Prediction of total soil Pb from Mehlich3 Pb in a commercial soil testing laboratory
A lower cost alternative for soil lead screening (?)

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Promising correlations in the literature for Mehlich3, Morgan, modified Morgan and 1N HNO₃ extracts


Commercial lab (cost) limitations

- Use standard soil scoop, weighing adds time and cost
- Grinding to <0.250 mm is too costly
- Must fit into current operations
Penn State Agricultural Analytical Services Laboratory Data Set

- 1952 samples
- Mehlich3 analysis
  - 1:10 soil to extract ratio
  - use 2.12 cm³ scoop to measure soil and 25 mL M3 solution
- Total sorbed Pb
  - EPA 3050B
  - 1:50 soil to extract ratio
  - Weigh 1 g soil and 50 mL solution
Regression of total sorbed Pb on Mehlich3 Pb

\[ Pb_{Tot} = 17.4 + 2.04 \, Pb_{M3} \quad R^2 = 0.80 \quad n=1952 \]
Ratio of Mehlich3 Pb to total sorbed Pb

M3 Pb/Tot Pb frequency distribution
Regression of total sorbed Pb on Mehlich3 Pb data trimmed of extreme Pb\textsubscript{M3}/Pb\textsubscript{Tot} ratios

\[ \text{Pb}_{\text{Tot}} = 11.1 + 2.25 \text{ Pb}_{\text{M3}} \]

\[ R^2 = 0.86 \quad n = 1882 \]
Regression of total sorbed Pb $<400 \text{ mg kg}^{-1}$ on Mehlich3 Pb

All data, $n=1833$

$\text{Pb}_{\text{Tot}} = 12.9 + 1.98 \text{ Pb}_{\text{M3}}$

$R^2 = 0.88$

Trimmed data, $n=1772$

$\text{Pb}_{\text{Tot}} = 11.7 + 2.03 \text{ Pb}_{\text{M3}}$

$R^2 = 0.89$
Regression of total sorbed Pb $>400 \text{ mg kg}^{-1}$ on Mehlich3 Pb

All data, n=119
$\text{Pb}_{\text{Tot}} = 248 + 1.69 \text{ Pb}_{\text{M3}}$
$R^2 = 0.53$

Trimmed data, n=110
$\text{Pb}_{\text{Tot}} = 127 + 2.08 \text{ Pb}_{\text{M3}}$
$R^2 = 0.89$
Regression of total sorbed Pb \(300-1000 \text{ mg kg}^{-1}\) on Mehlich3 Pb

All data, \(n=129\)
\[
Pb_{\text{Tot}} = 326 + 0.86 \, Pb_{\text{M3}}
\]
\(R^2 = 0.45\)

Trimmed data, \(n=120\)
\[
Pb_{\text{Tot}} = 273 + 1.12 \, Pb_{\text{M3}}
\]
\(R^2 = 0.53\)
Correlations of other measured parameters with $\text{Pb}_{M3}/\text{Pb}_{Tot}$ ratio

**Soil pH**
$R^2=0.01$

**Soil CEC**
$R^2=0.004$
## Summary

<table>
<thead>
<tr>
<th>Total soil Pb range</th>
<th>All data</th>
<th>Trimmed data</th>
</tr>
</thead>
<tbody>
<tr>
<td>All samples (0 – 4,000 mg/kg)</td>
<td>( Pb_{\text{Tot}} = 17.4 + 2.04 \ Pb_{\text{M3}} ) [ R^2 = 0.80 \quad n=1952 ]</td>
<td>( Pb_{\text{Tot}} = 11.1 + 2.25 \ Pb_{\text{M3}} ) [ R^2 = 0.86 \quad n=1882 ]</td>
</tr>
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Results are promising, but...

- Correlation is good for
  - Full Pb range (up to 4,000 mg/kg)
  - Very strong for samples up to 400 mg/kg
- Correlation is weak in critical mid-range 300 – 1,000 mg/kg
- No evidence that soil pH or CEC correlate with Pb extraction
- Need to examine if multiple regression with other soil parameters measured in routine analysis can improve prediction, particularly in mid-range.
- We have an expanded data set now of over 5,000 samples
  - will provide more samples in mid- to high range Pb
  - Will provide for stronger assessment of correlation of Pb with other soil parameters