



# Optimizing rhizomal propagation of rivercane (*Arundinaria gigantea*)

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# MSU Pearl River Project

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Stands of rivercane (canebrakes) have been shown to be effective riparian buffers, trapping sediments and nutrients from agricultural and of surface runoff. Ongoing studies at Southern Illinois University show that a mature canebrake (50 year-old) was found to reduce groundwater phosphorus-N, and total orthophosphate as a more effective buffer than the adjacent forest.

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Canebrake restoration projects throughout the southeastern U.S. focus on restoring habitat, ecosystem function, and plant materials available for Native American artisans. The restoration of canebrakes enhance habitat for other critically endangered species, including Bachman's warbler. Other parts of the world are using bamboo in restoration of ecosystem function. Canebrakes have several important and unique attributes important for water quality. They are able to increase soil porosity and enhance infiltration of surface water due to the interwoven system of rhizomes and roots and dense culms which disperse and decrease velocity of overland flow uniformly across the ground surface (10, 12). This combination of attributes demonstrates the vital role this plant community can play reducing sedimentation and non-point source contamination, while the stabilizing of stream and river banks.

The use of rivercane in restoration projects may depend largely on its ability to compete with exotics. A recent study at Duke University (48) shows that transplanted cane survives well in areas dominated by both Chinese privet (*Ligustrum sinense*) and Japanese stilt grass (*Microstegium vimineum*). However, cane clumps tend to expand more quickly when privet is removed (48).

A restoration study in Kentucky's (30) western Knobs region, studied the effects of woodchip mulch and composted manure culm clumps transplanted into a riparian corridor. Researchers found high establishment success (98%) and growth rate for transplanted culms over two growing seasons. Although soil amendments increased culm production untreated culms also had high establishment success and growth; careful site selection, transplantation and site maintenance may be sufficient to ensure adequate cane establishment.

**Examples of Restoration Projects:**

**EPA Region 4 grant: Mississippi Band of Choctaw Indians' Pearl River Wetland Demonstration Project (Mississippi State University).** A rivercane restoration project is currently underway on tribal lands belonging to the Mississippi Band of the Choctaw Indians (MBCT), along the upper reaches of the Pearl River. The MBCT relationship to rivercane reaches well beyond its value as a riparian buffer. Rivercane was traditionally used for more than 2000 items, from scoops to coffins. For more than a thousand years, artisans have woven an astonishing array of baskets and mats of rivercane for scores of uses. Although, resources are limited, artisans work daily to create integrally double-woven baskets for a market of collectors.

Hence, the conservation of these populations and their potential use as riparian buffers must begin to implement and address factors such as: improving mitigation of wetlands using canebrakes; enhancing propagation methods; maximizing genetic diversity and genetic drift; define protocols for canebrake restoration in riparian habitats, and develop adequate measures for monitoring and assessing wetland health by addressing ecological, cultural and economic factors. Funded by the EPA and the SeaWorld and Busch Gardens Conservation Fund, the aim of this project is to investigate

**[Description]**

Rivercane is a monopedal leptomorphic bamboo with evergreen foliage arising from rhizomes found in the upper 15 cm of soil (7, 40). It grows in neutral to acidic soils, where it is restricted to seeps, stream terraces, and natural levees (41). Rivercane needs moist soils with good drainage (sandy soils) (41). It can tolerate inundation, but not prolonged submergence (7).

Rivercane is sometimes confused with the exotic invasive, golden bamboo (*Phyllostachys aurea*), which also grows in similar habitats and can take over areas very quickly. Golden bamboo has thicker culms (1 to 2 inches in diameter) and flatter, more abundant leaves along the culm.

Rivercane shoots arise from rhizomes and emerge with culm leaves. Culms are unbranched until they reach their mature height (14). Culm growth begins in early spring to mid-summer, with a growth rate up to 30 mm/day (42). Culms reach their maximum diameter in primary growth, followed by the elongation of internodes (14). The growth habit is erect and self supporting as woody tissues harden through lignification of the culm tissues (14). Leaves are produced at the nodes and are made up of a sheath, inner ligula, outer ligula, and blade (14). Between the sheath and the blade, the leaf narrows abruptly to form a pseudopetiole (14). A leaf forms at each node and is capable of producing a branch (14). Culms can produce 3 branches per node (14). Individual culms live an average of 5-10 years (7). The syracoflorescence is paniculate with 1-3 orders of branching. Spikelets have 2-3 (2) glumes, 3 lodicules, 1-many fertile florets, with a rudimentary floret at the apex (14).

Like other bamboo, rivercane flowers sporadically and often simultaneously over a large area (7, 39), perhaps only every 30-40 years, though this has also been observed anywhere from 3 to 50 years (43). Flowering culms have bladeless sheaths arising from the rhizome. The flowering period seems to continue for about a year, with the flowering culms drying after setting seed (43). Large canebrakes have been observed to die following a flowering event, however, this is not always the case, with some individual culms flowering yearly (43). The length of time required for a seed to germinate, grow to full size and die is not known, though it has been suggested to be 20 years or more (44). Recently, an 8-month-old seedling was observed flowering in a greenhouse. Because of such sporadic flowering events, there is still much of the life history and ecology of rivercane that is unknown.

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**[Taxonomy and Systematics]**

Rivercane is a grass (Family Poaceae) native to North America. As a bamboo, it is included in the subfamily, Bambusoideae and the Bambusae tribe. Although it shares the subtribe, Arundinarieae, with species from East Asia and Africa, the genus *Arundinaria* is narrowly defined as only native North American bamboo (*Arundinaria sensu stricto*) (45).

Depending on the source, there are two or three species of *Arundinaria* recognized in North America. Some treatments recognize two subspecies of rivercane: *Arundinaria gigantea* (Walder) Muhl. ssp. *gigantea* (east cane) and *Arundinaria gigantea* (Walder) Muhl. ssp. *secta* (Walder) McClure (whitecane). Others recognize *A. gigantea* and *A. secta* as separate species, with *A. gigantea* occurring inland along floodplains and *A. secta* occurring in acidic swamps, seeps, and bogs of the Coastal Plain (46). A fairly recent discovery by Lynn Clark and Jimmy Triplett, of Louisiana State University, has

**Research**

- [ Rivercane Ecology ]
- [ Rivercane Activities ]
- [ Rivercane Propagation ]

Oversee the data for descriptions.

**Highlights of Current Research Activities**

- Descriptions of Presentment and Historical Canebrakes - Christopher Brantley, Steven Platt, and Thomas Reuter
- Phylogeny and Taxonomy of the genus *Arundinaria* - Jimmy Triplett
- Propagation Methods and Growth Enhancement of Rivercane Ramets for Use in Field Restoration Projects - Brian Babbitt, Margaret Crites, John Oudens, Scott Horne, and Scott Franklin
- The chemical and physical soil properties of *Arundinaria gigantea* in Western North Carolina - Adam Griffith and Gaby Mathew, Virginia Carolina University

**MISSISSIPPI BAND OF CHOCTAW INDIANS ENVIRONMENTAL PROTECTION AGENCY**

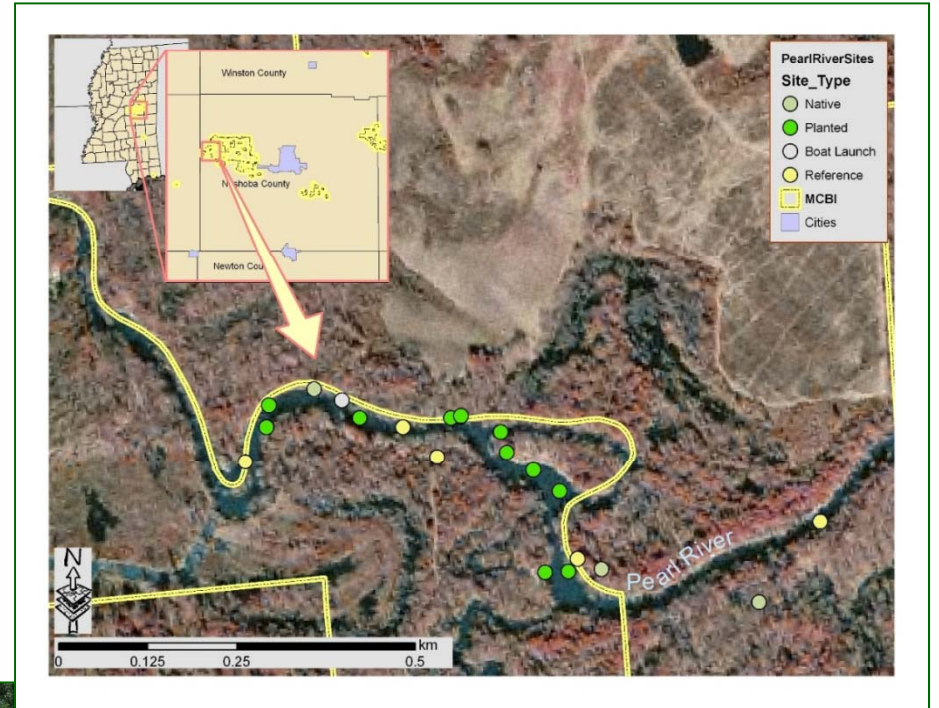
<http://www.rivercane.msstate.edu>

# Restoration objectives

- Restore riparian buffers along the Pearl River to:
  - enhance water quality
  - stabilize banks
  - reduce sediments entering main channel.



# Experimental plantings along the upper Pearl



# Rivercane Reproduction

- Important to restoration
- Not completely understood in any of the bamboos, much less rivercane



# Reproduction via Rhizomes

- Rhizomes or plants, usually dug and transplanted
  - Suffer embolisms, often resulting in death



# Reproduction via Rhizomes

- Extensive restoration via vegetative reproduction creates a mono-culture
  - Problematic in another endangered grass
    - Seaoats (*Uniola paniculata*)



# Reproduction via Flowering





# Regional variation in success

- Canebrakes in NC and Kentucky are producing seed in large quantities
- Canebrakes in Mississippi are producing little to no seed

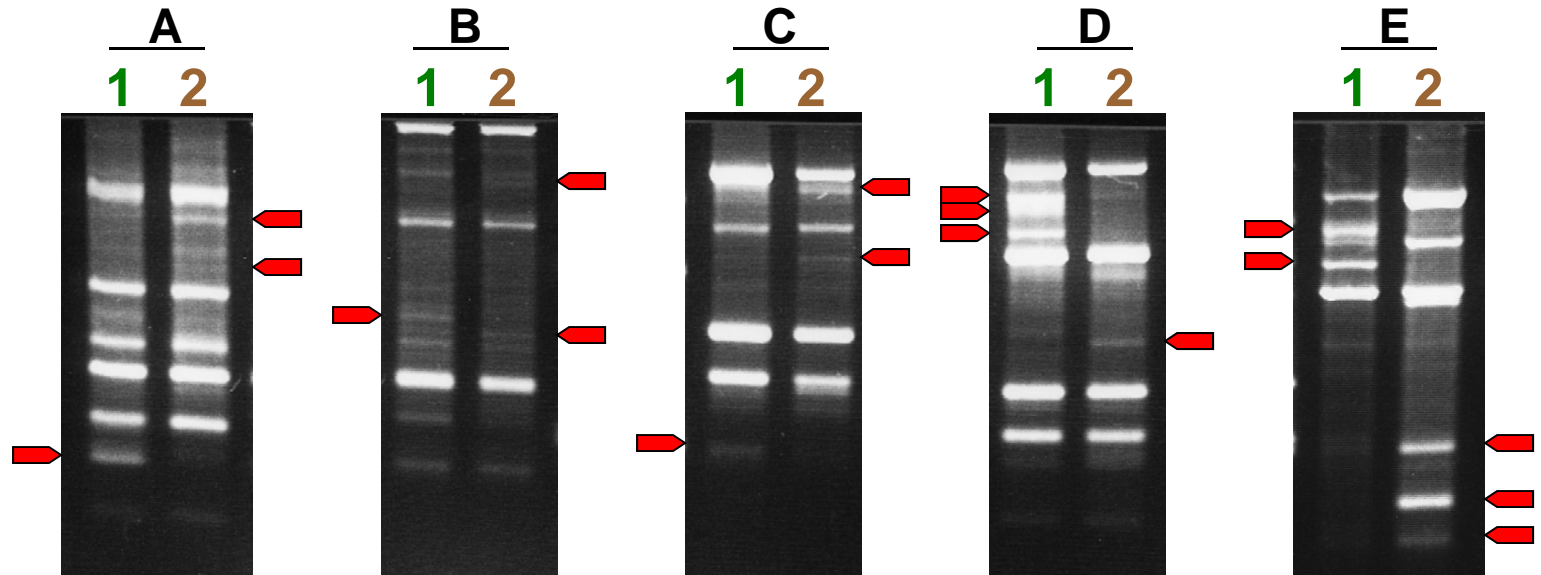




# Specific examples

- Koshy & Jee, 2001
  - Tropical bamboos are often self incompatible based on factors involving pollen viability and pollination.
- Judiewicz et al., 1999
  - Rivercane produces significant numbers of sterile or nonviable seed
- Baldwin et al., 2009
  - In an isolated plant with 1000 receptive flowers that produced 11 seed total, and ONLY 3 germinated.
  - However, manually crossing different genotypes resulted in viable seed (20 out of 28 germinated)
  - Appears to be self-incompatibility system

# Rivercane DNA Fingerprinting



Microsatellite approach:

DNA was digested with a specific restriction endonuclease, then amplified with one of five different sets of primers (A-E).

Samples (1, 2) were taken from rivercane brakes 0.8 miles apart.

➡ = DNA band not present in sample from other location

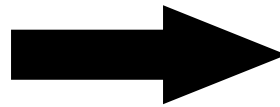


# Goals

- Collect rivercane accessions from around state & region (locally native ecotypes)
- Genotype accessions to optimize genetic diversity in restoration activities
- Develop protocol for successful propagation of rivercane from rhizomes

# Rivercane Propagation

- Objective: Refine methods for vegetative propagation in order to increase materials available for restoration projects.
  - Understand factors leading to highest success in bare rhizome propagation:
    - Timing of rhizome harvest
    - Diameter and location of rhizome segments
    - Rhizome pre-treatments (fungicide, GA)
    - Environment (i.e., temperature, humidity)

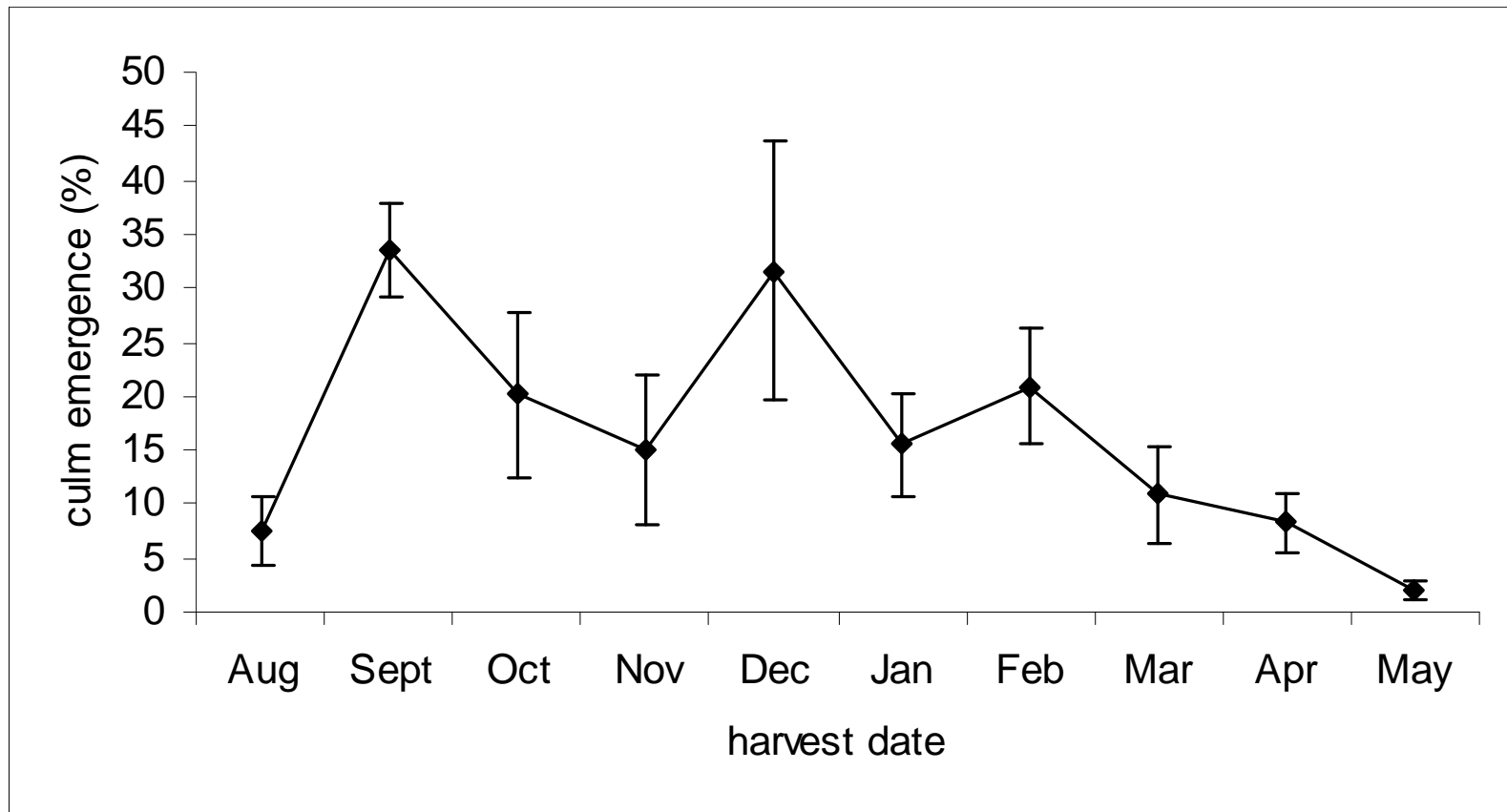


# Methodology

- 44 genotypes
- 10 planting dates
- Planted by:
  - Segment location (proximal, mid, and distal)
  - Diameter size (<3mm, 3-6 mm, >6 mm)
  - Treatment
    - Fungicide soak (40 ppm triadimefon)
    - Gibberelic acid soak (1,000 ppm)
    - Control

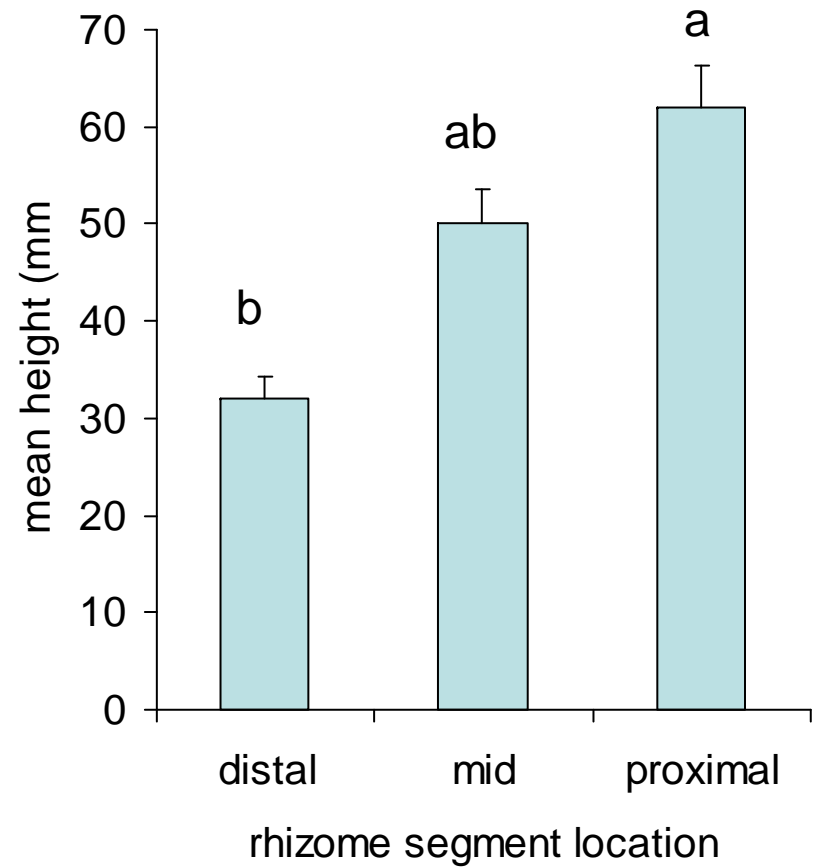
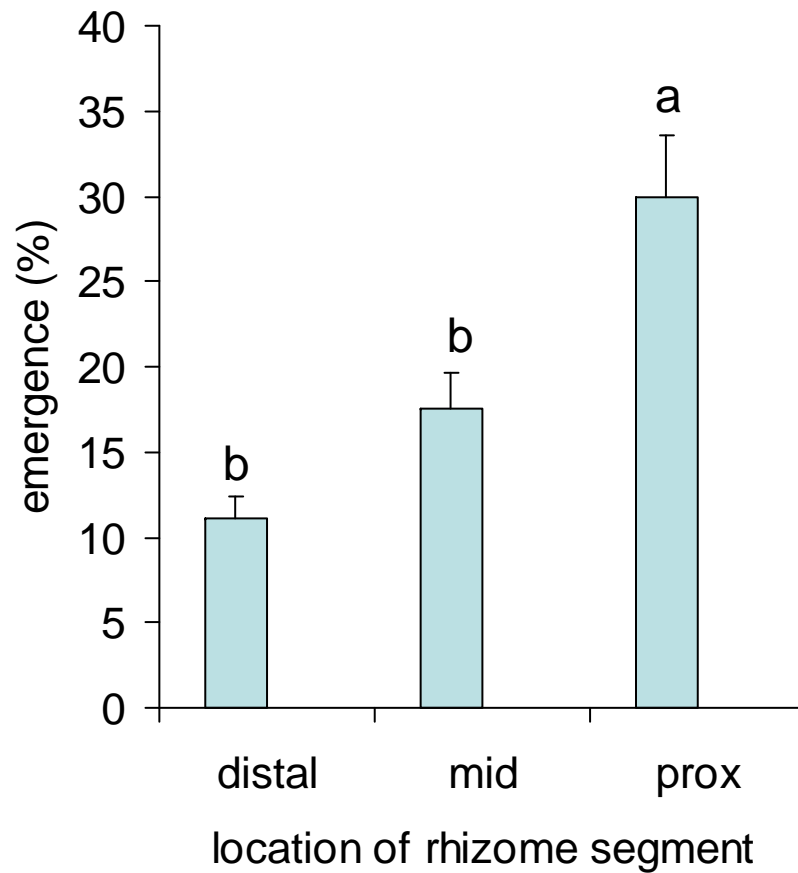


# Time of rhizome harvest



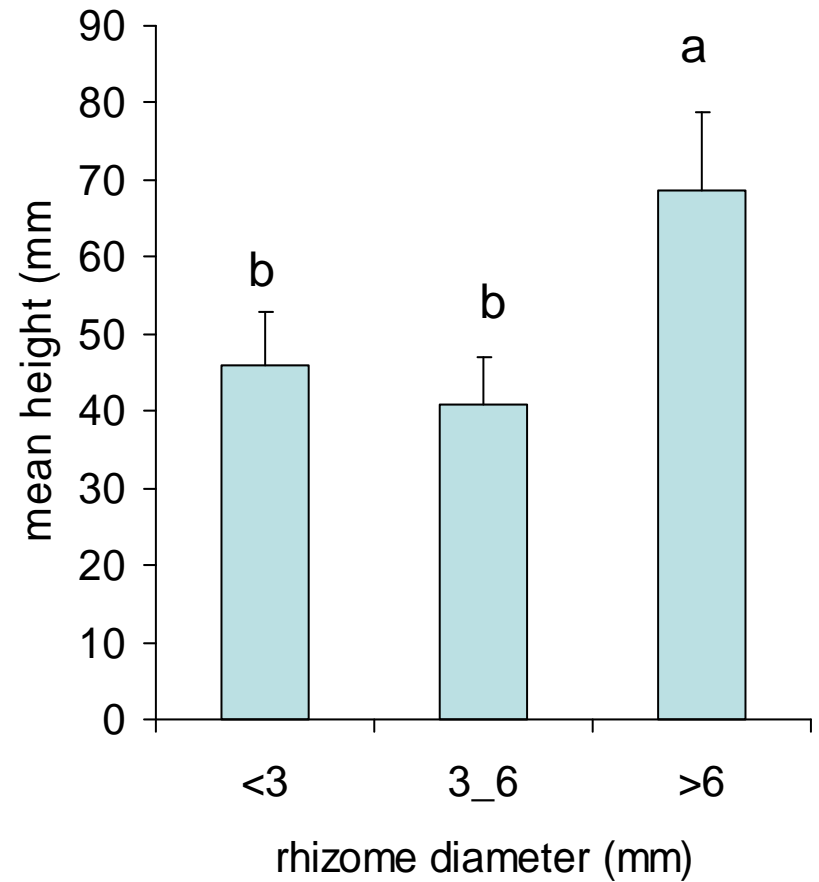
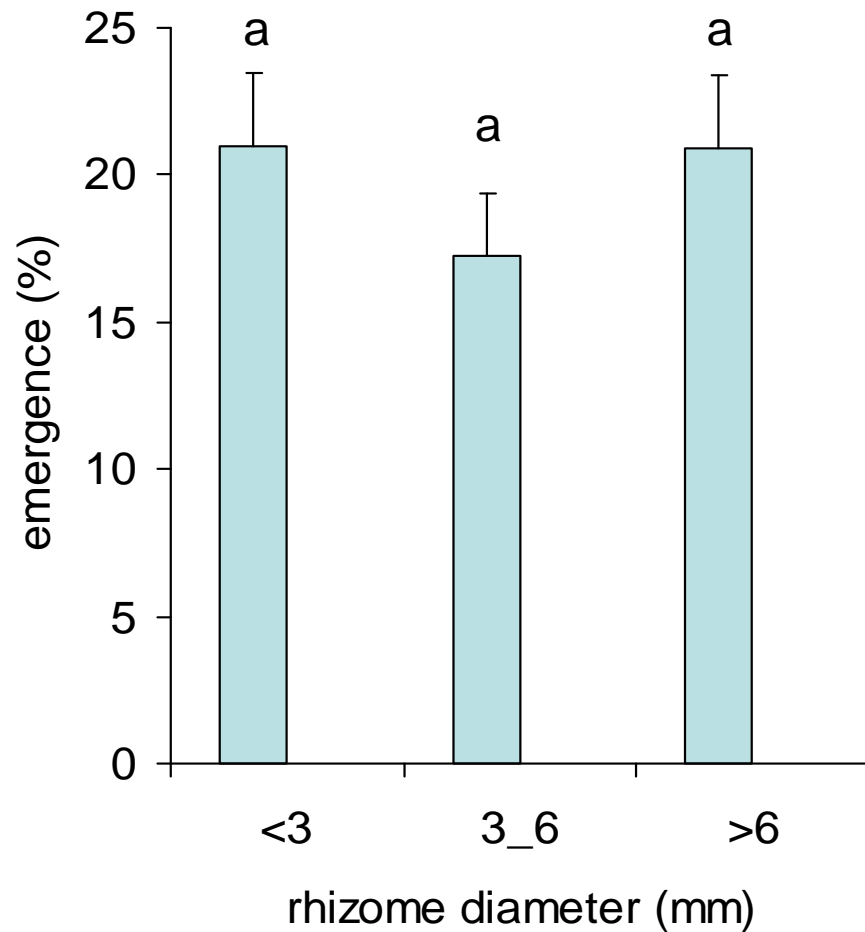
Percent culm emergence at week 5 for each harvest date.

# Rhizome segment location

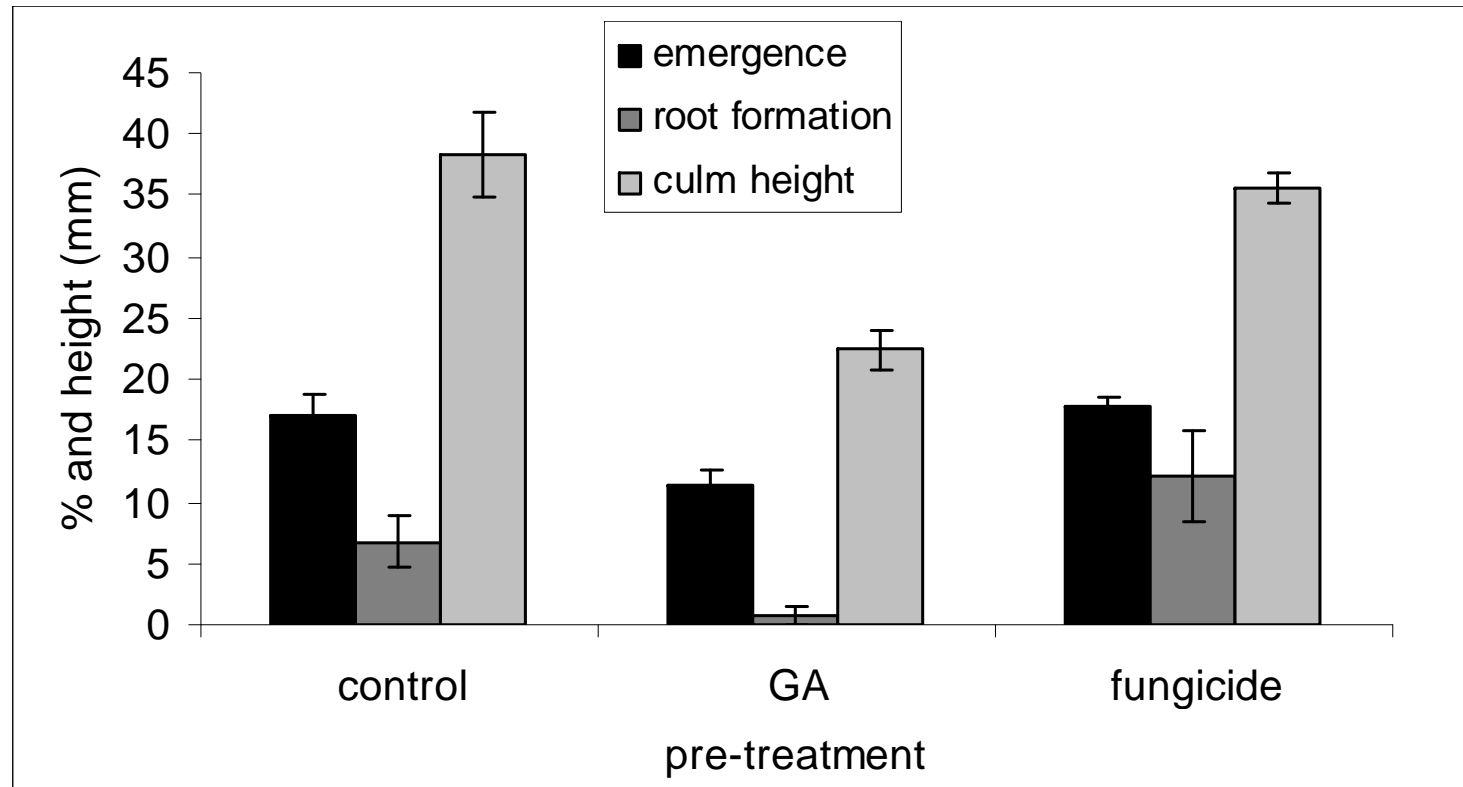




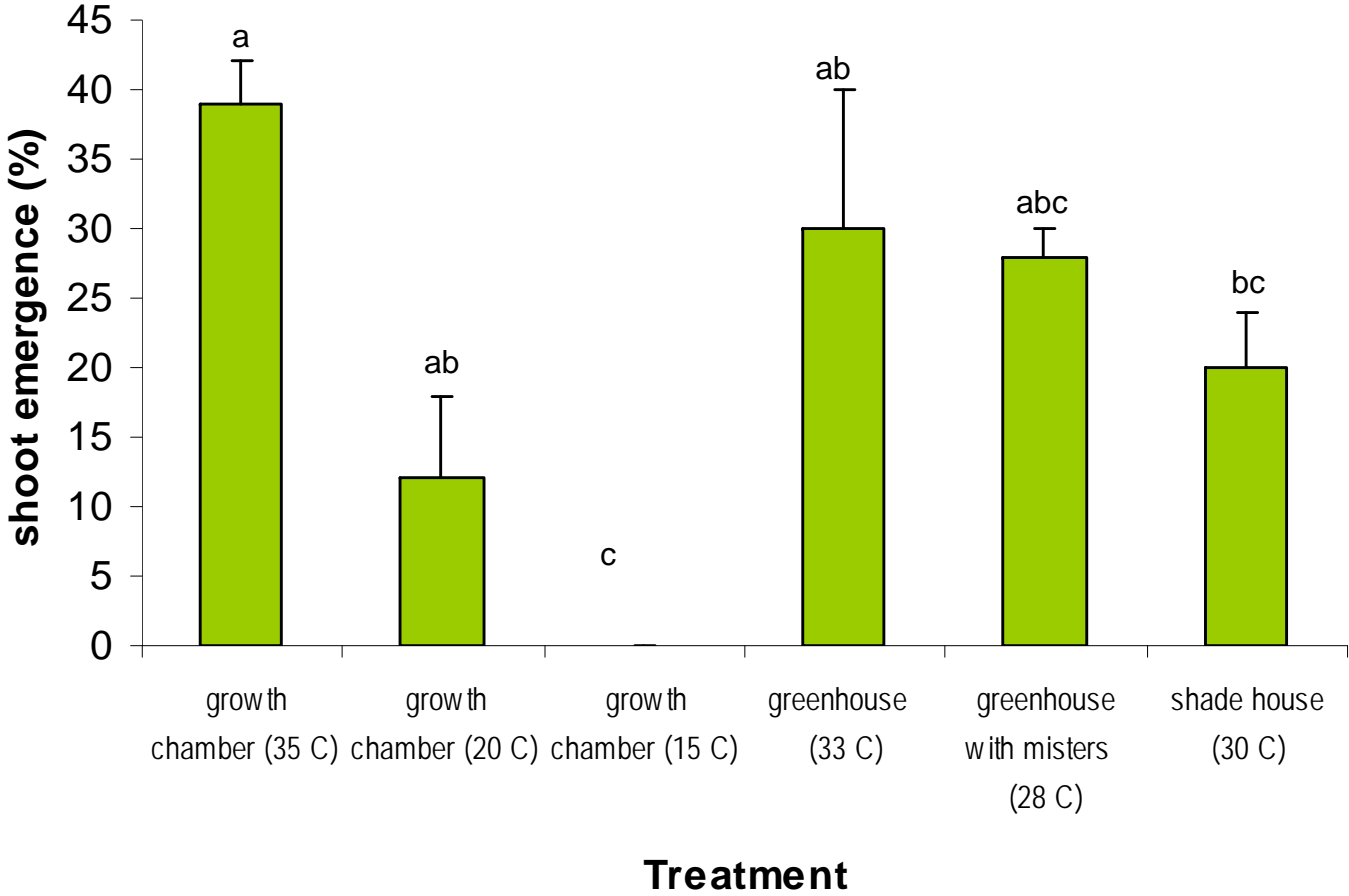
# Rhizome segment diameter



# Pre-Treatments



# Treatments



# Propagation – Summary

- Highest success from rhizomes harvested from proximal region and during autumn.
- Diameter unimportant to emergence success.



# Propagation – Summary

- Pre-treatment of no benefit.
- Warmest environments produced the highest number of culms (but also highest mortality).

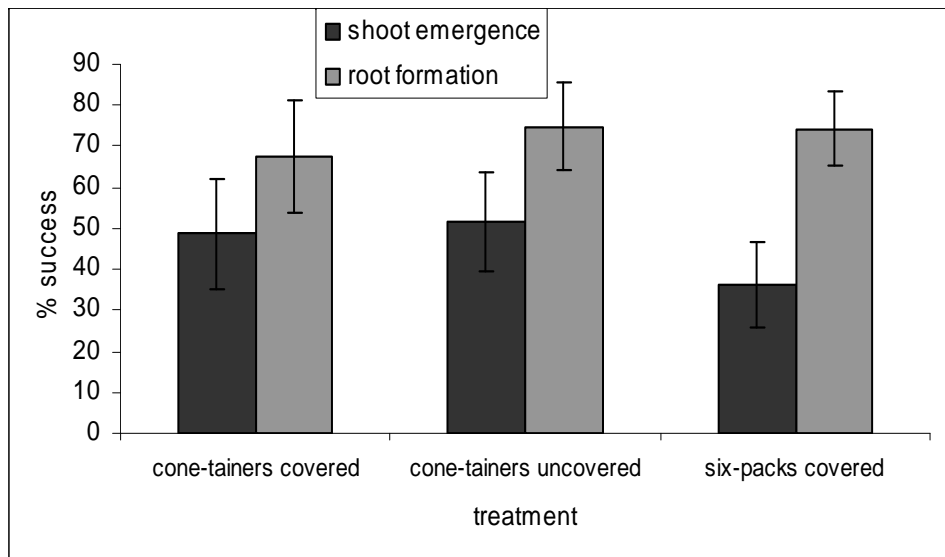
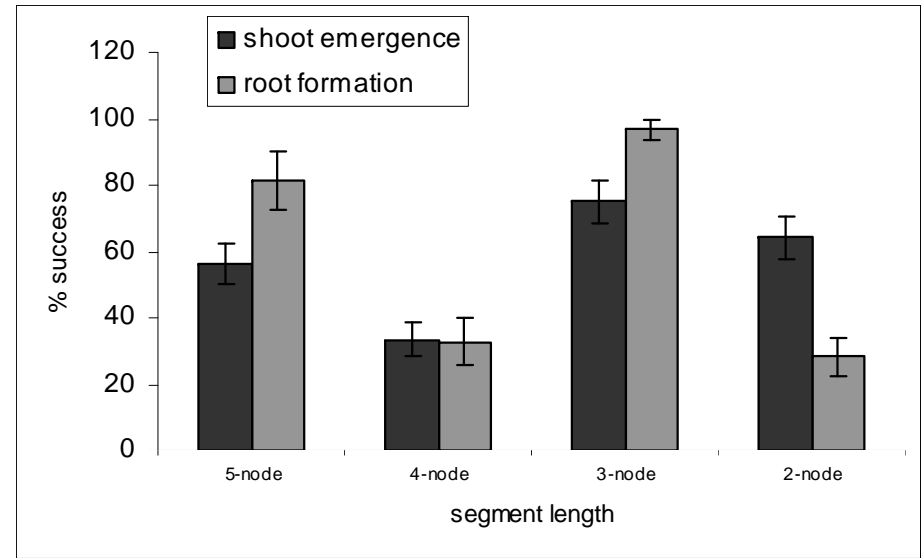


# Propagation – current studies

- Comparing different growth media and planting techniques



# Results



# Questions...

