

Propagation of Giant Cane (*Arundinaria gigantea*) for Riparian Habitat Restoration

James J. Zaczek
Rebecca L. Sexton
Karl W. J. Williard
John W. Groninger

James J. Zaczek is Associate Professor of Forest Ecology, Rebecca L. Sexton is an undergraduate student, Karl W. J. Williard is Assistant Professor of Forest Hydrology, and John W. Groninger is Associate Professor of Silviculture, Department of Forestry, Southern Illinois University, Carbondale, IL 62901-4411. Corresponding author J. Zaczek; telephone: (618) 453-7465; e-mail: zaczek@siu.edu

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Abstract: The objectives of this research were to identify factors that influence rhizome cutting propagation of giant cane (*Arundinaria gigantea*) and to develop procedures for producing machine-plantable stock for use in canebreak restoration. Phase I of the study investigated factors that influenced culm production from rhizome sections under intermittent mist in the greenhouse. Rhizome sections with at least 10 internodes that were surface planted and exposed to sunlight produced greater numbers of culms compared to those buried and with fewer internodes. Phase II studied the effect of collection date and site (putative genotype) in the production of culms for rhizomes planted in containers under mist in the greenhouse. Culm production varied by date of collection and genotype, with 76% of 435 rhizomes generating at least 1 culm shoot. Results indicate that rhizome cutting propagation may be used to generate machine-plantable stock for giant cane restoration.

Keywords: giant cane, switchcane, *Arundinaria gigantea*, rhizome cuttings, propagation

Introduction

Giant cane or switchcane (*Arundinaria gigantea* (Walter) Muhl.), a native bamboo and member of the Poaceae family, is a component of bottomland and riparian forest ecosystems ranging from southern Maryland west to southern Ohio, Indiana, Illinois, and Missouri, south to central Florida, and west to Texas (Marsh 1977; Simon 1986). Canebreaks, or giant cane-dominated communities, formerly occupied extensive areas in the landscape throughout the region (Smart and others 1960; Platt and Brantley 1993). However, agricultural and urban land conversion, grazing, and fire suppression have greatly reduced canebreak frequency and extent to a limited number of small patches. Canebreaks are now considered to be a critically endangered ecosystem (Platt and Brantley 1997; Bell 2000; Platt and others 2001).

Canebreaks served as habitat for a number of associated wildlife species (Platt and others 2001), including the endangered (or perhaps extinct) Bachman's warbler (*Verivora bachmanii*) and extremely rare Swainson's warbler (*Limnolophus swainsonii*) (Eddleman and others 1980; Thomas and others 1996; Platt and others 2001). Additionally, giant cane growing in riparian buffers enhances water quality and stabilizes streambanks, reducing nitrates and sediments in ground water and overland flow because of its dense mat of culms and rhizomes (Schoonover 2001; Schoonover and Williard 2003). Consequently, there is considerable interest in canebrake restoration throughout the region. Restoration efforts, however, have been limited by the lack of available planting stock and difficulties propagating the species (Feeback and Luken 1992).

Propagation of giant cane can be carried out either sexually by seeds or asexually through transplanting culms. Seed propagation is problematic because seeds are sporadically produced and are often low in viability (Farrelly 1984; Platt and Brantley 1997). Propagation by digging and transplanting culms and allowing for subsequent spreading of rhizomes is labor intensive, cumbersome, and costly (Platt and Brantley 1993). Using rhizome cuttings to produce planting stock is possible, but little quantitative research has been conducted to determine methods for the successful culm production for the species. The

objectives of this research were to identify factors influencing rhizome cutting propagation of giant cane and to develop methods for producing machine-plantable stock for use in canebreak restoration.

Methods

This paper reports on 2 phases of research. In Phase I, the objective was to determine whether culm (shoot) production was affected by the number of internodes within a rhizome section or by exposure to light during propagation. On September 22, 2000, rhizomes and attached culms were hand dug and collected from 4 different sites in Pulaski County, Illinois. Plant material was bulked together, wrapped in polyethylene to avoid desiccation, and transported to the Forest Education and Research Station (ForestERS) greenhouses at Southern Illinois University for processing. Rhizomes were rinsed in water to remove excess residual soil, had any attached culms removed, and were cut into 3 treatments of varying rhizome lengths (2, 4, or 10 and greater (10+) internodes long). Ninety rhizome sections of each treatment length were randomly located in a heated greenhouse on benches covered in perlite medium. Half (45) of the rhizomes of each internode length treatment were placed on the surface of perlite and the other half buried to a depth of 2 cm (0.8 in) to test for treatment differences relative to exposure to light. Rhizomes were misted for 12 seconds every 6 minutes during daylight hours. Data were collected for culms (shoots) greater than 1 cm (0.4 in) long arising from the rhizomes through December 15, 2000. Because of malfunctioning mist and heating systems in the greenhouse, further work with these propagules was discontinued. Comparisons in culm production among rhizomes of varying lengths and planting position were made relative to the number of internodes in each treatment by using chi-square analysis at $\alpha = 0.05$.

Utilizing findings from Phase I, the Phase II study was designed to determine if rhizome sections could be used to generate machine-plantable stock for site restoration. When temperatures were above freezing and the soil was unfrozen, rhizomes were collected by hand-digging from 2 separate cane patches (putative genotypes or clones) at Butter Ridge Road and Hickory Bottoms, in Pulaski County, Illinois, on 2 dates (February 26 and March 23, 2001). Rhizomes were kept moist and cool but not frozen until processing at the ForestERS greenhouse within 2 days after collecting. In all, 139 rhizome cuttings from collection date 1 and 296 from date 2 were processed. Rhizomes with varying numbers of internodes, but with a mean length of 25.9 cm (10.2 in) (std. error = 0.25 cm [0.10 in]) were planted distal end up slightly off vertical in D40 Deepots (Stuwe and Sons, Inc, Corvallis, OR) having a pot diameter of 6.4 cm by 25.0 cm deep (2.5 by 9.8 in deep) in premoistened peat/composed bark-based medium. At least 3 cm (1.2 in) of each rhizome was left exposed to sunlight and not buried in medium. Pots were placed in a heated greenhouse under a misting regime of 12 seconds every 6 minutes during daylight hours. The number of culms formed that were greater than 1 cm long was noted for each rhizome cutting on April 18, 2001. Rhizomes that formed culms were later transplanted outside to determine future

field survival and growth. A chi-square-based test procedure was used to test if the mean percentage of rhizomes that produced at least 1 culm differed by collection date or by collection location (putative genotype) at $\alpha = 0.05$ (Hines and Sauer 1989; Sauer and Williams 1989).

Results

Phase I

Surface-planted rhizomes produced 75 culms compared to the 26 culms produced by buried rhizomes (Table 1). For those rhizomes planted below the medium surface, culm production was independent of the treatment (number of internodes per rhizome section) ($P = 0.200$). When planted on the surface, culm production was dependent on the number of internodes per rhizome ($P \leq 0.001$). Considering the total number of internodes that were in each treatment (2, 4, and 10+), surface-planted rhizomes with 10+ internodes averaged the fewest number of internodes (7.9) needed to produce at least 1 culm. In other words, cutting rhizomes up into sections with fewer internodes (as was the case in the 2 and 4 internode pieces) resulted in fewer culms produced for a given amount of available rhizome tissue. It was observed that when multiple culms formed on a rhizome section, the buds distal to the original culm from which the rhizome was detached tended to sprout first and grow more rapidly, resulting in longer culms than those of more proximal origin.

Phase II

Of the 435 rhizome sections planted in containers, 76% produced at least 1 culm, 28% had produced 2 or more culms, and 9% produced 3 culms. Culm production varied by collection site (putative genotype) and date of collection (Table 2). Rhizomes collected from Hickory Bottoms were more likely to form at least 1 culm than those from Butter Ridge Road for both the first ($P < 0.001$) and second ($P = 0.005$) collection dates. The percentage of culm-producing rhizomes did not differ between dates for collections at Hickory Bottoms ($P = 0.590$); collections from Butter Ridge Road differed among dates ($P < 0.001$). Even though the majority of the rhizome sections were planted below the surface of the medium, 75% of the culms were produced from the portion of rhizome above the surface of the potting medium.

Discussion

Exposure of rhizomes to sunlight during propagation increased the number of culms that were produced, particularly for those that were greater than 10 internodes long. We had noticed that rhizome sections that had previously been uprooted in the field and left exposed to sunlight on the soil surface tended to form culms more often, whereas portion of rhizomes remaining below the surface had fewer culms. Although not specifically referring to the propagation of giant cane, Bell (2000) suggests that other leptomorphic (running) bamboo species can be propagated by rhizome cuttings with no need for light until culms form.

Table 1—The number of giant cane culms generated from buried (2 cm [0.8 in] deep) and surface planted 2, 4, and 10+ internode rhizome sections (n = 45 for each treatment combination) cultured under intermittent mist.

Rhizome placement	Number of internodes per section	Total internodes	Number of culms generated	Mean number of internodes per culm
Buried	2	90	0	—
	4	180	4	45
	10+	575	22	26
Surface	2	90	4	22
	4	180	6	30
	10+	513	65	8

Table 2—Influence of collection date and site (putative genotype) on the production of at least 1 culm from giant cane rhizomes planted in containers.

Date	Collection site	Number of rhizomes	Percentage of rhizomes producing 1 culm or more
February 26, 2001	Butter Ridge Road	76	61
	Hickory Bottoms	63	81
March 23, 2001	Butter Ridge Road	183	77
	Hickory Bottoms	113	82

In our study, we observed light-exposed rhizomes growing on the mist bench surface or those partially unearthened in the field change from their normal tan color to green. This may suggest that the rhizomes become photosynthetic and thus provide energy needed to help stimulate production and the growth of culms. Exposure to light of normally shaded or light-excluded tissues may also stimulate bud break from dormant buds, as is seen in the production of epicormic shoots in trees (Kozłowski and Pallardy 1997). Light stimulation of dormant buds on rhizomes was apparent, as 75% of the culms arose above the potting medium surface even though most of the rhizome was buried.

Simon (1986) and Bell (2000) recommend collecting rhizomes of related cane species for propagation in the late winter and early spring. We found that culm production from rhizome cuttings was greater when collected in early spring compared to those collected in late winter (at least for one putative genotype). However, considerable numbers of culms were also generated from the 10+ internode treatment exposed to light from rhizomes that were collected in the autumn.

It has been recommended that rhizome sections should be 45 to 60 cm (18 to 24 in) long when used for cutting propagation (McClure 1993). In our study, although the rhizomes were about half that size, 76% of them produced culms. Smaller rhizome sections offer the advantage of being able to set out more propagules with the same amount of collected plant material. Additionally, smaller rhizomes are easier to handle for outplanting.

Results demonstrate that giant cane planting stock of a manageable size for machine planting under field conditions can be produced by using rhizome cuttings under intermittent mist. Preliminary outplanting observations indicate that the majority of this planting stock has survived through the first 2 growing seasons and has begun to

spread. Containerized giant cane planting stock has great potential to improve the feasibility and success of canebreak restoration efforts.

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