Soil Sampling

While experienced growers can usually recognize a well-nourished crop, it is not possible to look at a soil and predict if the soil is too acid or if there are proper amounts of the essential nutrients present. Soils vary in their need for lime and other nutrients, depending on soil characteristics, previous fertilization, and nutrient requirements of the crop. Soil testing is used to provide economically and environmentally sound nutrient and lime recommendations. It provides the most reasonable means for growers to assess soil pH and plant-available nutrients, to determine the need for lime and nutrients, and to minimize losses and environmental damage from improper lime and fertilization practices.

Good animal manure management includes soil sampling one time per year of every field on which manure is applied. Soil labs can analyze soil samples and make agronomic recommendations for lime and nutrient applications. Your animal manure utilization plan or operating permit may require that you use a state-certified lab to satisfy monitoring requirements. General sampling guidance follows. Check with experts in your state for specific rules and recommendations.

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Procedures

Every soil sample you submit for testing should consist of about 15 to 20 cores taken at random locations throughout one field or area. A sample should include cores from no more than about 20 acres even if the soil appears to be uniform over a larger area. Keep in mind that each sample should represent only one general soil type or condition (Figure 35-5). If the field you are sampling contains areas that are obviously different in slope, color, drainage, and texture and if those areas can be fertilized separately, submit a separate sample (consisting of 15-20 cores) for each area. Before filling the shipping container, pulverize the cores and mix them thoroughly in a clean, plastic bucket. Then fill the shipping container about two-thirds full with this mixture.

When collecting samples, avoid small areas where the soil conditions are obviously different from those in the rest of the field, for example, wet spots, old manure and urine spots, places where woodpiles have been burned, severely eroded areas, old building sites, fence rows, spoil banks, etc. Because samples taken from these locations are not typical of the soil in the rest of the field, including them could produce misleading results. Areas within a field where different crops have been grown in the past should be sampled separately, even if you now plan to grow the same crop in the whole field. Areas that have been limed and fertilized differently from the rest of the field should also be sampled separately.

To avoid contaminating the samples, collect them with stainless-steel or chrome-plated sampling tools and plastic buckets. Avoid brass, bronze, or galvanized tools. Make sure that the buckets and sampling tools are clean and free of lime and fertilizer residues. Even a small amount of lime or fertilizer transferred from the sampling tools to the soil can seriously contaminate the sample and produce inaccurate results.

For soil samples intended for P and other immobile nutrient analyses, collect samples to the same depth that the field is tilled (usually about 6-8 inches) because this is the zone in which lime and fertilizer have been incorporated. For areas that use soil nitrate testing, a two-foot or greater core sample is needed. For fields where perennial crops such as fescue,

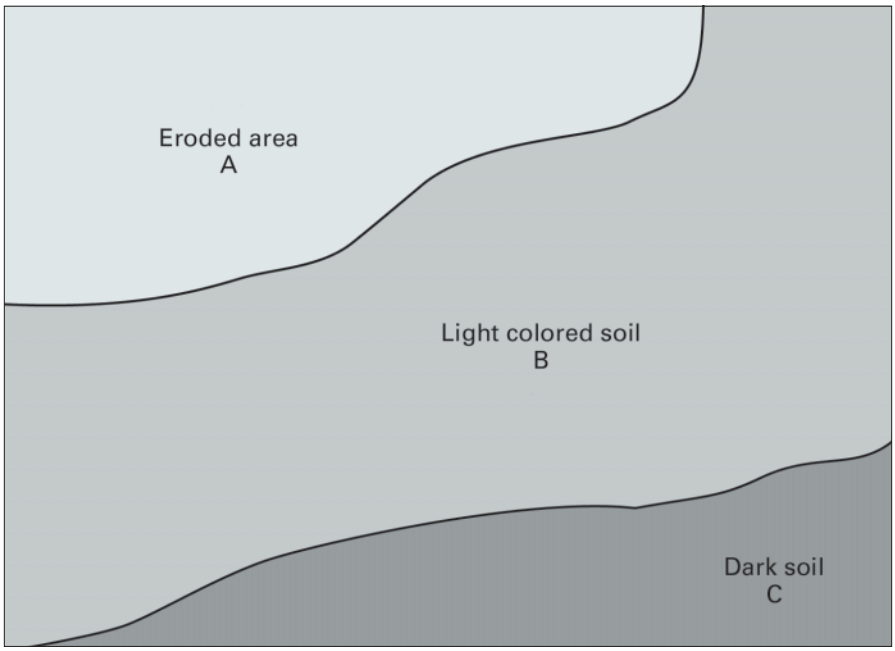

Figure 35-5. Within each field, collect a separate sample from each area that has a different type of soil or different management history.

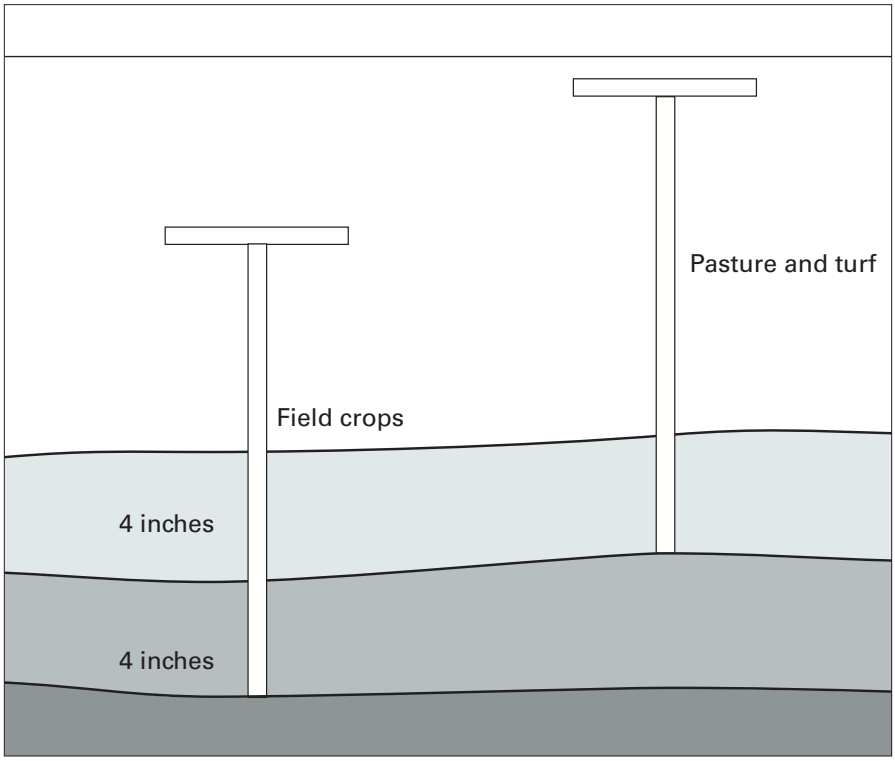

Figure 35-6. Sample to a depth of 8 inches in fields tilled for row crops and 4 inches where perennial pasture or turf crops are grown. Deep (2-4 ft) soil samples are required for soil-nitrate testing.

Each sample should represent only one general soil type or condition.

alfalfa, and turf are being maintained, samples taken to a depth of 4 inches will best represent the crop's lime and fertilizer needs. Where these perennial crops are to be established, however, sample to the regular plow depth. Figure 35-6 shows appropriate sampling depths for field crops and pasture. Once the soil test results are known, the final fertilizer and lime suggestions can be made. Recommendations are typically given on an acre basis, nutrient by nutrient.

What does my soil test report tell me?

Your manure utilization plan is designed to apply the recommended rates of N and/or P. The soil test report will provide useful information about the possible need for lime, the relative amount of nutrients in the soil, and agronomic recommendations for nutrient application. A soil test can be used to monitor nutrient accumulation. Only the most essential items will be discussed here. For more information, see your CES agent or Certified Crop Advisor.

Nitrogen. Not all labs test for soil N. Nitrogen is a very mobile nutrient in the environment, and soil levels can change rapidly in a short period. If you are using a lab that does N testing, it is important to remember that the sampling depth for N may be different than for other plant nutrients (P, K, or pH) and that the test is only relevant if a sample can be obtained, analyzed, and reported back to the producer in a short period. Nitrogen sampling in this mode is very valuable and saves money by reducing fertilizer costs and environmental risks. Check with your lab or state's land-grant university to see if they analyze for soil N. Then you can determine what specific situations may justify the expense of sampling and its usefulness to your operation.

Soil pH and lime. Soil pH affects the availability of nutrients required for plant growth. An incorrect soil pH will reduce crop growth and yield, resulting in less nutrient uptake and more potential for environmental problems. Adding high amounts of N will also acidify the soil. Low pH increases the availability of metals such as aluminum, zinc, copper, and manganese, all of which can become toxic to plants at high concentrations. Depending on the amount of N applied, soils with high metal concentrations and low pH may require the addition of lime to maintain the pH in a range suitable for plant growth. Lime also supplies calcium and magnesium, which are essential for crop growth.

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The soil test report indicates the amount of lime required, in tons, to achieve the target pH for your soil type and crop. Soils with high amounts of organic matter require a much lower pH than soils with low organic matter contents. For most crops, the desired pH is 6.0 for Mineral soil, 5.5 for Mineral-Organic soil, and 5.0 for Organic soil classes.

Nutrient index values. The soil nutrient concentrations on a soil test may be reported as index values. Index values can be used to predict soil fertility levels or potential heavy metal toxicities. Index systems are used to relate soil fertility levels to the likelihood of an increase in crop yield resulting from a fertilizer application. An example of an index system is shown in Table 35-1. When the index value is high or very high, no additional plant nutrients need to be added. When soil test index values are less than these critical levels (generally classed as low or medium), the soil test report will indicate the amount of nutrient to apply for optimum plant growth in the Recommendations section of the report.

Note: Soil test index values above 100 indicate excessive amounts are present in the soil. Some labs use a concentration level (e.g., ppm) in the soil

as the basis for the index system. Table 35-1 presents all nutrients on a similar relative scale.

How can a soil test be used to adjust and monitor manure utilization plans?

Most often, N is the target nutrient in manure utilization plans. As a result, most manure application rates are based on supplying crop N needs. Ideally, N is not applied at rates greater than the crop can use, because the nitrate form of N can leach through the soil and threaten groundwater quality. Other nutrients may be stored in the soil just as one stores money in a bank. These nutrients will generally remain in the soil until needed by plants. Phosphorus, copper, and zinc are not subject to leaching at a soil pH normally used to grow crops, and they remain in the soil until taken up by plants. As nutrients continue to accumulate, they may become toxic to plants (e.g., copper, zinc) or become an environmental liability (e.g., P). The level at which toxicity occurs depends on the element's concentration in the soil, the crop's sensitivity, soil pH, and the cation-exchange capacity (CEC). These unneeded nutrients can also become a source of nonpoint source pollution if soil erodes from the site and moves into nearby surface waters.

Ranking Fields for Manure Applications. By monitoring soil test index values for various nutrients, you can take steps to avoid nutrient buildup to undesirable levels. In general, manure products should be applied as a priority in fields where there is evidence of the greatest need for nutrients. If the soil index for P or micronutrients is high, other fields should be considered for manure application. The long-range goal of nutrient management is to maintain good soil fertility levels in all fields and avoid nutrient buildup.

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Table 35-1. Relationship between soil test index and crop response.
(Note: These ratings may not be relevant in your state.)

Soil Test Index	Expected Crop Response to Nutrient Application			
Range	Rating	P*,**	Zinc	Copper
0 to 25	Low	High	High	High
26 to 50	Medium	Low	None	None
51 to 100	High	None	None	None
100+	Very high	None	None	None

* For soils in the ORG class, the range for P Ratings are Low (0 to 16), Medium (16 to 30), and High (30+).
** Phosphate recommendations above the 50 index are designed to replenish nutrients removed by crops and for building purposes.