rather high. Because of close cropping (plants approximately 7 × 5 inches apart) and controlled water conditions, it is desirable to maintain higher nutrient levels than with many other crops. We try to maintain nitrogen at 150 to 250, phosphorus at 50 to 75, potassium at 200 to 300, calcium at 1000, magnesium at 150+, boron at 2 to 4, manganese at 2.5 to 10, copper at 1 to 2, iron at 2.5 to 5, and zinc at 2.5 to 10 pounds per acre. The nutrients are checked at 2-week intervals and adjusted if necessary.

Gladioli. About 10,000 acres of gladioli are grown annually in the open in Florida. Original concepts of feeding with low nitrogen levels to reduce bulb rots have had to be markedly reversed under Florida conditions. Because gladioli are grown mostly on sandy soils, lack of nitrogen is often a problem. Better dipping procedures with new fungicides have greatly lessened the bulb losses to Fusarium, permitting much higher nitrogen levels.

At present we try to maintain an available nitrogen level of 50 to 75, phosphorus of 15 to 25, potassium of 100 to 150, calcium of 1000+, magnesium of 100+, boron of 2 to 4, manganese of 2.5 to 10, iron of 1 to 5, and zinc of 2.5 to 20 pounds per acre until time of spiking. These levels are adjusted on a 2-week interval analysis, if scheduled applications have not maintained desired amounts. At time of spiking the potassium level is raised into the 150- to 250-pound range and maintained until shortly before the spike is cut.

On light soils calcium deficiency often causes bud malformation. Part of the difficulty is brought about because of the high potassium level necessary to produce good quality bulbs and the antagonism between the two elements. To correct this situation, several sprays of calcium chloride or nitrate at the rate of 4 pounds per 100 gallons are applied to plants beginning shortly before spiking has started.

Vegetables. Practically all the vegetables common to other areas, except such perennials as asparagus, rhubarb, and dill, can be grown in Florida. Special varieties adapted to the area have improved yields and quality; skill in proper planting, insect and disease control, and fertilization have made this production feasible.

Generally we maintain nitrogen at 50 to 150, phosphorus at 12 to 25, potassium at 150 to 250, calcium at 1000+, magnesium at 100+, boron at 1 to 2, manganese at 2.5 to 10, copper at 1 to 2, and zinc at 2.5 to 20 pounds per acre.

Nearly all vegetable crops are checked often, key samples usually being taken every 2 weeks.

What Is Required for a Commercial Consulting and Soil-Testing Service

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In conducting a commercial laboratory, factors to be considered are: accuracy of soil analyses, type of extractant and interpretation of results, nutritional elements involved, the specific soil problems of concern, and achievements expected. With these data available and a broad knowledge of soil, plant, and animal mineral nutritional requirements, the laboratory is well on its way toward success.

In 1934 only a few scientists were interested in soil testing, and many were opposed because of lack of information. The first publication of the author (*1*) in 1934 culminated several years of chemical research aimed to assist the grower in crop production.

Within the next few years scientists in every state and in many parts of the world began to take seriously this approach to a solution of the grower's problems. Publications began to appear in the scientific literature, practically all in favor of soil testing. Different methods were developed, some adapted to specific locations and conditions.

A method of soil testing which is chemically accurate and gives basic information about a soil is desirable, and interpretation of the data accumulated from the use of this system, in the light of the crop concerned, is the most scientific approach to the solution of the problem. Any organization that

Table I. Variations in Soil Conditions on One Farm

(Soil type RBSiL)

Field	pH	% Organic Matter	Pounds per Acre: Nitrogen NO_3	NH_3	P_2O_5	K_2O	Ca	Mg	Fe	Mn	B	Cu	Zn	Toxic Al	Mo, Parts per 2 Billion
3	5.8	3.8	0.9	12	32.5	126	2225	106	0.4	0.65	0.34	0.5	0.27	0.60	50
4	6.0	3.6	5	8	50	191	2225	98	0.3	1.30	0.28	1.0	0.19	1.48	50
8	5.4	3.0	7	4	32.5	126	921	98	0.3	1.69	0.36	1.0	Trace	0.60	20
9	5.8	3.1	1	5	50	126	1150	130	0.4	1.56	0.38	0.5	1.5	0.12	10
10A	5.8	3.4	11	7	42	99	1880	126	0.3	1.65	0.25	1.6	2.3	0.18	50
12	4.8	3.4	8	10	35	140	921	50	0.4	4.80	0.42	3.3	2.5	0.72	20
25	5.9	3.5	11	12	31	82	1650	130	0.4	1.69	0.38	1.3	Trace	0.60	20
26	4.7	3.1	3	5	44	112	1185	32	0.3	5.25	0.37	4.3	2.5	0.48	50
Mean	5.53	3.36	5.86	7.88	39.63	125.25	1519.63	96.25	0.35	2.32	0.35	1.69	1.54	0.60	33.75
Mean dev.	0.42	0.22	3.39	2.63	6.88	20.69	475.38	27.63	0.05	1.48	0.04	1.06	0.89	0.25	16.44

establishes a commercial laboratory with a conscientious approach must have basically a very broad knowledge of the history of soil testing and the requirements of the crops concerned.

Table I illustrates in what great detail a grower must consider his problems to be a successful producer. These data are from one farm, but the average of these tests is virtually worthless. There is such a great variation in the analyses that each field presents a separate fertilizer and soil amendment problem.

Probably no soil in the world has the ideal concentrations of all the elements essential to the proper growth of plants and animals. The fertilizer industry has striven energetically to supply these essential elements to the grower in the proportions needed. It has recognized the very great differences in the requirements of plants. Two very different crops are blueberries and alfalfa. Blueberries thrive on an extremely acid soil with high magnesium and potash content and other essential elements. Alfalfa requires a high pH, which controls the availability of molybdenum, essential to nodule formation.

The methods of soil analysis developed by this laboratory are based on extraction of the soil with sodium acetate at pH 5.0. The sodium, a very active element, replaces most of the readily available cations in the soil. The acetate anion has the specific ability to replace available anionic plant nutrients such as phosphates. This salt complex is desirable from the standpoint of analytical procedures, because it does not involve essential plant nutrients.

Commercial laboratories have a unique position, because they are not hampered by limitation of field activities and concentration on any one crop. They correlate data and information accumulated for all crops into a rounded picture of soil conditions and plant nutrient requirements. This laboratory has analyzed soil from 24 states and many South and Central American countries. Correlation of the information from all these sections adds to the value of information ascertained from a single analysis of a specific crop.

Progressive plant and animal breeders recognize that there are superior genes, but they have conceded that the essential nutrition of plants and animals helps them to achieve maximum efficiency. This point is illustrated by the fact that this laboratory has been called upon periodically to analyze the soil on which is produced feed for the race horses of a number of the leading breeders and racers.

Literature Cited

(1) Hester, J. B., Va. Truck Expt. Sta., Bull. 82 (January 1934).

Operation of a Soil-Testing and Recommendation Service in a Plant Food Sales Program

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New laboratory facilities provide farmers in the Corn Belt with a means of getting their soil tested by the newest equipment and the latest analytical procedures.

MANY new, modern soil-testing laboratories employing the very latest methods and procedures have been established in recent years throughout the United States. Farmers are benefiting from this service, through which they have been able to keep their total production costs at a minimum while increasing their yields and profits. The farmer feels that the ideal soil fertility program is the one that makes the most money for him, considering his time and investment. He is, therefore, depending more and more on the interpretation of soil tests to aid him in making profits.

Many farmers do not know the proper procedure for collecting soil samples—how to take them, how many to take, or how to interpret the recommendations of the soil-testing laboratory. However, in most instances, they know they can depend on local agricultural authorities for assistance. They are "getting the message" from all directions: The efficient way to raise any crop is to farm intensively with the heaviest practical fertilizer applications on fewer acres. They are being told again and again that proper fertilizer usage takes a big share of the "gamble" out of farming, that during periods of drought and in areas of consistently low rainfall crops grown on fertilized acres make more efficient use of rainfall and soil moisture, and that crops grown on properly fertilized land are better able to withstand the effects of diseases, insects, and other natural enemies.

In any fertilizer soil-testing program, the basic and primary requisite is to provide recommendations on properly feeding the soil, so that the soil, in turn, can properly feed the crop being grown. Recommendations should be aimed at building up good soil tilth, providing adequate quantities of plant food, and supplying an abundance of organic matter throughout the surface of the soil where all of the roots—as well as the important soil bacteria—can be nourished to full capacity at all times. Recommendations for supplemental plant food, however, cannot be used as a formula that will give an exact answer in terms of crop yields. A great deal depends on the kind of season experienced, and how efficiently a soil management program is followed. The soil test serves only as a guide to good fertilizer and management practices to produce the desired yield.

A soil testing service must consider five general phases of soil testing:

Obtaining the sample.
Analyzing the sample.
Calibrating.
Interpreting and recommending.
Evaluating the soil test.

Consolidated Laboratories, Congerville, Ill., is an example of the workings of a modern soil-testing laboratory. This laboratory was opened September 10, 1958, to serve the needs of farmers in the Corn Belt area. It uses the newest equipment and the very latest analytical procedures. Facilities were installed following a thorough study of laboratory techniques as practiced in several state universities in the Midwest. The laboratory technicians were sent to the various colleges and universities to learn first-hand the latest techniques and procedures of soil testing employed in each state. Their resulting Soil Master Series specializes in the following tests:

Measuring the exchange capacity (the ability of the soil colloids to hold plant food), and determining what needs to be done to utilize the capacity of the colloids.

Measuring status of the organic matter, for management purposes in determining