GIANT CANE PROPAGATION TECHNIQUES FOR USE IN RESTORATION OF RIPARIAN FOREST ECOSYSTEMS

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ABSTRACT.—This study was initiated to determine factors important for rhizome cutting propagation of giant cane for use in canebreak restoration. Experiment I showed that greater numbers of culms were produced for rhizomes with more internodes especially when surface planted rather than buried. Experiment II determined that 76 percent of the 435 rhizomes tested produced at least one culm and, of these, 28 percent had produced two or more culms. Culm production varied by date of collection and collection site (putative genotype). These results suggest that rhizome cutting propagation may be used to improve the success of giant cane restoration efforts.

Giant cane (*Arundinaria gigantea* (Walter) Muhl.), a member of the *Bambusoidae* division of the grass family *Poaceae* (Simon 1986), is a component of bottomland and riparian forest ecosystems in 22 states throughout the southeastern United States. Its range extends from southern Maryland west to southern Ohio, Indiana, Illinois, and Missouri, south to central Florida, and west to Texas (Marsh 1977). Giant cane dominated communities or canebreaks formerly occupied extensive areas throughout the region. However, land conversion for agricultural purposes, grazing, and fire suppression has greatly reduced the number and extensiveness of giant cane dominated communities with most being restricted to small patches. Cane-breaks are now considered by some to be a critically endangered ecosystem (Platt and Brantley 1997, Bell 2000, Platt and others 2001).

The reduction of canebreak habitat has led to a decline in associated wildlife species (Platt and others 2001), most notably Swainson's Warbler (Thomas and others 1996). Giant cane vegetation in riparian zones enhances water quality because of its dense mat of culms and rhizomes that stabilize streambanks. Additionally, riparian zone canebreaks have high infiltration rates and are effective filters of agricultural runoff (Schoonover 2001). Consequently, there is great interest in giant cane restoration within the region. Unfortunately, giant cane restoration has been limited by the lack of available planting stock and the lack of practical methods of propagating the species (Feeback and Luken 1992).

Giant cane can be propagated sexually but seed is sporadically produced and is characterized by low viability (Farrelly 1984, Platt and Brantley 1997). The species also spreads by rhizomes and can be asexually propagated by digging and transplanting culms or culm offsetting. However, this method is labor intensive, cumbersome, and costly (Platt and Brantley 1993). Rhizome cuttings could potentially be used but little is known about factors that are associated with successful shoot (culm) production for the species. The objective of this study was to determine whether giant cane culms can be produced from rhizome cuttings in a framework that produces machine-plantable stock.

METHODS

This paper reports on two experiments. In Experiment I, rhizomes were dug on 2000 September 22 at four different sites in Pulaski County, Illinois. Plant material was bulked together, kept moist, and transported to the Forest Education and Research Station (ForestERS) greenhouses at Southern Illinois

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University for processing. Any attached culms were removed from rhizomes and they were cut into pieces that were 2, 4, or 10 and greater (10+) internodes long. Ninety rhizome sections of each internode length were randomly located on greenhouse benches. To test for differences in planting position, half (45) of the rhizomes of each internode length were placed on the surface of perlite and the other half buried to a depth of 2 cm. Plant material was misted for 12 seconds every 6 minutes during daylight hours.

Production of culms greater than 1 cm long arising from rhizomes was noted through 2000 December 15. Because of malfunctioning mist and heating systems that impacted the study, further work with propagules of Experiment I were 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.

Experiment II involved collecting rhizomes from two separate cane patches (putative genotypes, Butter Ridge Road and Hickory Bottoms) in Pulaski County, Illinois, on two dates (2001 February 26 and 2001 March 23). Rhizomes were kept moist and cool until processing at the ForestERS greenhouse within 2 days after digging. Rhizomes with a mean length of 25.9 cm (std. error = 0.25 cm) were planted distal end up slightly off vertical in D40 Deepots (Stuewe and Sons, Inc., Corvallis, OR) having a pot diameter of 6.4 cm by 25 cm deep in pre-moistened peat/composed bark based media. At least 3 cm of each rhizome was not buried in media and exposed to sunlight. After potting, plant material was misted for 12 seconds every 6 minutes during daylight hours. In all, 139 rhizome cuttings from collection date 1 and 296 from date 2 were processed.

On 2001 April 18, the number of culms formed greater than 1 cm long were noted for each rhizome cutting. 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 one culm differed by collection date or by collection location (putative genotype) at alpha = 0.05 (Hines and Sauer 1989, Sauer and Williams 1989).

RESULTS EXPERIMENT I

There were 75 culms produced from rhizomes that were surface planted versus 26 culms from those planted below the surface (table 1). The longer rhizome pieces (10+ internodes) tended to produce more culms. This was especially true when left unburied and planted on the surface. When considering only those rhizomes planted below the media surface, culm production was independent of rhizome length treatment when considered relative to the total number of internodes in each rhizome length treatment ($p = 0.200$).

When planted on the surface, culm production was dependent on rhizome length treatment ($p \leq 0.001$). Considering the total number of internodes for each rhizome length (2, 4, and 10+) surface-planted rhizomes with 10+ nodes averaged the fewest number of internodes (7.9) to produce a culm. When multiple new culms were formed on a rhizome, the buds distal to the culm that the rhizome originated from tended to sprout first and these culms were also longer than those of more proximal origin.

RESULTS EXPERIMENT II

Of the 435 rhizomes tested, 76 percent produced at least one culm and, of these, 28 percent had produced two or more culms and 9 percent produced three culms. Of the rhizomes that

Table 1.—*The number of culms produced from buried and surface planted 2, 4, and 10+ internode long sections of giant cane rhizomes cultured under intermittent mist*

Rhizome placement	Number of internodes per section (n = 45 each)	Total internodes	Number of culms produced	Mean number of internodes per culm produced
Buried 2 cm	2	90	0	—
Buried 2 cm	4	180	4	45.0
Buried 2 cm	10+	575	22	26.1
Surface	2	90	4	22.5
Surface	4	180	6	30.0
Surface	10+	513	65	7.9

produced culms, 25 percent produced culms that originated on the portion of the rhizome planted below the potting media surface. Culm production varied by collection site (putative genotype) and date of collection (table 2). Rhizomes from Hickory Bottoms stock were more likely to form at least one culm than those from the Butter Ridge Road site 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 Bottom ($p = 0.590$) but collections from Butter Ridge Road differed among dates ($p < 0.001$).

DISCUSSION

Findings in Experiment I suggested that exposure of rhizomes to sunlight appeared to increase the number of culms that were produced particularly for those that were greater than 10 internodes long. Although not specifically propagating giant cane, Bell (2000) suggests that other leptomorphic (running) bamboo species can be propagated by rhizome cuttings but there is no need for light until culms form. Our observations of rhizomes exposed to light when grown on the mist bench surface or those partially unearthed by digging in the field turn from their normal tan color to green suggesting that they become photosynthetic which may provide needed energy to help stimulate production of culms.

Sudden exposure to light may also stimulate bud break from dormant buds, as is the case in the production of epicormic shoots in trees (Kozlowski and Pallardy 1997). Light stimulation of bud break from dormant buds on rhizomes may have occurred in Experiment II as only 25 percent of the culms were formed below ground even though most of the rhizome length was buried.

Simon (1986) and Bell (2000) suggest that late winter and early spring are recommended times for collecting rhizomes for propagation in related cane species. Our results bear this out as 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) and especially for those collected in fall.

It has been suggested that rhizome pieces should be from 45-60 cm long for cutting propagation (McClure 1993). In the present study, the rhizomes were about half that size and 76 percent of them produced culms. Smaller rhizomes, if successful at producing culms, offer the advantage of being able to produce more planting stock with less rhizome material and are easier to handle for outplanting.

We found that it is possible to produce giant cane planting stock that is a manageable size for machine planting under field conditions by using rhizome cuttings under intermittent mist in a greenhouse. Preliminary outplanting results suggest that this stock is capable of surviving through at least the first growing season. Utilizing containerized giant cane planting stock may improve the success of canebreak restoration efforts.

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Table 2.—*The influence of date of collection and collection area (putative genotype) on the production of at least one culm from giant cane rhizomes*

Date	Collection area	Number of rhizomes tested	Percentage of rhizomes that produced at least one culm
Feb. 26	Butter Ridge Road	76	60.6
	Hickory Bottom	63	81.0
Mar. 23	Butter Ridge Road	183	77.1
	Hickory Bottom	113	82.1

LITERATURE CITED

Bell, M. 2000. The gardeners guide to growing temperate bamboos. Portland, OR: Timber Press. 159 p.

Farrelly, D. 1984. The book of bamboo. San Francisco, CA: Sierra Club Books. 340 p.

Feeback, D.; Luken, J.O. 1992. Proper transplanting method critical in restoration of canebrakes (Kentucky). Restoration and Management Notes. 10: 195.

Hines, J.E.; Sauer, J.R. 1989. Program CONTRAST - a general program for the analysis of several survival or recovery rate estimates. Tech. Rep. 24. U.S. Department of Interior, Fish and Wildlife Service.

Kozlowski, T.T.: Pallardy, S.G. 1997. Physiology of woody plants. New York, NY: Academic Press. 411 p.

Marsh, D.L. 1977. The taxonomy and ecology of cane, *Arundinaria gigantea* (Walter) Muhlenberg. Fayetteville, AR: University of Arkansas, 303 p. M.S. thesis.

McClure, F.A. 1993. The bamboos. Boston, MA: Smithsonian Institution Press. 345 p.

Platt, S.G.; Brantley C.G. 1993. Switchcane propagation and establishment in the southeastern United States. Restoration and Management Notes. 11: 134-137.

Platt, S.G.; Brantley C.G. 1997. Canebrakes: an ecological and historical perspective. Castanea. 62: 8-21.

Platt, S.G.; Brantley, C.G.; Rainwater, T.R. 2001. Canebreak fauna: wildlife diversity in a critically endangered ecosystem. Journal of the Elisha Mitchell Scientific Society. 117(1): 1-19.

Sauer, J.R.; Williams, B.K. 1989. Generalized procedures for testing hypotheses about survival or recovery rates. Journal of Wildlife Management. 53: 137-142.

Schoonover, J.E. 2001. Attenuation of nutrients and sediment in agricultural surface and subsurface runoff by giant cane and forest riparian buffer zones. Carbondale, IL: Southern Illinois University. 138 p. M.S. thesis.

Simon, R.A. 1986. A survey of hardy bamboos: their care, culture, and propagation. Combined Proceedings of the International Plant Propagators Society. 36: 528-531.

Thomas, B.G.; Wiggers, E.P.; Clawson, R.L. 1996. Habitat selection and breeding status of Swainson's warblers in southern Missouri. Journal of Wildlife Management. 60: 611-616.