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Effect of Small Rhizome Propagation on First-Year Growth of Rivercane (*Arundinaria gigantea*)

Emma Knight

Department of Environmental Science
The University of North Carolina at Asheville
One University Heights
Asheville, North Carolina 28804 USA

Faculty Mentor: Prof. Ashley Case

Abstract

Rivercane (*Arundinaria gigantea*) is a bamboo native to the Southeastern United States. The species has been reduced to an estimated 2% of its historical ground cover due to land-use changes since colonization, predominantly from urban and agricultural development. Rivercane is ecologically important as a unique habitat and riparian buffer, and culturally significant to many Indigenous groups. This study sought to investigate the effect of small rhizome macropropagation on the first-year growth of rivercane, in an effort to evaluate potential influences on propagation and first-year growth. Rhizomes were harvested from three different locations on or adjacent to the University of North Carolina at Asheville's (UNC Asheville) property in late March of 2025. Rhizomes were cut into segments containing 2-5 nodes, and measurements of rhizome circumference and length were taken before placing them in individual plastic sandwich bags containing site soil. They were then propagated in the lab for approximately six weeks. A total of 87 segments were collected, of which 46 were successfully propagated and replanted. The propagated plants were planted in a randomized study design, and monthly measurements of height (cm), diameter at ground level (cm), number of live leaves, and dieback of shoots (cm) and leaves were collected from May to December of 2025, and then again in March of 2026.

There were no significant correlations between rhizome volume and number of nodes with continuous growth, number of leaves present, or dieback in the first year. The location of rhizome collection had a significant impact on propagation success, with the Asheville Botanical Garden trail edge showing the highest shoot emergence success rate. Rhizome volume had no impact on shoot emergence. Rivercane propagation can be successful using various methods, and long-term studies are needed to determine which factors yield the highest propagation and survival rates.

Introduction

Rivercane or giant cane (*Arundinaria gigantea)* is a bamboo native to the Southeastern United States (Rajewski 2015). The species, which will be referred to as rivercane throughout our study, has experienced a drastic decline, predominantly due to an increase in agricultural development, large-scale urbanization, and overgrazing, since colonization. Rivercane has been diminished to an estimated 2% of its historical ground cover (Sharma & Wait 2024). The substantial reduction of this species has been detrimental due to its ecological and cultural importance (Bugden et al. 2011).

Rivercane serves as a riparian buffer, filtering sediment and nutrients, and is also a unique natural habitat for both aquatic and terrestrial species. Canebrakes, which are dense rivercane stands, support fauna by creating cover, and can be used as maternal den sites for some mammals (Platt et al. 2001). Rivercane stabilizes banks through its dense mat of rhizomes, which reduces streambank erosion (Eade et al. 2023).

Rivercane is significant to many Indigenous tribes, including the Eastern Band of Cherokee. The rivercane has traditionally been used to make blowguns, flutes, baskets, building materials, and more. Basket weaving using rivercane is an essential traditional practice, and with the reduction in canebrakes, finding locally available materials for this practice is becoming increasingly difficult, often requiring further travel (Farmer 2023).

Sourcing seeds for rivercane restoration can be difficult because of its monocarpic flowering pattern and low viability (Baldwin et al. 2009). The flowering time is unpredictable, occurring once at the end of the mature cane’s lifecycle, which is between 31 and 50 years. After seed production, the rivercane stand typically dies (Eade et al. 2023). The unpredictable timing of seed production forces asexual rhizomal methods of propagation to be the predominantly used propagation technique.

Studies have compared the success rates of different propagation methods, using different source material, growing containers, and soil types. In 2009, Baldwin et al. compared multiple propagation techniques, including micropropagation, which uses tissue culture explants, macropropagation, a method using rhizome segments, and seed germination. The study found that in micropropagation, explants can continue to be divided, reducing the need for rhizome material (Baldwin et al. 2009). However, this method isn't as successful for large-scale restoration as macropropagation, due to the lack of sustained root development. Macropropagation was found to have the highest shoot emergence yield, using rhizome sections containing 2-3 nodes. Eade et al. (2023) compared the success of polypropylene, treated burlap, and non-treated burlap as growing containers, with different growth media and macropropagation. They found that the non-treated burlap growing containers, with mixed soil and no fertilizer, showed the highest success rate of emergence and survival. Most literature supports using macropropagation, but the node length and soil mix vary across the literature. Eade et al. (2013) had the most success using rhizomes 6-18 nodes in length, Baldwin et al. (2009) used rhizomes 2-3 nodes in length, and Sexton et al. (2009) used rhizomes 10 nodes in length.

Restoration of rivercane has gained significant momentum, and tracking the success of different methodologies is important to inform better practices. In this study, a propagation method was used that involved transplanting rivercane from rhizome sections, a method developed by Laura Young while working with Friends of the Cedars in southwest Virginia (Griffith and Young 2025). The purpose of this study was to investigate whether the collection location and rhizome size affect initial propagation and first-year growth. Our research questions were the following:

(1) Does the location where rhizomes are harvested or the rhizome volume affect shoot sprouting success?

(2) Is rhizome volume or number of nodes correlated with first-year continuous growth, number of leaves present, or die back?

For research question one, we hypothesized that rhizomes collected from the north and south of Reed Creek locations would have greater shoot emergence than the trail edge location, due to their proximity to the creek's riparian zone. This is the typical habitat where rivercane is found, so we predicted this soil could create conditions that would allow for the highest propagation success. We also hypothesized that a larger rhizome volume would allow for higher shoot sprouting success due to the potential for greater nutrient storage in the rhizome that could be utilized in propagation.

For research question two, we hypothesized that greater rhizome volume in initially collected rhizome segments would be correlated with greater first-year continuous growth, a greater number of leaves, and less dieback. This is due to the rhizomes' potentially higher nutrient storage capacity. Secondly, we hypothesized that rivercane segments with two or more nodes in initial collection would be correlated with higher first-year growth, a greater number of leaves, and less dieback. Two or more nodes were recommended in the macropropagation work done by Laura Young, on which this study's methods were based.

Methods

Rhizome segment collection materials included quart-sized Great Value® sandwich bags, hand trowels, pin flags, pruning shears, and plastic tubs. Great Value® bags were specifically used, as Laura Young's macropropagation method was employed, and this is the brand they recommend. On March 25, 2025, rhizomes were collected from mature rivercane stands at three sites, two on UNC Asheville's property, and one adjacent, in the Asheville Botanical Gardens. One collection location was along the main gravel trail of the botanical gardens, and two were on the north and south sides of Reed Creek. Locations were chosen because of the presence of established rivercane, so that the minor disturbance wouldn't affect the vitality of the stand.

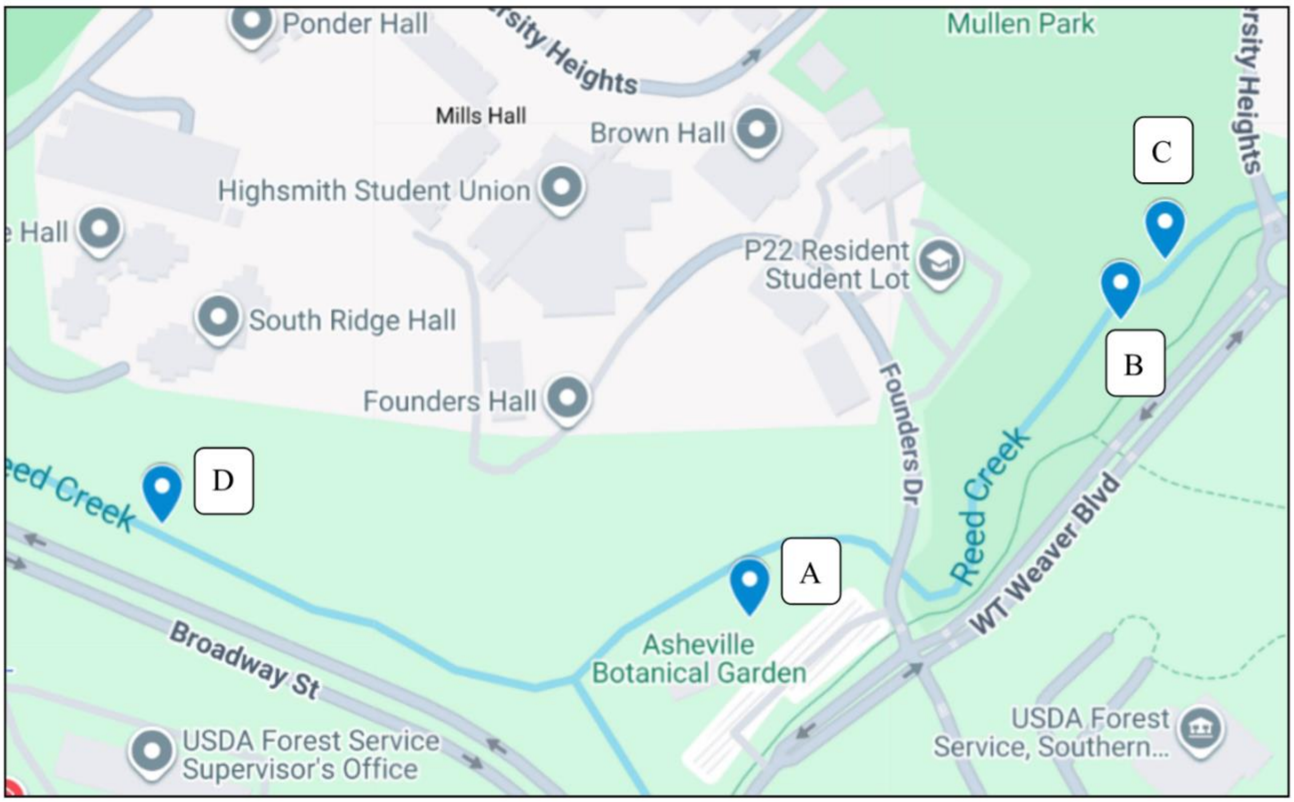

Figure 1. Map of rhizome collection sites and plot for randomized planting. Label A is the Asheville Botanical Garden trail edge site. Label B is the south side of the Reed Creek site. Label C is the north side of the Reed Creek site. Label D is where successfully propagated rivercane was planted.

A hand trowel was used to dig directly beneath rivercane to locate the below-ground rhizome. Hand trowels were placed under the rhizome to gently lift it from the soil. Rhizomes traveling away from the main plant were collected to avoid mature culms and focus on actively growing rhizomes. Pruning shears were used to cut a large rhizome segment that was then removed and cut into smaller segments. Smaller segments ranged from 1 to 7 nodes, with a desired node length of 2 to 5. The circumference and length of the segments were measured in centimeters before they were placed into individual bags. Great Value® quart-sized bags were filled halfway with soil directly from the site. Rhizome segments were placed horizontally in the bag so that the entire segment was covered with soil, and each bag was given an identification number labeled with a Sharpie®. A total of 87 samples were collected, with 40 from north Reed Creek, 31 from south Reed Creek, and 16 from the Asheville Botanical Garden's trail edge (figure 1). Differing amounts of rhizome collection from each site were unplanned.

The tops of the Great Value® bags were folded outward to form openings and used as growing containers in the lab. They were placed by a window in plastic tubs, allowing for partial sunlight to reach the containers. In the month between rhizome harvesting and planting, the samples were monitored twice a week to keep the soil saturated. On April 29th, 2025, 41 rivercane shoots that had successfully emerged were planted alongside a riverbank located in the Asheville Botanical Gardens. Rivercane was planted in a plot with seven to eight plants per row for a total of seven rows; all plants were spaced approximately 1 meter apart. Labeled plants were assigned a location using a random number generator and planted approximately four inches deep. Each plant's location was labeled with a pin flag and an ID number. On June 6th, five more rivercane plants were planted that had emerged in the lab after the first planting. Of the 87 rhizomes that were harvested, a total of 46 were planted (figure 4).

A Chi-squared test of independence (RStudio Team 2020) was used to evaluate whether initial shoot emergence significantly differed between sites. An independent t-test was used to test whether rhizome volume affected the presence or absence of initial shoot emergence. Rhizome volume was calculated using circumference and length measurements with the following equation:

$$\text{Volume} = (\pi \times (circumference\ of\ rhizome\ /\ (2 \times \pi)) \div (\ 2 \times length\ of\ rhizome)$$

First-year growth of rivercane was monitored in the field, followed by evaluation. Rivercane data was collected once a month from April through December 2025 and again in March 2026. Height, diameter at ground height, the number of live leaves, and the dieback (measured by both the number of leaves and centimeters) were recorded. A Pearson correlation test was performed to evaluate whether the number of nodes or rhizome volume of collected segments showed significant correlations with continuous growth, number of leaves, or dieback. All analyses were conducted in RStudio (2020), and a 95% confidence interval was used to determine the significance of all tests.

Results

Question (1) Results

The Chi-squared test of independence showed a significant difference in shoot sprouting success based on the segment's site of origin ($\chi^2 = 8.624$, df =2, p-value = 0.013). The segments from the Asheville Botanical Garden trail edge had a significantly higher sprouting rate of 68.75% compared to that of the segments from the north of Reed Creek (30.00% success rate) and south of Reed Creek (29.03% success rate) (Figure 2). Using an independent t-test, results showed that the volume of the rhizome segments did not have any significant impact on the shoot sprouting success during initial propagation (t = 1.077, df = 85, p-value = 0.285). We fail to reject the null hypotheses for research question one.

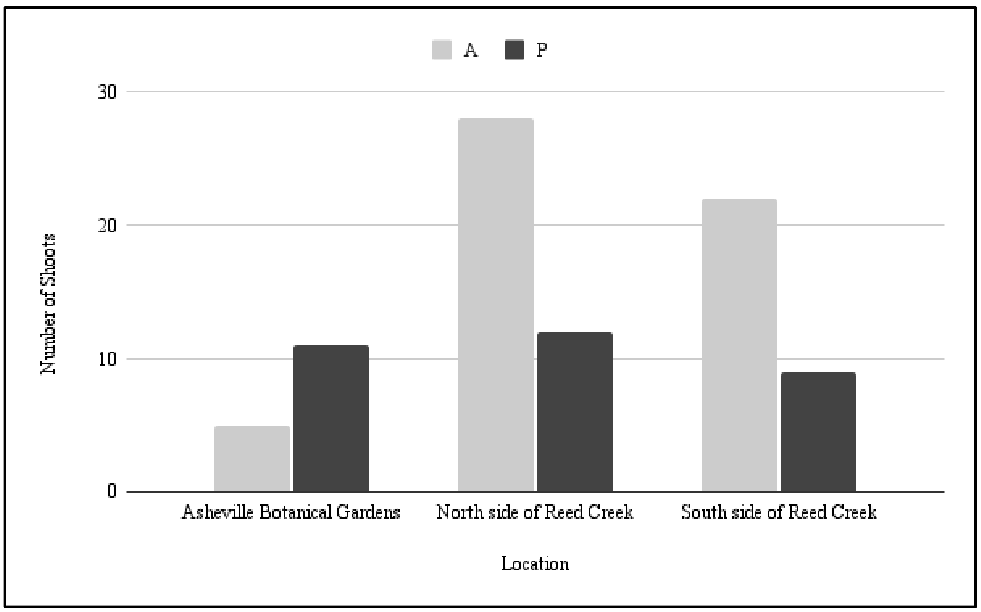

Figure 2: Number of shoots by location that were present (P) and absent (A) on April 7th, 2025, 13 days after the start of propagation.

Question (2) Results

The Pearson correlation test results show that there was no significant correlation between rhizome volume and continuous growth (t = 0.705, df = 46, p-value = 0.481), rhizome volume and live leaf count (t = 0.828, df = 46, p-value = 0.412), and rhizome volume and dieback (t = 0.657, df = 32, p-value = 0.516). The Pearson correlation test results also show that there was no significant correlation between the number of nodes and continuous growth (Figure 3) (t = 0.285, df = 46, p-value = 0.777) (Figure 3), the number of nodes and live leaf count (t = 2.001, df = 46, p-value = 0.051), and the number of nodes and dieback (t = 0.886 df = 32, p-value = 0.383). We fail to reject the null hypotheses for research question 2.

A total of 87 rhizomes were collected, of which 46 were successfully propagated, yielding a 53% propagation success rate. By March 2026, 29 of the 46 propagated rhizomes remained, ending with a first-year survival rate of 33% from the initial 87 (Figure 4).

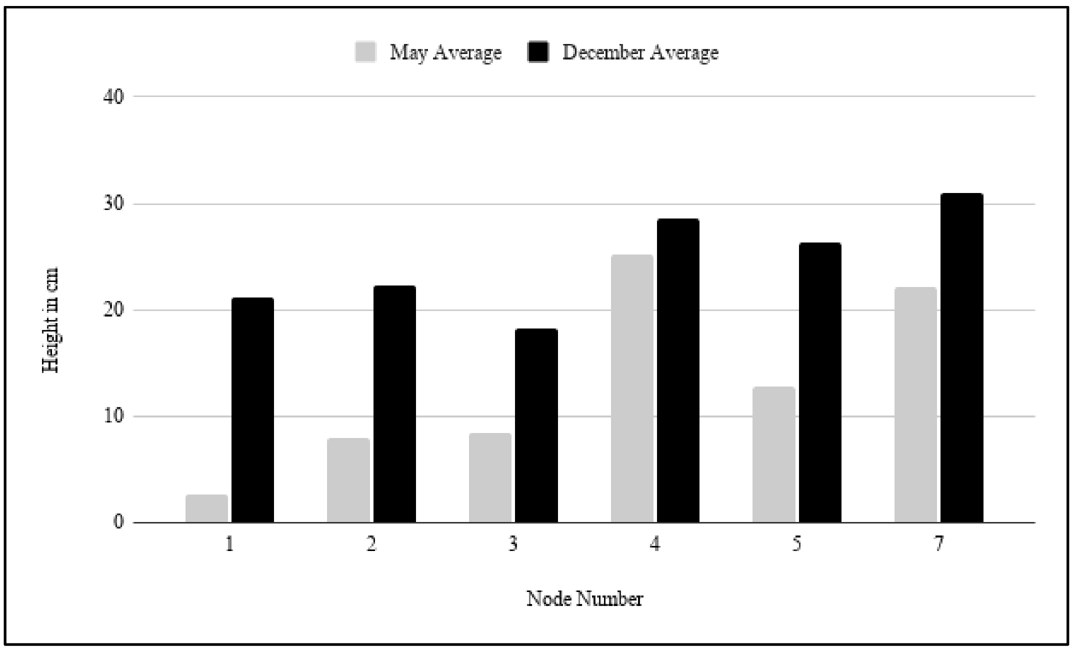

Figure 3. Average height in May and December by number of nodes measured on segments that were collected on March 25, 2025.

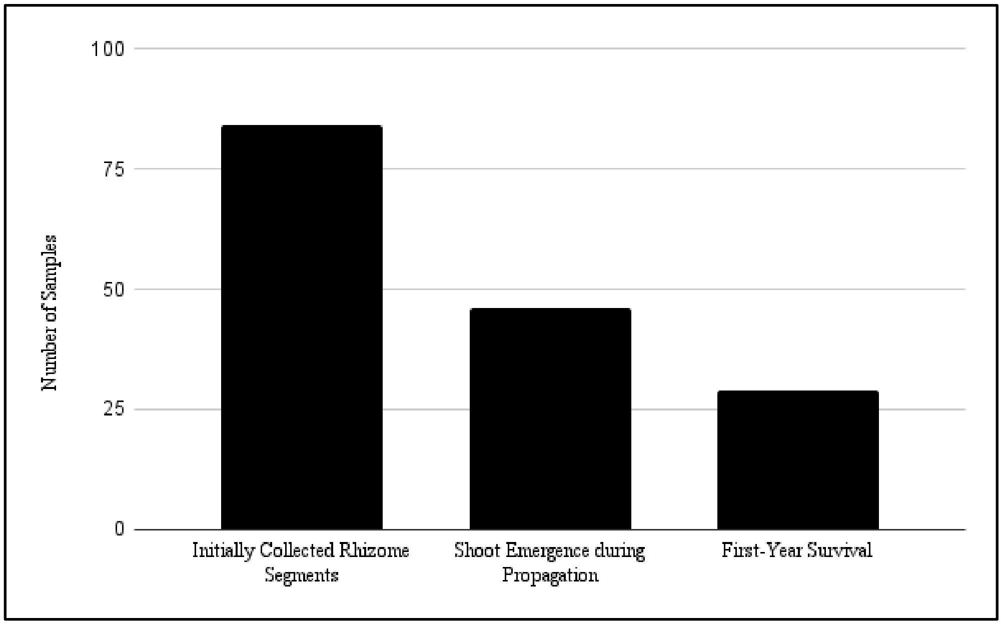

Figure 4. Total of rhizome segments that were collected on March 25, 2025 (87), the number of those segments that had successful shoot emergence in the lab during propagation (46), and the number of samples that survived the first year in the field (29).

Discussion

Contrary to our hypothesis, the number of nodes and rhizome volume of collected segments didn't have a significant effect on the first-year growth parameters we measured. It is worth noting that more data was collected in March 2026; however, no growth, dieback, or change in leaf count was detected. There was no additional dieback between November 2025 and March 2026, suggesting that dieback was most prevalent at the beginning of the first growing season. Further research is suggested to follow plants for multiple growing seasons to understand how dieback affects the establishment of rivercane over time.

Our results differ from those of previous studies, such as the experiment described by Sexton et al. (2003). Their methods utilized rhizomes smaller than other methodologies previously suggested, measuring around 22-30 cm, and still found a 76% success rate in propagating at least one culm. However, similar results to ours were found in a study done by Schoonver et al. (2011). They more than doubled the lengths of their rhizome segments and found that there was no significant change in survival rate between different lengths. This suggests that rivercane propagation can be successful even when varying methodologies are used. A variety of methodologies suggest there may be other factors that influence successful propagation. Possibly soil moisture, soil type, or handling techniques, location of harvest in the stand, or stand age. Our research further supports the notion that rivercane has a high tolerance to a variety of propagation techniques (Griffith et al. 2009) due to the difference in collection material as well as the location of harvest, which still resulted in successful propagation across different groups. Further work is necessary to determine the reasons for the differing results.

Although no significant correlation was found between the number of rhizome nodes in initially collected segments and the live leaf count of rivercane in the field (p-value of 0.051), the Pearson correlation test suggests that there may be a marginal correlation between the two variables, suggesting that the number of nodes may have a weak correlation to leaf growth. The results may be due to the small sample size, and increasing the sample size could allow for a stronger analysis and conclusion.

Only 63% (29/46) of the rivercane that was planted survived the first year in the field (Figure 4). Of the 37% that died after planting, multiple plants were completely removed from the plot. The plot had no fencing or barriers protecting it from wildlife. The absence of any shoots could be due to animals such as the white-tailed deer or rabbit feeding on the young shoots. Future studies could consider fencing their plots and ensuring they harvest three times the number of cane shoots needed for planting or restoration, due to our study's first-year survival rate of 33% and initial shoot emergence of 53%. Our rate was lower than reported in another study that had emergence rates of 76% (Sexton et al. 2011). However, Sexton et al. (2011) only examined initial propagation success, not long-term survival after planting.

The successful emergence of shoots in initial propagation differed between the locations of collection (Figure 2). Other studies have found similar results. Conley (2015) found that rivercane rhizome collection sites strongly influenced rhizome propagation success. Conley hypothesized that this may be due to different genotypes and the age of rivercane stands. The location that had the highest rate of success in our study was the farthest from the stream's edge, which was not what we hypothesized. However, the stand located on the trail edge was the largest, which could have allowed for more success due to the healthy rhizome system. In a previous study that analyzed nutrient levels in rivercane restoration sites, rivercane was shown to be a generalist; the species didn't seem to be significantly affected by low or differing nutrient levels in the soil (Griffith et al. 2009). Further research could include soil analysis of where the rhizome segments were collected to provide further insight into the soil composition of established rivercane.

Our study aimed to add a deeper understanding of how rhizome volume and node count impact first-year growth. Many rivercane propagation projects don't follow the rivercane's first-year growth in the field. Future studies could continue to monitor growth to make the data more applicable to further restoration practices. By creating a thorough understanding of the needs of rivercane to successfully propagate, restoration practices can become more efficient and understood.

Conclusion

Root volume and number of nodes did not have a significant correlation to continuous growth, number of live leaves, or dieback. Rhizome segment volume did not have an effect on the success of shoot emergence in initial propagation. However, the sites where rhizome segments were harvested significantly influenced the emergence of shoots in initial propagation. The macropropagation method that was used resulted in a 53% success rate of shoot emergence, and 63% of those planted survived the first growing season.

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