W 1223

CONVERTING BETWEEN MEHLICH 1 AND 3 SOIL TEST VALUES FOR WEST TENNESSEE SOILS

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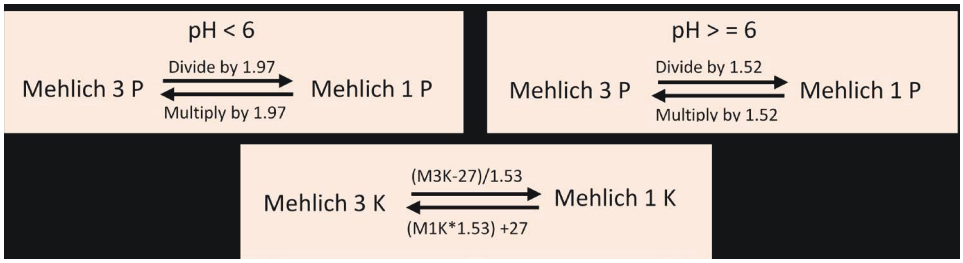

Conversion equation between (Top left) Mehlich 1 and 3 P for soil pH less than 6, (Top right) Mehlich 1 and 3 P for soil pH greater than or equal to 6, and (Bottom) Mehlich 1 and 3 K.

INTRODUCTION

Soil testing has been adopted and widely used in Tennessee since the 1940s as a tool in determining agricultural lime and fertilizer recommendations for producers. The importance of soil testing can be understood using the three Ps: *Productivity* (identify nutrient deficiency and variability within a field and then implement proper management of plant nutrition), *Profitability* (optimize crop production returns by using the correct fertilizer application rate) and *rrootection* (prevents over application which promotes environmental stewardship, protection, and quality).

A soil test analysis estimates the soil's nutrient supplying capacity for a particular crop using a particular chemical extractant. There are several chemical extractants used in the United States. Two of the most commonly used extractants in the Southeast region are Mehlich 1 and Mehlich 3. The University of Tennessee began using Mehlich 1 in the 1980s. Mehlich 3 was developed in 1984 to overcome some of the limitations of Mehlich 1 and the later developed Mehlich 2 extractant (Mehlich, 1984). However, because of the difficulties in calibrating a new extractant, some soil testing laboratories continue to use Mehlich 1.

Most of the commercial and state soil testing laboratories in and around Tennessee use and prescribe fertilizer recommendations using Mehlich 3. Most growers may receive soil test results from laboratories using Mehlich 3, but the University of Tennessee gives fertilizer recommendations based on the Mehlich 1 extractant. This makes it difficult for growers to take advantage of UT fertilizer recommendations. Currently, the Mehlich 1 and 3 conversion equations used in Tennessee were derived from the University of Kentucky, which are based on Kentucky soils. Thus, there is a need to generate conversion equations between Mehlich 1 and 3 for West Tennessee soils. This will allow producers to use the fertilizer recommendations from UT even if they send their samples to a lab using Mehlich 3.

The purpose of this fact sheet is to report on the relationship between Mehlich 1 and 3 soil tests (phosphorus) P and (potassium) K for West Tennessee soils. To evaluate the relationship between the extractants, we collected and analyzed over 600 soil samples (sampled to a depth of 6 inches) for soil pH, Mehlich 1, and Mehlich 3 extractable elements. The number of soils used for the P and K conversion equations were 625 and 608, respectively.

CONVERSION EQUATIONS

Phosphorus

Mehlich 3 P soil test values were correlated to but higher than Mehlich 1 P. For soils with pH <6, the conversion factor between Mehlich 1 and 3 was different than for soils with a pH >6. The agronomic range (< 40 pounds per acre), the R2 of the data was 0.82 and 0.90 when soil pH was < 6 and >= 6, respectively. Within the agronomic soil test level range, Mehlich 3 P extracted approximately 97% and 52% more P than Mehlich 1 P when the soil pH was < 6 and >= 6, respectively. To convert M3 P to Mehlich 1 P, for soils with < pH 6.0, divide Mehlich 3 P by 1.97 and for soils with pH >= 6.0, divide Mehlich 3 P by 1.52.

$$M1\ P = \begin{cases} \left(\frac{M3\ P}{1.97}\right), & pH < 6.0 \\ \left(\frac{M3\ P}{1.52}\right), & pH \geq 6.0 \end{cases}$$

Conversion equation between (Top) Mehlich 1 and 3 P for soil pH less than 6, (Bottom) Mehlich 1 and 3 P for soil pH greater than or equal to 6

For example: If the Mehlich 3 P soil test value is 80 pounds per acre, what is the equivalent in Mehlich 1 P in pounds per acre when the soil pH is (i) 5.7 and (ii) 6.3?

(i) since 5.7 is < 6.0, then
Mehlich 1 P = (80/1.97) = 40.6 pounds P per acre
(ii) since 6.3 is > 6.0, then
Mehlich 1 P = (80/1.52) = 52.6 pounds P per acre

Table 1. Soil Test Calibrations for Mehlich 1 Extractable Phosphorus and Potassium in Tennessee

Rating	Phosphorus, lbs/acre (All Crops)	Potassium, lbs/acre (All crops but cotton)	Potassium, lbs/acre (Cotton)
Low (L)	0-18	0-90	0-140
Medium (M)	19-30	91-160	141-280
High (H)	31-119	161-319	281-319
Very High (VH)	120 and above	320 and above	320 and above

Table 2. Soil Test Calibrations for Mehlich 3 Extractable Phosphorus (soil pH < 6) and Potassium in West Tennessee

Rating	Phosphorus, lbs/acre (All Crops)	Potassium, lbs/acre (All crops but cotton)	Potassium, lbs/acre (Cotton)
Low (L)	0-35	0-165	0-241
Medium (M)	36-59	166-272	242-455
High (H)	60-234	273-515	456-515
Very High (VH)	235 and above	516 and above	516 and above

NB. For Tables 2 and 3, the conversion equation for the agronomic ranges were used for all the rating. UT does not recommend fertilizer application for high testing soils so conversion would not be relevant at the high testing soils and beyond.

Table 3. Soil Test Calibrations for Mehlich 3 Extractable Phosphorus (soil pH>= 6) and Potassium in West Tennessee

Rating	Phosphorus, lbs/acre (All Crops)	Potassium, lbs/acre (All crops but cotton)	Potassium, lbs/acre (Cotton)
Low (L)	0-27	0-165	0-241
Medium (M)	28-46	166-272	242-455
High (H)	47-181	273-515	456-515
Very High (VH)	182 and above	516 and above	516 and above

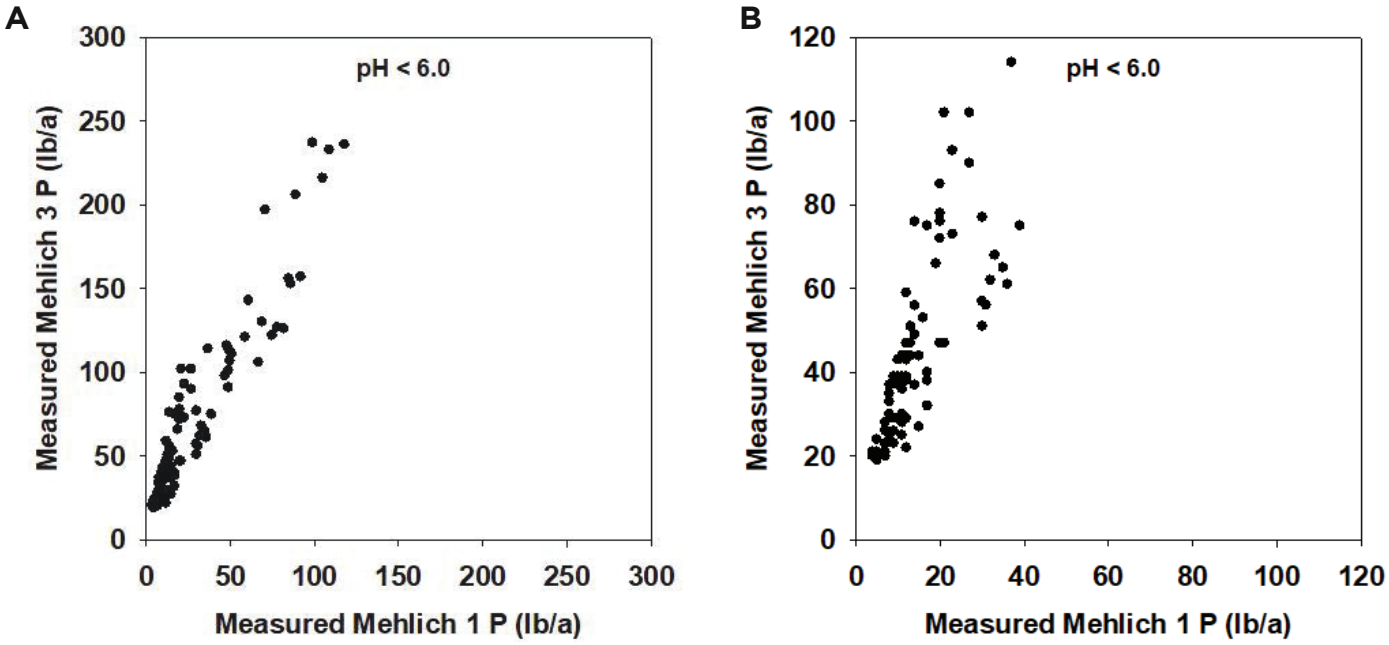

Figure 1. *Relationship between Mehlich 1 and 3 soil test phosphorus (P) when soil pH (1:1) is less than 6 for (***a***) soils with 0-120 pounds per acre and (***b***) with less than 40 pounds P per acre.*

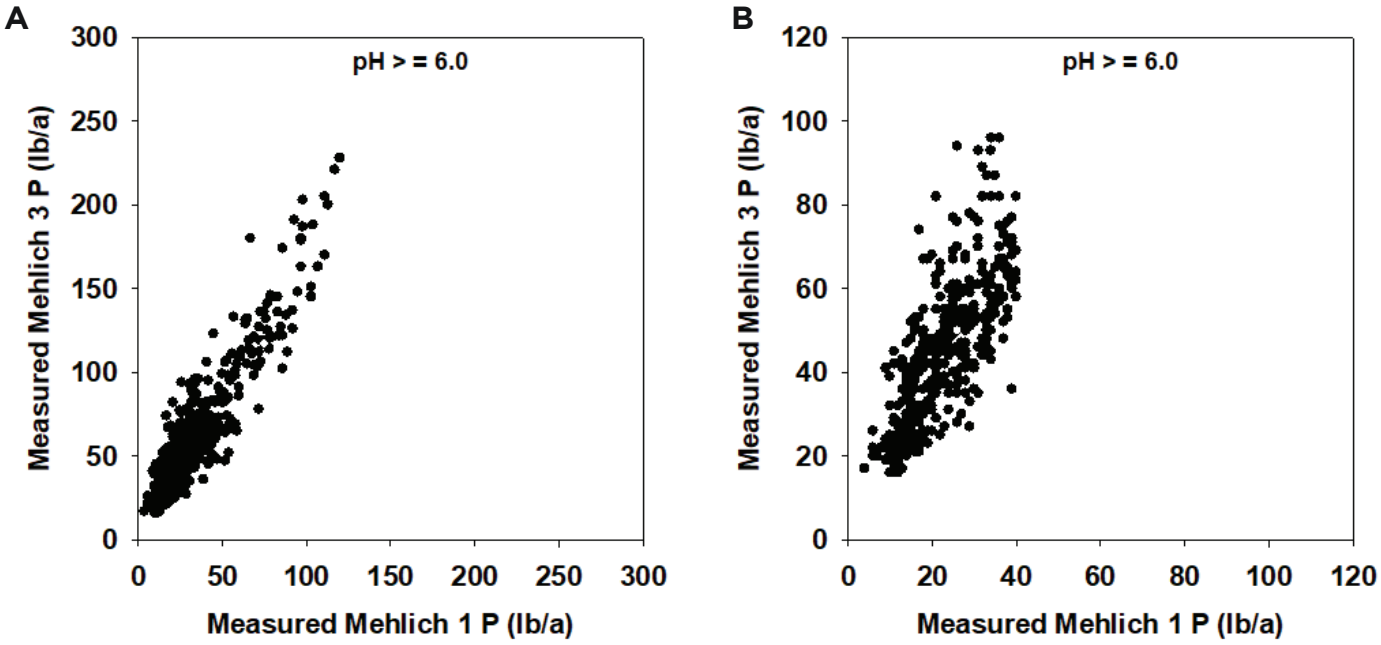

Figure 2. *Relationship between Mehlich 1 and 3 soil test phosphorus (P) when soil pH (1:1) is more than 6 for (***a***) soils with 0-120 pounds per acre and (***b***) with less than 40 pounds P per acre.*

Potassium

Mehlich 3 K soil test values were correlated to but higher than Mehlich 1 K (Figure 3). The soil test values used in this study ranged from the low to high Mehlich 1 soil test levels for K (0-320 pounds per acre). For the agronomic range, the R2 of the data was 0.91. To convert Mehlich 3 K to Mehlich 1 K, subtract 27 from Mehlich 3 K, then divide the resultant value by 1.53. The Mehlich 1 soil test ranking based on data and calibration from previously used soil extractant is shown in Table 1. The equivalent Mehlich 3 conversion for the soil test ranking is shown in Tables 2 and 3.

$$M1\ K = \left(\frac{M3\ K - 27}{1.53}\right)$$

For example: If the Mehlich 3 P soil test value is 80 pounds per acre, what is the equivalent in Mehlich 1 P in pounds per acre when the soil pH is (i) 5.7 and (ii) 6.3?

(i) since 5.7 is < 6.0, then
Mehlich 1 P = (80/1.97) = 40.6 pounds P per acre
(ii) since 6.3 is > 6.0, then
Mehlich 1 P = (80/1.52) = 52.6 pounds P per acre

Soil test K and P values for Mehlich 1 and 3 were highly correlated to each other. In order to avoid error, it is important to use soil test values within the range of data used to create the conversion equation when converting from Mehlich 3 to Mehlich 1 and vice versa.

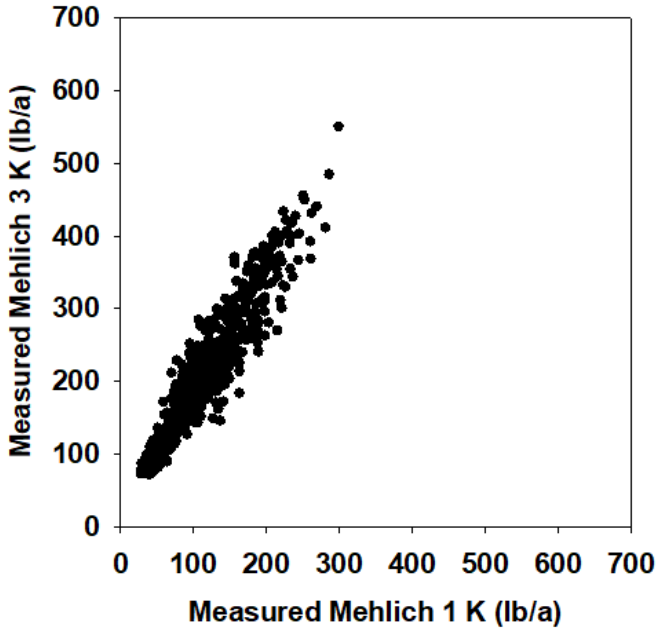

Figure 3. *Relationship between Mehlich 1 and 3 soil test potassium (K).*

FURTHER READING

Duncan, L., Joines, D. and H. Savoy. UT Fertility Recommendations for Tennessee Row Crops. SP 763.
https://extension.tennessee.edu/publications/Documents/SP763.pdf

Savoy Hubert. Interpreting Mehlich 1 and 3 Soil Test extractant results for P and K in Tennessee, Extension Publication, W229.
https://extension.tennessee.edu/publications/documents/W229.pdf

Mehlich, A. (1984) Mehlich 3 soil test extractant: A modification of Mehlich 2 extractant, Communications in Soil Science and Plant Analysis, 15:12, 1409-1416, DOI: 10.1080/00103628409367568

SERA-IEG-6. Conversion equations for soil test extractant: Mehlich 1 and Mehlich 3. Southern Regional factsheet.
https://aesl.ces.uga.edu/sera6/FACT/SERA-6-FS-5.pdf

THIS RESEARCH WAS FUNDED BY THE TENNESSEE SOYBEAN PROMOTION BOARD.

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