

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

Jennifer Christhlf, Warren Reed, Lillian Hill, David Eissenstat

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 NH_4 and NO_3 , 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

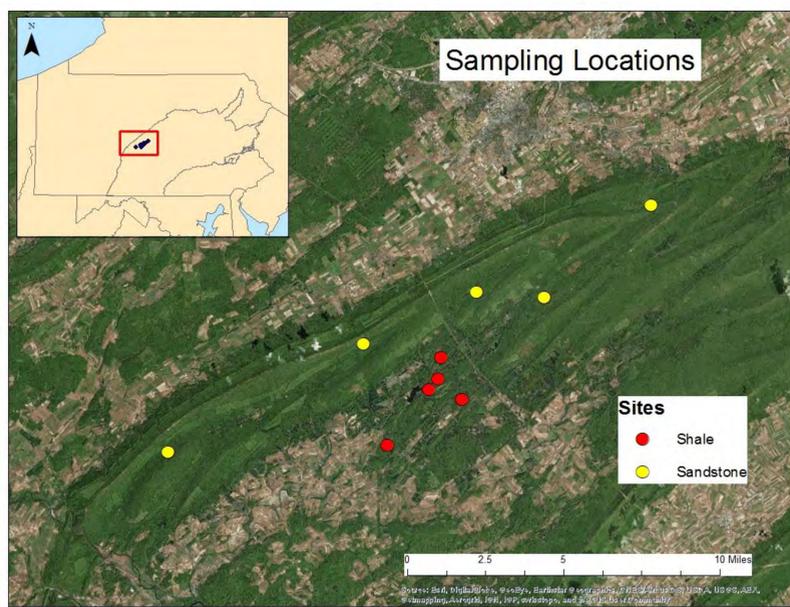


Figure 1. Map of ten sites chosen for study. The Ridge and Valley Province of PA is shown.

Methods

- Soil NO_3 and NH_4
 - Sample collection with soil cores to depth of 40cm
 - 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

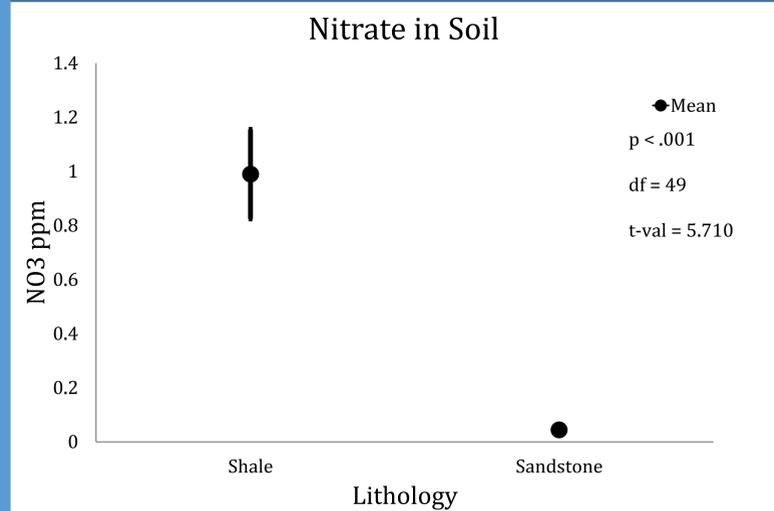


Figure 2. Nitrate concentration in shale-based and sandstone-based soils. The mean of the measurements at all sites with standard error bars was used.

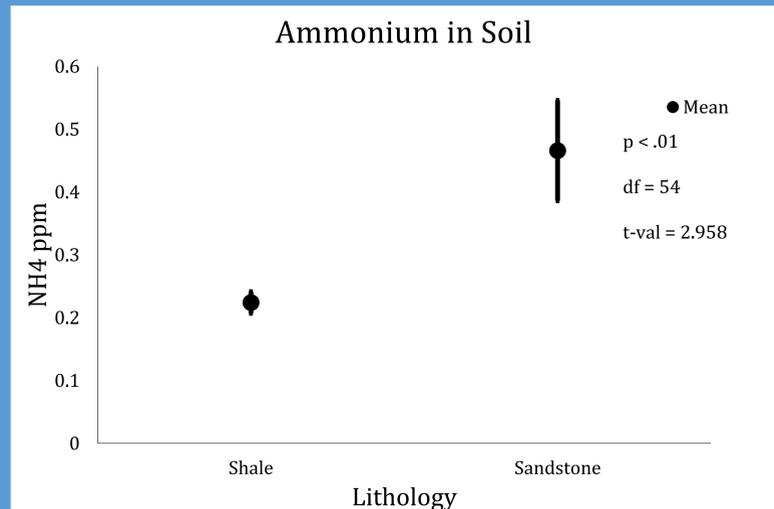


Figure 3. Ammonium concentration in shale-based and sandstone-based soils. The mean of the measurements at all sites with standard error bars was used.

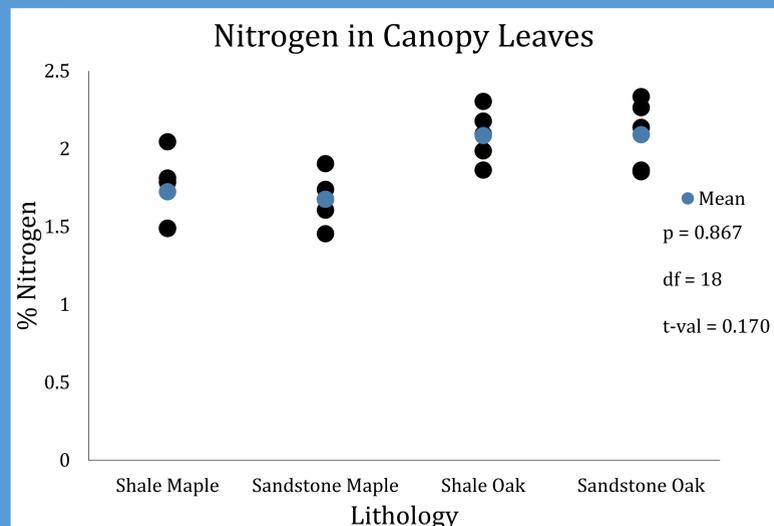


Figure 4. Percent of nitrogen in canopy trees growing in shale-based and sandstone-based soils. The species used are red maple (*Acer rubrum*) and red oak (*Quercus rubra*).

Conclusions

- There is a significant difference in NO_3 between shale and sandstone soils, with more nitrate found in shale.
- There is a significant difference in NH_4 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.



Upper Left: Shale Site
Lower Left Sandstone Site
Right: Canopy Leaf Collection

Acknowledgements

Special thanks to J. Kaye Lab, the Shale Hills Critical Zone Observatory, and Penn State University's Department of Ecosystem Science and Management for their support.