Propagation of Giant Cane (*Arundinaria gigantea*) Using Rhizome Cuttings©

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INTRODUCTION

There is a great deal of interest in the ecological restoration of giant cane or switchcane (*Arundinaria gigantea* (Walter) Muhl.), a North American native bamboo. A member of the *Poaceae* family, the species 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). Giant cane dominated communities better known as canebreaks formerly occupied extensive areas throughout the region (Smart et al., 1960; Platt and Brantley, 1993) but land conversion has greatly reduced canebreak ecosystems to a fraction of their former extent. Canebreaks are now considered to be a critically endangered ecosystem that hosts a number of rare wildlife species (Platt and Brantley, 1997; Bell, 2000; Platt et al., 2001). Giant cane growing along streams, lakes, and wetlands can serve as a filter that enhances water quality, stabilizes stream banks, and reduces nitrates and sediments in runoff because of its dense thickets of culms and below ground rhizomes (Schoonover, 2001; Schoonover and Williard, 2003). However, cane restoration efforts have been hindered because of difficulties propagating the species and the lack of available planting stock (Feeback and Luken, 1992).

Giant cane reproduces by seed or vegetatively through spreading of rhizomes. Seed is sporadically produced and is often low in viability (Farrelly, 1984; Platt and Brantley, 1997) presenting difficulties for nursery propagation. Digging and transplanting culms is labor intensive, cumbersome, and costly (Platt and Brantley, 1993) and is limited primarily to removing cane growing in existing field sites. Rhizome cuttings can produce culms for planting stock but there is little quantitative research comparing techniques to do so. This paper describes factors that influence rhizome cutting propagation of giant cane in the greenhouse in containers to produce machine-plantable stock for canebreak restoration.

METHODS

Two greenhouse studies were conducted. Study 1 investigated whether shoots (culms) could be generated from rhizomes and whether rhizome length influenced culm production. Additionally, based on field observations in disturbed areas, we suspected that exposing rhizomes to light may influence culm production. On 22 Sept. 2000, rhizomes and attached culms with root systems were hand dug from four different sites in Pulaski County, Illinois. Plant material was wrapped in polyethylene to avoid desiccation and transported to greenhouses at Southern Illinois University (SIU). Rhizomes were removed from culms and rinsed to remove residual soil. Rhizomes were cut into three treatments: 2, 4, or 10 and greater (10+)

internodes long. Ninety rhizome sections of each treatment length were randomly located on perlite-covered benches in a heated greenhouse. Half (45) of the rhizomes of each internode length treatment were placed on the surface of perlite and the other half were buried to a depth of 2 cm and both were misted for 12 sec every 6 min during daylight hours. Shoots (culms) greater than 1 cm long arising from the rhizomes were noted through 15 Dec. 2000. Because of malfunctioning mist and heat systems in the greenhouse, further work with these propagules was discontinued. Comparisons in shoot production by length and light treatments were statistically tested using chi-square analysis at alpha=0.05.

Using results from Study 1, Study 2 was conducted to determine if date of collection, cane collection location (putative genotype), and rhizome size (length, diameter, and number of nodes) were related to culm production in a system generating machine-plantable stock in containers for ecological restoration. Rhizomes were collected by hand-digging from two separate cane patches (which may have been two separate clones) at Butter Ridge Road and Hickory Bottoms, in Pulaski County, Illinois, on 26 February and 23 March 2001. On 26 Feb. 2001, 139 rhizomes and on 23 March 2001, 296 rhizomes were collected. Rhizomes were kept moist and cool before processing which occurred within 2 days after collection. Rhizomes having a mean length of 25.9 cm (std. error=0.25 cm) and varying number of nodes were planted distal end up slightly off vertical in D40 Deepots (pot diameter of 6.4 cm by 25.0 cm deep, Stuewe and Sons, Inc. Corvallis, Oregon) in pre-moistened peat and composted bark-based media. At least 3 cm of each rhizome was left unburied and exposed to sunlight. Pots were placed in a heated greenhouse under 12 sec of mist every 6 min during daylight hours. The number of shoots (culms) formed that were greater than 1 cm long was noted for each rhizome cutting on 18 April 2001. Rhizomes forming shoots were later transplanted in field plantings in early summer. Chi-square tests were completed to determine if rhizomes that produced shoots differed by collection date or by collection location (putative genotype) at alpha=0.05 (Hines and Sauer, 1989; Sauer and Williams, 1989).

In the early Summer of 2001, propagules that produced shoots were transplanted at two field sites. At Rose Farms, the planting received some irrigation and weed control during the first growing season. At SIU Farms half of the outplanted cane was planted in initially weed-free spots and others in an established mix of herbaceous plants and did not receive irrigation.

RESULTS AND DISCUSSION

In the fall rhizome collection of Study 1, rhizome sections planted on the surface exposed to light produced 75 culms compared to 26 culms produced by buried rhizomes (Table 1). Bell (2000) states that leptomorphic (running) cane can be propagated by rhizome cuttings without light, at least until culms form. We observed that light-exposed rhizomes change from their normal tan color to green. This suggests that the rhizomes become photosynthetic and may provide energy needed to help initiate and grow culms. Additionally, light exposure may also affect internal auxin status through photo degradation releasing buds from auxin-induced suppression. For buried rhizomes, culm production did not depend upon the number of internodes ($p=0.200$). When surface planted, culm production was greater for longer rhizomes ($p< 0.001$) and rhizome sections with 10+ internodes averaged the fewest

Table 1. Study 1 results for the number of giant cane culms generated after 85 days from buried (2 cm deep) and surface planted 2, 4, and 10+ internode rhizome sections (n=45 for each treatment combination) cultured under intermittent mist.

Rhizome placement	Internodes per section (no.)	Total internodes	Culms generated (no.)	Internodes per culm mean number
Buried	2	90	0	--
	4	180	4	45.0
	10+	575	22	26.1
Surface	2	90	4	22.5
	4	180	6	30.0
	10+	513	65	7.9

Table 2. Study 2 results showing the influence of collection date and site (putative genotype) on the production of at least one culm from giant cane rhizomes planted in containers.

Date	Collection site	Rhizomes (no.)	Rhizomes producing one culm or more (%)
26 February 2001	Butter Ridge Road	76	60.6
	Hickory Bottoms	63	81.0
23 March 2001	Butter Ridge Road	183	77.1
	Hickory Bottoms	113	82.1

number of internodes (7.9) needed to produce at least one culm. Two- and four-node rhizome pieces resulted in fewer culms produced per node of rhizome tissue. For those rhizome sections that formed multiple culms, buds distal to the original culm tended to sprout first and grow more rapidly compared to those of more proximal origin. These results suggest that it may be advantageous to leave the distal end of the culm unburied and exposed to light when planting rhizome sections.

Of 435 rhizomes sections planted in containers in Study 2, 76% produced one or more culms, 28% produced two or more culms, and 9% produced three culms. Even though less than 20% of the rhizome was planted below the surface of the media, 75% of the culms were produced from light-exposed portions. Rhizomes originating from different locations (putative genotypes) differed in culm production (Table 2): those collected from Hickory Bottoms produced culms more frequently compared to those from Butter Ridge Road for both the first ($p<0.001$) and second ($p=0.005$) collection dates. Rhizome production was independent of date for collections at Hickory Bottoms ($p=0.590$) but was dependent on date for those from Butter Ridge Road ($p<0.001$). Collecting rhizomes for the propagation of other related cane species is recommended during the late winter and early spring (Simon, 1986; Bell, 2000). We found greater culm production from rhizome cuttings when collected in early spring compared to late winter. Others have recommended that rhizome cuttings be 45-60 cm long for propagation (McClure, 1993). In our study, with rhizomes about half that size, 76% of them produced culms. Somewhat smaller rhizomes as we had used in Study 2 (mean length of 25.9 cm) may allow for generating a greater number of propagules with limited plant material. Additionally, smaller rhizomes allow for utilizing smaller containers and facilitate easier handling.

Survival after one growing season was 63% at the Rose farms site where plants had been irrigated and received competition control compared to 43% survival at SIU farms under essentially no aftercare. The planting stock was relatively underdeveloped, planted less than 4 months after the initial collection and potting which may have affected their field survival. Observations on root development at the time of field planting suggest that surviving plants had more developed root systems. Longer development in containers may increase competitiveness after field planting. By 3 years after planting, nearly 40% of the plants were still alive and were spreading by rhizomes.

These studies demonstrate that giant cane nursery stock of a manageable size can be produced for machine planting under field conditions utilizing rhizome cuttings. Culm production by rhizome sections depended on light exposure, collection date, site of collection, and rhizome size. We suggest that culms be cultured longer after formation and further developed to produce more competitive planting stock before field planting to help ensure survival.

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