SECTION 8
PROPAGATION

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Rooting and Survival of Stewartia monadelpha Cuttings in Gypsum-amended Rooting Media.

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Georgia

Nature of Work: Rooted shoot cuttings of Stewartia monadelpha Sieb. & Zucc. often break bud in the spring after rooting and then produce weak growth, wilt, and then die (5). This phenomenon of wilting could be caused by cold damage to the vascular system or insufficient reserves to support growth. This wilting may also be due to calcium deficiency that causes a leaf edge burn (3). The roots of these wilted cuttings exhibit another symptom of calcium deficiency: browning and death of root tips(3).

The purpose of this experiment was to determine if calcium supplied by gypsum in the rooting media could increase the survival of the rooted cuttings.

Materials and Methods: Four- to six-inch long, terminal, semi-hardwood cuttings were collected from a l0 yr-old landscape specimen of S. monadelpha on 8 July 1991. The bases of the cuttings were dipped in 8000 ppm of the potassium salt of lH-indole-3-butanoic acid (KIBA) in water for 5 sec and placed in 2.5 in x 2.5 in x 3 in deep pots containing a 2 perlite: l peat (v:v) rooting medium containing different levels of gypsum. The treatments consisted of rooting media amended with 0 (control), 2, 4, and 6 lbs per cu. yd. of gypsum (minimum calcium: 20%). Gypsum was used as a source of calcium to prevent any difference in media pH from confounding the results. The cuttings were misted for 2 l/2 sec every 7 minutes for 7 weeks on a greenhouse propagation bench.

The rooted cuttings were moved from the greenhouse to a plastic-covered overwintering house on 3 Dec. Cuttings were not exposed to temperatures below 32F. Rooting results (5 Sept l99l) and survival data (l June 1992) were assessed on 5 blocks of 5 cuttings per treatment per block. The leachate calcium and pH were measured on 5 Sept. and 3 Dec.

Results and Discussion: The pH of the media on 5 Sept. (4.5) and 3 Dec. (5.2) did not differ among the treatments. Similarly, the measured calcium levels (1 to 2 ppm) did not vary among the treatments on the two dates. Most of the calcium may have leached out of the media before the first measurement (6). Little calcium was supplied during irrigation, as the leve1 of the calcium in the tap water was less than 10 ppm.

As the amount of calcium in the media increased, the number of roots decreased and the average root length increased (Tab. l) Eliasson (2) demonstrated that calcium was necessary for continued root elongation, but the root number: root length response to calcium in the media varies among taxa (4). The total root length was similar for all treatments; thus, no treatment differences in subsequent growth are expected.

The levels of calcium used in the study may not have been high enough to prevent observed wilting as the measured values of calcium in the media (1 to 2 ppm) were lower than recommended levels of 10 to 15 ppm (7). The treatment levels were selected because Diver and Whitcomb (1) observed decreased rooting of Juniperus conferta at dolomitic limestone levels above 4 lbs per cu. yd.

Differences in medium calcium levels did not prompt any differences in survival (Table 1). Typically, a low percentage of S. monadelpha rooted cuttings survive the winter. However, in this study and a previous one (5) conducted by the senior author, a large percentage of rooted cuttings have survived the winter. Mild winter temperatures during both studies may have improved survival, but the effect of milder winter temperatures on survival is unclear. The senior author has observed 0% survival in preliminary studies even though the cuttings were not exposed to temperatures below 32F.

Significance to the Industry: This study and a previous study have demonstrated that S. monadelpha cuttings can overwinter successfully in a plastic-covered house in Georgia. Amending the media with calcium supplied with gypsum does not increase the survival percentages of the cuttings. Further research is required to determine why some S. monadelpha cuttings grow weakly in the spring, wilt, and then die.

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Table 1: Rooting and survival of Stewartia monadelpha cuttings as influenced by gypsum incorporation into the rooting media.

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Gypsum (lbs/cu. yd)	Rooting percentage	Number of roots	Average root length(mm)	Total root length(mm)	Survival percentage
0	92	30	l 1	344	84
2	100	27	14	399	88
4	84	24	14	341	64
6	92	24	16	406	80
Linear	n.s.	*	*	n.s.	n.s.
Quadratic	n.s.	n . s .	n.s.	n.s.	n.s.

-Cuttings inserted 12 July 1991. Rooting data: 5 Sept 1991. Survival data: 1 June 1992.

n.s.,* - non-significance and significance at alpha = 0.5, respectively.

Propagation Medium Moisture Level and Rooting of Woody Stem Cuttings

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Nature of Work: Intermittent mist systems are commonly used to reduce transpirational water loss from cuttings during propagation. A problem with this system is maintaining a wet leaf surface without overwetting the rooting medium. Water and air compete for pore space in a medium (2) and oxygen availability may be reduced as the volume of water in the medium is increased. Studies of various media have revealed that physical characteristics of media, such as particle size, are less deterministic of rooting performance than are air and water content (3,4). Thus, the lack of oxygen in an overwet medium may cause propagation failure.

Cut stems will absorb water from the propagation medium despite limitations to water movement by internal stem resistances and the lack of roots (1). Incomplete contact of the stem cutting base with the film of water surrounding the medium particles can be a major source of uptake resistance. Water uptake by stem cuttings may be directly proportional to the water content of the propagation medium (2). If transpiration exceeds water uptake, cutting turgidity and survival will be reduced.

Propagators face a dilemma in providing adequate but not excessive moisture to stem cuttings both above and below the medium surface. The objective of this study was to determine the influence of a range of moisture levels in the propagation medium on the cutting water potential, adventitious rooting, quality, and survival of stem cuttings of Blue Rug juniper, ‘Hino-Crimson’ azalea, and ‘Helleri’ holly.

Stem cuttings of Blue Rug juniper (Juniperus horizontalis Moench ‘Wiltonii’), ‘Hino-Crimson’ azalea [Rhododendron (Lindl.) Planch ‘Hino-Crimson’], and ‘Helleri’ holly (Ilex crenata Thunb. ‘Helleri’) were propagated in I:I peat/perlite (v/v) at one of five moisture levels based on medium dry weight (125%, 250%, 375%, 500%, or 625%). Under normal intermittent mist situations, a peat/perlite medium would be at 400-500% moisture. Thus, the 625% treatment contained excessive water compared to a “normal” propagation situation. Please consult the Journal of the American Society for Horticultural Science 116:632-636 for more details of this experiment.

Results and Discussion: In all three species, cutting survival and percentage of rooted cuttings was highest at the highest medium moisture level (Table 1.) Incidence of cutting basal rot was not directly related to medium moisture level, but was related more to the growth stage of the stock plant. Midday xylem water potential of cuttings for each species was highest in the wettest propagation medium (about -lMPa) and lowest in the driest medium (about -4MPa), (Data not shown). Basal water uptake by cuttings was highest in the wettest medium moisture level (Table 2). Water uptake was highest during the first few days after insertion, and thereafter decreased until root emergence.

Significance to Industry: These results indicate that excessive amounts of water in the propagation medium are not as inhibitory of rooting of cuttings as once thought. Unrooted cuttings absorb a significant amount of water from the propagation medium and the contact of the basal part of the unrooted stem with free water encourages water uptake. This contact is especially critical during the first few hours after inserting the cuttings into the propagation medium.

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Table 1. Survival, basal rot, and rooting percentages of stem cuttings propagated in a peat/perlite medium at five moisture levels.

Medium moisture (%)	Survival (%)	Basal rot (%)	Rooting (%)
Blue Rug Juniper			
125	77[z]	43	0
250	95	24	0
375	100	43	10
500	100	43	5
625	100	33	48
Significance	**	NS	*
Hino-Crimson Azalea			
125	13	0	0
250	19	0	0
375	81	0	19
500	100	0	38
625	100	0	75
Significance	*	NS	*
Helleri Holly			
125	0[z]	0	0
250	74	0	26
375	96	0	74
500	91	0	74
625	100	0	92
Significance	*	NS	*

Table 2. Water uptake by 27 April 'Helleri' holly stem cuttings from a peat/ perlite medium at five moisture levels.

	Days after sticking					
Medium Moisture	4	8	12	16	23	27
(%)	Water uptake (g)^z					
125	0.16	0.12	0.11	0.06	0.02	0.03
250	0.28	0.17	0.16	0.06	0.32	0.42
375	0.34	0.18	0.12	0.07	0.31	0.42
500	0.20	0.20	0.20	0.05	0.31	0.42
625	0.41	0.35	0.21	0.08	0.17	0.53
Significance (P-values of components)						
Linear	0.08	0.02	0.12	0.79	0.18	0.03
Quadratic	0.94	0.37	0.83	0.82	0.01	0.32

^{z}Mean uptake of 10 cuttings, over previous four days. Linear and quadratic

P-values for uptake data over time were less than 0.05 except at the 125 percent treatment.

Effects of Nutrient Variation on Foster Holly Propagation and Early Development

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Nature of Work: Ilex X attenuata Ashe 'Foster #2' (Foster holly) is a clone notorious among ornamental producers for variable branching structures and plagiotropic growth among propagules. As demand for the clone changes, producers often discontinue production for a time before resuming propagation with cuttings indiscriminately obtained from trees in landscapes or other sources. Understanding sources of variation among and within stock plants should lead to a better understanding of factors retained in cuttings that affect propagation and early plant development.

Twenty-four stock plants of Foster holly were randomly selected which sampled the available range of sizes (2 to 24 feet) in landscapes in the Huntsville and Decatur, Alabama area. Selected plants were judged to be in good health as reflected by leaf color and the production of sufficient current season's growth to make cuttings. Age of selected plants (2 to 28 years) was estimated by counting annual growth rings in cores taken 6 inches above ground level. Ramets were arbitrarily subgrouped by age with plants 2 to 6 years in group 1, plants 9 to 16 years in group 2, and plants 19 to 24 years in group 3.

Cuttings were collected from 2 ft horizontal bands around the crown of each plant, beginning at the band from ground level to 2 ft and continuing up the entire crown of each tree on July 1-3, 1989. Twenty, 2.5 inch long terminal cutting of uniform diameter were randomly selected within each band with a total of 100 bands sampled in the 24 stock plants.

Bottom leaves were removed from the base of each cutting and grouped to form a composite sample (sample 1) from each band. Three to five terminal leaves were retained on each cutting which was then dipped for 5 seconds in 2500 ppm IBA and stuck in four randomized blocks in unitized trays in a mixture of 1:1 Canadian peat and perlite by volume and placed in a greenhouse. Mist was applied to cuttings from 8 a.m. until 5 p.m. every 15 minutes for 15 seconds on sunny days. The greenhouse was covered with 55% transmittance shade fabric throughout the experiment.

By August 7, 1989 (5 weeks) the majority of cuttings had rooted and misting was discontinued. Plants were thereafter fertilized weekly with a 175 ppm drench of 20-20-20 with supplemented micro-elements (0.05% Mg, 0.05%

Fe, 0.0031% Mn, 0.0025% Zn, 0.0036% Cu) (W.R.Grace, Fogelsville, PA). Day length was maintained at 14 hours with cool-white fluorescent lights and the minimum temperature was fixed at 65°F. Composite foliage samples (sample 2) were collected from propagules from each band on Jan 10, 1990 (6 months). Plants were then pruned back to two nodes above the original cutting and allowed to go dormant for approximately two months by discontinuing fertilization, artificial lighting, and subjecting the material to seasonal temperature fluctuations. A minimum temperature of 33°F was maintained, however, to prevent freeze injury.

In early March growth resumed under natural conditions so the minimum temperature was raised to 65°F and weekly fertilization resumed. Plants had regrown to approximately the same size as before pruning on August 8, 1990 when leaf samples (sample 3) were again collected from the plants representing original bands.

Results and Discussion: Age group, plant per age group and band within the plant had no significant effect on the number of Foster holly cuttings which rooted. Differences in leaf nutrient levels between sampling dates occurred for N, P, K, Ca, Mg, Mn, and Cu but not for Fe and Zn. Age group and band where the sampled cuttings originated did not affect the foliage nutrient content of any of the nine elements. There was a consistent pattern of differences for all elements except Fe in the leaf samples from individual plants within the three age groups. Such differences were anticipated because the twenty-four sampled sock plants were being maintained with random fertility programs.

The number of rooted cuttings was positively correlated with the Zn levels in leaf samples collected when cuttings were prepared for propagation while rooting was negatively correlated with increased levels of K, Ca, and Mg. Mean levels of N and Cu were indicated to be below the optimum range for the first sampling interval (when the cuttings were collected) while mean levels of K, Ca, Mg, and Mn were indicated to be above optimum levels. Mean levels of P were within the optimal range (Smith and Gilliam, 1981; Jones et al., 1991).

Correlations between the nine elements sampled revealed that N, P, and Cu levels had a highly positive relationship as did K, Ca, Mg, and Mn levels. However, elements in the two groupings were consistently negatively correlated with each other for the Foster holly leaf samples analyzed in this study. Levels of Fe and Zn appeared to be independent of other elements sampled.

One goal was to determine how rapidly an environmental factor such as nutrition could be eliminated as a variable in clonal material collected from random environments. After exposure to uniform fertility programs for six and twelve months, mean levels of the nine sampled nutrients were generally in a more optimum range than when cuttings were collected. Coefficients of variation calculated for the three sampling dates indicated the nutrient variation among propagules was reduced for N, P, K, Mg, Mn, and Cu, but not reduced for Ca, Fe, and Zn. The speed at which intraclonal nutrient variation is reduced apparently varies among individual nutrients.

Significance to Industry: Position where Foster cuttings were collected within the plant crown and stock plant age had no effect on rooting percentage of cuttings. Rooting was negatively correlated with levels of K, Ca, and Mg that ranged above levels considered optium while Zn levels above the optimum range inhanced rooting. Foster holly intraclonal variation associated with environmental factors such as stock plant nutrition is retained in propagules for more than a year after uniform cultural pratices are begun and is more difficult to remove from propagules than anticipated. Any program to produce uniform liners should begin with stock plants that are maintained at optimum levels for propagule development.

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Sexual Propagation of Adapted Ornamental Grasses

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Georgia

Nature of Work: After centuries of misunderstanding and avoidance, ornamental grasses are becoming popular in the United States - the New American Garden. Being suitable plant materials in xeriscapes and environmental (low maintenance) gardens, they are being used as specimen plants, intermingled in herbaceous borders, and in developing informal designs of naturalistic landscapes. From the world collection of ornamental grasses, 18 grasses were determined as well adapted to the southeast. Their propagation modes are listed in Table 1. Ten of these are seed propagated, providing an opportunity for nurserymen to expand their plant taxa offerings, particularly when these can be further promoted and contract grown. Production scheduling research was conducted during the past several years to determine scheduling requirements for interested growers. Seeds were sown in greenhouse flats using the usual techniques for artificial soil mixes and liquid fertilizers for producing bedding plants from seeds. Seedlings were transplanted from cell packs to four inch and gallon nursery containers. Their germination, seedling development, and plant development in saleable containers were recorded.

Results and Discussion: Table 2 shows that seed propagated ornamental grasses, although finished in four inch or larger containers, are relatively fast cropping, providing a viable new crop for nurserymen to produce. These data are presented with the intent of comparing economics of production of these grasses with instant color annuals and mainline perennials. Seed germination is fairly rapid in two to four weeks and saleable plants in quarts or gallon containers can be produced in three to four months.

Significance to Industry: Ornamental grasses are being utilized by designers of the “New American Garden” concept where informal designs incorporate environmental plant materials which require reduced maintenance inputs. Research has shown that most grasses are fast cropping and efficient for nurserymen to produce. When markets exist, ornamental grasses should be grown, demonstrated, and promoted.

Literature Cited

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Table 1. Propagation modes of superior ornamental grasses.

Scientific name	Common name	Persistence	Propagation Seeds	Propagation Vegetative
Arundo donax versicolor	Variegated Giant Reed	Perennial		X
Calamagrostis acutifolia	Feather Reed Grass	Perennial		X
Chasmanthium latifolium	Upland Sea Oats	Perennial	X	X
Cortaderia selloana	Pampas Grass	Perennial	X	X
Cortaderia selloana 'Pumila'	Dwarf Pampas	Perennial		X
Elymus glaucus (arenarius)	Blue Lyme Grass	Perennial		X
Erianthus ravennae	Ravenna Grass	Perennial	X	X
Miscanthus sinensis gracillimus	Maiden Grass	Perennial	X	
Miscanthus sinensis variegatus	Variegated Miscanthus	Perennial		X
Miscanthus sinensis zebrinus	Zebra Grass	Perennial		X
Panicum virgatum	Switch Grass	Perennial	X	X
Panicum virgatum rubrum	Red Switch Grass	Perennial	X	X
Pennisetum alopecuroides	Dwarf Fountain Grass	Perennial	X	X
Pennisetum alopecuroides purpurascens	Purple Dwarf Fountain Grass	Perennial	X	X
Pennisetum setaceum	Fountain Grass	Annual	X	
Pennisetum setaceum rubrum	Crimson Fountain Grass	Annual		X
Pennisetum villosum	Feathertop Grass	Perennial	X	X
Phalaris arundinacea picta	Ribbon Grass	Perennial		X
Sorghastrum nutans	Indian Grass	Perennial	X	X

Table 2. Early spring production schedules for sexually propagated southeastern ornamental grasses.

Taxa	Hardiness zone**	Germination	Weeks to: Marketable Plants
Chasmanthium latifolium Upland Sea Oats*	5	4	10
Cortaderia selloana Pampas Grass	8a	3	12
Erianthus ravennae Ravenna Grass	5	3	12
Festuca ovina glauca Blue Sheep Fescue	4	3	14
Panicum virgatum Switch Grass*	5	3	12
Panicum virgatum rubrum Red Switch Grass*	5	3	12
Pennisetum alopecuroides Dwarf Fountain Grass	5	2	12
Pennisetum alopecuroides purpurascens Purple Dwarf Fountain Grass	6	2	12
Pennisetum setaceum Fountain Grass	9	2	12
Pennisetum villosum Feathertop Grass	8a	2	12
Sorghastrum nutans Indian Grass*	6	3	14

* Native to Southeast
** USDA Hardiness Zone Map

Vegetative Propagation of Eastern Redcedar by Stem Cuttings: Factors Affecting Adventitious Rooting

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Nature of Work: Studies were conducted to investigate the effects of season (timing), indolebutyric acid (IBA) application, genotype, crown position, type of cutting (straight vs. heel), cutting length, and stock plant age upon adventitious rooting of stem cuttings of eastern redcedar (Juniperus virginiana L.) (1).

Results and Discussion: Genotype had a strong influence on percent rooting, root number, and root length of cuttings from 4-year-old trees. With trees of this age, percent rooting was maximized (87%) with hardwood cuttings taken in January and treated hith 5000 ppm IBA. Crown position from which cuttings were collected did not influence rooting. Straight cuttings, with or without a light wound, rooted at a significantly higher percentage (78%) than heel cuttings (52%). With 30-year-old trees, cuttings from the lower third of the crown rooted at a significantly higher percentage (67%) than cuttings from the middle third (43%). Better rooting was obtained with straight (68%) cuttings than heel (47%). Cutting length affected rooting, with root number and length maximized in longer cuttings. Increased tree age reduced rooting, although cuttings from 40-year-old trees retained substantial rooting capacity.

Significance to Industry: Seedling populations of eastern redcedar are extremely variable in growth habit and offer considerable potential for selection and propagation of clones with desirable morphological and/or physiological characteristics. Results of this research indicate that vegetative propagation of the species by stem cuttings is feasible and may allow nurserymen to clone superior selections.

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