Occurrence of Arsenic and Phosphorus in Ditch Flow from Poultry Litter-Ammended Soils and Barn Areas

USDA-ARS
Pasture Systems and Watershed Management Research Unit
State College, PA

MLRA’s in Susquehanna River Watershed

Allegheny Plateau
Ridge and Valley
Piedmont
Coastal Plain

≈ 620,000,000
Broiler Chickens
Why Arsenic ???

✓ As is fed to chickens in the form of Roxarsone

✓ 20-50 metric tons of arsenic per year is spread on the DelMarVa Peninsula
Chemistry of Arsenic

P and As Occurrence at UMES

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>Fields</td>
<td>2.74</td>
<td>421</td>
<td>0.29</td>
<td>6164</td>
<td>7680</td>
<td>0.004</td>
<td>0.19</td>
<td>0.005</td>
<td>0.363</td>
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<td>2</td>
<td>Fields</td>
<td>1.77</td>
<td>447</td>
<td>0.37</td>
<td>11556</td>
<td>15581</td>
<td>0.002</td>
<td>0.31</td>
<td>0.005</td>
<td>0.488</td>
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<tr>
<td>3</td>
<td>Fields</td>
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<td>449</td>
<td>0.31</td>
<td>12827</td>
<td>14138</td>
<td>0.002</td>
<td>0.36</td>
<td>0.004</td>
<td>0.209</td>
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<tr>
<td>5</td>
<td>Fields</td>
<td>1.10</td>
<td>467</td>
<td>0.26</td>
<td>3174</td>
<td>6857</td>
<td>0.002</td>
<td>0.71</td>
<td>0.003</td>
<td>1.005</td>
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<tr>
<td>6</td>
<td>Fields and 1 barn</td>
<td>1.04</td>
<td>497; 661</td>
<td>0.34; 0.65</td>
<td>1414</td>
<td>2149</td>
<td>0.002</td>
<td>2.02</td>
<td>0.009</td>
<td>1.880</td>
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<tr>
<td>7</td>
<td>barns</td>
<td>1.20</td>
<td>382</td>
<td>0.27</td>
<td>3450</td>
<td>6215</td>
<td>0.008</td>
<td>1.95</td>
<td>0.008</td>
<td>1.914</td>
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<tr>
<td>8</td>
<td>Fields, 2 barns, litter storage shed, poultry litter</td>
<td>0.82</td>
<td>466; 3113</td>
<td>0.44; 0.91</td>
<td>3345</td>
<td>4425</td>
<td>0.012</td>
<td>3.37</td>
<td>0.026</td>
<td>3.067</td>
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<tr>
<td></td>
<td>Poultry Litter</td>
<td>0.11</td>
<td>19765</td>
<td>2.208</td>
<td>922</td>
<td>1196</td>
<td>922</td>
<td>1196</td>
<td>922</td>
<td>1196</td>
</tr>
</tbody>
</table>

Second value applies to soil in immediate vicinity of poultry barn.
Second value applies to soil in immediate vicinity of litter storage shed.
Ditch Concentrations and Losses of Phosphorus and Arsenic 2006 and 2007 Water Years

As and P Concentrations
As and P Losses

Concentrations and Losses of Phosphorus and Arsenic During Storm Events
Correlations Between Phosphorus and Arsenic

Concentrations in Soils and Litter

\[ [\text{As}] = 0.001718 \times [\text{P}] - 0.048591 \]
\[ r = 0.90 \]

- NonPoint_D1-5
- MS
- Litter
- D8
- Forest_As

![Graph showing correlation between Phosphorus (mg/Kg) and Arsenic (mg/Kg) concentrations in soils and litter.](image)
Concentrations in UMES Ditches

![Graph showing arsenic vs DRP concentrations for different ditches.](image)

P and As Loads in Ditches

A. As vs P Loads
   Ditch 2
   (Non-Point Source)
   \( r = -0.007 \)

B. As vs P Loads
   Ditch 6
   (Mixed Source)
   \( r = 0.25 \)

C. As vs P Loads
   Ditch 8
   (Point Source)
   \( \text{As Load} = 0.0039(\text{P Load}) - 0.00017 \)
   \( r = 0.99 \)
Removal of Arsenic and Phosphorus Using Industrial Materials

Industrial by-products

- Acid mine drainage treatment residuals
- Bauxite mining and production waste (red mud)
- Steel slag waste
- Drinking water treatment residuals
- Fly ash
- Waste recycled gypsum
- Paper mill waste
Removal of P and As by AMD Filter

Removal of P and As(??) by Gypsum Filter

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