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Sampling Soils for Fertilizer and Lime Recommendations

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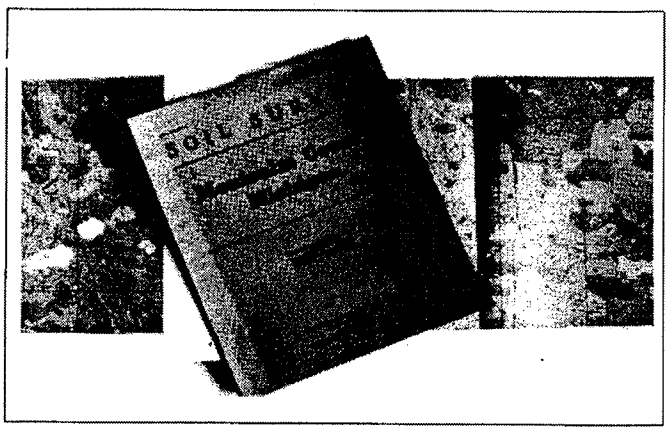
Soil sampling farm fields is an investment that leads to profitable use of lime and nutrient inputs in crop production. Soil testing begins with a representative composite soil sample and continues with the analysis, interpretation of the test results and recommendations. Soil test results are the basis for developing nutrient management programs for individual fields and farm operations. Evaluation of changes in soil pH and available nutrient levels over time requires collection of soil samples that represent the conditions in a field each time it is sampled.

Sample uniform areas

Before sampling a field, evaluate it for differences in soil characteristics. Consider its productivity, topography, texture, drainage, color of topsoil and past management. Where these features are uniform throughout the field, each composite sample can represent up to 10 or 15 acres. Because most farm fields in Michigan are not uniform, samples representing more acres than this are less likely to be representative of any soil in the field.

Sampling is an averaging process. The goal in soil sampling is to sample within a reasonably uniform area so that the composite sample is relatively uniform. When samples are collected from within a field with variable soil characteristics, the composite sample is quite heterogeneous. Within a variable field, areas with reasonably uniform soil characteristics need to be identified for sampling.

Most farmers are quite familiar with the general properties of their fields and can delineate (map) areas that are similar or different. Farm consultants who offer soil sampling services become familiar with fields over time. But initially, a County Soil Survey is an excellent source of information for determining the kinds of soils in each farm field, and it can be helpful in establishing area boundaries for collecting soil samples. Soil survey information is available from the Crop and Soil Sciences Department at Michigan State University or from the Natural Resources Conservation Service. Many farmers are now monitoring yields when harvesting and developing yield maps. These may also be helpful in delineating soil sampling areas.



Use your County Soil Survey Report for determining the kinds of soils in each field of your farm.

When delineating sampling areas, take into consideration the management history. Knowing the cropping rotation or where manure was spread or where limestone was stockpiled or spread is essential. Knowledge of the tile system also is helpful. Unusual spots, those that are atypical or have exhibited plant growth problems, should be avoided or sampled separately if they're large enough to be of economic importance. Field edges are frequently atypical because of dust from roads, spoil from ditches or the effects of trees.

Using all of the information available, sketch a map of each field indicating the uniform soil areas. This will serve as a guide for collecting soil samples.

Soil sampling tools

Soils are most easily sampled with a standard soil sampling probe or screw auger, but a spade also works satisfactorily. Screw augers work better in stony soils than does a push probe. Soil probes are available from

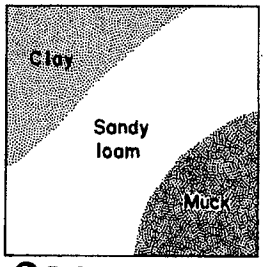
most county MSU Extension offices, the MSU Soil and Plant Nutrient Lab or a number of mail-order supply companies.

Sample collection

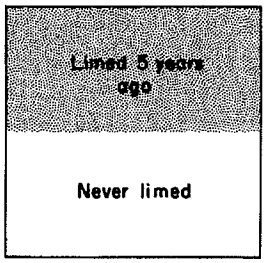
Well mixed composite samples consisting of 20 soil cores from a given area have been found to give more consistent laboratory test values than samples made up of only 5 to 10 cores. Prepare a composite sample from each uniform field area by taking 20 samplings consisting of vertical cores or slices of soil approximately 0.5 to 0.75 inch thick. (A standard soil probe takes a core 0.75 inch in diameter.) Take each slice or core to a consistent depth. The exact depth is especially important for reduced-tillage and no-till systems because of nutrient stratification. Concentrations are highest near the soil surface because of limited incorporation of nutrients from fertilizers, manures and crop residues. Sample soils that are plowed to the depth of plowing. For reduced-tillage systems and no-till systems, sample to 8 inches. Where nitrogen is annually surface applied without incorporation, collect a second sample to a depth of 3 inches for determination of soil pH. This is important for determining the proper lime rate and efficacy of herbicides.

Delineate areas to sample separately based on soil type (1), past management or cropping history (2,3,4), topography (5) and field size (6).

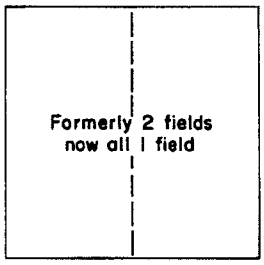
Subsoil samples can provide additional information that may be helpful in determining the appropriate fertilizer and/or lime recommendation. This may be most important for some of the coarser textured soils with a finer textured zone in the subsoil. In these soils, nutrients may accumulate in the subsoil where they can still be utilized by growing crops. When this occurs, crop response to recommended fertilizer amounts, based on a surface soil sample and test, will be less than expected. In organic soils, acid or alkaline layers may occur at varying depths in the profile. As these soils subside, the pH of the plow layer may change significantly over time. Hence, a test of the subsoil may



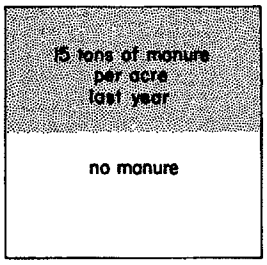
❶ 3 Composite samples



❷ 2 Composite samples



❸ 2 Composite samples



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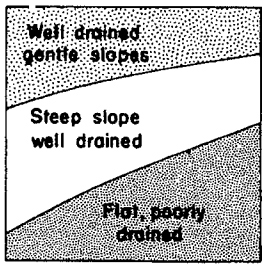

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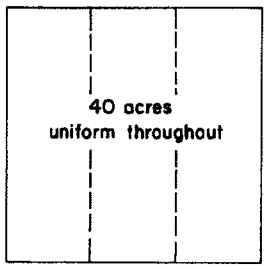

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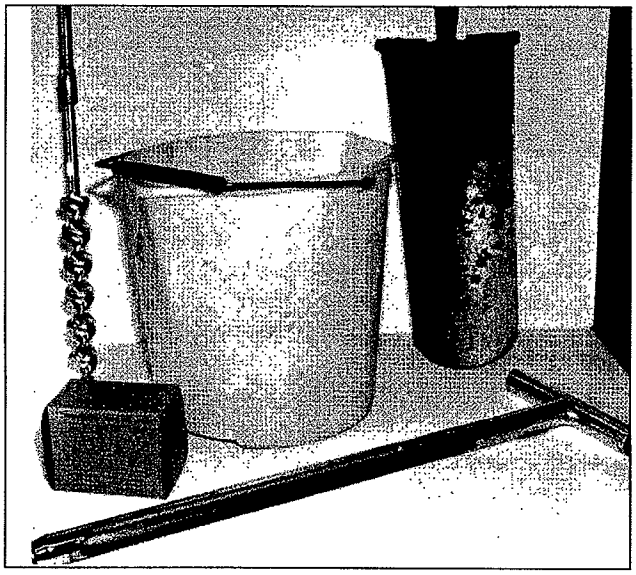


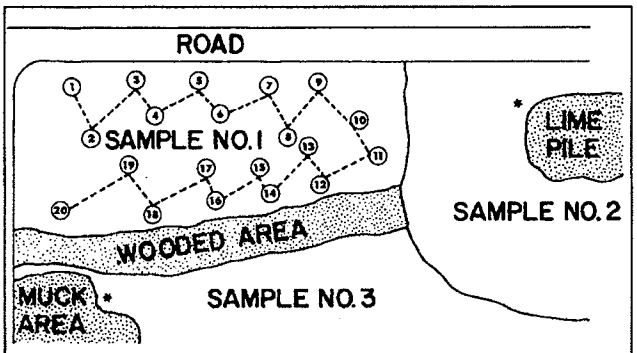
Soil Sampling Equipment

Plastic pail: 10- to 12-quart size. (Do not use metal pail if sample is to be tested for micronutrients.)

Any one of the following: square pointed shovel or spade, soil auger or soil sampling probe.

Containers for samples: sample boxes or special paper bags. All equipment and containers should be absolutely clean.

Follow a Zig-Zag pattern when sampling.



***Omit or take separate samples**

In a non-uniform field, as shown above, a minimum of 3 samples are required to adequately represent the area. Sample numbers 1, 2 and 3 represent 3 different soil management groups. This condition is common in glaciated areas such as Michigan.
Each composite sample is made up of 20 borings taken as in sample No. 1.

help indicate whether the lime or fertilizer recommendation should be adjusted.

Studies have shown that a representative composite sample is best generated by using a zigzag sampling pattern, in which the sampling points are at predetermined distances based on the dimensions of the field. Avoid fertilizer bands when their location is known. And scrape aside the crop residue before inserting the soil probe, auger or spade. Collect the soil cores in a clean plastic pail.

After all the sample cores for one composite sample are taken, mix the soil thoroughly. Be sure to break up the soil cores and discard any stones and crop residue. This is easy to do when the soil is friable. For soils that are quite wet and contain significant amounts of clay, it may be necessary to partially dry the soil prior to mixing the soil. Fill the soil sample bag or box with about a pint of the well mixed soil. This is the composite sample that will be analyzed.

When to sample and test

Soil samples may be taken any time during the year when temperatures, soil moisture and field conditions permit. Hydraulic probes are available that make it possible to collect soil samples even when the ground is frozen.

Soil pH and extractable nutrient levels do vary some with the time of the year. Soil pH tends to be higher in the spring than in the fall. Extractable nutrient levels tend to be lowest in the fall after crop harvest and rebound some over the winter and spring months. For tracking soil test values over time, it is best to soil sample a field at the same time of the year each time. However, if changes are made in the crop management system that necessitate sampling at a different time of the year, do not delay. Having soil test results available in the fall and early winter enables development of a soil fertility management plan in a more timely manner than testing soils in the spring. Where lime is needed, it is desirable to apply it six months before seeding forage crops, especially alfalfa. There may be advantages to sampling at certain times of the year or at certain points in a crop rotation, but the most important thing is to soil sample and soil test sometime.

Frequency of sampling

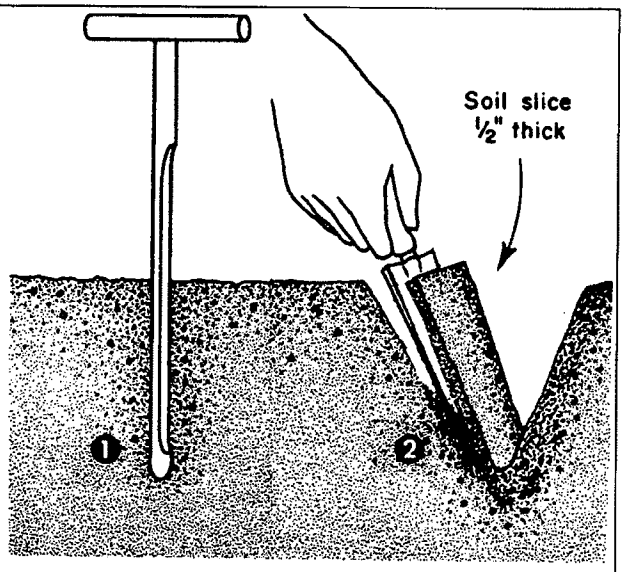
For most field cropping systems, sampling and testing the soil in each field at least once every 3 years is adequate. Soil pH and nutrient levels are more stable in soils with higher cation exchange capacities (CECs). In sandy soils with CECs below 6 me/100 g, the potassium, magnesium and calcium levels may change more rapidly because of crop uptake and possible leaching. In these soils, sampling more frequently is suggested. Sampling the entire farm at one time is a good practice because it provides an evaluation of the whole-farm fertility program at a given point in time. This may not always be practical, however. For large farm operations, sampling and testing one-third of the acreage each year is an alternative that provides continuity over time.

For intensive cropping systems where large amounts of fertilizer may be applied annually or crop removal may be high, annual soil testing enables the grower to maintain stable soil fertility conditions. This is especially important for many of the vegetable crops that are grown on sandy soils.

Intense soil sampling

Advances in fertilizer spreader technology have made it possible to vary the amount of fertilizer applied to various parts of a field on the basis of available nutrient levels. As a result, there is considerable interest in intense soil sampling to develop nutrient management maps. The main approach has been grid sampling - collecting soil samples according to a grid laid out across a field. The objective is to develop a map of soil test values (pH, P, K, Ca, Mg) for a field so that lime

How To Use Sampling Tools



1. **Sampling probe provides uniform sampling cores—easy to use—saves time—best tool for sampling farm soils.**
2. **Use a narrow (1½ inch) garden dibble to take a slice of soil ½ inch thick.**

and fertilizer may be applied at the appropriate rates in the appropriate locations within the field. The appropriate approach, value and economics of intense soil sampling are still the subject of considerable evaluation and discussion. From the economics standpoint, it is difficult to justify a grid size less than 300 x 300 feet (one sample for each 2 acres). Intense soil sampling on a systematic or geo-referenced base does provide a good base of information about the variability of soil test values within a field. Hence, information from a one-time intense sampling can be of value in developing soil fertility management plans over longer periods of time.

Crop management history

The crop management history associated with each soil sample assists the soil test laboratory or consultant to develop the most appropriate lime and nutrient recommendation for the crops to be grown. Be sure to fill out the information sheets provided by the soil testing lab and send them along with the samples. Indicate the previous crop and crops to be grown during the next two years. Also, indicate any significant management practices-such as cover crops, manure application and tillage system-that may affect the recommendation.

Soil testing services are available from the MSU Soil and Plant Lab and several commercial soil testing labs. Contact the local MSU Extension office for more information. An interactive fertilizer recommendation program is available through Michigan State University Extension that allows customizing of fertilizer recommendations. This program can handle soil test information from a number of soil test labs for developing a fertilizer recommendation.

SOIL SAMPLING SUMMARY

1. Develop a map of uniform areas within the field. Make use of soil survey maps, topography and management history.

2. Designate the sampling areas of economic importance.

3. For each composite sample, collect 20 cores to the appropriate depth using a zigzag pattern.

4. Thoroughly mix the soil cores. Partially dry very wet samples before mixing.

5. Fill a soil sample bag or box with the composite sample.

6. Fill out the information form with all the pertinent cropping management information.

7. Send the composite soil sample and information sheet to a reliable soil testing lab for analysis.

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ADDENDUM to MSUE Bulletin E-498

Extension Bulletin E498S ■ New, June 2006

Sampling Soils for Fertilizer and Lime Recommendations: Frequency of Soil Sampling

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Summary

The appropriate frequency for soil sampling may vary from 1 to 4 years, depending on crops grown, crop rotation, soil texture and the approach used for sampling. Sampling once every 1 to 2 years is appropriate in situations where significant short-term change in soil test values may occur or when there is a need to establish a soil fertility history. Once a history of soil test information is established, sampling once per crop rotation, not to exceed 4 years, is appropriate. Compared with whole-field composite sampling or traditional sampling of 15 to 20 acre blocks, intensive soil sampling enables improved nutrient management by providing information to better match inputs to soil and crop requirements, so sampling once every 4 years is appropriate. Refer to the summary table for suggested sampling frequency guidelines.

Summary table

Sampling situation	Suggested sampling frequency
Need to establish soil test history	1 to 2 years
High nutrient inputs or high nutrient removal by crops	1 to 2 years
2-year rotation	2 or 4 years
3-year rotation	3 years
4-year rotation	2 or 4 years
Rotation greater than 4 years	2 times per rotation; sampling interval not to exceed 4 years
Established forage	3 years
Intensive sampling (zone or grid)	4 years

Introduction

Soil sampling is a management tool used to determine the status of soil pH and available nutrients, which is used to determine the appropriate amounts of lime and nutrient inputs needed for the crop(s) grown. Collecting soil samples representative of the area sampled is the first step toward sound nutrient management. Soil pH and nutrient levels change over time, depending on nutrient inputs and removal of nutrients in harvested portions of a crop.

Soil pH and nutrient levels are in a dynamic state of change immediately after lime or nutrient additions. Therefore, the preferred time to sample soils to assess the nutrient status is either before lime and nutrients are applied or after the soil has had sufficient time to equilibrate.

As a nutrient management tool, soil sampling provides the greatest benefit when samples are collected during the same time of the year and at the same point in a crop rotation each time.

Within a 4-year time frame, the appropriate frequency of soil sampling depends on: how closely an individual wants to track soil nutrient changes, crop(s) grown, cropping rotation, soil texture, and the approach used for sampling fields.

Tracking change: Build to and maintain optimum soil test levels over time.

The goal of nutrient management and soil testing is to maximize return to nutrient inputs while minimizing negative environmental impacts. Minimizing variability in soil test values over time enables stability in nutrient management over time. Stability is attained by tracking soil test values relative to crop production practices that will affect changes. Frequent sampling improves an individual's familiarity with the soil fertility conditions in a field and with how quickly changes are taking place. When initiating a soil sampling and testing program, sampling every 1 or 2 years results in an understanding of how soil test values are changing in relation to nutrient management practices more quickly than sampling

every 3 or 4 years. Once an adequate history of soil test values is established by sampling at least two times at 2-year intervals, sampling once every 3 or 4 years provides sufficient information for stabilizing soil test values.

Crop grown: Nutrient removal and change in soil test value varies with crop.
Changes in soil nutrient status generally occur most rapidly with crops requiring relatively large nutrient inputs and/or crops that remove relatively large amounts of nutrients. When these types of crops are grown, soil sampling every 1 to 2 years is important for acquiring information necessary to maintain stability of soil fertility conditions. Compared with field crops, potatoes and vegetable crops generally have greater nutrient requirements. When most or all of the above-ground portion of the crop is removed one or more times a year, such as corn silage or hay crops, greater crop removal of soil nutrients will occur than with most other field crops. Therefore, more frequent soil sampling is beneficial for tracking changes in soil nutrient availability for crops.

Crop rotation: Soil sample at the same time during a crop rotation.
Collecting soil samples at the same time during a crop rotation is the best approach for establishing soil sampling intervals. Comparing soil tests from samples taken at different times in a crop rotation may create difficulty in understanding nutrient changes that have occurred. In a 2-year rotation, such as corn-soybean, the appropriate sampling frequency is every 2 or 4 years. For 3-year rotations, such as corn-soybean-wheat, sampling and testing every 3 years is appropriate. For 4-year rotations, sampling once every 4 years is acceptable, but only after establishing a soil test history by sampling at least two times at 2-year intervals. When a rotation is longer than 4 years, soil samples should be collected at two consistent points in the rotation.

Soil texture: Changes in soil pH and potassium level occur more quickly in sandy soils, so more-frequent sampling of these soils is encouraged.
Change in potassium availability for crops and soil pH occurs more rapidly in sand, loamy sand and sandy loam soils because of leaching losses of potassium, calcium and magnesium. Sampling once every 2 years is encouraged for sandy soils.

Sampling approach: Information obtained through intensive soil sampling is useful in understanding and managing a field's nutrient status for up to 4 years. After the initial intensive sampling is completed, samples should be collected every 3 to 4 years from representative grids or zones as guides for modifying nutrient management.
The availability of global positioning system (GPS) technology has enabled users to geographically mark and return to the same soil sample locations or areas, thereby minimizing some of the variability from one sampling event to the next. Information this technology provides in conjunction with intensive soil sampling can be used for the development of soil fertility and nutrient management maps. The two most common intensive soil sampling approaches are grid sampling and zone sampling.

Grid sampling involves the collection of 6 to 10 soil cores around specific grid points or within specified grids across a field. The grid size most commonly used is 2.5 or 3 acres. The grid sampling approach provides useful information about the variability of soil test values in fields and serves as a basis by which lime and nutrient inputs can be more closely matched to variations in soil fertility across a field. Using grid sampling appropriately to plan for and apply nutrients minimizes the potential for overfertilization and adverse environmental effects.

Zone sampling includes the identification of specific management zones on the basis of one or more properties, such as topography, soil type, drainage, soil color, yield maps, management history or observations of past crop growth. Management zones will vary in size but are typically around 5 to 8 acres. For any given field, the size of management zones should average about 6 acres with no single management zone exceeding 10 acres. Using GPS or some other means to record management zone boundaries used in soil sampling enables site-specific application of nutrients and/or lime. Within each zone, 15 to 20 soil cores should be collected to form a composite sample. Like the grid sampling approach, zone sampling can provide more detailed information (compared with traditional soil sampling areas of 15 to 20 acres) about variability in the field. More detailed information allows producers to apply nutrients and/or lime where they are needed and at variable rates.

For more materials available online, visit the MSU Extension Web site at:
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