adapt it to their own regions.

Educational effort was devoted to demonstrating the value of soil testing without creating unrealistic expectations about the kinds of problems it could solve. Initial enthusiasm over the new tool caused some growers to view it as a panacea, forgetting that planting dates, crop variety, weeds, insects, diseases, nematodes, soil physical conditions and a host of other variables all affect yields as well. Division representatives emphasized that optimum production requires that each of these variables be carefully managed.

Equal attention was devoted to teaching farmers the proper means of taking a representative soil sample—a variable which, to this day, remains the weakest link in the testing process. As Director Fitts stated, "A soil testing laboratory does not test a farmer's land, only the sample submitted." Getting farmers to submit samples that accurately reflect field conditions is one of the enduring challenges faced by any soil testing program.

By the early 1950s, soil testing was an established part of the state's most efficient agricultural enterprises. Nonetheless, administrators felt that a 400% increase in sampling would be required if the state was to maximize its productive potential. To help meet this expanded workload, the division moved to the new Agricultural Building Annex in 1955. Under the leadership of director S. L. Tisdale, the division also established a research position responsible for developing more accurate chemical tests and a more precise means of translating test findings into field results.

Throughout the 1950s, the division maintained close ties with N.C. State University. By the mid-1950s, the division was performing more than 6,000 soil tests per year for university researchers. In collaboration with the university's visual aids department, the division also prepared an educational soil testing film for use by extension agents and vocational teachers.

In the early 1960s, farmers were spending 10–20% of their gross incomes on fertilizer and lime. As director Eugene J. Kamprath explained, farmers needed reliable information about where and when to apply those amendments if they were to the maximize the return on their investments. This was precisely the role the division was empowered to fulfill.

During Kamprath's tenure, the division began compiling county-by-county summaries of soil test results, liming rates and recommended fertilizer grades for all major crops.

These summaries helped local agricultural workers identify the principal fertility constraints to plant growth. They also helped fertilizer dealers and policy makers respond to long-term, region-specific needs.

Under director Preston R. Reid, the division took advantage of laboratory equipment innovations, such as the atomic absorption spectrophotometer, to improve both the accuracy and the range of its services. Also about this time, the division found itself responding to the needs of a much broader range of users. In 1966, more than 3,300 urban homeowners submitted soil samples in an effort to improve their lawns and gardens. In responding to their needs, the division not only helped to beautify the state, it also helped to curb a serious, but often overlooked, environmental hazard: overly zealous fertilization of small plots by large urban populations.

The division's laboratories continued to serve as an important training ground. From 1964 to 1966, for example, agronomists from more than 27 countries in Europe, Asia, Africa and Latin America attended training sessions at the facility. In addition, tours and training classes for state residents were conducted throughout the year. The division also worked closely with other state laboratories to promote nationwide uniformity of soil testing methods and recommendations.

In 1969, director Donald W. Eaddy identified a number of gaps in the agronomic services available to state farmers. To close those gaps and improve land use efficiency, Eaddy proposed that the Soil Testing Division be expanded into a more comprehensive Agronomic Division. The new division would add to its established duties

- soil analyses for micronutrients and toxic elements,
- plant tissue analyses,
- a pilot program on waste and solution services and
- nematode assays.

In 1971, the North Carolina legislature approved Eaddy's proposal, along with his request for a new building capable of supporting the division's expanded role. These changes were to take effect in 1973.

The Agronomic Division: 1973–present

As the range of division services broadened, NCDA officials recognized the need for regionally based agronomists who could help growers implement management recommendations in a cost-effective and environmentally sound manner. These agronomists would also help maintain two-way communication between growers and the division's central offices, thus ensuring that the various laboratories remained responsive to field level problems. By the time the division moved into its new Ballentine Building in 1974, the first regional agronomist was already in the field, and by the end of the decade, three additional positions had been added.

Among the more important events of the 1970s was the decision to hire, as a consultant, the world-renowned soil chemist Dr. Adolf Mehlich. During his 13 years with the division, Mehlich developed the soil testing procedure Mehlich-3, which provides information on all essential soil nutrients. Working in the division's new Cooperative Greenhouse Facility, Mehlich also developed an improved method for measuring humic-matter levels, thus allowing growers to determine lime requirements and herbicide needs more accurately. For its broad impact on improving land management practices in both developed and developing countries, Mehlich's research stands as a source of pride to all those associated with the Agronomic Division.

Throughout this period, the division was also refining its nematode assay and plant/waste/solution sections so that they could provide users with the most scientifically up-to-date information possible. The utility of these services, as measured by rising workloads, called for steady increases in staff size. Additional lab technicians and regional agronomists were hired.

As public concern about environmental issues increased, the division was called upon to play a larger role in three areas:

- protecting long-term productive capacity of the agricultural resource base,
- safeguarding water from contamination by nutrients and pesticides and
- protecting food from contamination by nitrates, heavy metals and other chemicals.

As a result, the division's workload increased by 76 percent from 1980 to 1994.

Not only was the division asked to evaluate more samples, but also the number of determinations per sample was rising dramatically (i.e., the division was deriving more and more information from each sample). The workload in the plant/waste/solution section, for example, increased by 158 percent from 1982 to 1992. Such increases severely taxed the division's laboratory resources and personnel.

By the close of the 1980s, state policy makers recognized that, in order to fulfill its expanded agricultural and environmental responsibilities, the division would require a larger facility with state-of-the-art equipment. In 1990, funds for a new agronomic building were approved. At that time, the soil testing section purchased instruments with the capability of evaluating 19 elements simultaneously, including heavy metals that may pose an environmental threat.

Before moving into the new building in May 1994, the division expanded its staff to include additional agronomists and technicians, along with a computer analyst and a communications specialist. By 1995, all data generated in the new laboratories were being collected and transferred electronically.

In 1996, the division became the first agronomic testing facility to put its reports online via the Internet. Growers who send in samples are able to check their lab results as soon as analysis is complete—without waiting for a report to arrive in the mail.

In 1997, all agronomic laboratories developed expert computer systems to generate

interpretations and recommendations for routine samples based on sample analyses. As a result, section specialists could give more attention to interpreting analyses and writing individualized recommendations for the more troubling problem samples.

By 1998, a new section—field services—was created within the division to manage a newly reorganized and expanded team of regional agronomists. That same year, the soil testing and waste analysis laboratories received DENR-DWQ certification for providing testing for animal waste permit compliance purposes. A new recommended policy statement for heavy metal loading rates was developed in conjunction with the Soil Science Department at N.C. State University.

In March 1999, Dr. Richard C. Reich assumed directorship of the division and initiated laboratory equipment upgrades. The plant/waste/solution section acquired a new Perkin Elmer 3300DV ICP (inductively coupled plasmaspectrometer) for more efficient analysis of essential elements and selected heavy metals. In September, the division installed a 900-gallon bulk argon tank to facilitate uninterrupted laboratory operation of all ICP units.

During 2001, the division added online data entry capabilities to its Web site so users could fill out and submit information sheets for all types of agronomic samples via the Internet. In addition, the nematode assay section adopted a new microsystem for identifying races of soybean cyst nematode. Due to increasingly stringent environmental regulations and more intensive sampling in connection with precision agriculture, the division's soil sample load continues to increase (Figure 1).

Figure 1. NCDA&CS Agronomic Division: Number of Soil Samples Analyzed from 1965-2000.