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Soil Sampling Fields with Four Types of Probes

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Abstract

Soil testing is a vital component of a crop nutrient management program. Field experiments were conducted to compare the time required to collect samples for soil testing using four types of soil probes. Soil sampling time on sandy loam and clay soils was reduced significantly with a cone probe compared with the straight tube and foot-pedal probes. Composite samples were collected from a 20-acre field with clay soil in 22 minutes with a cone probe compared to 38 minutes with straight tube and foot-pedal probes. The cone design saves time by reducing probe clogging and allowing 8 to 10 cores to be collected before emptying soil from the probe.

Introduction

Soil testing is the single most important guide to profitable application of fertilizer and lime (2). By using a nutrient management plan based on soil test results, farmers can optimize crop production and reduce environmental risks. The Environmental Quality Incentives Program (EQIP) in the 2002 U.S. Farm Bill encourages farmers to adopt conservation practices such as nutrient management planning (4). Farmers and ranchers may receive financial and technical help through EQIP to develop and implement nutrient management plans for their farms.

The availability of nutrients already present in the soil should serve as the basis for determining the supplemental nutrient requirements of crops (3). In a nation-wide survey reported by the Conservation Technology Information Center (1), 53% of the farmers said that they did not practice soil testing on their farms. In the survey, major reasons cited for farmers not adopting crop nutrient management were unwillingness to change, expense, and concerns that it would be time-consuming. Most farmers understand the importance of soil sampling and testing; however, the time required to collect samples is a constraint. An average person requires 15 to 40 minutes to walk a 20-acre sampling area and collect a representative composite soil sample.

Although most of this time is spent walking between sampling points in a field, a significant amount of time is required to collect a core at each sampling point. The type of probe that is used may affect the time needed to collect and remove soil cores at each point.

A soil sampling experiment was conducted on fields with silt loam, sandy loam, and clay soils at the University of Missouri's Delta Research Center at Portageville, Missouri. The objective of the test was to determine whether the time required to sample fields with different soil textures is affected by the type of soil probe used.

Features of Soil Probes

Four types of soil probes were evaluated (Table 1). Each probe has unique features that are desirable (Fig. 1). The foot-pedals on the Oakfield™ and M&M™ models help when pushing a probe into compacted soils. The main difference between the Oakfield and M&M models is the split tube design in the M&M probe (Fig. 2A). The split-tube probe has a hinge at the top that allows the tube to open and close. For soils that tend to stick in the tube, this feature allows for faster removal of the sample. The Oakfield foot-pedal model is the only probe

that we tested with interchangeable tips. The tip supplied with the probe had an inside diameter of 0.7 inch (18 mm). This produces a slightly smaller core than the inside of the tube and should make the soil core easier to remove after it is the sampling tube. The Hoffer™ straight tube probe is best when a sample is needed from a soil depth greater than 6 inches.

Table 1. Companies that manufacture the 36-inch soil probes used in the test.

(a) Straight tube Hoffer model	JBK Manufacturing and Development Company, Dayton, Ohio 45430
(b) Foot-pedal Oakfield LS model	Oakfield Apparatus Company, Oakfield, Wisconsin 53065
(c) Split-tube M&M model	M & M Supply Company, Mitchellville, Iowa 50169

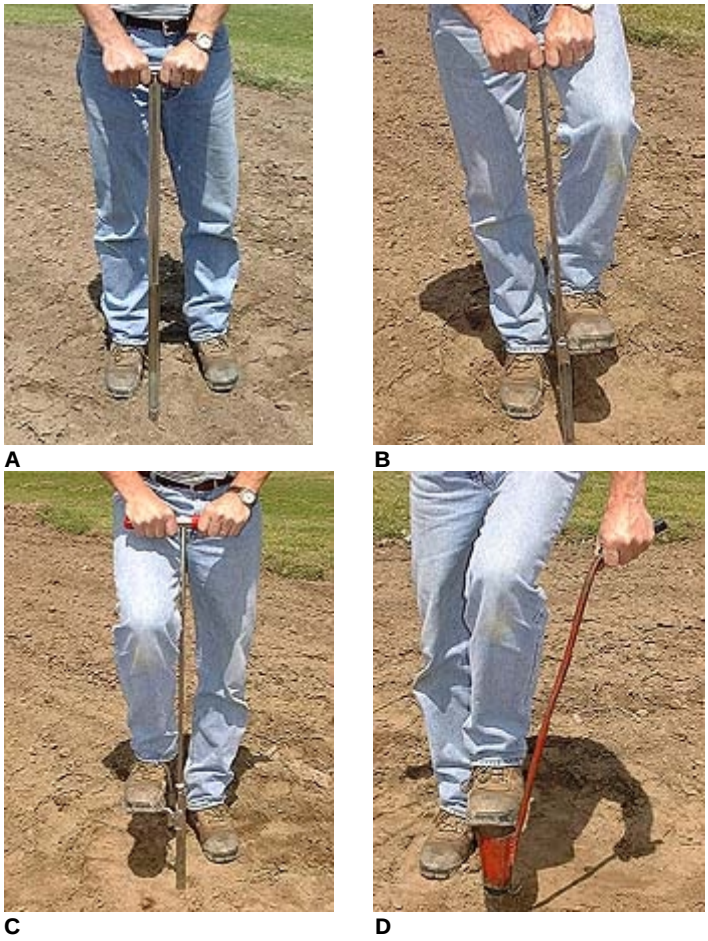
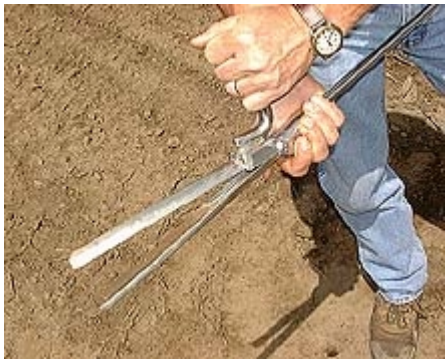


Fig. 1. Four types of soil probes tested were: (**A**) Hoffer straight tube, (**B**) Oakfield foot-pedal, (**C**) M&M split-tube, and (**D**) Esser cone.



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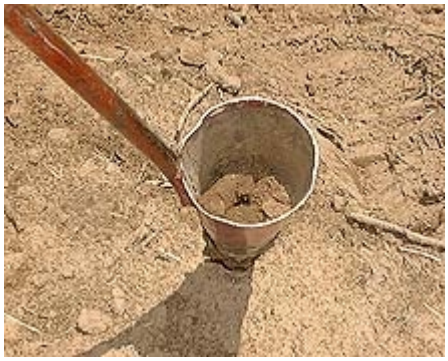

B

Fig. 2. Split tube design with M&M probe (**A**) and cone tube design with Esser probe (**B**).

The cone probe used in our study was custom made by a local machine shop in Caruthersville, Missouri. Robert Esser invented the cone-type probe for sampling nematodes in sandy soils in Florida (Steve Koenning, *personal communication*, 2001). Don Schmitt and Clifton Alston at North Carolina State University later made modifications to the cone design to allow for sampling finer textured soils. The cone probe that we used holds approximately 1 pint of soil in the cone. To collect a core at each sampling point, a person places his or her foot on top of the cone and pushes the probe in the soil. This forces the individual core sample up into the cone chamber. A person can usually collect 8 to 10 cores before having to dump the cores from the cone into a bucket or box (Fig. 2B).

The cone was made from 11-gauge sheet metal cut into a trapezoid shape (9.5 inch at top, 10 inch tall, and 3.7 inch at bottom). The sheet metal was rolled and welded along the edges. A 1/2-inch-diameter-×-28-inch-long rod was welded to the cone and bent to best fit a person's wrist. A 4-inch section of rubber hose was inserted over the rod handle at the top for gripping with the hand.

Method of Soil Sampling

Soil samples were collected with each soil probe from three fields, approximately 20 acres each, of Tiptonville silt loam, Bosket sandy loam, and Sharkey clay soils. The soil water content was near field capacity. Four people walked zigzag courses marked with flags and collected 25 soil cores from sample points spaced 208 feet apart. Core samples were collected from 0- to 6-inch soil depths. Each person used all four probes at each field. Soil cores were composited into a bucket and mixed thoroughly. A sub-sample was taken from the bucket and placed in a sample box and labeled. The time required to complete the sampling process with each probe and the incidences of clogging with each probe was recorded.

Fastest Sampling Probe

Sampling time for fields with sandy loam and clay soils were significantly less with the cone probe than the straight tube probe (Table 2). Although the cone probe was originally designed for sampling sandy soils, there was no incidence of clogging on any of the soils. We attributed this to the continuous tapered shape of the cone tube. The split-tube feature on the M&M model probe is helpful on fine textured soils that tend to clog soil probes. However, having to split the tube open to take out each soil sample on the sandy loam field significantly slowed down the sampling process as compared to the other probes.

Table 2. Average sampling time and clogging for soil probes on different soil textures.

Soil Probe	Time to collect composite sample from 20-acre field			Clogging incidence per field		
	Silt loam	Sandy loam	Clay	Silt loam	Sandy loam	Clay
	-- minutes per field --			-- clogs per field --		
Straight tube	19.7 ab*	18.5 b	38.7 a	1 a	0.3 a	14 b
Foot-pedal	19.3 ab	17.5 bc	38.3 a	0.8 a	0.3 a	18 a
Split-tube	20.6 a	21.5 a	23.4 b	0.5 a	0.3 a	0 c
Cone	17.3 b	15.3 c	22.2 b	0 a	0 a	0 c

* Numbers followed by the same letter are not significantly different at 0.05 level.

Usually, more time was required to sample the field with the clay soil than the fields with silt loam and sandy loam soils (Table 2). The workers collecting the samples reported that more effort was required to push the probes into the clay soil. The fastest sampling with the least amount of probe clogging occurred in the sandy loam field. Clogging was a serious problem with the foot-pedal (Oakfield model) and straight tube probes on the clay soil. When the probes clogged, the person collecting the sample had to stop and use a knife to remove the samples. This added to the sampling time. The foot-pedal probe clogged on average 18 times per composite sample on the clay soil. The foot-pedal helped the worker push the probe in the ground. However, sampling time measurements did not show that it saved any time compared to the straight tube probe. For fields with compacted soil, the extra force provided by a person's foot might save time by not having to use a hammer or mallet to drive the probe in the ground.

In summary, farmers may reduce the time and labor required for soil sampling by carefully selecting the type of proper probe for the task. Averaged across all soils, time required for composite sampling with the Esser cone probe was 29% less than the straight tube probe. More time was required to soil sample fields with clay soil than fields with medium or coarse textured soils.

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