area to another, including from inside to outside, should be provided.

Colored lights can be used effectively in the landscape, but they should not be overused. Many colors used simultaneously in a small area can create a busy, confusing atmosphere and should be avoided. Clear light brings out the intensity of all colors.

The Planning Process

Landscape lighting is often an after-thought, but should be planned before the first plant is transplanted into the landscape (1, 2). Examine the overall landscape plan and identify the access routes to the house as well as play and service areas. Determine the focal points in the landscape and assess the potential benefits of illuminating features at these focal points. Locate electrical service junction boxes and landscape elements such as pools that would interfere with placement of electrical wires and light fixtures.

If no other lighting is provided, the path from the driveway and/or street should be lighted. Flood lights positioned on the corners of a house generally do not adequately light the access or entrance area. These lights are usually designed to provide light on objects to be viewed from inside the house and can limit the vision of someone approaching the house. Work and play areas should be next on the priority list to be lighted. Down-lighting is most effective in such areas. Light fixtures positioned at least 14 feet above the children's area in a tree or on a pole have proven effective.

Once the locations of lighting fixtures have been determined, an electrical system must be planned to connect them to the elecctrial source. It is recommended that a certified electrician be consulted on this process. The position of lighting fixtures relative to each other and the electrical source is the first consideration in determining the number of circuits needed. A large number of circuits will add more flexibility in the use of the system, but also adds to the installation costs.

Installation and Estimated Costs

Low voltage lighting systems are recommended to maximize the safety of the system during *its operation.* Installation of a low voltage sytem is also not as dangerous as the installation of a high voltage system. Although low-voltage lighting systems can be purchased, they usually do not provide the flexibility necessary to provide a complete, interesting and effective landscape lighting plan.

The central core of a low voltage lighting system is the transformer that reduces standard 110-volt house current to 12 volts. The size of transformer needed depends upon the total wattage of the fixtures in a system. Timers or other types of controllers are connected to the transformer and the individual circuits are wired to the controller. Water-proof wire and switches, sockets and fixtures rated for outdoor use should be used. A more detailed examination of a residential lighting system is presented in Florida Cooperative Extension Service Circular 588, available from county extension offices (3).

Installation costs will differ with the size of the system and the accessibility of electrical current suitable for outdoor service. However, the equipment and materials costs necessary for a low voltage, residential lighting system comprised of 19 fixtures, a transformer and time-clock controller has been estimated at $500. Operating costs obviously depend on the frequency and duration of use. Assuming flexibility to operate several lighting circuits independently, the average annual cost of a system described above would $80 to $100.

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BAMBOO—AN EMERGING PLANT FOR INTERIORS

RICHARD W. HENLEY AND RICHARD T. POOLE
University of Florida, IFAS
Central Florida Research and Education Center—Apopka
2807 Binion Road, Apopka, FL 32703

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Abstract. **Considerable interest in usage of selected bamboo species and cultivars as indoor ornamentals has developed recently. Eleven bamboos are presently listed by Florida wholesale nurseries for commercial interiorscapes. Of 16 bamboo species evaluated at CFREC-Apopka, *Bambusa oldhami, B. vulgaris* 'Vittata', *B. glaucescens* and *Sasa palmata* seem to have the most interiorscape potential. *Pseudosasa japonica* was taller when grown under 47 percent shade compared to plants under full sun, but plant grade and number of culms were the same. Development of rhizomes through container drainage holes were the same whether grown in conventional round pots or pyramid root pruning containers.**

Bamboos are members of the grass family, *Gramineae,* and are indigenous to every continent except Europe and Antartica (6); approximately 1000 species of bamboo are reported to exist worldwide (7). Bamboo has a long history of utility in many areas of the world where it is used for many types of construction, tools, food, fuel, paper and

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other applications. Farrelly (3) provides descriptions and drawings of many structural and mechanical applications of bamboo utilized by several cultures.

Bamboo has also been used as a landscape plant for centuries, particularly in southern Asia. Reported observations and measurement of bamboo in Florida appear sporadically throughout the proceedings of this Society (volumes 9, 12, 18, 19, 23, 25, 27, 34, 44, 60 and 85). To date, these articles have concentrated on propagation, culture and exterior landscape properties of relatively few bamboo species.

The most recent interest in bamboo in the United States has been for interior applications as foliage plants. A few foliage plant nurseries in southern Florida list several species and cultivars finished in containers for the interiorscape trade. The purpose of this paper is threefold: 1) report those bamboos which are currently available in wholesale quantities from Florida nurseries, 2) present the results of an evaluation of several container-grown bamboo produced in Apopka, and 3) describe the results of an experiment to measure the influence of container design and light intensity on growth of one monopodial species of bamboo.

Currently available bamboo

Wholesale availability lists, advertisements in two national interiorscape magazines (4 and 5) and the *Florida Foliage Locator* (2) were surveyed for species and cultivars of bamboo produced for the interiorscape trade. Eleven different bamboos were listed in the 1987 trade publications examined. A tabulation of the plants and number of Florida wholesale nurseries listing each item is presented in Table 1. Additional species and cultivars are being grown commercially in Florida and will probably be listed at the wholesale level as desired sizes become available. Plants were advertised in a container diameter range of 15 to 91 cm, depending upon the species and nursery. At this time, *Bambusa vulgaris* 'Vittata' and *Phyllostachys nigra* 'Henon' are sold in greatest volume for interiorscapes. Many of the applications require plants of 6 m or more in height.

Bamboo evaluation

Origin, USDA landscape hardiness zone and maximum height and culm diameter of 16 different bamboo species and cultivars used in a containerized plant production evaluation at Central Florida Research and Education Center—Apopka during 1986-1987 are presented in Table 2. Plant size information refers to the maximum dimensions of established plants growing in the ground, under ideal environmental conditions for each species (1). This data gives some indication of relative hardiness, degree of winter protection required and possible application of containerized plants, though it does not reveal the local climatic influence of central Florida or influence of container size on development.

Bare-root divisions of 16 species and cultivars of bamboo were potted 12 June 1986 in 8-liter containers with a 3:1 mix (Florida peat:builder's sand, v:v) amended wih 4.0 kg dolomite and 0.9 kg Micromax (Sierra Chemical Co., Milpitas, CA 95035) per cubic meter. Plants were maintained in a shadehouse with 3,000-4,000 ft-c natural light and a temperature range of 20-35°C. Plants received 10 g 19-2.6-10 (N-P-K) slow release fertilizer (Sierra Chemical Co., Milpitas, CA 95035) per 8-liter container per 3 months. On 7 Apr. 1987 two plants of each type were transplanted to 16-liter containers and placed in full sun to be grown on with 15 g of 19-2.6-10 per container per 3 months. Measurement of plant height, number of culms, foliage characteristics, and number of rhizomes penetrating the container drainage holes were made 21 Sept. 1987 (Table 3).

Table 1. A partial list of bamboos and number of Florida wholesale sources, which advertised plants for interiorscape application—1987.

Horticultural name Common name	Number of nurseries listing species
Bambusa glaucescens Hedge bamboo	1
Bambusa tuldoides Punting pole bamboo	1
Bambusa ventricosa Buddha's belly	1
Bambusa vulgaris 'Vittata' (*B. vulgaris* 'Aureo-Variegata') Hawaiian striped bamboo	3
Phyllostachys aurea Golden bamboo	2
Phyllostachys aureosulcata Yellow grove bamboo	1
Phyllostachys dulcis Sweetshoot bamboo	1
Phyllostachys meyeri Meyer bamboo	1
Phyllostachys nigra Black bamboo	1
Phyllostachys nigra 'Henon' Henon black bamboo	1
Shibataea kumasaca	1

Arundinaria gigantea produced a dense stand of culms but there was a distinct lack of lateral branching and attractive foliage.

Of the 16 species examined, *Bambusa* species had the most vigor throughout the summer of 1987, and resulted in the tallest plants. *Bambusa glaucescens* cultivars produced rather stiff, upright plants with numerous culms that lacked graceful lateral branch development. 'Alphonese Karr' culms emerged with pink and green stripes which later changed to golden yellow and green. The white sectors initially observed in foliage of 'Silver-Stripe' were not evident during the summer.

Bambusa oldhami had upright culms, with full, open lateral branches and coarse foliage. This species had unique character and stood out among the species evaluated.

Bambusa ventricosa developed the Buddah's belly configuration on only a few culms. This was probably due to an adequate supply of water, potting media and fertilizer during culm development. Wide spreading lateral shoots from the base to top made this species difficult to utilize indoor without extensive pruning, particularly the removal of some lateral shoots from the base.

Bambusa vulgaris 'Vittata' had beautifully striped culms (golden yellow and dark green) which changed little as they matured. This was the most vigorous plant in evaluation. The "parent" culm, which was collected from Hawaii, had considerable mechanical injury evident on the surface that detracted from its beauty. It would seem that plants that are entirely nursery grown will be most attractive.

Table 2. Origin, landscape hardiness, and maximum[z] height and culm diameter of 16 bamboos used in a containerized plant production evaluation, 1986-1987.[y]

Horticultural name Common name	Origin	USDA hardiness zone	Height (m)	Culm diameter (cm)
Arundinaria gigantea Canebreak	Se. U.S.	7	4.6	1.9
Bambusa glaucescens 'Alphonse Karr' Alphonse Karr hedge	China	9	3.0	3.2
Bambusa glauscescens 'Silver-stripe' Silverstripe hedge bamboo	China	9	3.0	3.2
Bambusa oldhami Oldham bamboo Giant clumping timber bamboo	China, Taiwan	10	16.8	8.3
Bambusa ventricosa Buddha's belly bamboo	S. China	10	16.8	5.7
Bambusa vulgaris 'Vittata' Gold-stripe common bamboo	China	10	18.0	12.7
Chimonobambusa quandragularis Square-stem bamboo	China	8	9.0	2.5
Otatea acuminata Mexican weeping bamboo	C. & S. America	10	6.0	3.8
Phyllostachys aurea Golden bamboo	China	8	6.0	4.1
Phyllostachys bissettii	China	10	7.0	2.2
Phyllostachys nidularia Big node bamboo	China	8	10.0	3.8
Phyllostachys nigra Black bamboo	China	8	7.9	3.2
Phyllostachys nigra 'Henon' Henon black bamboo	S. China	8	15.2	7.6
Phyllostachys purpurata	China	8	5.5	1.9
Pseudosasa japonica Arrow bamboo	Japan	8	4.6	1.9
Sasa palmata	Japan	7	2.4	7.9

[z]When grown in the ground under ideal environmental conditions.
[y]Most data were adapted from Hortus Third (1). Additional information was provided by Robert Perry, Sunset Nursery, Tampa, personal communication.

Table 3. Growth and landscape design characteristics of sixteen containerized species or cultivars of bamboo growth in full sun, Apopka, FL, 1987.

Horticultural name	Height (cm)	Culm diameter (mm)	Culms (no)	Rhizome habit[z]	Rhizome through drainage holes (no)	Branching habit[y]	Foliage color[x]	Foliage texture[w]	Foliage density[v]
Arundinaria gigantea	85	4.5	52	M	2	SU	IG	I	D
Bambusa glaucescens 'Alphonse Karr'	178	9.4	26	S	0	SU	LG	F	I
Bambusa glaucescens 'Silver-stripe'	198	11.2	15	S	0	SU	LG	F	I
Bambusa oldhami	195	19.1	5	S	0	US	LG	VC	O
Bambusa ventricosa	173	14.2	12	S	0	US	IG	I	I
Bambusa vulgaris 'Vittata'	230	14.7	2	S	0	SU	IG	C	O
Chimonobambusa quandrangularis	103	7.0	38	S	0	SU	IG	C	O
Otatea accuminata	158	13.2	3	M	1	US	LGG	VF	O
Phyllostachys aurea	140	9.1	10	M	2	US	LG	I	I
Phyllostachys bissettii	92	4.9	14	M	6	US	DG	I	D
Phyllostachys nidularia	83	6.1	11	M	3	US	DG	I	D
Phyllostachys nigra	142	9.5	13	M	2	US	DG	I	D
Phyllostachys nigra 'Henon'	150	7.7	14	M	3	US	IG	I	D
Phyllostachys purpurata	95	5.0	9	M	4	US	DG	I	I
Pseudosasa japonica	72	4.4	22	M	9	US	IG	C	D
Sasa palmata	39	4.4	29	M	7	LS	DG	C	D

[z]Rhizome habit: M = monopodial or running, S = sympodial or clumping.
[y]Branching habit: LS = low spreading, US = upright spreading and SU = stiff upright.
[x]Foliage color: LGG = light grayish green, LG = light green, IG = intermediate green and DG = dark green.
[w]Foliage texture: VF = very fine, F = fine, I = intermediate, C = coarse and VC = very coarse.
[v]Foliage density: O = open, I = intermediate and D = dense.

Chimonobambusa quadrangularus was prolific in production of stiff upright culms which lacked extensive lateral shoot development. Plants did not have unique or particularly desirable appeal as a pot plant.

Otatea accuminata was unique, with very thick rhizomes, prominent culms, and fine, grayish green leaflets on wide spreading lateral branches. The plant was intermediate between monopodial and sympodial rhizome development and production of new culms was slow. Plants are best suited to containers sizes 50-cm and larger, due to wide spacing culms.

As a group, *Phyllostachys* did not develop culms of substantial caliper or height in full sun during the spring and summer in Apopka. Growth tended to be erratic and grassy. *Phyllostachys aurea, P. nigra* and *P. nigra* 'Henon' produced a few culms of desirable caliper and character but most culms which emerged from below the medium surface were very weak. All the culms of *P. bissettii, P. nidularia* and *P. purpurata* were thin and limber. Since *Phyllostachys* species evaluated are adapted to temperate climates, their production and landscape utilization should be encouraged further north than central Florida.

Pseudosasa japonica produced a coarse textured, dark green canopy which could be used as a tall ground cover. *Sasa palmata* developed a dark green, coarse textured canopy which has excellent low-to-medium height ground cover potential.

In this study, *Bambusa oldhami* and *B. vulgaris* 'Vittata' seemed to have the most potential as interior trees. With removal of some lower lateral branches to expose more culms on *B. ventricosa,* it should also be an acceptable tree. Cultivars of *B. glaucescens* might be considered for small tree applications if the clumps are thinned by culm removal and some of the lower laterals removed. The best ground cover evaluated was *Sasa palmata.* The long term position of the bamboos in the interior plant industry will require several more years of plant evaluation, experience in plant production and maintenance under interiorscape conditions. The plants are more difficult to grow in containers and manage under interiorscape conditions than commonly used foliage plants.

Container design comparison

On 7 Apr. 1987 plants of *Pseudosasa japonica,* Arrow Bamboo, in 8-liter round containers were transplanted to 12-liter nursery containers of two designs: conventional round or square, "pyramid root pruning" square containers (Imperial Plastics, 101 Oakley Street, Evansville, IN 47706-0958). Both containers had 4 drainage holes per unit. Plants in each container type were grown in full sun and in a shadehouse with maximum light levels of 3,000-4,000 ft-c, in this 2x2 factorial experiment. Measurement of plant height, number of culms per pot, plant quality grade and rhizomes growing through the container drainage holes were made on 21 Sept. 1987.

Table 4. Influence of container design and light level on growth of Arrow Bamboo, *Pseudosasa japonica,* Apopka, FL, 21 Sept. 1987.

Treatment	Culms (no)	Height (cm)	Plant grade[z]	Rhizomes through drainage holes (no)
Light intensity				
Full sun	21	73	2.7	7.5
47% shade	18	92	2.8	7.4
Significance	NS[y]	*	NS	NS
Container configuration				
Round	20	85	2.7	7.1
Square	20	80	2.8	7.8
Significance	NS	NS	NS	NS

[z]Plant grade: 0 = nonsalable, 5 = excellent quality.
[y]NS, * = Non-significant and significant at the 5% level.

Growth in height of *P. japonica* was influenced significantly only by light level (Table 4). Plants in full sun were shorter than those grown under 47 percent shade. Number of culms, plant grade and rhizome growth through the container drainage holes were not significantly influenced by the square, "pyramid root prunning containers" or light level.

Growth of rhizomes through the drainage holes of containers is a problem confronting nurserymen attempting to grow the monopodial bamboos. To date, container design modification and porous fabric ground covers (woven and nonwoven) have not restricted rhizome growth sufficiently to prevent rooting into the ground below the container A very shallow saucer or plate will help.

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