Soil Sampling for REDUCED TILLAGE

With more emphasis being placed on soil and water conservation, reduced tillage systems are occupying more acreage than ever before. Reduced tillage can take on many forms, with tillage intensity varying among systems and the no-till method designated the most conservative system.

The objective of this publication is to discuss the changes in soil sampling procedures that are necessary when reduced tillage is adopted. The type of tillage system and fertilizer management are the two most important factors affecting the manner in which soil samples should be collected. Type of tillage system influences the degree and depth of mixing of soil and added nutrients. Under conventional tillage systems, fertilizer is mixed to a depth 4 to 10 inches. However, reduced tillage systems do not incorporate nutrients to such an extent. The method of fertilizer application also influences the spatial distribution of nutrients before any tillage. Due to these factors, changes in sampling depth and pattern are necessary under reduced tillage.

Effect of Tillage on Nutrient Distribution

Researchers report that surface broadcast application of relatively immobile nutrients, such as phosphorus (P) and potassium (K), can lead to significantly higher nutrient levels near the soil surface (2.5 to 4 inches) as tillage is reduced. Results show clear differences in the vertical distribution of P and K after 7 years of continuous corn grown under four tillage systems. Under conventional tillage, P and K were distributed uniformly throughout the 0- to 9-inch layer (plow layer). Added P and K were mixed to a depth of less than 6 inches under chisel systems, with levels significantly higher in the 0- to 3-inch layer (Table 1).

Due to the mobility and transformations of nitrogen (N), broadcast applications of N fertilizers do not result in stratification of readily available N. However, reduced tillage has resulted in significantly higher levels of organic N in surface layers. Surface broadcast applications of N usually decrease soil surface layer pH values, depending on amount of N applied (Table 2). Soil pH in surface layers were lower in no-till treatments than conventional tillage after 10 years.

Effect of Fertilizer Application Practices on Nutrient Distribution

Fertilizer management adds another factor to consider in soil sampling. Subsurface applications of anhydrous ammonia or UAN solution are popular practices. These practices can create zones of undesirable acidity below the soil surface layer. Anhydrous ammonia injected between rows for 7 years resulted in the formation of acid zones in the 3- to 6-inch soil layer (Table 3). This effect is evident among chisel, ridge, and no-till treatments. In conventional tillage, pH is more uniform throughout the surface layers due to more thorough mixing of the acidified and non-acidified zones each year.

Table 1.
Soil test P and K levels after 7 years of continuous corn grown under four tillage systems.

	Tillage system							
Sampling	**Conventional**		**Chisel**		**Ridge-till**		**No-till**	
Depth	**P**	**K**	**P**	**K**	**P**	**K**	**P**	**K**
Inches	Pounds per acre							
0 to 3	78	246	172	480	154	450	182	566
3 to 6	98	270	78	256	52	226	62	240
6 to 9	62	270	30	210	22	190	34	210
9 to 12	26	220	26	210	16	200	26	210

Table 2.
Soil pH of the 0- to 3-inch and 3- to 6-inch layers after 10 years of N application in two tillage systems.

	Soil pH after 10 years			
	Conventional		**No-till**	
Annual N rate	**Inches**			
pounds/acre	**0 to 3**	**3 to 6**	**0 to 3**	**3 to 6**
0	6.45	6.45	5.75	6.05
75	6.40	6.35	5.20	5.90
150	5.85	5.83	4.82	5.63
300	5.58	5.43	4.45	4.88

Table 3.
Soil pH* after 7 years of continuous corn with anhydrous ammonia (250 pounds N per acre) injected between rows.

	Tillage system			
Soil depth	**Conventional**	**Chisel**	**Ridge-till**	**No-till**
Inches	**Soil pH***			
0-3	5.6	5.9	5.5	5.8
3-6	5.5	5.3	5.1	5.1
6-9	5.6	5.6	5.6	5.6
9-12	5.8	6.0	6.1	6.2

* Samples collected from the midrows of all treatments.

Banded application of P and K below and to the side of the seed row is often used in reduced-tillage systems. If row placement in a field does not change over a number of years, zones of residual P and/or K will develop. This can cause variability of soil test results, depending on sampling zone. To insure an average sample from a field, where the band location is known, the number of cores to be taken between the bands for every core taken in-the-band is equal to 8 times the band spacing. **For example**, if the band spacing is 30 inches, 20 (2.5 feet x 8) cores should be taken between sampling, where the first sample is taken at random and the second sample of the pair is taken perpendicular to the band direction and 50 percent of the band spacing from the first sample.

Recommended Sampling Procedures

In a reduced-tillage system, take samples from surface to the plow depth or to the depth at which fertilizer is being injected. This means most samples should be collected at depths of 0 to 6 inches. In a no-till system in which fertilizer is surface applied, two separate samples should be collected. A sample 0 to 3 inches should be collected for soil pH and 0- to 6-inch sample for P and K. Opinions differ among researchers as to the number of samples needed for a composite sample in a reduced-tillage system. The recommended number of samples for a composite sample varies from 10 to 60. This number will vary with different fertilizer application practices. If soil has been limed or broadcast fertilized in the last 2 years, you should take at least 30 individual cores. More samples are needed if high soil variability or unknown locations of banded fertilizers exist.

Gather cores in a random, zigzag pattern over the area involved. This reduces sampling variability. Field size per composite sample should not be any larger than 10 acres. Smaller field sizes will help eliminate the variability within the field. Break up clods, spread out soil, and dry at room temperature. Mix dried soil and package one pint in a soil sample box available from your county Extension agent or the Soil Testing Laboratory at Mississippi State University. **Label carefully to insure identification**.

Four Steps for Sending Soil Samples To Be Tested

1 • Fill out the information sheet—this includes your name, address, and the county in which you live; a description of problems you may be having; identification of your samples with a 5-digit name or number; and the appropriate code numbers for the crops you wish to grow (see sample form).

2 • Make check or money order (no cash please) payable to MCES and mail the top sheet with $3 per sample box to:
Mississippi Cooperative Extension Service
Accounting Department
Box 9602
Mississippi State, MS 39762

3 • Mail the second copy and soil samples to:
Extension Soil Testing Laboratory
Box 9610
Mississippi State, MS 39762

4 • Keep the third copy for your files. You will find additional helpful information on the lower front and back of this third sheet.

Mississippi Cooperative Extension Service
Soil Testing Laboratory • Mississippi State University

Name________________________ Mailing Address _________________________ Town __________ Zip Code ________

County ______________________ Date _____________ Describe any specific problem ___________________________

Send $3.00 per sample submitted. Mail this copy with a check or money order for total charges to
Mississippi Cooperative Extension Service
Accounting Department
Box 9602
Mississippi State, MS 39762

Total Charges

Please PRINT CLEARLY and PRESS FIRMLY so all copies will be readable. _____ Samples @ $3 each _________

Field Number (5 spaces or less)							
Crop To Be Grown Use Code # From Below							

Names and addresses of those (other than farmer and county agent) who want a copy of this test ________________________________ MAIL WITH PAYMENT

CROP CODE NUMBERS. REGULAR TESTS on all samples include pH, Lime Requirement, Phosphorous, Potassium, Calcium, Magnesium, Sodium, and Zinc.

FIELD CROP Code Numbers (Regular Tests Plus Organic Matter)

4 Corn and sorghum for silage
5 Corn and sorghum for grain
62 Corn for grain - high yield
2 Cotton
31 Peanuts (vines and nuts removed)
37 Rice
32 Small grains (oats, wheat, rye, barley)
59 Sorghum and sugarcane for syrup
1 Soybeans
9 Soybeans/small grain rotation
49 Sunflower
66 Tobacco

FORAGE/PASTURE/HAY Code Numbers (Regular Tests)

15 Alfalfa
35 Hybrid bermudagrasses
55 Johnsongrass
57 Lespedeza (annual)
58 Lespedeza (serecia)
56 Mixed grass hay (dallis, bermuda, bahia)
51 Southern peas

Winter/Spring Grazing Crops —

40 Annual grasses (wheat, oats, barley, ryegrass)
46 Forage legumes (white, red, caley peas, vetch, ball clover)
23 Perennial wintergrass pasture (fescue or orchardgrass)
53 Perennial wintergrass pasture with clover (white, red, subterranean with fescue or orchardgrass)
52 Winter/spring annual legumes with ryegrass

Summer Grazing Crops —

25 Johnsongrass (grazing)
54 Perennial grasses (bermuda, dallis, bahia plus annual legumes (crimson, arrowleaf, ball, subterranean clovers)
18 Perennial grasses (bermuda, callis, bahia) plus perennial or late-maturing annual legumes (white, red, arrowleaf)
34 Perennial or mixed summer grass pasture (bahia, bermuda, dallis)
25 Summer annual grass pastures (millet, sorghum, sudan, sorghum/sudangrass hybrids, crabgrass)

References

Blevins, R.L., Thomas, G.W. , Smith, M.S., Frye, W.W., and Cornelius, P.L. 1982. Changes in soil properties with long-term continuous no-tillage and conventionally tilled corn. Soil and Tillage Res. 3:135-146.

Mengel, D.B. 1986. Soil sampling and other reduced tillage systems. Proc. Ind. Plant Food and Ag. Chem. Conf. p. 89-99.

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