Evaluating physiological and growth responses of *Arundinaria* spp. to inundation

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Overview

• Background
• Goals and Objectives
• Flooding Study
  – Materials & Methods
  – Results
  – Conclusions
• Significance of Research
Why Restoration?

- Canebrakes sparse due to:
  - Land clearing
  - Overgrazing
  - Absence of wildfires
  - Urban encroachment

- Extent of canebrake habitat has declined by 98% (Noss et al. 1995)

- Found in many different habitats
Benefits

• Ecological
  – Riparian buffer
  – Water quality
  – Wildlife habitat

• Cultural

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Ideal Restoration Site Factors

- **Disturbance Regime**
  - Moderate (field edges, overstory removal)
    (Platt & Brantley, 1997)

- **Existing Vegetation**
  - Interaction with other plant species

- **Hydrology**
Hydrology

• Described as flood tolerant
  – ONLY 1 study looked at effects of soil moisture (Cirtain et al. 2004)
    • Found rivercane seedlings were tolerant to simulated flooding events

• Lack of research:
  – Regarding tolerance of rivercane to extended flooding
  – Effects of flooding on vegetative propagules, which are currently being explored for restoration activities
Observations

- Field studies (December 2008) have indicated *Arundinaria* spp. are highly susceptible to inundation immediately after planting.
Objectives

- Assess the responses of *A. gigantea* and *A. tecta* to different periods of inundation.

- Determine the duration of flooding that can be best tolerated by the two most common species.

- This information will help land managers choose potential restoration sites based on hydrologic conditions and increase the chances of cane survival at restoration sites.
Study Site

R. R. Foil Plant Science Research Center
Greenhouse, Mississippi State University

Arundinaria gigantea ramets being grown in the greenhouse
Experimental Design

• Completely randomized
• Four flooding treatments
  – 0, 2, 4, 6 weeks
• Two *Arundinaria* species
  – *A. gigantea* (Oktibbeha County, MS)
  – *A. tecta* (Kemper County, MS)
• Approximately eight replicates of each species in each flooding duration
Rivercane (*Arundinaria gigantea*)

- Leaf length = 11 cm (± 2)
- Leaf width = 1 cm (± 0.2)
- Aerenchyma absent
- Internode groove
- Leaf blade underside hairiness

Switch cane (*Arundinaria tecta*)

Leaf length = 20 cm (± 3)
Leaf width = 1.7 cm (± 0.3)

Aerenchyma present
(spongy tissue)

Branching

Hypotheses

• *A. tecta* will grow better than *A. gigantea* under longer periods of inundation.

• *A. tecta* will have higher mean photosynthetic rates (Pn) and stomatal conductance (Gs) than *A. gigantea* under longer periods of inundation.
Methods

- **Pot in Pot (Root Ball Submersion)**
  - Ramets from both species were transplanted into plastic pots (25 cm x 25 cm)
  - Pots with ramet were placed into larger plastic pots (30 cm x 30 cm)
Methods

• Inundation
  — Simulated with heavy-duty plastic sheeting placed between the inner and outer pots
  — Inner pot was filled with water
  — Water levels were maintained manually during flooding durations
  — Non-flooded plants similarly received water, but at 3-day intervals
Measurements

- Initial measurements before planting
- Additional bi-weekly measurements (Physiological)
  - Mean net photosynthesis rates (Pn)
  - Stomatal conductance (Gs)
- Additional weekly measurements (Growth)
  - Plant Size Index (cm$^3$)
  - Culm Height (cm)
  - Culm Diameter (cm)
  - Number of Culms
Statistical Methods

• SPSS 16.0 (Chicago, IL)
  – Repeated Measures (Physiological data)
    • 3 INITIAL pre-flood measurements
    • 5 measurements PRIOR to end of flooding
    • 5 measurements AFTER end of flooding

  – Univariate ANOVA (Growth data)
    • Measurements corresponding to time periods above
Physiological Results
INITIAL Measurements

NO significant differences ($p < 0.05$)
**PRIOR to End of Flooding**

- **Pn between species**
  - *A. tecta* is less variable and has a higher Pn in the last week of flooding.

- **Pn between treatments**
  - 0 week > 6 Week
AFTER End of Flooding

Pn between species

A. tecta > A. gigantea
AFTER End of Flooding

Gs between species

*A. tecta* > *A. gigantea*
Physical Measurements
AFTER End of Flooding

A. tecta > A. gigantea
AFTER End of Flooding

![Bar chart showing plant size index (cm³) over weeks of flooding. Week 0 has the highest value, followed by weeks 2 and 4, with week 6 also having a notable value.}
Results

• Once flooded, ramets in the 6 week flood treatment had significantly lower Pn rates than those ramets not flooded
  – Flooding length AFFECTS photosynthesis

• *Arundinaria tecta* had a higher Pn than *A. gigantea* during the last week of flood and was less variable
Results

- Once flooding stopped, *A. tecta* had significantly higher Pn and Gs rates than *A. gigantea*

- *Arundinaria tecta* had significantly more culms than *A. gigantea*
Conclusion

- *Arundinaria tecta* appeared to be MORE flood tolerant than *A. gigantea*, in agreement with habitats in which *A. tecta* is known to occur, and with morphological features of *A. tecta*.
Continuing Research Goals

1. Possible repeated flooding study with longer lengths of inundation
2. Generate protocol for successful establishment of rivercane stands
3. Provide land managers the resources and information necessary to choose potential restoration sites
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Questions?
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<thead>
<tr>
<th>Character</th>
<th><em>A. gigantea</em></th>
<th><em>A. tecta</em></th>
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</thead>
<tbody>
<tr>
<td>Sulcus</td>
<td>Usually present</td>
<td>Usually absent</td>
</tr>
<tr>
<td>Culm Leaf Duration</td>
<td>Deciduous</td>
<td>Persistant</td>
</tr>
<tr>
<td>Top Knot # of Leaves</td>
<td>6- 8</td>
<td>9-12</td>
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<tr>
<td>Top Knot Blade Length</td>
<td>16-24 cm</td>
<td>20-30 cm</td>
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<td>Primary Branch Length</td>
<td>15-25 cm</td>
<td>Usually &gt;50 cm</td>
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<tr>
<td>Lacunae</td>
<td>Usually absent</td>
<td>Usually present</td>
</tr>
</tbody>
</table>

Modified from Triplett et al. (2006), A new species of Arundinaria from the S. Appalachians