

Characteristics of Purdue Soil Testing Data from Plugs Taken Out of Experimental Plots¹

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Abstract

Fifteen individual soil plugs from a single field experimental plot were taken at four different locations in Indiana. These individual plugs were tested for pH, available phosphorus, and available potassium in the Purdue Soil Testing Laboratory. Statistical analyses were then run on these data.

The coefficients of variation were smallest with soil pH values and ranged from 2.3 to 6.8 percent. The coefficients of variation for potassium ranged from 7.5 to 19.6 percent and for phosphorus from 17.3 to 36.9 percent.

The number of cores or plugs required to obtain a sample with 19 to 1 odds of being within plus or minus 10 percent of the true mean was smallest for soil pH and greatest for phosphorus and potassium. From 3 to 5 cores were required for soil pH, 5 to 18 for potassium, and 15 to 55 for phosphorus to meet these requirements. There was a positive correlation between coefficients of variation and numbers of cores required.

Cline (1) reported potassium and calcium data from single soil cores or plugs when he described principles to be observed in sampling soils. Hammond, Pritchett, and Chew (2) found that the number of soil samples needed and the expected variance of a mean were much lower for pH than for either phosphorus or potassium soil test values. Reed and Rigney (3) found that variation among soil samples from the same field is often so great that great precision used in analyzing these samples in the laboratory is unnecessary.

It is the purpose of this study to (1) characterize Purdue Soil Testing Laboratory data from individual plugs taken from experimental plots, and (2) to determine the number of plugs required to obtain averages of soil chemical determinations which will fall within a stated confidence interval of the true mean.

Methods and Procedure

Soil plugs were taken from one experimental plot in each of four fertilizer experiments in the fall of 1966. These four experiments were located on Runnymede loam on the Pinney-Purdue Farm near Wanatah, on Blount silt loam on the Herbert Davis Farm near Farmland, on Crosby silt loam on the Animal Science Farm near Lafayette, and on Crosby silt loam on the Robert E. Brown Farm near Lafayette. Fifteen Hoffer tube soil plugs of the plow layer were taken about two and one-half feet apart in a vertical line between the two center of four corn rows in each plot on three of these farms. On the fourth, or Animal Science Farm, these fifteen plugs were taken approximately one foot apart between the center two corn rows. No samples were taken nearer than five feet to the end of a plot.

¹Journal Paper No. 3214, Purdue University Agr. Exp. Sta.

²The author acknowledges the help of Wyman E. Nyquist and N. T. Houghton.

All plots had been in continuous corn with high annual rates of broadcast phosphorus and potassium fertilizer for three or more years just previous to this sampling. The Runnymede loam and the Crosby silt loam on the Brown Farm had been limed during the previous three year period.

The soil plugs were air dried, crushed, run through a 10-mesh screen, and analyzed for soil pH, available phosphorus, and available potassium by the methods of Spain and White (5, 6) as used in the Purdue Soil Testing Laboratory.

The range, mean, standard deviation, coefficient of variation, and standard error of the mean, as defined by Snedecor (4), were used to characterize pH, phosphorus, and potassium values from each plot.

The number of plugs required to obtain a mean with a given confidence interval was calculated using the method of Stein explained by Steel and Torrie (7).

Results and Discussion

The range in both phosphorus and potassium values for the 15 plugs within a plot was quite wide (Table 1). The coefficients of variation for soil pH values were smallest, ranging from 2.3 to 6.8 percent. The coefficients of variation for potassium ranged from 7.5 to 19.6 percent, and for phosphorus from 17.3 to 36.9 percent.

The number of plugs required to obtain a sample with 95 to 5 odds of being within ± 10 percent of the true mean was smaller for pH and greater for phosphorus and potassium. From 3 to 5 cores were required for soil pH from 5 to 18 for potassium, and from 15 to 55 for phosphorus to stay within the ± 10 percent confidence interval.

When a ± 5 percent confidence interval for the mean was used, the number of plugs required to obtain such an average increased over the number used for the ± 10 percent confidence interval. However, the increase for pH was not relatively as great as that for phosphorus or potassium. It is believed that phosphorus and potassium fertilizers had not been as well mixed with the plow layer as had lime.

Literature Cited

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TABLE 1
Characteristics of Purdue soil testing data, 1966.

Measurement	Brown Farm plot			Herbert Davis Farm plot			Pinney-Purdue Farm plot			Animal Science Farm plot		
	pH	P	K	pH	P	K	pH	P	K	pH	P	K
	lbs/A			lbs/A			lbs/A			lbs/A		
Range	5.3-6.8	33-100	150-270	6.8-7.3	50-96	150-195	5.9-6.4	126-305	135-255	5.7-6.4	41-126	135-210
Mean	6.17	62.4	225	7.09	74.9	167	6.13	180	199	6.01	68.6	175
Standard deviation	.417	22.5	34.9	.163	13.0	12.5	.139	45.2	39.1	.193	25.3	33.4
Coefficient of variation, %	6.76	36.1	15.5	2.29	17.3	7.49	2.67	25.0	19.6	3.21	36.9	19.1
Standard error of the mean	.109	5.81	9.02	.042	3.35	3.23	.0359	11.7	10.1	.0498	6.55	8.63
Number of cores to stay within a variation of the mean of $\pm 10\%$	5	53	12	3	15	5	3	27	18	3	55	17
$\pm 5\%^*$	10	202	40	4	49	12	4	99	62	5	213	59

* At 95 chances that the mean will fall within this range to 5 chances that it will not.