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G91-1000 Guidelines for Soil Sampling

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G91-1000-A

Guidelines for Soil Sampling

Soil test values are no better than the soil samples you collect. Proper soil sampling procedures must be followed to obtain meaningful test results for fertilizer decisions.

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The best guideline for determining fertilizer needs is a reliable analysis of a soil sample that is representative of the field. Proper procedures must be followed to collect representative soil samples.

Objectives

The objectives of soil sampling are to: 1) determine the average nutrient status in a field and 2) obtain a measure of nutrient variability in the field. When the variability is known, fertilizer application can be adjusted to more closely meet the supplemental nutrient needs of a crop for specific field areas. Correct fertilizer nutrient use can result in increased yield, reduced cost, and reduced potential water pollution.

General Guidelines

Divide Fields

Fields must be divided into uniform areas before soil samples are collected. These divisions should be based on soil type, slope, degree of erosion, cropping history, known crop growth differences, and any

other factors that may influence nutrient levels in the soil.

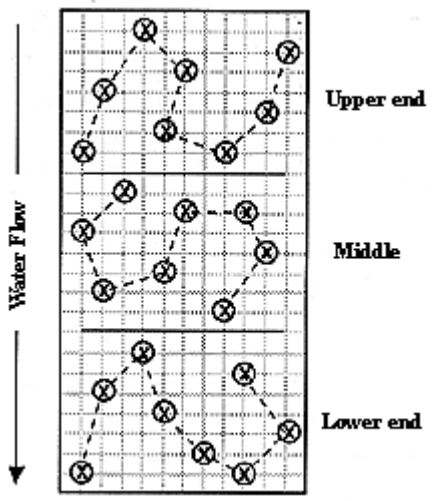

Figure 1. Dividing and sampling a 60-acre gravity irrigationd field.

When sampling soil for nitrate-nitrogen tests in furrow irrigationd fields, the upper, middle, and lower portion of the field should be sampled and analyzed separately (*Figure 1*). The amount of water that percolates into the soil will influence the amount and depth of nitrate-nitrogen in the soil.

Odd areas in the field (eroded spots, turn rows, abandoned farmsteads, or feedlots) must be avoided or sampled as separate areas. Soil samples from these areas can change the test results for the rest of the field. For specific guidelines for sampling soil in ridge planted fields, see NebGuide *G90-996, Ridge Plant Systems: Fertility.*

Select Proper Sampling Depth

Surface (tillage layer) samples are used for determining soil pH, lime need, organic matter, phosphorus, potassium, sulfur, and zinc. Soil test correlations and calibrations for these tests are based on surface samples. Usually the tillage layer is considered to be the 0-6 inch or the 0-8 inch depth. It is best to use the same sampling depth from year to year so soil test values can be more accurately compared. Sampling deeper than the tillage layer generally results in lower soil test values for organic matter, phosphorus, and zinc. Potassium and pH may increase, decrease, or remain the same with tests from deeper samples.

Both surface and subsurface soil samples are needed to estimate nitrate-nitrogen in the root zone because nitrogen in the nitrate form leaches into the subsoil. Nitrate-nitrogen in the root zone is used by plants. For most soils, grain crop roots will penetrate to a depth of four or more feet. Therefore, samples for nitrate-nitrogen ideally should be taken to a depth of four feet, unless rooting depth is limited because of high water table, rock layer, coarse sand, or a gravel layer.

Surface soil samples are needed for all crops. Fertilizer recommendations for all nutrients except nitrogen are based on the crop to be grown and soil tests of the surface samples.

Surface and subsoil samples are needed for nitrogen recommendations for grain crops and sugar beets. Soils should be sampled to a depth of three or four feet for grain crops. Without deep samples, nitrogen recommendations are based on crop to be grown and yield goal. With deep soil test information, nitrogen fertilizer recommendations are adjusted according to soil tests for nitrate-nitrogen.

Collect Soil Cores

A soil core is an individual boring or coring at one spot in the field. Soil cores can be collected at random in the sample area or in a grid pattern. Collection at random (*Figure 2A*) may save some time; however, cores need to be collected from the entire area to obtain the most reliable estimates.

Collecting soil cores in a grid pattern (*Figure 2B*) may require more time to establish the grid; however,

it does ensure that the entire area is represented in the sample. Less variation from year to year is expected when samples are collected in a grid pattern from the same areas each year.

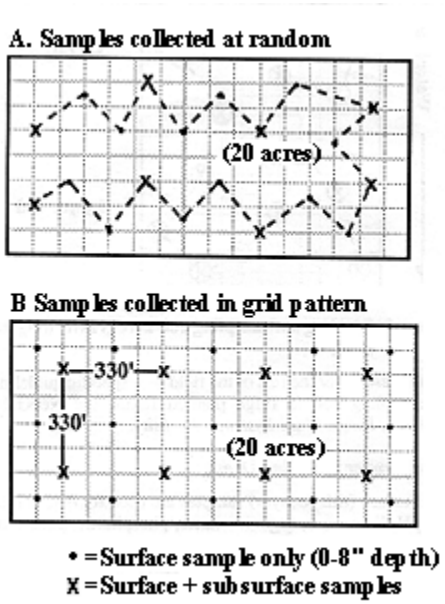

Figure 2. Methods of collecting soil cores from a field.

Proper random sampling can provide an accurate picture of the average nutrient level in the field. In addition, grid sampling can provide an opportunity to obtain even more information. If individual samples from a grid sampling pattern are analyzed separately, they can be used to produce nutrient level maps of the field. Various computer programs are available to help with averaging and mapping. These maps then can be used as a data base for fine-tuning fertilizer application across a field when a computerized fertilizer applicator is used. This equipment is available on a limited basis today, but like all technology, it maybe widely available in a few years. Grid sampling will cost more when individual samples are analyzed, but the additional information should help customize fertilizer application.

Take Continuous Cores

As soil cores are collected, the entire core for the desired depth should be placed in a plastic pail for mixing. Separate pails are needed for surface cores and each subsurface depth sampled (*Figure 3*). Soil cores in each pail are then thoroughly mixed and a subsample placed in a separate bag or box which has been labeled for the sample area in the field, and for the depth of sample.

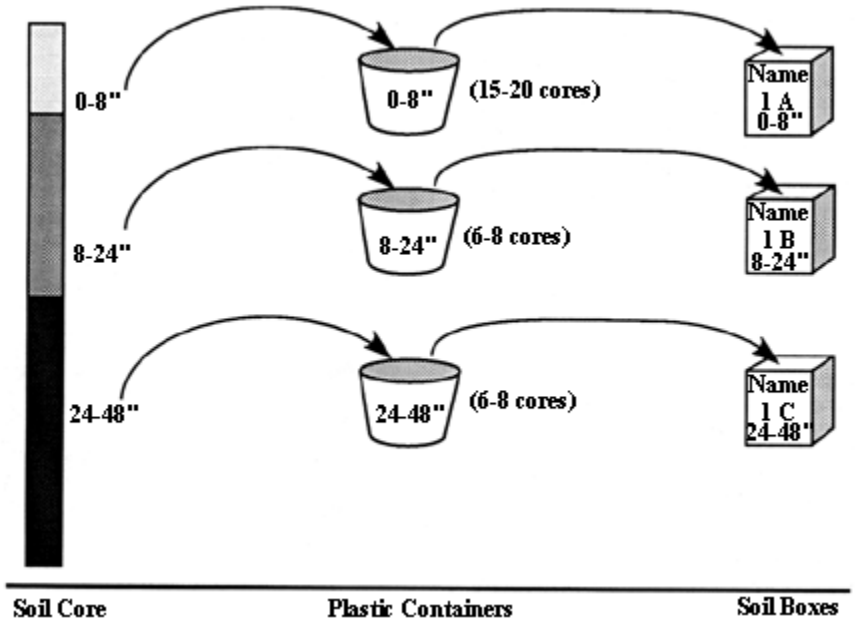

Figure 3. Division of soil cores by depth.

Continuous cores must be taken to accurately represent the average nutrient content in the sample layer. Individual sections of a core may not be representative of the entire core. Never collect a sample from a

small portion of the profile, such as the 18-20 inch portion of an 8-24 inch layer. Always collect a continuous core to the desired sample depth.

Time of Sampling

Late fall or winter is a good time for soil sampling except for testing for nitrate-nitrogen in sandy soils. Fall sampling allows more time to get the results from the testing laboratory and avoids the busy laboratory schedule in the spring.

Fall samples should provide meaningful results for all nutrients; however, excessive rainfall between sampling and when crops grow the next year may result in some leaching of nitrate-nitrogen to greater soil depths. If more than 8 inches of effective rainfall (total amount that percolates into the soil) occurs on fine textured soils between the time samples are collected and the crop is planted, leaching losses may have occurred. To determine the remaining nitrate-nitrogen in the soil, additional samples should be taken. For sandy soils, 4 inches of effective rainfall can cause significant leaching.

Spring sampling prior to planting is preferred. Delaying sampling until spring provides for soil moisture replenishment from fall, winter, and early spring precipitation. Thus, the soil test should reflect the nitrate-nitrogen distribution more accurately for when the crop is growing.

Late spring or early summer sampling after the crop is growing may have value for predicting sidedress nitrogen needs of the crop. Late sampling cannot be used if anhydrous ammonia was applied in the fall or spring before sampling. Also, soil test values for nitrate-nitrogen from late spring sampling are still being calibrated for Nebraska soils.

Mid or late summer is the appropriate time to collect soil samples for winter wheat. Phosphorus level in the soil should be determined prior to seeding winter wheat. Nitrate-nitrogen tests made prior to planting winter wheat help predict nitrogen fertilizers needs for the crop.

Select Soil Sampling Equipment

Surface soil samples can be collected by using a soil probe, soil auger, or spade; however, for collecting subsoil samples, a spade is not very satisfactory. A post-hole digger can be used for collecting deep samples, but its use requires some special techniques.

The *soil probe or tube* is the most desirable tool for collecting soil samples. It will give a continuous core with minimal disturbance of the soil. The cores can be divided for the various depths. There should be very little contamination of subsoil sample with surface soil when using a soil probe. A soil probe cannot be used when the soil is too wet, too dry, or frozen. If the soil is frozen, the frozen layer will need to be fractured before a probe can be used. Soil probes cannot be used in soils that contain gravel.

The *soil auger* can be used in soils that are frozen or contain gravel; however, great care must be taken to obtain representative samples and to avoid mixing of soil from different depths.

The use of a soil auger in wet, sticky soils will result in mixing soil from different depths. A soil auger will not effectively gather dry, powdery soils. Use a soil auger only when a soil probe cannot be used.

Soil Sampling Procedures

Most Desirable

1. *Collect one sample for each 20 acres* (or less for small fields). This will give a good measure of the average nutrient status in the field. Divide large fields into areas of 20 acres or less to obtain a good measure of variability. By knowing the variability in a field, fertilizer application can be adjusted accordingly.

2. *Determine cores per sample.* Collecting 15-20 cores for the surface sample and six to eight cores for subsurface samples per 20 acres usually will give reliable mean values for the sampled area.

   When cores are collected in a grid pattern (*Figure 2B*) and a nutrient level map of the field is to be developed, individual cores should be kept separate and analyzed individually. Although the procedure will require more time and will increase the cost of analysis, it provides more information. This procedure will give a picture of the nutrient variability in the field and will provide a reliable estimate of the nutrient means for the area sampled.

3. *Set sampling depths.*
   a. Use surface samples to eight inches for all tests.
   b. Use subsurface samples to 48 inches (72 inches for sugar beets) for nitrate-nitrogen.

4. *Division of cores by depth.*
   a. Surface sample: 0-8 inches.
   b. Subsurface sample: 8-24 inches.
   c. Deep subsurface sample: 24-48 inches.
   d. Additional depth for sugar beets: 48-72 inches.

This division of each sample will provide information for all nutrients. Fertilizer recommendations for nutrients other than nitrogen are based on the surface sample. An estimate of nitrate-nitrogen available in the root zone for plant use is based on the total amount measured in the samples. The distribution of nitrate-nitrogen by depth tells where the nitrate-nitrogen is in the root zone. This is helpful to estimate the relative effectiveness of the nitrate-nitrogen in the soil as influenced by depth and the chance of loss from leaching.

Acceptable

1. *Collect one sample for each 40 acres.* The average nutrient status can be determined with acceptable accuracy; however, less than ideal measurement of field variability is obtained.

2. *Determine cores per sample.* Acceptable measurement of the average nutrient status can be obtained with 10-15 surface cores and six to eight subsurface cores taken from a field area of 40 acres. More variation in mean values from year to year is expected when areas larger than 20 acres are included in a sample unless more cores are taken.

   For gravity irrigationd fields, four to five subsurface cores per 20 acres will generally give more usable estimates of soil nitrate-nitrogen than will six to eight cores per 40 acres, provided the field is divided into upper, middle, and lower portions.

3. *Sampling depths.*
   a. Use surface samples to eight inches for all tests.
   b. Use subsurface samples to 36 inches, except for sugar beets, for nitrate-nitrogen.

4. *Division of cores by depth.*

a. Surface sample: 0-8 inches.
b. Subsurface sample: 8-36 inches.

This division of each sample will allow testing of surface samples for all nutrients and subsurface samples for nitrate-nitrogen. If the sample is not divided by depth, then only the nitrate-nitrogen test can be interpreted.

A sample representing soil from the soil surface to three feet deep is acceptable for a nitrate-nitrogen test; however, this procedure has severe limitations. It is difficult to obtain a representative sample when using this approach. Variations in soil moisture content and soil density by depth may result in collecting different amounts of soil from different depths. This will bias the test results.

Uniformly mixing a large mass of soil is difficult. The sample obtained may not be representative of the area sampled; consequently, there is greater risk of predicting soil nitrate-nitrogen contents that are too high or too low.

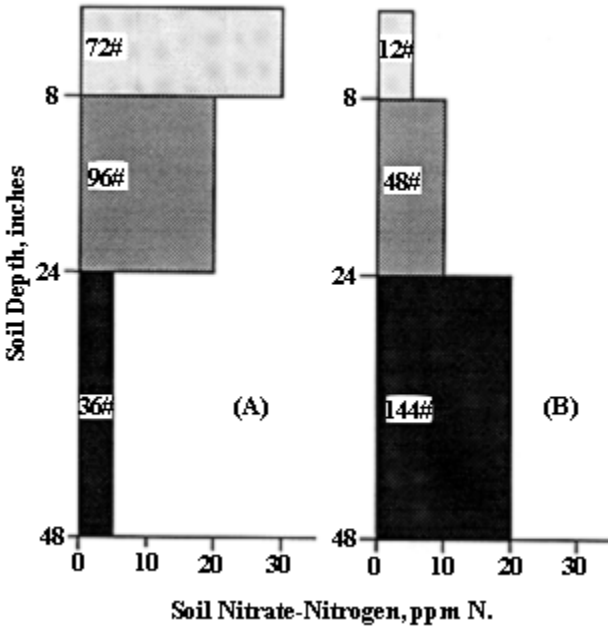

Figure 4. Distribution of nitrate-nitrogen in two soils. Both contain 204 lbs NO_3-N/acre four feet.

The use of one sample to represent the total depth sampled may give the average nitrate-nitrogen content in the sample area but does not provide information on distribution in the soil. When the nitrate-nitrogen is concentrated near the surface (*Figure 4A*), a total depth sample will underestimate the soil nitrogen effectiveness. If the nitrate-nitrogen concentration is near the bottom of the sampled depth (*Figure 4B*), effective nitrogen may be overestimated.

Unacceptable

1. *Sample represents more than 40 acres.* Soil test values usually will not be representative of some areas in the field. These soil test values are not dependable for use in making fertilizer recommendations.
2. *Less than ten cores per surface sample or four cores per subsurface sample.* Soil test values may not be representative of the area sampled; thus, soil test values obtained are not dependable for use in determining fertilizer needs.
3. *Soil samples less than two feet deep for nitrate-nitrogen.* This does not give a good indication of nitrogen in the root zone. A nitrate-nitrogen test on a shallow sample has value only if the test is high. Then additional samples and to a greater depth are suggested.
4. *Soil samples deeper than the tillage layer.* These are not acceptable for tests other than nitrate-nitrogen or some special tests. Soil test calibrations for all nutrients except nitrogen are based on surface samples.

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