APPENDIX F - SOIL SAMPLING AND TESTING

The nutrient status of the soil is one of the most important components of a nutrient management plan. A soil test is a laboratory procedure that measures the plant-available portion of soil nutrients. This measurement is used to predict the amount of nutrient or nutrients that will be available during the growing season. Soil test results form the basis for nutrient recommendations. Traditional soil tests include tests for pH, phosphorus, potassium, nitrogen, soil organic matter, and electrical conductivity. You should sample each field area where animal waste nutrients are to be applied. If different field areas have different soil types, past cropping histories, or different production potentials, you should sample and manage these areas separately. You can use soil test results to characterize soil conditions and to determine the agronomic nutrient application rate (see Appendix I) for animal waste application.

Description

Soil sampling determines the average nutrient concentration in a field, and allows you to measure nutrient variability in the field. When you know the variability, you can adjust the fertilizer application rates to more closely meet the supplemental nutrient needs of a crop, which can increase crop yield, reduce commercial fertilizer costs, and reduce environmental risk.

Send all samples to an accredited laboratory for analyses. An accredited laboratory is one that has been accepted in one or more of the following programs:

- State-certified programs;
- The North American Proficiency Testing Program (Soil Science Society of America); and
- Laboratories participating in other programs whose tests are accepted by the Land Grant University in the state in which the tests are used as the basis for nutrient application.

The analytical results from a soil test extraction are relatively meaningless by themselves. You and/or your Certified Nutrient Management Specialist must interpret soil nutrient levels in terms of the soil's ability to supply the nutrients to crops. Most soil test laboratories use qualitative terms such as "low," "medium or optimum," and "high or very high," which are related to quantities of nutrients extracted, to label the results.

Soil testing is a chemical evaluation of the nutrient-supplying capability of a soil at the time of sampling. Poor soil-sampling procedures account for more than 90% of all errors in fertilizer recommendations based on soil tests. The test is only as good as the sample, so you must handle the sample properly for it to remain a good sample. A testing program can be divided into four steps: 1) taking the sample, 2) analyzing the sample, 3) interpreting the sample analyses, and 4) making the fertilizer recommendations.

Take samples as close as possible to planting or to the time of crop need for the nutrient, approximately two to four weeks before planting or fertilizing the crop. It usually takes one to three weeks from the time you sample for you to receive the results. Very wet, very dry, or frozen soils will not affect results, but obtaining samples during these climatic conditions is very difficult. Do not sample snow-covered fields because the snow makes it difficult to recognize. Avoid unusual areas in the field because your sample may not be representative.

You may need to sample once every year and fertilize for the potential yield of the intended crop, especially for mobile nutrients. Whether you need an analysis of a nutrient depends on such things as mobility in the soil and the nutrient requirements of the crop. Having an analysis performed for every nutrient each year is not necessary, although EPA requires that, at a minimum, Large CAFOs should sample soil at least once every five years.

Collect soil samples from each field at least once during each crop rotation cycle, keeping a record of the results for each field to evaluate long-term trends in nutrient levels. Work with your state and local agricultural Cooperative Extension Office to ensure that you develop the best procedures for your conditions and animal waste management methods.

Instructions for Collecting Soil Samples

Below is a set of sampling instructions that you can use to help you develop sampling procedures at your farm. You will need a soil auger or probe (a shovel or spade can be used for shallow samples), a ruler, several 5-gallon buckets for compositing samples, some plastic sheeting, and soil collection bags. Be sure all of your equipment is clean so as not to contaminate any of your samples.

Avoid unusual areas such as eroded sections, dead furrows, and fence lines when sampling. If your sample area contains various topography, subdivide it into relatively uniform areas (i.e., sampling units). Omit small units from sampling since they are probably not treated differently from adjacent units. Sampling units should be approximately 20 acres in area, though some units may be bigger and some smaller.

Number of Subsamples

Collect one sample for each sample unit. (Note that if you collect samples at different depths, such as for nitrogen samples, you will have more than one sample per unit; you will have one sample, per depth, per unit.) Within each sampling unit, take soil samples from several different locations (at the same depth) and mix these subsamples into one composite sample for the unit for a given depth. The number of subsamples you take depends on the size of the unit. You can use the chart below as guidance.

Field Size (acres)	Number of Subsamples
Fewer than 5	15
5 to 10	18
10 to 25	20
25 to 50	25
More than 50	30

Source: Soil Sampling, University of Idaho.

If you sample several units, this guidance may be impractical and unrealistic because of the time required to take the recommended samples. You need to collect a minimum of 10 subsamples from each unit to obtain a representative sample. Your composite sample for the unit should be at least 1 pint in size (approximately 1 pound).

This guidance is also more applicable to surface (i.e., tillage layer) samples. If you take samples at greater depths, take at least 10 or more subsamples at a given depth at random within the sampling unit.

Sampling Depth

The depth at which you should sample depends on your crop, cultural practices, tillage depth, and nutrients to be analyzed. You need surface soil samples for all crops because fertilizer recommendation for all nutrients (except nitrogen) are based on the crop and soil tests from the surface samples. Typically, surface samples are used for determining pH, lime need, organic matter, phosphorus, potassium, sulfur, and zinc. The tillage layer is considered to be the 0-to-6- or 0-to-8-inch depth. Sampling deeper than the tillage layer for these parameters can result in inaccurate results.

When sampling for mobile nutrients such as nitrogen and boron, take samples by 1-foot increments to the effective rooting depth of the crop, which may be 5 to 6 feet for some crops. Therefore, you will have five or six composite samples for the sampling unit (not including your surface sample). Effective rooting depth for some common crops are listed below. You will need subsurface soil samples for these nutrients because they leach into the subsoil. Collect these samples separately from your surface samples.

Crop	Depth (feet)
Cereals (wheat, barley, oats)	5 to 6
Corn	5 to 6
Alfalfa, rapeseed	4 to 5
Hops, grapes, tree fruits	4 to 5
Sugarbeets	2 to 3
Peas, beans, lentils, onions, potatoes, mint	2
Vegetable seed	1 to 1.5

Source: Soil Sampling, University of Idaho.

Sample Collection

Collect the appropriate number (at the appropriate depth) of samples in your bucket, one unit at a time. Take all subsamples randomly from the unit, ensuring that you are getting a representative distribution of samples. Zig-zag through the unit, staying away from the unusual areas as described above. Scrape away any surface residues and mix the sample to break up the soil aggregates. After you have collected all of your subsamples, stir your composite at least 50 times and spread out the sample on a piece of plastic or plywood. Fill your soil bag with 1 pint of soil per unit, discarding the rest of the soil from the unit. Repeat the collection process for each unit and for each depth.

Sampling Handling

Keep moist soil samples cool at all times during and after sampling. Samples can be refrigerated or frozen for extended periods of time. If samples cannot be refrigerated or frozen soon after collection, air-dry them or take them directly to the testing laboratory. Air-dry by spreading the entire sample from a given unit in a thin layer on a plastic sheet, breaking up any clumps, and spreading the soil in a layer about 0.25 inch deep. Dry at room temperature, using a fan (if available) for more rapid drying. When the soil samples are dry, again mix the soil thoroughly, breaking up any large clumps. Take about 1 pint of well-mixed soil from the sample and place it in a soil sample bag or other container. When sending samples to your laboratory, be sure to include which nutrients you want to have analyzed, your last crop grown, and future cropping plans.

Interpreting results

Soil-testing laboratories use different test methods, which may influence results and subsequent recommended agronomic nutrient application rates. Adequate soil nutrient levels vary depending on plant species. Soil test results can be grouped into broad categories that describe the relative crop availability for a given nutrient: low, medium, optimum, and excessive. These categories are described below.

- Low: The nutrient content in the soil is inadequate for optimum growth. Additional nutrients are needed for optimal crop growth.
- Medium: The nutrient content in the soil may or may not be optimum for growth. Additional nutrients may be needed for optimal crop growth.
- Optimum: The nutrient content in the soil is adequate for optimum growth of most crops. Additional nutrients may not be needed for optimal crop growth.
- Excessive: The nutrient content in the soil is more than adequate for optimum growth of most crops. No additional nutrients should added. Additional nutrients may cause excess nutrient leaching or eroding from crop fields into water bodies.

References

Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. Guidelines for Soil Sampling. G91-1000-A, February 1991.

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Maryland Cooperative Extension, University of Maryland College Park/Eastern Shore. Soil Sampling Procedures for Nutrient Management. March 1999.

Oregon State University Extension Service. Soil Test Interpretation Guide, EC 1478, August 1999.

Who to Contact for More Information

Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)