Do forests in Central PA have more available nitrogen on shale than on sandstone?
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Introduction

As a major component of chlorophyll and amino acids, nitrogen (N) is a vital plant nutrient that is commonly limiting in temperate forests. In soil solution, mineral N nitrogen is found as NH₄ and NO₃, with nitrate being the form readily available to plants. We examined the effect of lithology on N status of forests and forest soils in the Ridge and Valley Province of Central Pennsylvania. We hypothesize that trees growing on sandstone-based soils will have less available N than those growing on shale-based soils.

Study Sites

Figure 1. Map of ten sites chosen for study. The Ridge and Valley Province of PA is shown.

Methods

- Soil NO₃ and NH₄
  Sample collection with soil cores to depth of 40 cm
  KCl extraction
  Microplate reading
- Canopy leaf %N
  One red maple (Acer rubrum) and one red oak (Quercus rubra) chosen from each site
  Collection of canopy leaves by shooting
  Preparation by drying and grinding
  CHNS Analyzer for total N
- Analysis - T-test

Results

Nitrate in Soil

![Nitrate in Soil Graph](image)

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale</td>
<td>1.0</td>
</tr>
<tr>
<td>Sandstone</td>
<td>0.5</td>
</tr>
</tbody>
</table>

$p < .001$
$df = 49$
$t\text{-val} = 5.710$

Ammonium in Soil

![Ammonium in Soil Graph](image)

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale</td>
<td>0.2</td>
</tr>
<tr>
<td>Sandstone</td>
<td>0.6</td>
</tr>
</tbody>
</table>

$p < .01$
$df = 54$
$t\text{-val} = 2.958$

Nitrogen in Canopy Leaves

![Nitrogen in Canopy Leaves Graph](image)

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale Maple</td>
<td>1.5</td>
</tr>
<tr>
<td>Sandstone Maple</td>
<td>1.0</td>
</tr>
<tr>
<td>Shale Oak</td>
<td>2.0</td>
</tr>
<tr>
<td>Sandstone Oak</td>
<td>2.5</td>
</tr>
</tbody>
</table>

$p = 0.867$
$df = 18$
$t\text{-val} = 0.170$

Conclusions

- There is a significant difference in NO₃ between shale and sandstone soils, with more nitrate found in shale.
- There is a significant difference in NH₄ between shale and sandstone soils, with more ammonium found in sandstone.
- There is no significant difference in %N in leaves between trees growing on shale or sandstone soils.
- There is more available nitrogen in shale-derived soils than in sandstone-derived soils.
- Shale and sandstone-based soils seem to have similar impacts on tree nitrogen uptake.

Acknowledgements

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