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MANAGEMENT OF SOILS
IN SOUTHEASTERN MINNESOTA
A Correspondence Course

Unit 1: Soil Testing

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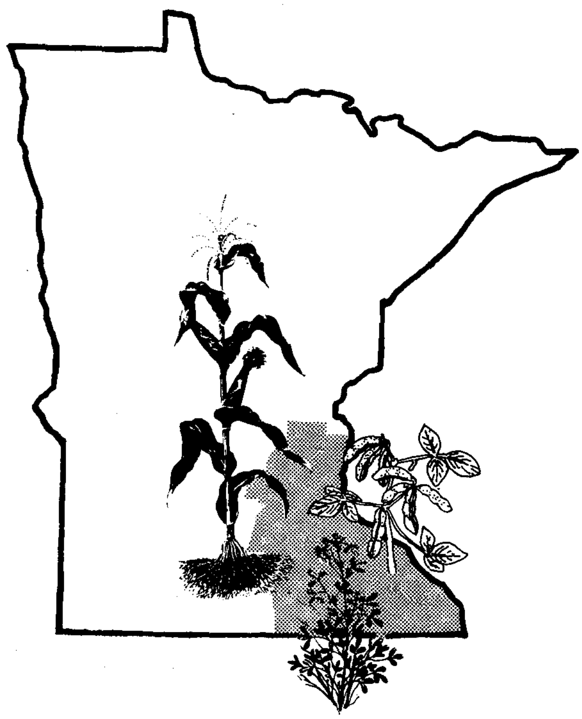
Objectives

- Gain an understanding of the importance of soil testing.
- Become acquainted with the techniques involved in obtaining accurate and representative soil samples.
- Become familiar with, in a general way, the principles involved in arriving at fertilizer recommendations.



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THE IMPORTANCE OF A SOIL TEST

There is general agreement among those who work with fertilizer recommendations and fertilizer use that there is no substitute for a regular soil testing program as a management tool for crop production. Routine soil testing provides a basis for adequate, but not excessive, fertilizer recommendations.

There are, of course, other methods for arriving at fertilizer recommendations. For example, you could use the same fertilizer program as your neighbor, replace the amounts of nutrients that the crop removes each year, or guess at the amount of fertilizer needed. All of these approaches can be expensive. Excessive fertilizer use leads to added cost without added return. Inadequate fertilizer use usually produces lower yields, reducing the economic return.

Fertilizer does not supply all of the nutrients used by the growing crop. The soil is capable of supplying some, and in many cases all, of the essential nutrients. If a nutrient in the soil is not adequate, the soil test provides a basis for determining the amount of that nutrient that should be applied in a fertilizer program.

Sometimes we expect a soil test to do more than what it is intended to do. A soil test does not measure the total amount of plant nutrients in soils. Except for extreme cases, it does not tell us if a "balanced" fertilizer program is being used. A test for a given nutrient does not measure the amount of that nutrient available to crops. A soil test is simply intended to give a grower an index of the nutrient status of the soil. It's a gauge to tell us if nutrient levels are low, medium, or high. If we know the relative level of a nutrient, we can develop a fertilizer program that will produce optimum yields.

COLLECTING SOIL SAMPLES

Collecting a soil sample is not a complicated task, but it is one that should be taken seriously. The results of any soil test can be only as good as the sample submitted for analysis. In collecting soil samples, give special attention to soil type, sampling depth, and time of sample collection.

In the past, an adequate soil sample consisted of 15 to 20 cores for each 20-acre field. For today's agriculture, it is suggested that fields be sampled according to soil type. Cores from similar soils are combined into one sample using this technique, and one soil sample can represent few or many acres. In any given field, sample cores are collected from areas where the soils have similar properties. If there is more than one major soil type in a field, each major soil type should be sampled.

A copy of a modern USDA—SCS Soil Survey is needed before fields can be sampled by soil type. The old sampling procedure should be followed in counties where the modern soil survey has not been completed.

It's important to collect samples from the same depth each year to prevent wide fluctuations in fertilizer recommendations. This depth can vary from 0-to-6 to 0-to-8 inches without causing problems.

Samples can be collected in either fall or spring. It's important, however, to be consistent in the time of sampling. There are several advantages for collecting samples in the fall. Special attention given to depth of sampling and consistent time of sampling will result in consistent, cost-effective fertilizer recommendations.

In many cases the local fertilizer dealer has the equipment and experience necessary for collecting soil samples. Generally, fertilizer dealers are not committed to sending soil samples to a specific soil testing laboratory. The grower may choose the laboratory for analysis and fertilizer recommendations.

Conservation Tillage Systems

Collection of soil samples where corn is planted in a ridge-till system presents a special situation. There is no widespread agreement on the best sampling procedure to use for this planting system. We suggest that samples be taken in the ridge six inches from the row. The depth of sampling should remain at 0-to-6 or 0-to-8 inches.

Frequency of Sample Collection

In southeastern Minnesota there is no need to collect soil samples each year. Soil test values for phosphorus (P) and potassium (K) do not change dramatically in a short time.

Fields should be sampled at least once in three years. This sampling schedule makes it easy to monitor any changes in soil test levels and make necessary corrections in the fertilizer program.

It is important to collect samples about one year before seeding alfalfa to allow time to broadcast and incorporate lime. Annual topdress applications of P and/or K for alfalfa also can be based on the results of analysis of soil samples collected at this time.

The Information Sheet

Every laboratory that provides a chemical analysis of soil samples and corresponding fertilizer recommendations requests an information sheet for the field represented by the soil sample. Although some growers may think that the information is not necessary, it is needed before accurate fertilizer recommendations can be made. This is especially true if soil samples were taken from problem areas in a field.

The information sheet also gives the grower the opportunity to select the tests that will be used on the soil sample. For southeastern Minnesota, it's not necessary to have each soil sample analyzed for all nutrients. For example, nitrogen recommendations for this part of the state are based on yield goal, cropping history, and the organic matter content of the soil, so there is no need to have the soil sample analyzed for nitrogen.

Most soil testing laboratories offer a basic test that includes a measurement of pH and organic matter content as well as the concentration of P and K. This basic test should be completed for all soil samples. The soil test for sulfur is appropriate only for sandy soils. This test does not accurately predict the need for sulfur on fine-textured soils that are dominant in southeastern Minnesota. Zinc (Zn) is the only micronutrient that may be needed for crop production in this part of the state. You may want to have a soil sample analyzed for Zn, especially if the sample was taken from a problem area. Soils in southeastern Minnesota have an adequate supply of the other micronutrients. Adequate magnesium (Mg) will be supplied if dolomitic lime is used in the crop rotation, so there is no reason to test for Mg unless plant growth symptoms indicate that soil Mg may be inadequate.

SOIL TESTING AND DIFFERENT FERTILIZER RECOMMENDATIONS

In recent years, many growers evaluated the usefulness of soil testing by collecting soil from a field, dividing the sample in two, and sending the two samples to different soil testing laboratories. The fertilizer recommendations returned didn't agree. So, the growers logically questioned the usefulness of soil testing in determining the amount of fertilizer to use.

Several universities in the north-central United States have taken the evaluation one step further, using the widely different recommendations and recording fertilizer costs and yields. After five years with this study in Minnesota, there are some general conclusions.

First of all, the quality of the chemical analysis is high for nearly all soil testing laboratories. The laboratory results are comparable, although values are rarely identical for a particular soil sample since there is always a small amount of variability in laboratory procedures.

There are, however, large differences in the fertilizer recommendations that come from the analysis of identical soil samples. In the Minnesota studies, fertilizer recommendations coming from some commercial soil testing laboratories headquartered in other states would cost a corn grower $20 to $40 per acre per year more than recommendations from the University of Minnesota (Table 1). Thus, the soil testing laboratory that the grower chooses can have a major impact on fertilizer costs.

Table 1. Effect of fertilizer recommendations on total crop value, total fertilizer cost, and return on testing sites very high and medium high in P and K at Waseca, six-year total (1980-1985).

	Very High Testing Site			Medium High Testing Site		
Testing Laboratory	Crop Value	Fertilizer Cost	Return	Crop Value	Fertilizer Cost	Return
	$/A					
A & L	1929	337	−101	2154	371	+180
Harris	1946	352	− 96	2159	435	+121
MVTL	2009	248	+ 71	2159	283	+273
Cropmate[a]	1999	407	− 98	2159	432	+124
U of M	1962	206	+ 66	2165	255	+307
No fertilizer	1690	0	—	1603	0	—

[a]Cropmate no longer has a soil testing laboratory.

The results of this comparison study emphasize the difference between two general approaches used in making fertilizer recommendations. The approach that is usually associated with the highest fertilizer costs has two objectives, to *build up* the nutrient status (primarily P and K) to a desired level, and to *maintain* the nutrient status at these optimum levels.

With this approach, more fertilizer is applied than is needed to achieve optimum yields until the nutrient status of the soil reaches the "optimum" level. There is, however, no universal agreement as to what the "optimum" levels are. For example, a soil test value of 300 pounds of K per acre might be considered "optimum" by some but low or medium to others, who would recommend adding potash to build the K to a higher level. Thus, a lack of agreement on an "optimum" soil test value creates some differences in fertilizer recommendations.

The approach that is usually associated with the lower fertilizer costs focuses on providing nutrients that will result in optimum yields. Very little emphasis is placed on achieving an "optimum" level of a plant nutrient in the soil. In this approach, plant nutrients are applied only when the soil test level indicates that there is a high probability that yields will increase if the nutrient is applied. This approach requires a considerable amount of research in the field, laboratory, and greenhouse. Lower fertilizer costs without reduced yields demonstrate that there is no substitute for field research as a basis for making fertilizer recommendations.

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