Introduction

- Developing a water budget for a watershed at the Texas A&M Soltis Research Center, near San Isidro de Penas Blancas, Costa Rica, will facilitate understanding of the area’s hydrologic cycle.
- Soil water storage represents a significant component of a water budget.
- The volume of water held in soil at 10 kilopascals (kPa) and between 10 and 1500 kPa provides an estimate of soil water storage and plant available water, respectively.

Objectives

- Quantify soil water storage and plant available water at three representative sites.
- Determine the variability of soil water storage and plant available water between each site and horizon.

Research Site

- Three sites were selected to represent different slope classes and vertical distance from watershed stream.

<table>
<thead>
<tr>
<th>Site</th>
<th>Slope</th>
<th>Position</th>
<th>Depth to saprolite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25°</td>
<td>Low (dug pit)</td>
<td>65 cm</td>
</tr>
<tr>
<td>2</td>
<td>45°</td>
<td>Middle (trail cut)</td>
<td>116 cm</td>
</tr>
<tr>
<td>3</td>
<td>32°</td>
<td>High (trail cut)</td>
<td>59 cm</td>
</tr>
</tbody>
</table>

Measurements

1. Gravimetric water measurements (kg kg⁻²) were converted to volumetric units (g cm⁻³) using bulk density measurements from each soil horizon and site.
2. Soil water storage (in mm) is estimated as volumetric water content at 10 kPa (θ₁₀kPa) multiplied soil depth (z) in mm.
3. Soil plant available water (in mm) is estimated as (θ₁₀kPa - θ₁₅₀₀kPa) * z.

Results

Soil Water Content vs. Tension at three sites

- Horizon A
  - Site One: 0.64 cm³ cm⁻³
  - Site Two: 0.62 cm³ cm⁻³
  - Site Three: 0.61 cm³ cm⁻³
- Horizon Bw
  - Site One: 0.62 cm³ cm⁻³
  - Site Two: 0.61 cm³ cm⁻³
  - Site Three: 0.63 cm³ cm⁻³
- Horizon BC (site one) or B/Cr
  - Site One: 0.66 cm³ cm⁻³
  - Site Two: 0.61 cm³ cm⁻³
  - Site Three: 0.62 cm³ cm⁻³

Soil Properties

- Site 1: A, 0-10 cm, 0.623 cm³ cm⁻³, 0.64 cm³ cm⁻³, 0.61 cm³ cm⁻³
- Site 2: B, 10-20 cm, 0.542 cm³ cm⁻³, 0.562 cm³ cm⁻³, 0.56 cm³ cm⁻³
- Site 3: C, 20-30 cm, 0.509 cm³ cm⁻³, 0.529 cm³ cm⁻³, 0.52 cm³ cm⁻³

Water Holding Properties

- Site 1: 116 cm, 563 mm H₂O, 365 mm H₂O
- Site 2: 590 mm H₂O, 294 mm H₂O, 250 mm H₂O
- Site 3: 650 mm H₂O, 336 mm H₂O, 263 mm H₂O

Summary

- Differences in soil between sites:
  - Site one soil has lower bulk density and higher porosity
  - Site one soil holds less water at field capacity (10 kPa)
  - Preliminary particle size analysis indicates that site one is higher in clay-sized particles
  - The Andic soils at the Soltis Center have lower bulk density than tropical Oxic soils.

Conclusions

- Delineations in slope and distance from the stream did not significantly control differences in soil properties, though soil on the shallowest slope had higher porosity.
- The water holding capacity of soils at the Soltis Center is determined by the properties of amorphous clays in Andic soils.
- More research in the tropics is needed to distinguish the water holding properties of Andic soils from those of Oxic soils.

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- NSF-funded Texas A&M University REU in Costa Rica
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Water Retention Properties of Soil in a Tropical Pre-Montane Transitional Forest

Jordan Nichole Burns⁸, Rachel Passig Oien⁹, Jason Ackerson¹⁰

⁸Department of Geosciences, University of Arkansas, Fayetteville, AR
⁹Department of Geology, Gustavus Adolphus College, St. Peter, MN
¹⁰Department of Soil & Crop Sciences, Texas A&M University, College Station, TX