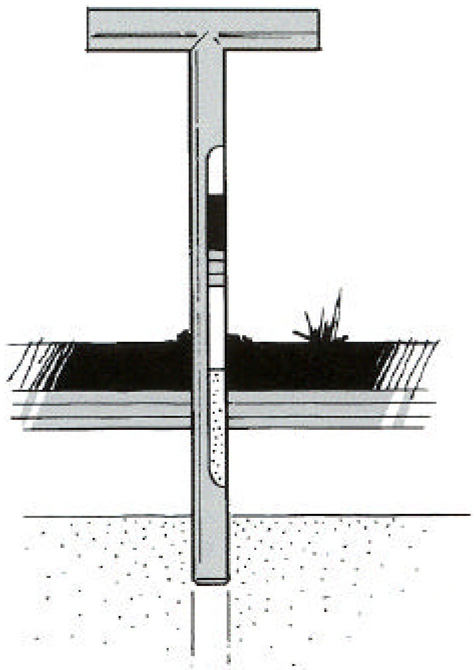
SOIL SAMPLING



Midwest Laboratories℠

MIDWEST LABORATORIES, INC. • 13611 B STREET • OMAHA, NE 68144 • 402-334-7770 • FAX 402-334-9121

Soil Sampling Methods

Properly collecting soil samples is the most important step in any nutrient/soil amendment management program. Soil sampling should reflect tillage, past fertilizer/soil amendment placement, cropping patterns (and corresponding irrigation requirements), soil type (including drainage and slope characteristics) and perhaps old field boundaries (such as old feedlots, windrows, altered stream beds, etc.). Trends toward reduced and/or zero tillage and technology for variable rate fertilization (VRF) have especially demanded that soil samples be taken more comprehensively and intensively for more accurate fertilizer and soil amendment application. This brochure will discuss the many methods used for taking an accurate soil sample using various methods and under several different types of tillage situations.

The most commonly used method for soil sampling would be based on soil types. Fields are split into sampling areas that contain similar soils. Hillsides are kept separate from bottoms since the soil types will vary. Soil survey maps, if applicable, can help organize the soil types throughout the sampling area. Samples will not necessarily need to be collected for every soil type; however, similar soils should be kept together. Sampling maps can be kept to note the locations of the cores for subsequent sampling.

The sampling area will be dependent on the soils and topography. Generally, an area of forty acres is considered the maximum size. Smaller sampling areas may be needed if the soils are quite variable or a production problem is apparent.

Once the sampling area is determined, a sufficient number of cores should be taken to acquire a representative sample. This is generally 10 to 20 cores. The depth of sample for surface soils would be 0 to 6 inches or as deep as the primary tillage. Deeper samples to 24 or 36 inches can be taken for residual nitrate-nitrogen. These deep samples would be kept separate from the surface samples and noted accordingly on the bag and submittal form.

Seasonal Effects on Soil Test Values

There can be considerable seasonal influence on soil test values and every effort to maintain consistency within season when taking soil tests should be made. The two analytes most affected by seasonal influences are potassium and pH.

In the northern corn belt regions (Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, northern Missouri, Nebraska, northern Kansas and the Dakotas) on soils having medium to high clay contents, potassium soil test values have a tendency to be higher during the winter months.

Soil pH values can also vary appreciably over the year depending on nitrogen and sulfur inputs, amounts of rainfall or irrigation and soil buffering capacity (amount and types of clay and free carbonates).

Given that soil test values will vary between seasons, one approach as to when soil samples should be taken is during those periods when the variations hit average values. These periods are generally in the early fall (September-November) and again in the late March-April time frames. In attempts to ideally correlate soil test values to yield, tests should be taken to coincide with a given crop's critical nutrient demand period, usually when nutrient uptake is at its fastest rate. Most generally, however, the ideal time frame for taking soil samples should be based on ease of field access, so that differences in soil type, slope, drainage and cropping pattern can be most easily accounted for.

Year to year variation of soil test values can be appreciable as well, depending on the amount and timing of rainfall, and the duration of freezing and thawing over the winter months. Considerable interpretive value can be obtained from soil tests taken consecutively over 5-7 years to establish the extent of yearly variability in attempts to better manage fertilizer and soil amendment inputs for build-up, draw-down or maintenance purposes.

Crop Effects on Soil Test Values

Soil sampling events should be consistent as much as possible as significant differences in total nutrient uptake between crops or crop specific nutrient inputs exist that can impact on soil test values. For instance, in the fall, exchangeable potassium will test lower following corn than following soybeans, due to larger seasonal potassium uptake by corn during the growing season. Soil pH may be lower in the early fall following corn vs. following soybeans, due to nitrogen and/or sulfur inputs on the corn. Irrigation requirements vary between crops, leading to possible soil test variations following the irrigation season in the areas of nitrate-nitrogen, sulfate-sulfur, boron, soil pH, sodium, carbonates, and electrical conductivity as a function of soluble salts. Effect of a given crop on seasonal nutrient uptake and crop specific nutrient/irrigation requirements can help explain a great deal of year to year soil test variation.

Reduced Tillage, Ridge Tillage and Zero Tillage

These tillage systems have been demonstrated to cause significant layered, stratification of organic matter, pH and soil nutrients (especially where subsurface banding of fertilizer is not utilized). Reduced tillage, ridge tillage and zero tillage soil samples should include some samples that are split into 0"-3" and 3"-7" depth increments, to properly assess to what extent stratification is occurring in order to modify fertilizer/soil amendment rates, timing and/or placement. When sampling for ridge till, it is recommended that the sample is taken halfway down the ridge at a 45° angle to the ridge.

Soil Sampling in Fields Where Fertilizer Has Been Banded

Where location of bands are known:

(i) 30-inch band spacing: one in-the-band core for every twenty between-the-band cores.

(ii) 15-inch band spacing: one in-the-band core for every eight between-the-band cores.

Where location of the bands are unknown: at least 20 pairs of cores to make one sample taken in a random pattern. The second core of each pair is taken at a distance of 50% of the band spacing from the first core, perpendicular to the band direction.

Grid Soil Sampling

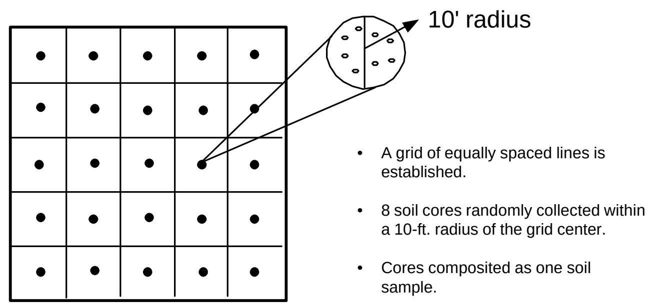
Development of site-specific nutrient management via global positioning systems (GPS) and variable rate fertilization (VRF) demands that soil sampling be intensively organized into a systematic grid pattern.

Grid soil samples should be taken at a specific point, either within the grid cell or at intersection points between grid cells, consisting of 8-10 cores per sample taken within a 10-foot radius (see figure 1). To more correctly represent soil test variability within a field (especially for implementation of soil test mapping), the grid sample points should be organized into a systematic grid-diamond pattern or a systematic unaligned grid pattern as shown in figures 2 and 3. The grid-diamond pattern is accomplished by shifting the sample points to the left or right of the grid cell center in alternating rows perpendicular to the measurement pattern (established by counting rows, using distance measuring devices, or GPS). The systematic unaligned sampling pattern is best utilized via GPS, following this procedure:

- Divide the field into cells by means of a coarse grid. Square cells are the norm but not mandatory.
- Superimpose a finer grid (reference grid) in each coarse cell. For example, if there are 5 rows and 5 columns in the coarse grid, you might choose to divide each coarse cell into 25 smaller cells.
- Choose a corner of the coarse grid, say top left, and randomly select a reference cell—in this sample, one of the 25 reference cells.
- Move horizontally to the next coarse cell in the top row and keep the X coordinate the same but randomly select a new Y coordinate.
- Repeat the process for all the coarse cells in the top row.
- Return to the upper left corner and repeat the process down the first column of cells, this time keeping the Y coordinate the same, but changing the X coordinate in each successively lower coarse cell.
- The remaining positions are determined by the X coordinate of the point in the left-hand square of its row and the Y coordinate of the point in the uppermost square of its column.

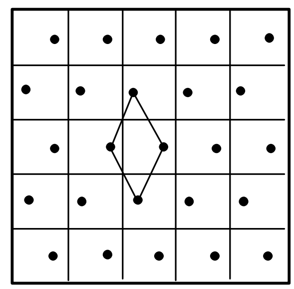
With this procedure a constant interval both along the rows and down the columns is maintained without alignment.

fig. 1. Schematic showing the layout of a square grid and locations where soil cores would be collected.



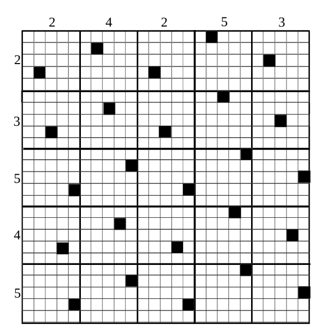
Systematic Grid -Square Sampling Pattern

fig. 2. Modification of a square grid where alternating rows of sample points are shifted one half thedistance from the cell center and edge.



Systematic Grid - Diamond Sampling Pattern

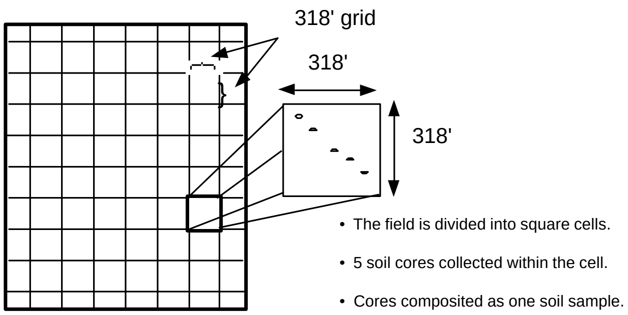
fig 3. Schematic showing the layout of a systematic unaligned grid. The x, y coordinates were determined from a random number table.



Systematic Unaligned Grid

The size of the grid cell sampling pattern should be based on previous fertilizer response over a given field, and can be further adjusted with ongoing yield data from on-board combine yield monitor systems. Fields that test high to very high in nutrient levels and that have consistently received crop removal fertilization rates should be grid point sampled on a 300 to 450-ft. grid (2.5 to 5.0 acres). Fields that have previously tested less than high in nutrient levels or that have demonstrated response to added fertilizer and also have received consistent crop removal fertilization should be grid point sampled on a grid no larger than 200 ft. (1.5 acres). If a single rate of fertilizer is to be applied, then a larger grid cell pattern can be utilized (450-600 ft:5-10 acres), following a grid cell sampling pattern, as shown in fig. 4.

fig. 4. **Schematic showing layout of 318-ft cells and locations where soil cores would be collected for a 125-acre field (total of 54 samples).**



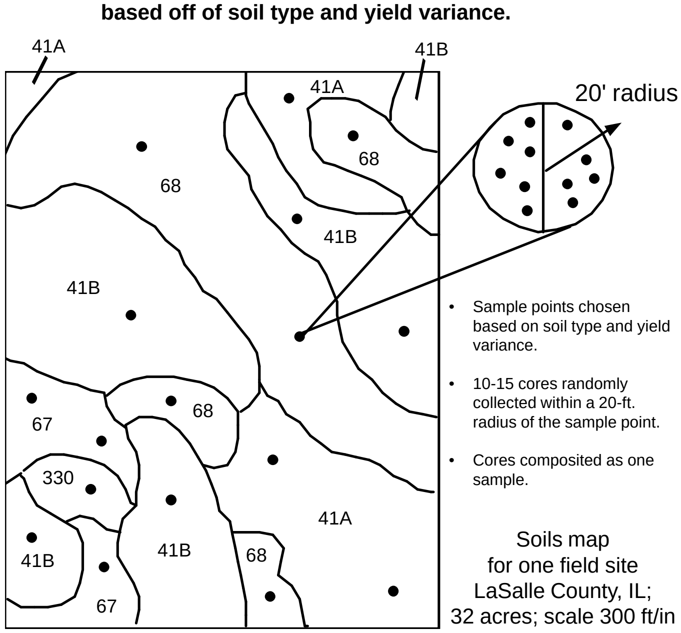
Grid Cell Sampling Technique
Soil Test Values Represent an Area

Non-Grid Soil Sampling

While this method is less systematic and precise than grid sampling, reliable results can be obtained if sample points and/or walk patterns are consistent between sampling events (utilizing row counts, distance measuring devices, or GPS). The area represented by each sample should be no more than 20 acres depending on soil type, slope, drainage, old field boundaries and variation in cropping pattern. 15-25 cores per sample are recommended.

A variation on the grid-point sampling technique can be useful in developing more consistent, non-grid sample results. Specific points within the field are chosen based off of soil type and yield data (if available), and 10-15 cores are taken within a 20-foot radius around each point. Using GPS would enhance relocating sample points to insure consistency for this sampling method (see fig. 5).

fig. 5. **Schematic showing the layout of a specific sample point based off of soil type and yield variance.**



Soil Summary

	Soil Type	Acres	-- Yield -- Corn	Beans
41A	Muscatine silt loam, 0-2% slope	8.8	167	51
41B	Muscatine silt loam, 2-4% slope	12.1	165	50
67	Harpster silty clay loam	2.6	136	44
68	Sable silty clay loam	9.7	156	51
330	Peotone silty clay loam	1.0	123	42
			159	50

NEMATODE SAMPLING

Soybean Cyst Nematodes (SCN)

The optimum time to sample for SCN is as close to soybean harvest as possible. The population will tend to fluctuate throughout the season and can be affected by soil temperature, moisture, host suitability and over winter survival. SCN populations tend to be highest when host plants are almost mature to shortly after harvest.

Samples should be taken 0 to 6 inches in depth and taken from similar soil textures. Cores should be taken within two inches of the row. If the row is not identifiable, make use of zigzag pattern throughout the intended field. Areas in the field where significant stress has occurred should be sampled differently. The cores should be taken between the affected plants and healthy plants. Severely stressed plants cannot support the higher populations.

Parasitic Nematodes

These nematodes are the microscopic organisms that are found in soils that can feed on many types of plants. Seasonal fluctuations will occur. The populations and nematode activity will decrease as root growth declines and soil temperatures cool between 60½ F and raise above 85½ F. The optimum sampling time would be when soil temperatures are between 60½ and 80½ F. Optimum moisture content should be 50-80% of field capacity. Samples should be taken 0-6 inches. Roots can also be submitted.

All samples should be stored in a cool place if there is a delay in shipping. Sample bags and submittal forms should be clearly marked indicating a nematode analysis is requested.

Sampling for Herbicide Residue

Normal sampling procedure should be used with certain exceptions. It is imperative that a representative sample is taken from the areas of the field that would demonstrate the highest carryover. Turn rows and lower organic matter areas will typically contain the highest ratios of carryover.

The sampling depth for herbicide residues should correlate to incorporation depth or any tillage performed since the herbicide was applied. Lighter soil types may demand slightly deeper sampling depths. However, this will depend on the leachability of the herbicide.

SUMMARY

Soil tests should be taken in such a manner to maximize their use as a soil fertility index based on comparison between sampling events. Consistency, in the areas of season, location (aided by GPS techniques), crop rotation, soil type and sampling depth must be maintained for proper soil test interpretation. Inconsistencies in any of these areas of soil sampling collection will lessen the interpretation value of soil test changes that occurred since the last soil sample was taken. Along with consistency, soil samples should reflect past soil and fertilizer/amendment management of a given field, taking into account tillage, crop rotation, fertilizer/amendment placement and also soil characteristics (texture, slope and drainage). Following these guidelines will allow soil tests to be used more effectively for nutrient management and crop diagnostics.