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

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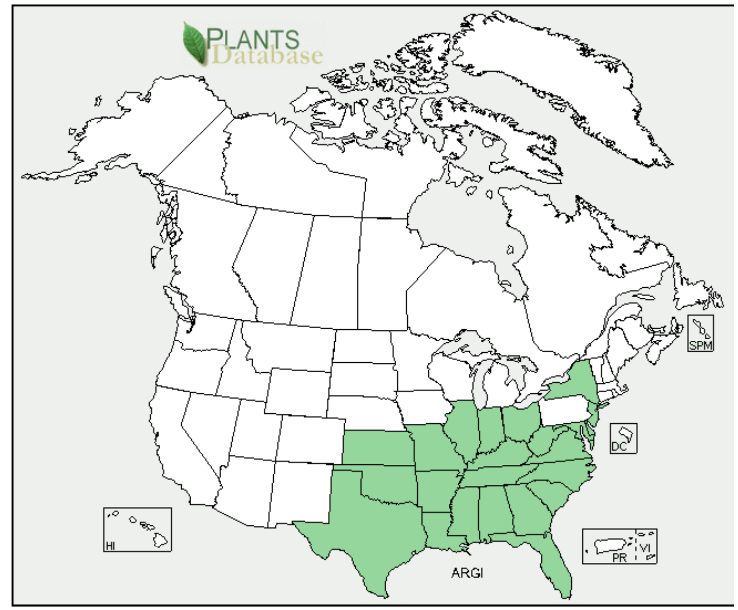
Overview

- 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



USDA-NRCS

- 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

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

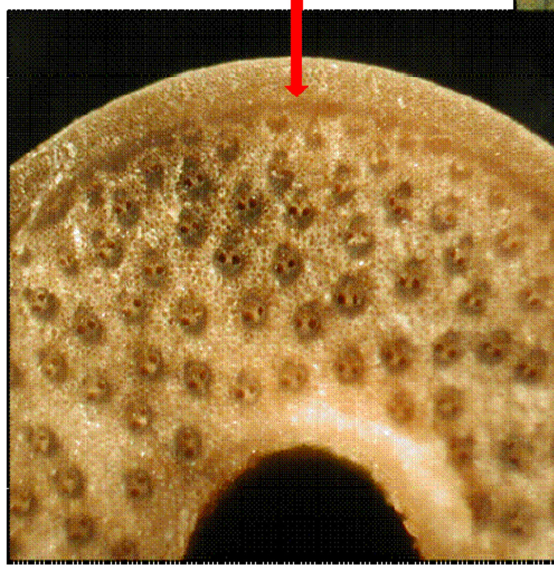
Experimental Design

- 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*)

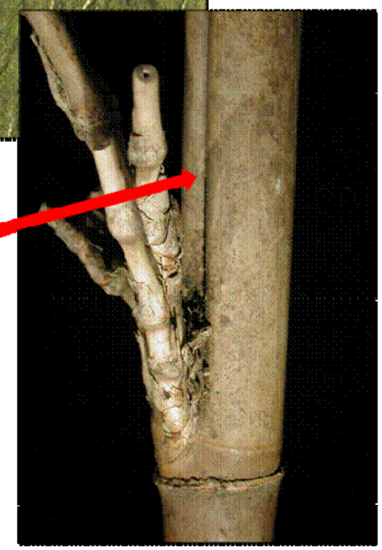
Leaf length= 11 cm (± 2)
Leaf width = 1 cm (± 0.2)

Aerenchyma absent



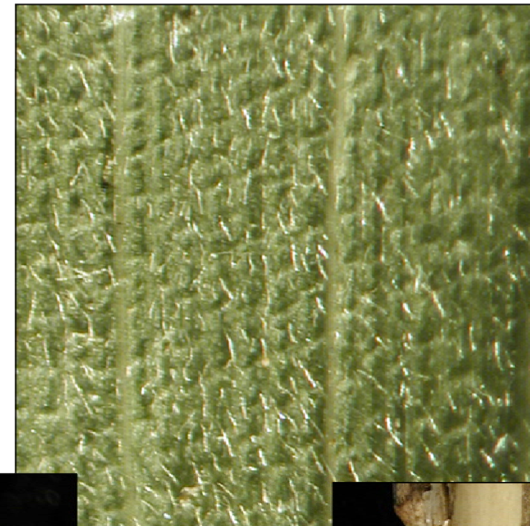
Leaf blade underside hairiness

Internode groove



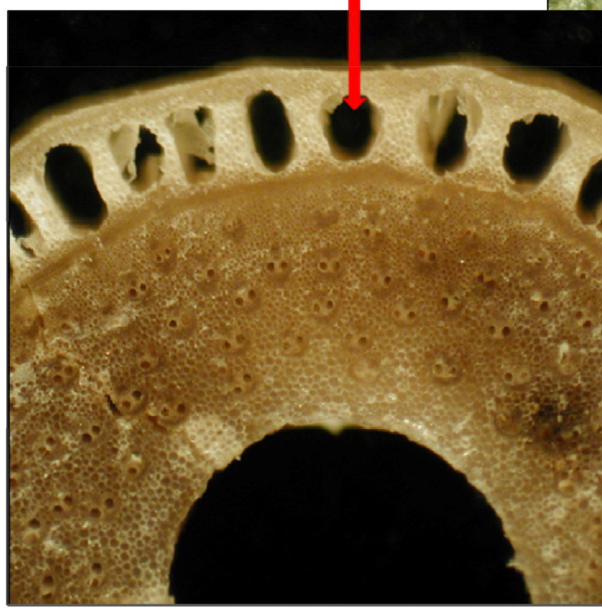
Pictures and information from **J. K. Triplett,** Phylogeny and Taxonomy of the Genus *Arundinaria* (Poaceae: Bambusoideae), Association of Southeastern Biologist Annual Meeting, March 2008.

Switch cane (*Arundinaria tecta*)



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

Aerenchyma present
(spongy tissue)



Branching

Pictures and information from **J. K. Triplett,** Phylogeny and Taxonomy of the Genus *Arundinaria* (Poaceae: Bambusoideae), Association of Southeastern Biologist Annual Meeting, March 2008.

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

Outcome of Pot in Pot Method with Inundation

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

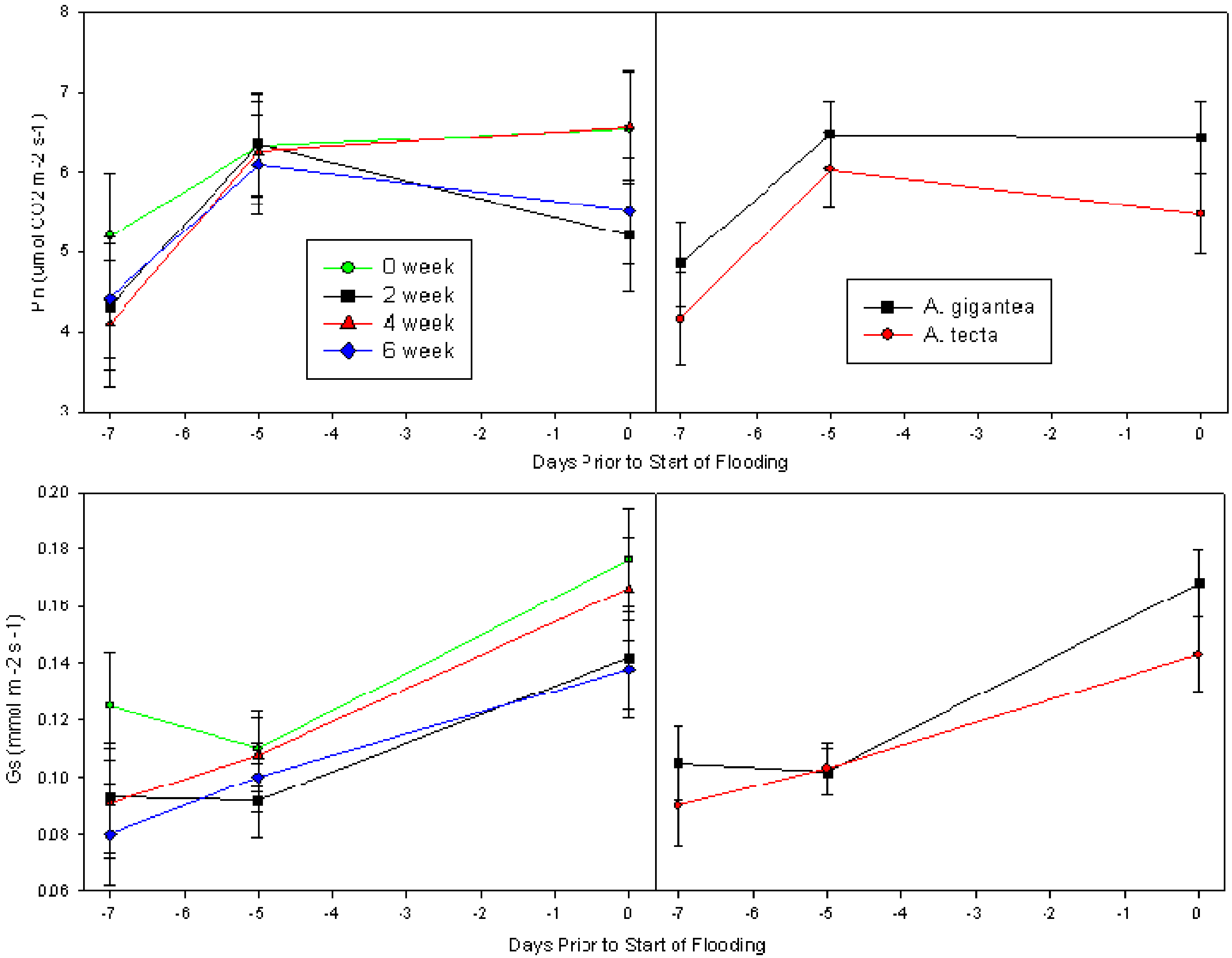

Pre-flood ramets
Photosynthesis Chamber
Li-Cor 6400 Portable Photosynthesis System

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

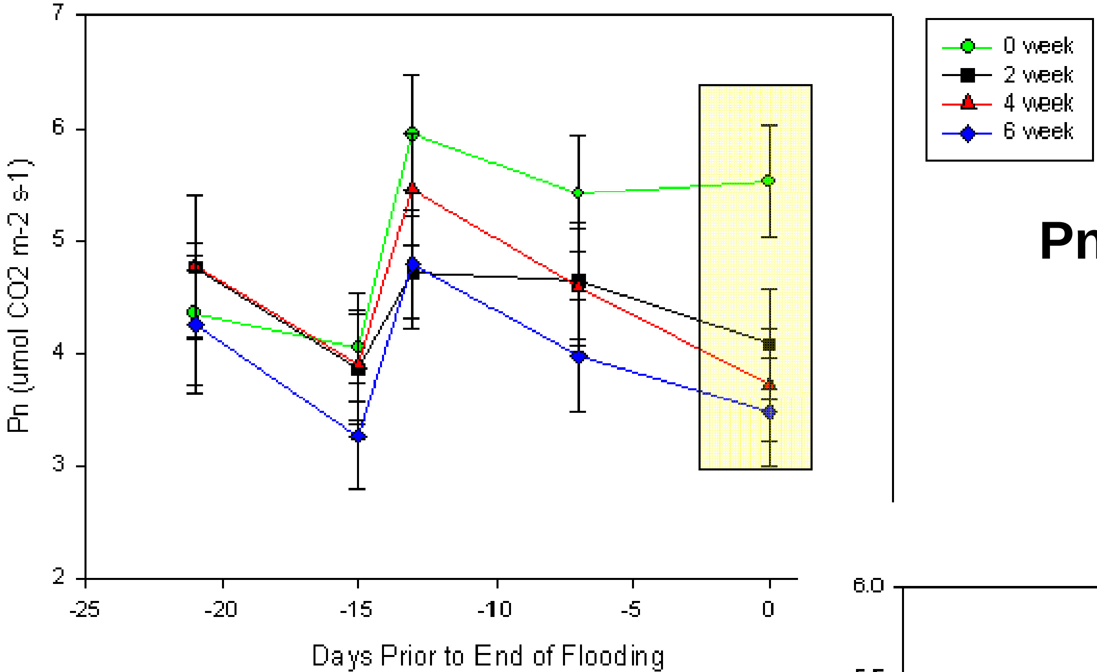
Physiological Results

INITIAL Measurements



NO significant differences ($p < 0.05$)

PRIOR to End of Flooding

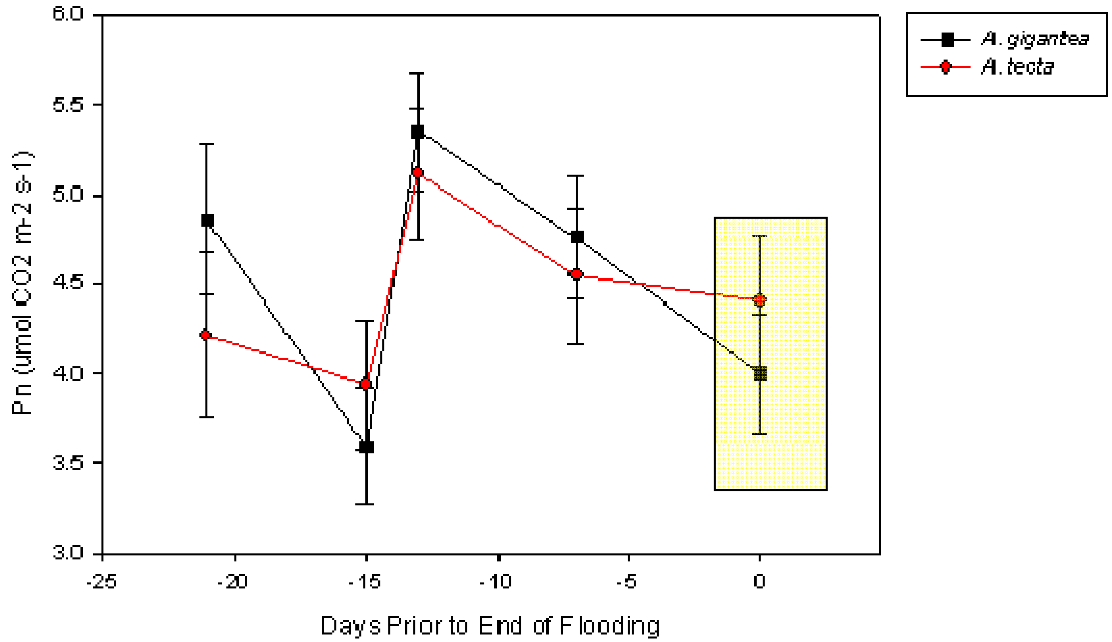


Pn between species

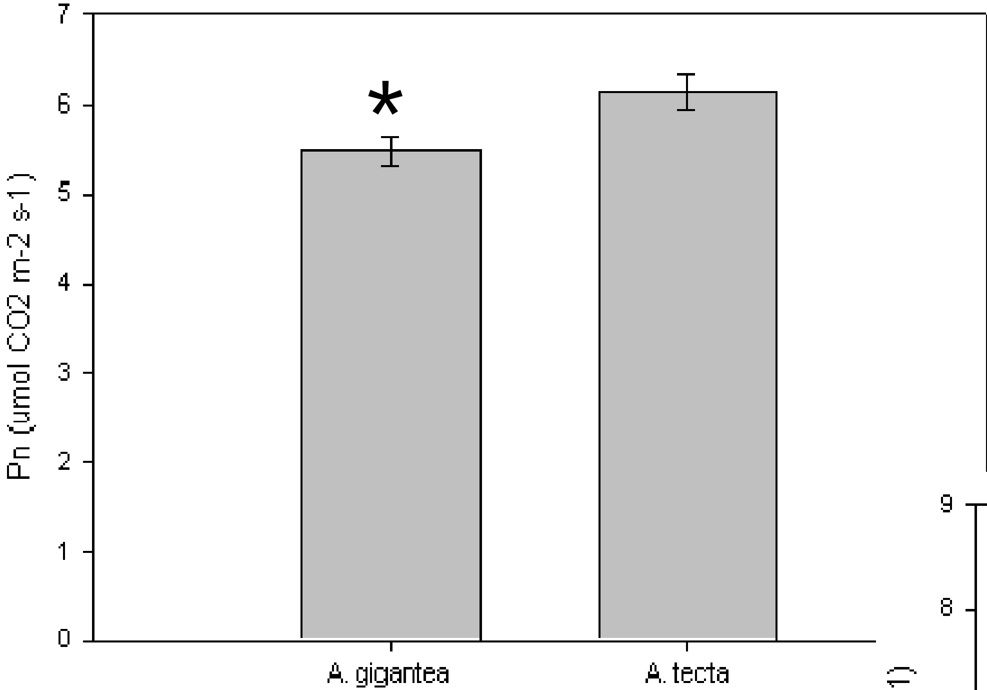
A. tecta is less variable and has a higher Pn in the last week of flooding

Pn between treatments

0 week > 6 Week

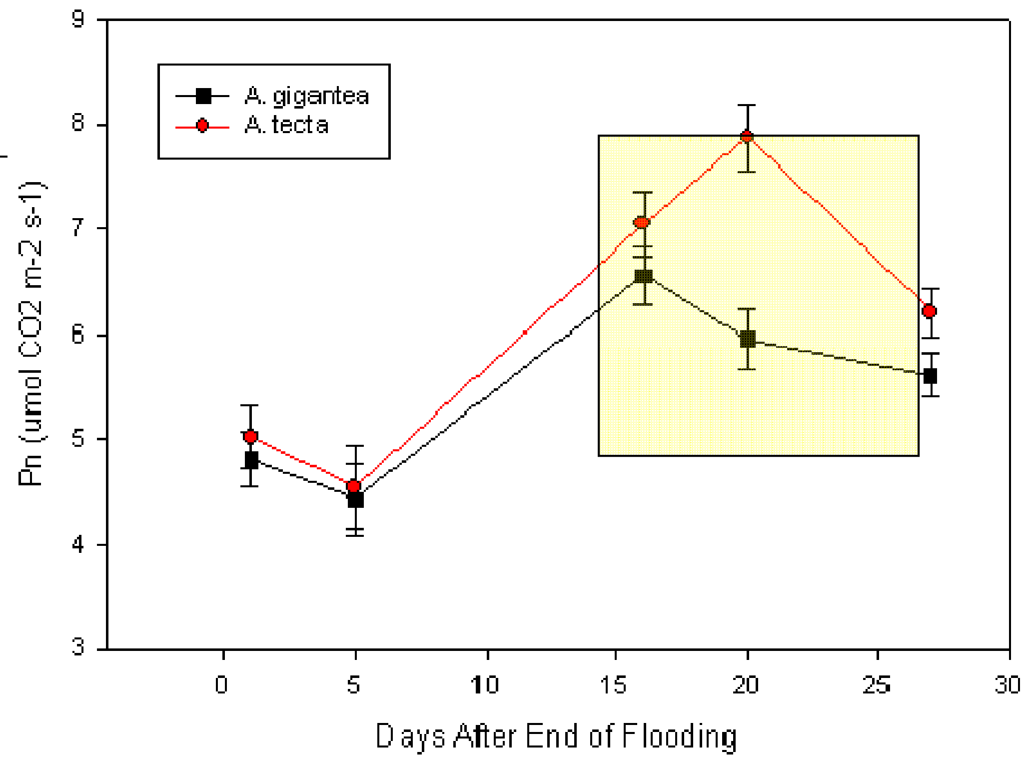


AFTER End of Flooding

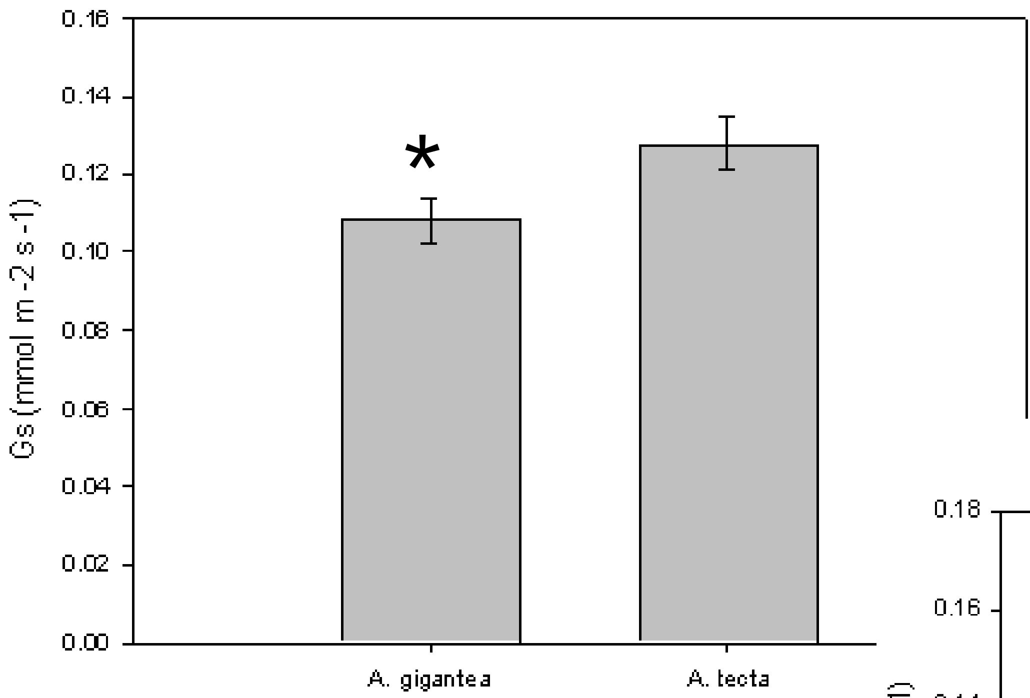


Pn between species

A. tecta > A. gigantea

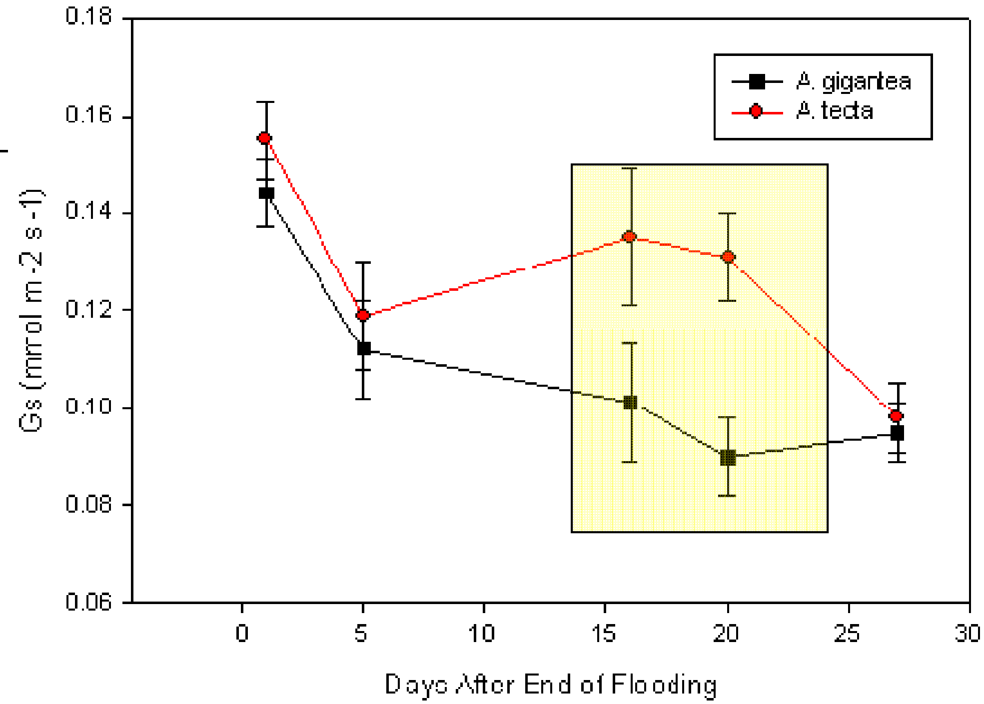


AFTER End of Flooding

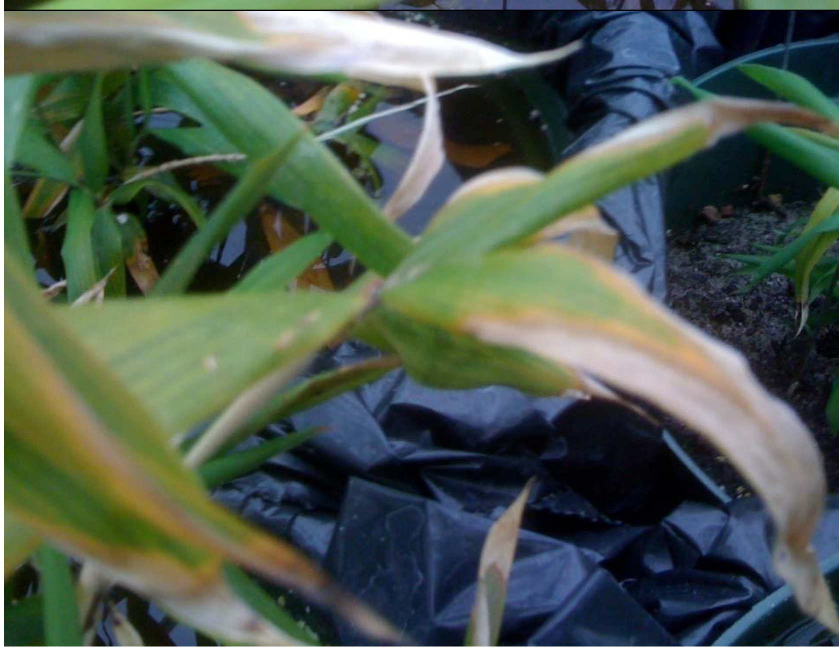


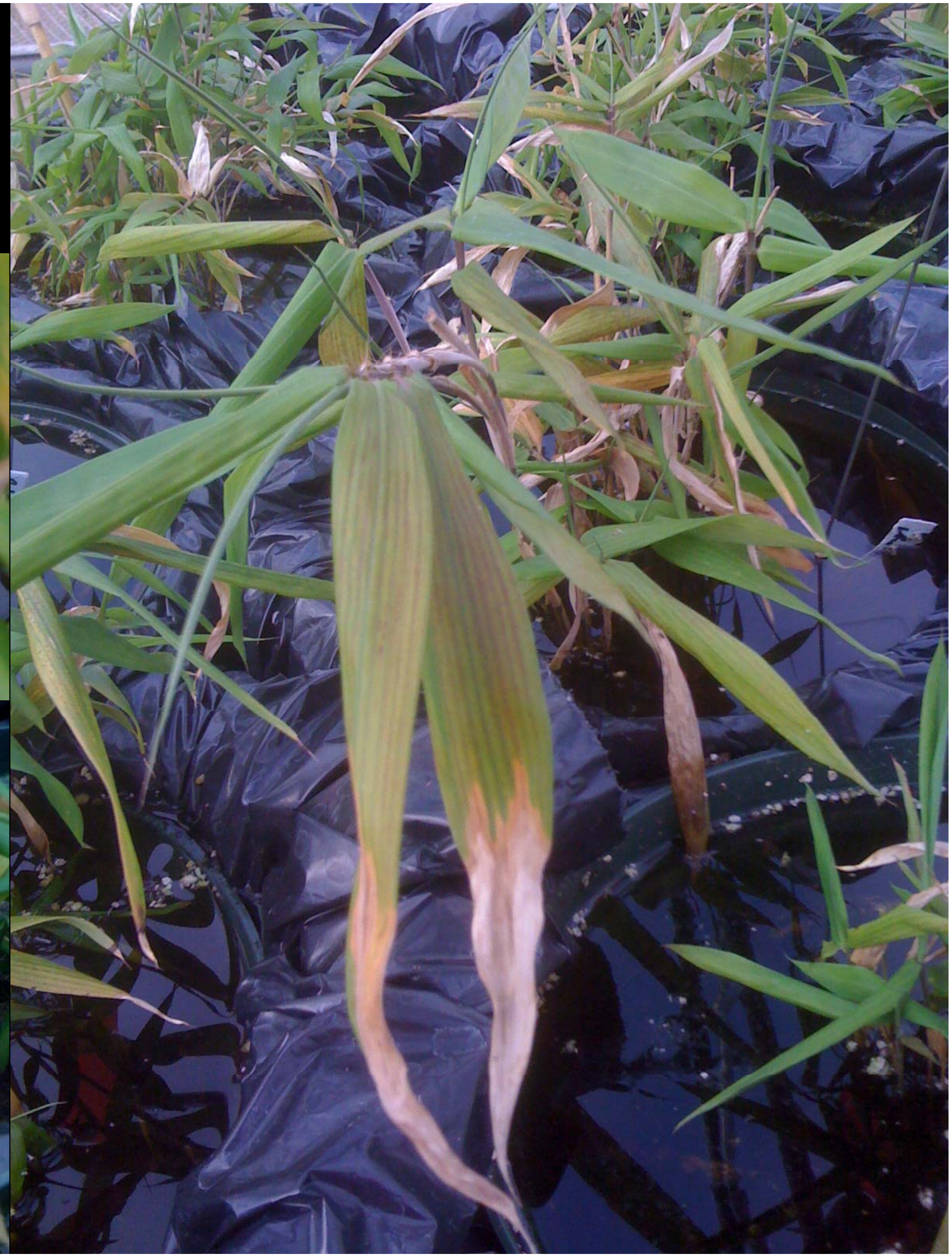
Gs between species

A. tecta > A. gigantea

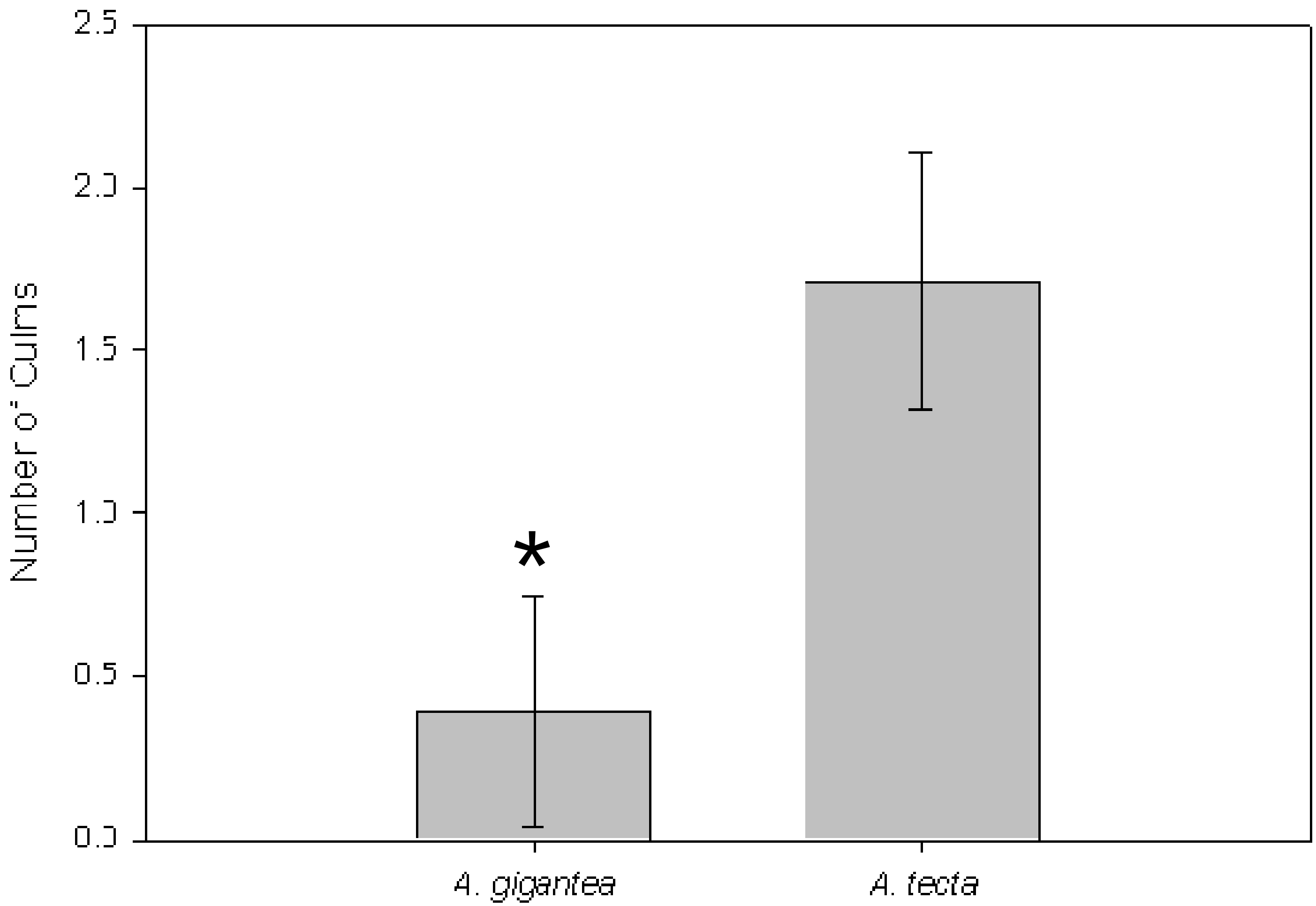


Physical Measurements



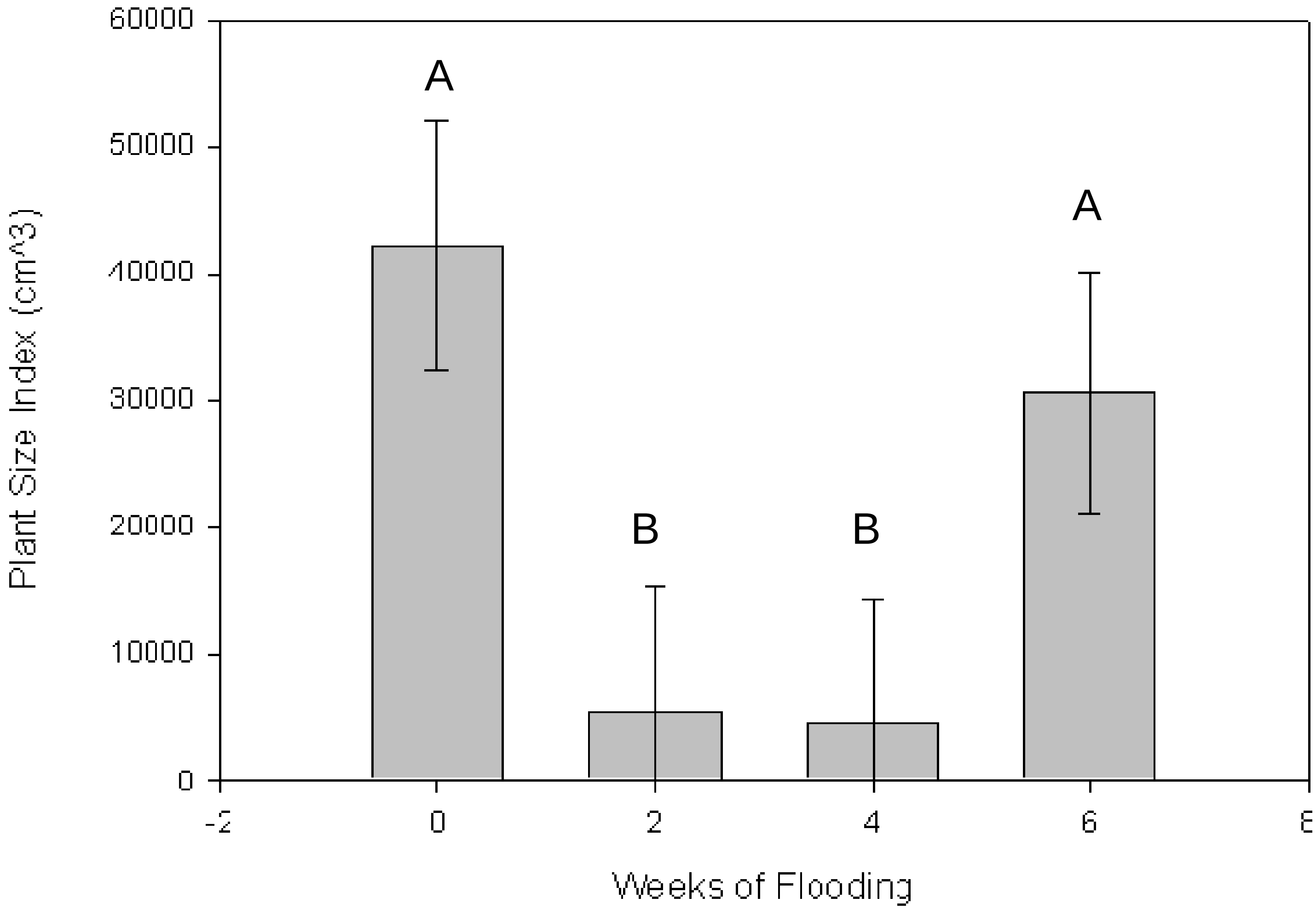


AFTER End of Flooding



A. tecta > A. gigantea

AFTER End of Flooding



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*

Absence of aerenchyma

A. gigantea

Presence of aerenchyma

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?

Arundinaria spp.

Character	*A. gigantea*	*A. tecta*
Sulcus	Usually present	Usually absent
Culm Leaf Duration	Deciduous	Persistant
Top Knot # of Leaves	6- 8	9-12
Top Knot Blade Length	16-24 cm	20-30 cm
Primary Branch Length	15-25 cm	Usually >50 cm
Lacunae	Usually absent	Usually present

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