SOIL SAMPLING ON SURFACE MINED SPOILS: SYSTEMATIC VS. SYSTEMATIC-COMPOSITE VS. RANDOM

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Abstract—When sampling soils, there is a balance between complete and adequate description of the resource and the sampling effort. Any technique that can reduce the cost of sampling without reducing its descriptive value is worthwhile. This problem is especially relevant when dealing with surface mine spoil. Mining procedures result in spoils with greater heterogeneity than agricultural soil or naturally developed forest soils. Most soil sampling techniques have been developed with intensively managed annual crops in mind, and the ones that deal with surface mine lands allow a composite sample to represent from 5 to 20 acres (Evangelou and Barnhisel 1981). However, research plots are much smaller and verification of soil attributes requires greater precision. Three different sampling techniques (systematic, systematic-composite, and random) were used on translocated surface mine spoil in eastern Kentucky and evaluated for similarities in their ability to describe soil characteristics.

METHODS

The spoil was moved from above the coal seam and placed into overburden piles which were then moved again and deposited into research plots. This translocation caused a mixing of the original topsoil and parent rock material. Based on this expected heterogeneity, we felt that systematic sampling would provide the best description of the soil attributes. From this baseline we compared systematic-composite and random sampling, which reduced the costs of sampling.

The systematic sampling consisted of five samples taken from each of nine research plots. A composite sample was taken from the five systematic samples and a separate random sample was taken from each plot. All samples were submitted for analysis of eleven parameters: organic matter, phosphorus, potassium, calcium, magnesium, pH, nitrate nitrogen, soluble salts, total nitrogen, sodium, and water holding capacity. A 95 percent confidence interval was established for the eleven parameters based on the systematic sample. If systematic-composite or random sampling can provide means for the eleven parameters that are within the 95 percent confidence interval for the systematic sample, these lower cost methods are preferable.

RESULTS AND DISCUSSION

While the outcome can be influenced by the soil parameters chosen, these parameters are typical in surface mine reclamation. Of the eleven parameters measured on the nine plots, three of the systematic-composite samples and eight of the random samples fell out of the systematic sample confidence interval (Table 1). The results indicate that a significant time and cost savings (Table 2) can be realized if systematic-composite sampling is used. Random samples offer a lower degree of statistical precision while only providing marginal cost savings over systematic-composite samples.

REFERENCES

Evangelou, V.P.; Barnhisel, R.I. 1981. Sampling surface mine lands before and after mining. Ext. Publ. AGR-41. University of Kentucky.

Table 1—Soil sampling parameters falling outside the 95 percent confidence interval established by the systematic sampling

Research plot	Systematic composite	Random
1	None	Organic matter Calcium Total nitrogen
2	None	None
3	None	None
4	None	None
5	None	Organic matter
6	Sodium Water holding capacity	Sodium Water holding capacity
7	None	None
8	None	Phosphorus
9	Water holding capacity	Water holding capacity

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Table 2—Soil sampling costs associated with the various soil sampling approaches on a per sample and per plot (20 m^2) basis

Sample method	Field[a]	lab	total	Number of samples	Total cost
	----- *Cost per sample* ----				
Systematic	$1.67	$4	$5.67	5	$28.35
Systematic composite	$2.50	$4	$6.50	1	6.50
Random	$1.67	$4	$5.67	1	5.67

[a] Field costs are based on a wage of $10/hr.