Variation of root distribution in relation to depth and lithology

Maggie Ruppel (REU)\(^1\), Siobhan Donnelly (RET)\(^2\), Tom Adams\(^3\), Dave Eissenstat\(^3\)

Wittenberg University\(^1\), CLC Charter School\(^2\), Penn State University\(^3\)
Research Focus

- Tuscarora Forest
  - Similar lithology to Shale Hills and Garner Run

- 12 pits total
  - 4 Clinton Group: Rose Hill Shale
  - 4 Tuscarora: Sandstone
  - 4 Juniata: Shale and Siltstone
Location
Soil Pit Locations
<table>
<thead>
<tr>
<th>Questions</th>
<th>Hypotheses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• How will depth affect root density?</td>
<td>• Shale pits will have a higher density of roots in the upper depth increments as compared to sandstone</td>
</tr>
<tr>
<td>• How will lithology affect root density and distribution?</td>
<td>• Sandstone pits will have a higher density of roots in the lower depth increments as compared to shale</td>
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<tr>
<td>• What factors drive root density and distribution in these lithologies?</td>
<td></td>
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</tbody>
</table>
Methods: TDR Sensors

- Time Domain Reflectometers
- Built 150 sensors
  - 3 transects x 4 sensors each in every pit
  - 20, 40, 60, 100 cm increments
- Future Soil Moisture Data
Methods: TDR Sensors

- 20 cm
- 40 cm
- 60 cm
- 100 cm
Methods: Root Sampling

- Collected 25 roots per pit
  - 5 transects x 5 samples each
  - 10, 20, 40, 60, 100 cm increments
  - Stored in cooler for preservation

- Tree DNA identification

- Mycorrhizal fungi DNA identification
Methods: Root Density via Photos

- 30cm x 30cm frame
- Record details
- 5 transects, 0-100 cm
- Macro setting for top 10cm
**Methods: Root Density via Photos**

<table>
<thead>
<tr>
<th>Counting Roots</th>
<th>Calculating Root Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Overlay grid lines</td>
<td>• Root intersections/area</td>
</tr>
<tr>
<td>• Subsample 2 grid sections per depth increment</td>
<td>• Average 2 subsamples per depth increment</td>
</tr>
<tr>
<td>• Count root intersections</td>
<td></td>
</tr>
<tr>
<td>▫ Imaginary plane intersecting roots</td>
<td></td>
</tr>
<tr>
<td>▫ Microsoft Paint to mark roots on photos</td>
<td></td>
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</tbody>
</table>
Methods: Root Density via Photos
Tuscarora Sandstone Pits

Depth Increment (cm)

0-10
11-20
21-40
41-60
61-80
81-100

Root Intersections cm²

0 1 2 3 4 5

BD
SPT
SD
BT

Tuscarora
Depth P<0.0001
Lithology(Juniata) P<0.0001
Depth*Lithology(50cm) P=0.0159

- Clinton Group Shale
- Tuscarora Sandstone
- Juniata Shale/Siltstone
Conclusions

- Difference in root density based on depth ($p<0.0001$)
- Significant difference in root density based on depth and lithology between Clinton and Tuscarora ($p=0.039$)
  - Interaction driven by top 10cm
- Juniata showed difference in root density based on lithology ($p<0.0001$)
- Difference in root density based on depth and lithology of Juniata ($p=0.0159$)
  - Driven by mid depth (50.54cm)
Discussion

- Sandstone has a greater porosity than shale
  - Sandstone does not retain water or nutrients as well as shale
  - Sandstone should
- Spike at 40cm in Tuscarora
  - possibly an alluvial fan
- What makes Juniata so different
For the future...

- Compare root distribution at Shale Hills and Garner Run
  - Similar lithologies
- Collect TDR data at Tuscarora
  - Relation between soil moisture to root distribution
- Root DNA samples
  - Test for species preference
Thanks!

- Dave Eissenstat
- Tom Adams
- Jessie Ward
- Liza Brazil
- Tim White
- Sarah Sharkey
- And Everyone Else