survived (Table 1). This survival rate was lower than that normally obtained during the summer by Burbage Tree Movers, but they usually put the trees in a holding area with frequent overhead irrigation for 2 to 6 weeks before transplanting. Visual ratings after 21 and 37 days were greater if trees were irrigated daily than those irrigated weekly. Sixty-seven, 80, 38, and 54% of trees survived when sprayed with water, Wilt-Pruf, or Cloud Cover or treated with Terra-Sorb, respectively.

Cloud Cover resulted in less leaf drop on day 6 than Wilt-Pruf and the effects of the control and Terra-Sorb were intermediate (Table 1). There were no differences in leaf drop due to treatments on days 15 or 21. There was no significant correlation between initial leaf drop and survival of these trees.

Neither antitranspirants nor the Terra-Sorb caused significant differences in visual quality rating of trees on day 36, 57, and 250 (Table 1). However, the quality rating of trees that survived was increased by Cloud Cover (3.0) compared to Wilt-Pruf (2.5), Terra-Sorb (2.4), and the control (2.5) on days 36 and 57. Mean branch tip growth was increased by the daily irrigation regime (2.7 inches) compared to weekly irrigation (2.2 inches) only if Terra-Sorb had been added to the planting hole. Otherwise, branch growth was not affected by treatments.

Transplanting 4-inch caliper live oaks in August in central Florida is risky under conditions described in this paper. Cloud Cover applied in the manner described in this paper was of no benefit to the trees in terms of survival, but improved slightly the visual appearance of surviving trees approximately 1 and 2 months after transplanting. Terra-Sorb increased spring growth when the trees were irrigated daily. Wilt-Pruf appeared to help in terms of survival. This study provided extreme conditions for tree survival and treatments might perform differently under different conditions.

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RESPONSE OF FOUR WOODY ORNAMENTAL SPECIES TO A SUPERPHOSPHATE-AMENDED CYPRESS SAWDUST, SAND, AND SEDGE PEAT MEDIUM.

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Abstract. **Shoot dry weights for *Ilex cornuta* Lindl. & Paxt. 'Burfordii Nana', *Juniperus chinensis* L. 'Parsonii', and *Ligustrum japonicum* Thunb. 'Variegatum', and root dry weights of *I. cornuta, J. chinensis,* and *Magnolia grandiflora* L. were not different after 9 months when grown in a 4 cypress sawdust: 1 sand: 1 sedge peat (v/v/v) medium with or without superphosphate (20% P) at 148 g P/m³. The growing medium for all species was amended with sludge (5.2N-2.2P-OK) at 9 kg/m³ and received monthly surface applications of Shore 8N-3.4P-6.6K (13 g) and sludge (13 g). Growing medium P levels 36, 151, and 238 days after potting were not different for any of the species, except for *J. chinensis* at day 36 and *L. japonicum* at day 151. Growing medium P levels for *J. chinensis* and *L. japonicum* were higher without (10 and 46 ppm, respectively) than with superphosphate (5 and 32 ppm, respectively).**

Most container-grown woody ornamentals are grown in media amended with superphosphate (9 or 20% P) and subsequently fertilized with slow-release fertilizers that contain P. Gouin and Link (2) and Yeager and Wright (6) have grown quality *Ilex crenata* 'Helleri' in 3 peat: 2 sand (v/v) and pine bark media, respectively, not amended with superphosphate but fertilized with surface applications of slow-release fertilizers that contain P. Therefore, the benefit of amending media with superphosphate is questionable if additional P is applied. The purpose of this research

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was to compare the vegetative growth of 4 woody ornamental species grown in a 4 cypress sawdust: 1 sand: 1 sedge peat medium (v/v/v) with and without a superphosphate (20% P) amendment.

Materials and Methods

Six-month old multiple branched liners of *Ilex cornuta* 'Burfordii Nana', *Juniperus chinensis* 'Parsonii', *Ligustrum japonicum* 'Variegatum', and *Magnolia grandiflora* seedlings (15 cm) were potted 17 Jan. 1983 in 6-liter containers with a 4 cypress sawdust: 1 sand: 1 sedge peat (v/v/v) medium. The potting medium was amended with 2.4 kg/m^3 of dolomitic limestone; 9 kg/m^3 of activated sewage sludge (5.2N-2.2P-OK, Shore Fertilizer Company, Plant City, FL); 37 g/m^3 each of $CuSO_4$, $ZnSO_4$, and NaFeEDTA; and 74 g/m^3 of $MnSO_4$. The medium contained 19.5% air space (5) and a particle size distribution (by weight) of 28% less than 0.5 mm, 33% between 0.5 mm and 1.4 mm, 26% between 1.4 mm and 4.0 mm, 8% between 4.0 mm and 6.4 mm (U.S. Series sieve #35, 14, 5 and 3, respectively), and 5% greater than 6.4 mm. Particle size distribution was obtained by shaking 3 replicate samples on a Tyler Portable Sieve Shaker (W. S. Tyler Inc., 8200 Tyler Blvd., Mentor, OH) for 20 min.

One-half of the medium was amended with 148 g P/m^3 from superphosphate (20% P). Thirty single-plant replicates of each species for the medium amended and not amended with superphosphate were arranged in a completely randomized design. Each container was placed on black plastic at Gramling Nursery, Inc., Plant City, FL and received 26 g of fertilizer (6.6N-2.8P-3.3K) monthly, which was applied to the surface of the growing medium. Fertilizer was composed 50% by weight of Shore 8N-3.4P-6.6K (a trademarked fertilizer of Shore Fertilizer Co., Plant City, FL) and sewage sludge (5.2N-2.2P-OK). Plants were watered as needed by overhead irrigation with approximately 2.5 cm per application. Maximum and minimum air temperatures (1) during the 9-month experimental period averaged 28 and 16°C, respectively, for Plant City, FL (latitude 28°00′ N, longitude 82°07′ W).

Thirty-six, 151, and 238 days after potting (T1, T2, and T3, respectively) 3 samples were obtained from the medium with and without superphosphate for each species. Each sample was comprised of approximately 10 core samples selected randomly from the 30 containers of medium with and without superphosphate. One core sample was obtained from the medium by pushing a 2.5-cm soil probe through the growing medium. Nitrate N, P, and K of each sample were determined according to the procedures for the University of Florida Soil Testing Laboratory (4).

On 12 October, *M. grandiflora* heights were measured from growing medium surface to the uppermost shoot tip and caliper was measured 2.5 cm above the uppermost roots; *I. cornuta* shoot tips were counted and stems of all plants were severed above the uppermost roots. Roots were washed, shoot and root dry weights were recorded, and shoot tissue P levels were determined (3).

Results and Discussion

Shoot dry weights for *I. cornuta, J. chinensis,* and *L. japonicum* and root dry weights for *I. cornuta, J. chinensis,* and *M. grandiflora* were not different when grown with or without a superphosphate amendment (Table 1). This concurs with the findings of Yeager et al. (8) who grew *I. vomitoria* 'Schellings Dwarf', *J. chinensis* 'Blue Vase', *Pittosporum tobira,* and *Photinia* x *fraseri* in a 1 sedge peat: 1 cypress sawdust: 1 cypress shavings (v/v/v) medium with or without superphosphate. Yeager and Wright (6) also determined that superphosphate was not necessary for *I. crenata* 'Helleri' grown in a 100% pine bark medium and subsequently fertilized with slow-release fertilizers supplying P. Root dry weights of *L. japonicum* were larger when grown without the superphosphate amendment, while the number of shoot tips for *I. cornuta* was not different with or without superphosphate.

Shoot dry weights, height, and stem caliper of *M. grandiflora* were greater for plants grown with superphosphate (Table 1) even though growing medium P levels with and without superphosphate were not different at T1, T2, or T3 (Table 2). Additionally, the greater growth for *M. grandiflora* grown with superphosphate can not be explained by growing medium NO_3 or K levels (data not shown).

Except for *J. chinensis* at T1, and *L. japonicum* at T2, growing medium P levels at T1, T2, and T3 were not different for any of the species grown with or without the superphosphate amendment (Table 2). Growing medium P levels for all species tended to increase from T1 to T3, which is in contrast to previous experimentation (8) where growing medium P levels decreased with time for superphosphate-amended media. However, in this study P levels increased whether or not superphosphate was used, indicating the increase in P levels was not attributable to superphosphate, but was probably a result of P mineralization of the sludge and/or the monthly fertilization with 8N-3.4P-6.6K. The P carrier resulting in the increase in growing medium P was not determined by this research.

Table 1. Shoot and root dry weights of 4 woody ornamental species and other selected growth parameters for *Magnolia grandiflora.* All plants were grown 9 months in a 4 cypress sawdust: 1 sand: 1 sedge peat (v/v/v) medium with or without a superphosphate (20% P) amendment (148 g P/m^3).

Phosphorus amendment g/m^3	*I. cornuta*			*J. chinensis*		*L. japonicum*		*M. grandiflora*			
	Dry weights (g)		Number of shoot tips	Dry weights (g)		Dry weights (g)		Dry weights (g)		Height of shoots (cm)	Stem caliper (mm)
	Shoots	Roots		Shoots	Roots	Shoots	Roots	Shoots	Roots		
148	52	21	22	156	38	88	30	81	34	70	15
0	44	20	25	166	41	83	39	54	24	52	13
	ns	ns	ns	ns	ns	ns	*	*	ns	*	*

ANOVA nonsignificant (ns) or significant at 5% (*) level

Table 2. Water extractable P levels (ppm) from a 4 cypress sawdust: 1 sand: 1 sedge peat (v/v/v) medium with or without a superphosphate (20% P) amendment (148 g P/m³).

Phosphorus amendment g/m³	*I. cornuta*			*J. chinensis*			*L. japonicum*			*M. grandiflora*		
	T1[z]	T2[y]	T3[x]	T1	T2	T3	T1	T2	T3	T1	T2	T3
148	6.8	37	47	4.6	40	56	10.9	32	72	8.6	36	76
0	17.7	31	44	10.4	34	50	12.7	46	64	11.0	31	65
	ns	ns	ns	*	ns	ns	ns	*	ns	ns	ns	ns

ANOVA nonsignificant (ns) or significant (*) at 5 % level

[z]T1 = 36 days after potting
[y]T2 = 151 days after potting
[x]T3 = 238 days after potting

Table 3. Shoot tissue P percentages for 4 woody ornamental species grown 9 months in a 4 cypress sawdust: 1 sand: 1 sedge peat (v/v/v) medium with or without a superphosphate (20% P) amendment (148 g P/m³).

Phosphorus amendment g/m³	*I. cornuta*	*J. chinensis*	*L. japonicum*	*M. grandiflora*
148	0.22	0.32	0.20	0.16
0	0.20	0.32	0.16	0.16
	ns	ns	*	ns

ANOVA nonsignificant (ns) or significant (*) at 5% level

Shoot tissue P levels (Table 3) were not different for *I. cornuta, J. chinensis,* or *M. grandiflora* grown with or without superphosphate. Shoot tissue P levels for *L. japonicum* were greater for plants grown with than without superphosphate. However, shoot dry weights for *L. japonicum* were not different indicating luxury consumption of P even though growing medium P levels at T2 were higher without than with the superphosphate amendment. Yeager and Wright (7) determined that *I. crenata* 'Helleri' absorbed excessive quantities of P at growing medium P levels higher than 5-10 ppm, and 5-10 ppm P were determined to be optimum growing medium P levels for *I. crenata* 'Helleri'. Growing medium P levels for all species in our experiment were higher than 10 ppm at T2 and T3.

These data indicate a superphosphate amendment (148 g P/m³) is not necessary when growing *I. cornuta* 'Burfordii' Naná, *J. chinensis* 'Parsonii', and *L. japonicum* 'Variegatum' in a 4 cypress sawdust: 1 sand: 1 sedge peat medium (v/v/v) fertilized with 9 kg/m³ of sludge (5.2N-2.2P-OK) and receiving monthly surface applications of Shore (13 g) 8N-3.4P-6.6K and sludge (13 g).

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