50% of final germination (Table 3). Prior to freezing, seeds in this study had moisture contents from 21% to 24%. Hartmann and Kester (5) report seeds must be in equilibrium with 70% RH or lower prior to storage at subfreezing temperatures or seed viability will rapidly be lost.

Previous research with palm seed has shown maximum germination depends on collecting seeds from fruit of proper maturity (1, 2), sowing within several months after harvest (7) and maintaining warm temperatures (1, 2, 3). *Coccothrinax argentata* germination was promoted by 35° C germination temperatures, with significant declines in total germination at warmer and cooler temperatures. Days to 50% of final germination were similar at 30° and 35° with significantly more days required at 25° and 40°.

Hartmann and Kester (5) report fluctuating day-night temperatures increase seed germination, with optimum diurnal variations of 10° C. Loomis (7) attributed improved *Hyphaene thebaica* palm seed germination to large daily temperature fluctuations of seeds in alternating sunlight and darkness. In this study alternating temperatures from 25° to 35° or 30° to 40° increased total germination, but delayed germination. Alternating diurnal temperatures have not previously been reported to delay seed germination.

Coccothrinax argentata seed was found to maintain viability during long periods, both at full hydration and low moisture levels. Seed unable to germinate fully hydrated at 25° and 40° C during 23 weeks had 82% and 50% germination respectively after placing at 35° for 4 weeks. Hydrated seed kept at unfavorable temperatures frequently develop secondary dormancy as reported by Thomson (10) for other plant species. Kitzke (6) reported no loss in seed viability of *Copernicia* palm during 9 months of soaking in tap water.

Loomis (7) reported seeds of many palm species lose viability when dehydrated. Our results indicate long-term storage of *Coccothrinax argentata* seed may be possible, since embryos don't shrivel after losing 81% of water content at harvest and storage at subfreezing –10° and –20° C promote increased total germination.

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VEGETATIVE PROPAGATION OF FLORIDA NATIVE PLANTS: III. SHRUBS

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Additional index words. Aronia arbutifolia, Cephalanthus occidentalis, Clethra alnifolia, Cornus foemina, Gaylussacia frondosa var. *tomentosa, Leucothoe racemosa, Lyonia lucida, Rhododendron serrulatum, Viburnum nudum, Viburnum obovatum.*

Abstract. **Time of year when cuttings were taken had a profound influence on rooting of *Aronia arbutifolia* (L.) Ell. (red chokeberry), *Cephalanthus occidentalis* L. (buttonbush), *Clethra alnifolia* L. (sweet pepperbush), *Cornus foemina* Mill. (swamp dogwood), *Gaylussacia frondosa* var. *tomentosa* Gray (dangleberry), *Leucothoe racemosa* (L.) Gray (fetterbush) *Lyonia lucida* (Lam.) K. Koch (shiny lyonia), *Rhododendron serrulatum* (Small) Millais (swamp honeysuckle), *Viburnum nudum* L. (possum haw), and *Viburnum obovatum* Walt. (Walter viburnum). The effect of IBA on quality and quantity of the roots varied with time of the year. In most cases IBA promoted root initiation during flowering period and/or at the end of the growing season but not at other times. In general, species reported here root relatively easily. Available information on germination of seeds is included to facilitate propagation of these taxa.**

Native shrubs are indispensable to revegetation efforts, and of primary concern in wildlife habitat and landscape plantings. Vegetative propagation of *Ilex* (hollies) and four widely adaptable tree species, among those considered for revegetation of phosphate mines, was reported by Dehgan et al. (6, 7). The most significant factors in rooting of cuttings appeared to be time of year and the flowering season. In this paper we report the results of trials with 10 additional shrub species, some are easy to propagate while others are rather specific as to the time of year when best rooting occurs. Promotion of wider use of native plants is one of the primary objectives of this report.

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Materials and Methods

Terminal semi-hardwood cuttings of *Aronia arbutifolia* (L.) Ell. (red chokeberry), *Cephalanthus occidentalis* L. (buttonbush), *Clethra alnifolia* L. (sweet pepperbush), *Cornus foemina* Mill. (swamp dogwood), *Gaylussacia frondosa* var. *tomentosa* Gray (dangleberry), *Leucothoe racemosa* (L.) Gray (fetterbush), *Lyonia lucida* (Lam.) K. Koch (shiny lyonia), *Rhododendron serrulatum* (Small) Millais (swamp honey suckle), *Viburnum nudum* L. (possum haw), and *V. obovatum* Walt. (Walter viburnum), were collected from undisturbed areas of Occidental Chemical Company Mines (Hamilton County) and/or W. R. Grace and Company in Bonny Lake and Four Corners Mines (Polk County). Except where noted, these were collected at approximately six week intervals, placed in plastic bags, moistened, and stored in a 41° F cooler for about 24 hrs. prior to treatment. Five replications of 15 cuttings each were used per treatment. These were dipped in 0, 2,500, and 5,000 ppm IBA for 5 seconds, planted in 1:1 (v:v) mixture of perlite and vermiculite. Flats were placed randomly under mist (5 sec/5 min). The temperature at the propagation greenhouse was maintained at 23 ± 5° C day/18 ± 2° C night. Cuttings were examined weekly for evidence of rooting and final data was collected when at least some appeared ready for transplanting. In a few cases similar data for consecutive months has been omitted from the tables.

Results and Discussion

Aronia arbutifolia (Table 1, Fig. A). Cuttings of red chokeberry exhibited little variation in rooting when taken from April to June. A 5,000 ppm IBA dip improved root initiation and root quality only in March. In general, root quality was superior from April to June. About one-half the time was required to initiation and development of roots when cuttings were taken on May 29th as compared to other collection dates. The higher concentration of IBA had an inhibitory effect on cuttings taken in May. Except for higher rooting percentages in our studies, these findings are similar to those of Dirr and Heuser (8), who reported 80% rooting in June-July when cuttings were dipped in 4,000 ppm IBA solution.

Rapid and uniform seed germination of 94% has been reported by Gill andd Pogge (11) after stratification for 90 days between 32 to 41° F. Similar results were obtained by Dirr and Jeuser (8) who have reported 100% germination when seeds were collected in January with no stratification. Because of the higher winter temperatures in Florida seeds collected at this time probably require a short stratification period.

Table 1. Effect of IBA concentration and time of year on cutting propagation of *Aronia arbutifolia* (L.) Ell.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
03/18/86	05/20/86	WS	Control	61.33 ± 11.47	2.5
03/18/86	05/20/86	WS	2,500 IBA	66.67 ± 15.20	2.5
03/18/86	05/20/86	WS	5,000 IBA	85.33 ± 17.59	3.0
04/10/87	06/10/87	WS	Control	80.00 ± 7.30	3.5
04/10/87	06/10/87	WS	2,500 IBA	90.67 ± 5.33	4.0
04/10/87	06/10/87	WS	5,000 IBA	93.33 ± 8.43	4.0
05/29/87	06/29/87	WS	Control	88.00 ± 12.93	3.5
05/29/87	06/29/87	WS	2,500 IBA	84.00 ± 5.33	3.5
05/29/87	06/29/87	WS	5,000 IBA	64.00 ± 9.04	3.0
06/10/86	08/04/86	WS	Control	93.33 ± 4.22	4.0
06/10/86	08/04/86	WS	2,500 IBA	92.00 ± 7.77	4.5
06/10/86	08/04/86	WS	5,000 IBA	92.00 ± 7.77	4.5

*<2: Unacceptable; 2: Inferior; 3: Good-Acceptalbe; 4: Very Good; 5: Excellent; WS = White Springs

Table 2. Effect of IBA concentration and time of year on cutting propagation of *Cephalanthus occidentalis* L.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
04/23/87	06/05/87	FCM	Control	100.00 ± 0.00	5.0
04/23/87	06/05/87	FCM	2,500 IBA	98.67 ± 2.67	4.5
04/23/87	06/05/87	FCM	5,000 IBA	94.67 ± 2.67	4.5
09/11/86	10/31/86	FCM	Control	66.67 ± 10.33	2.5
09/11/86	10/31/86	FCM	2,500 IBA	69.33 ± 12.36	3.0
09/11/86	10/31/86	FCM	5,000 IBA	66.67 ± 16.33	3.0

*<2: Unacceptable; 2: Inferior; 3: Good-Acceptalbe; 4: Very Good; 5: Excellent; FCM = Four Corners Mine

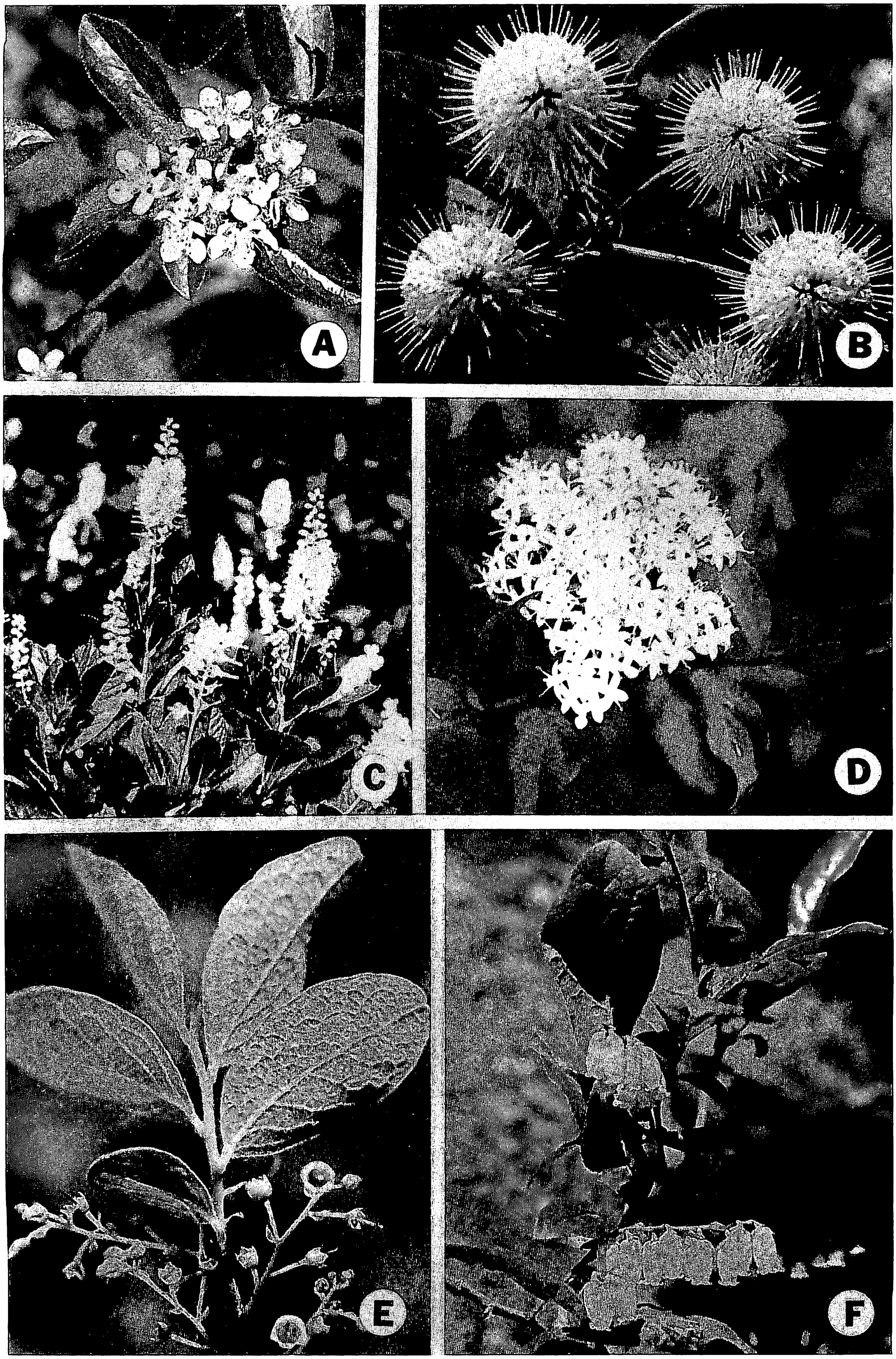
Cephalanthus occidentalis (Table 2, Fig. B). Nearly 100% rooting occurred from March through August, regardless of auxin treatment. Although within the acceptable range the number of cuttings and quality of root decreased significantly in September and remained low through the fall and winter months. Reduction in rooting appeared to be correlated with the onset of flowering and subsequent fruit enlargement in late summer and fall. It should be noted, however, that cuttings taken during the active growing season were soft or only slightly woody, whereas later cuttings had greater secondary growth and were somewhat more woody. These results agree with Dirr and Heuser (8) and those of Everitt and Alaniz (9) for *C. salicifolius*, an endangered species of ornamental value native to Texas. Seeds are said to germinate easily and without stratification or any other treatment (2, 8).

Clethra alnifolia (Table 3, Fig. C). Reduction in rooting during fall and winter months, as was noticed with most genera was also observed in this taxon. Late spring to early summer was the optimal period for vegetative propagation of this species, prior to the onset of flowering. Number

Table 3. Effect of IBA concentration and time of year on cutting propagation of *Clethra alnifolia* L.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
05/01/86	07/07/86	WS	Control	82.67 ± 12.36	3.5
05/01/86	07/07/86	WS	2,500 IBA	89.33 ± 6.80	4.0
05/01/86	07/07/86	WS	5,000 IBA	88.00 ± 7.77	4.0
05/28/87	06/29/87	WS	Control	82.67 ± 8.22	3.0
05/28/87	06/29/87	WS	2,500 IBA	100.00 ± 0.00	4.0
05/28/87	06/29/87	WS	5,000 IBA	100.00 ± 0.00	4.0
06/12/86	08/07/86	WS	Control	94.67 ± 2.67	4.5
06/12/86	08/07/86	WS	2,500 IBA	90.67 ± 6.80	4.0
06/12/86	08/07/86	WS	5,000 IBA	86.67 ± 11.93	3.5
09/25/86	11/13/86	WS	Control	61.33 ± 7.77	2.5
09/25/86	11/13/86	WS	2,500 IBA	62.67 ± 16.11	2.5
09/25/86	11/13/86	WS	5,000 IBA	68.00 ± 18.57	2.5
11/28/86	02/25/86	WS	Control	36.00 ± 9.04	<2.0
11/28/86	02/25/86	WS	2,500 IBA	42.67 ± 18.67	2.0
11/18/86	02/25/86	WS	5,000 IBA	65.33 ± 13.60	2.5

*<2: Unacceptable; 2: Inferior; 3: Good-Acceptalbe; 4: Very Good; 5: Excellent; WS = White Springs



Figs. A-F. Foliar and reproductive characteristics of Florida native shrubs: Fig. A. *Aronia arbutifolia* (red chokeberry); Fig. B. *Cephalanthus occidentalis* (buttonbush); Fig. C. *Clethra alnifolia* (sweet pepperbush); Fig. D. *Cornus foemina* (swamp dogwood); Fig. E. *Gaylussacia frondosa* var. *tomentosa* (dangleberry); Fig. F. *Leucothoe racemosa* (fetterbush.

and quality of roots were superior and rooted cuttings began growing actively while still under mist. IBA was most effective only during fall and winter months, although one additional month was needed for root initiation and/or development. Dirr and Heuser (8) have also noted the ease with which this species can be propagated and suggest no treatment for seed germination.

Cornus foemina (Table 4, Fig. D). Rooting of cuttings taken in September was superior to those taken at any other time of the year, particularly those taken in March when the plants were flowering. IBA significantly increased the number of rooted cuttings in all trials, except during March of 1987. In general, there was a direct relationship between rainfall and rooting of cuttings, irrespective of time of year or the locality where cuttings were collected. This is best illustrated by the difference between the results of March 1986 and 1987. There was considerably less rainfall in White Springs as compared to central Florida during summer of 1986, which probably explains the high rooting percentage in cuttings taken from the Bartow area. Although several related species (e.g. *C. florida* L.) are commonly cultivated in various areas of the country, there exists only scant literature for a few of the species (see for example 3)· We are not aware of any research report on propagation of this taxon.

According to Brinkman (3) and Dirr and Heuser (8), species of *Cornus* have an embryo dormancy which require several months of cold and/or warm stratification. Since this is a particularly attractive ornamental species and a desirable plant for wildlife plantings, future research should concentrate on its seed germination.

Gaylussacia frondosa var. *tomentosa* (Table 5, Fig. E). Propagation of this species was attempted only once, in January 1987. It is included here in part because of its attractiveness in native landscapes and promising wildlife potential. A clear capacity for improved rooting is indicated if cuttings are taken in later months, probably in April or May. Cuttings treated with 2,500 ppm IBA had significantly better rooting than either the control or those treated with 5,000 ppm IBA.

No report on propagation of this species has been found. The related species *G. brachycera*, however, has been reported by Dirr and Heuser (8) to root 100% when treated with 8,000 ppm IBA. The same authors noted 80% and 90% germination when seeds were cold stratified for one and two months, respectively,

Leucothoe racemosa (Data not presented, Fig. F). Except during its winter dormancy (leafless stage), cuttings of this species rooted 100% at all other times of the year. No auxin treatment were necesssary. Propagation of this species has not been reported in the literature, but seed germination can probably be accomplished with ease when sown on peat moss and kept moist.

Lyonia lucida (Table 6, Fig. G). Unlike most species in this report, shiny lyonia has the highest rooting percentage from April through June. Similar to many other species, however, the lowest rooting occurs in March, during the flowering season. This agrees with Schultz's (18) observation that the best time for propagation of *L. lucida* is in June. This is not surprising since the flowering season in this and related taxa of Ericaceae (for example, *Befaria*, *Gaylussacia*, *Rhododendron*, *Vaccinium*, etc.) is from late winter to early spring and is followed immediately by meristematic activity and shoot growth. There are many examples in the literature that show the enzymatic activity

Table 4. Effect of IBA concentration and time of year on cutting propagation of *Cornus foemina* Mill.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
03/04/87	05/09/87	WS	Control	74.67 ± 13.60	3.5
03/04/87	05/09/87	WS	2,500 IBA	74.67 ± 8.84	3.5
03/04/87	05/09/87	WS	5,000 IBA	72.00 ± 15.43	3.5
03/18/86	05/06/86	WS	Control	36.00 ± 29.69	<2.0
03/18/86	05/06/86	WS	2,500 IBA	56.00 ± 12.36	2.0
03/18/86	05/06/86	WS	5,000 IBA	46.67 ± 14.61	2.0
09/11/86	10/31/86	FCM	Control	69.33 ± 18.67	3.0
09/11/86	10/31/86	FCM	2,500 IBA	85.33 ± 12.93	3.5
09/11/86	10/31/86	FCM	5,000 IBA	89.33 ± 3.27	3.5

*<2: Unacceptable; 2: Inferior; 3: Good-Acceptalbe; 4: Very Good; 5: Excellent; WS = White Springs; FCM = Four Corners Mine

Table 5. Effect of IBA concentration on cutting propagation of *Gaylussacia frondosa* (L.) T. & G. var. *tomentosa* Gray.

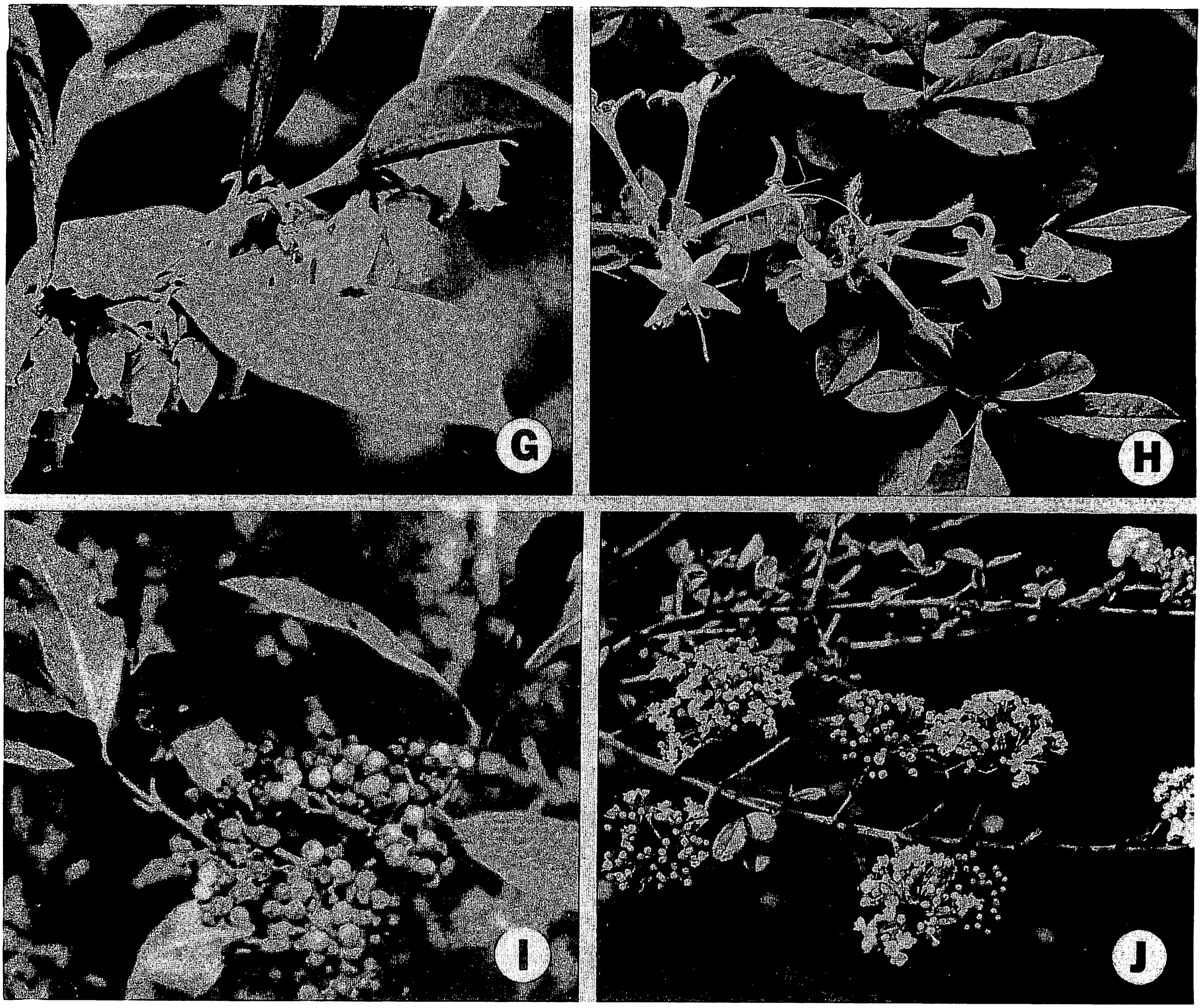
Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
05/28/87	07/30/87	WS	Control	34.67 ± 19.04	<2.0
05/28/87	07/30/87	WS	2,500 IBA	50.67 ± 17.18	<2.0
05/28/87	07/30/87	WS	5,000 IBA	42.67 ± 10.83	<2.0

*<2: Unacceptable; 2: Inferior; 3: Good-Acceptalbe; 4: Very Good; 5: Excellent; WS = White Springs

Table 6. Effect of IBA concentration and time of year on cutting propagation of *Lyonia lucida* (Lam.) K. Koch.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
01/28/87	05/15/87	WS	Control	74.67 ± 10.67	3.5
01/28/87	05/15/87	WS	2,500 IBA	87.67 ± 6.80	3.5
01/28/87	05/15/87	WS	5,000 IBA	80.00 ± 9.43	3.5
03/04/87	06/11/87	FCM	Control	2.67 ± 3.27	<2.0
03/04/87	06/11/87	FCM	2,500 IBA	1.33 ± 2.67	<2.0
03/04/87	06/11/87	FCM	5,000 IBA	4.00 ± 8.00	<2.0
04/10/87	06/30/87	WS	Control	93.33 ± 5.96	4.0
04/10/87	06/30/87	WS	2,500 IBA	93.33 ± 10.33	4.0
04/10/87	06/30/87	WS	5,000 IBA	86.67 ± 26.67	4.0
05/01/86	10/16/86	WS	Control	78.67 ± 14.24	4.0
05/01/86	10/16/86	WS	2,500 IBA	93.33 ± 5.96	4.5
05/01/86	10/16/86	WS	5,000 IBA	94.67 ± 2.67	5.0
06/12/86	08/26/86	WS	Control	98.67 ± 2.67	4.0
06/12/86	08/26/86	WS	2,500 IBA	98.67 ± 2.67	4.0
06/12/86	08/26/86	WS	5,000 IBA	90.67 ± 8.00	3.5
09/25/86	12/29/86	WS	Control	50.67 ± 11.62	2.0
09/25/86	12/29/86	WS	2,500 IBA	44.00 ± 22.94	2.5
09/25/86	12/29/86	WS	5,000 IBA	58.67 ± 11.47	3.0
11/25/86	02/23/87	WS	Control	76.00 ± 13.73	3.0
11/25/86	02/23/87	WS	2,500 IBA	76.00 ± 9.98	3.5
11/25/86	02/23/87	WS	5,000 IBA	88.00 ± 2.67	3.5

*<2: Unacceptable; 2: Inferior; 3: Good-Acceptalbe; 4: Very Good; 5: Excellent; WS = White Springs; FCM = Four Corners Mine



Figs. G-J. Foliar and reproductive characteristics of Florida native shrubs: Fig. G. *Lyonia lucida* (shiny lyonia); Fig. H. *Rhododendron serrulatum* (swamp honeysuckle); Fig. I. *Viburnum nudum* (possum haw); Fig. J. V. obovatum (Walter viburnum).

and endogenous auxin production to be asociated with meristematic activity (1, 14). In softwood cuttings roots often initiate without the aid of exogenous auxins during the active growth period, as exemplified by this and other studies (see for example 5, 6, 7). It is also not surprising that subterminal cuttings root best in the latter part of the season. As rainfall decreases and temperature rises, levels of endogenous auxins as well as carbohydrates (20), are depleted in young growth but somewhat higher amounts are stored in the older portions. Thus, while terminal cuttings root easily in early spring, subterminal and basal cuttings are more apt to root later in the season (17).

Seeds of *Lyonia* germinate without pretreatment (8, personal observation) when sown on peat moss.

Rhododendron serrulatum [= *R. viscosum* var. *serrulatum* (Small) Ahles] (Table 7, Fig. H). Propagation of this species was attempted once in January when the plants were leafless and again in April when they were growing actively. Roots in leafless cuttings developed in April, only after bud break and nearly four months after they were stuck. In contrast, cuttings taken in April rooted relatively rapidly and did not require auxins for root initiation, though root development was somewhat improved when IBA was used.

Propagation of the commonly cultivated *Rhododendron* species and cultivars have been studied and discussed in

Table 7. Effect of IBA concentration and time of year on cutting propagation of *Rhododendron serrulatum* Millais.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
01/08/87	05/21/87	FCM	Control	32.00 ± 15.43	<2.0
01/08/87	05/21/87	FCM	2,500 IBA	41.33 ± 10.67	<2.0
01/08/87	05/21/87	FCM	5,000 IBA	48.00 ± 19.96	<2.0
04/22/87	06/17/87	FCM	Control	93.33 ± 10.33	3.0
04/22/87	06/17/87	FCM	2,500 IBA	94.67 ± 6.53	3.5
04/22/87	06/17/87	FCM	5,000 IBA	85.33 ± 22.86	3.5

*<2: Unacceptable
2: Inferior
3: Good-Acceptalbe
4: Very Good
5: Excellent
FCM = Four Corners Mine

some detail by Dirr and Heuser (8). Native taxa, despite their potential as landscape and honey plants, have been mostly overlooked. The results of some recent studies on the genus are of interest and may be applicable to the native taxa. Supplementary night lighting from low-irradiance incandescent lamps stimulated rooting in *R.* 'Unique' and increased root-ball diameter in spring (February-June) and fall (September-January), but not summer or winter (10). Rooting of *R.* 'Anna Rose Whitney' was also stimulated with high pressure sodium lamps for 16 hrs., while inhibiting rooting or *R.* 'Sonata' (15). Williams and Bilderback (21) reported successful rooting of *R. maximum* L. and *Kalmia latifolia* L. by treating the cuttings with a talc formulation of 2,4,5-trichlorophenoxypropionic acid (Fenoprop). Their results, however, indicated inhibition of rooting by addition of Osmocote (18N-2.6P-10K) to the rooting media. The relationship between root water potential and rooting or *R.* 'Mrs. W. Agnew' was investigated by Loach (16), who concluded that although low mean water potential results in poor rooting, it is the combined effects of current day's water potential and radiation that determines root initiation. Clearly there is a cause and effect relationship between rooting of cuttings and ontogeny of flower-leaf development in *Rhododendron* spp. Unpublished data of the senior author indicated that best rooting in *R. austrinum* (Small) Rheder and *R. canescens* (Michx.) Sweet, two Florida native species, occurred soon after flowering in early spring. That supplementary lighting promotes or lengthens this activity is not surprising. Improved rooting is a secondary benefit of increased photosynthates (4, 20).

Viburnum nudum (Table 8, Fig. I). Primarily an understory species, possum haw can be propagated with relative ease. In concert with the results reported for other taxa in this and earlier papers (6, 7), most rooting occurred in July and least in March, coinciding with flowering. In this case the plant is evergreen and maintains the capacity for rooting throughout the year, though to a much lesser extent during fall and winter months, as well as during flowering. These results agree with that of Schultz (18) for the closely related species, *V. rufidulum* Raf. (rusty-haw). Except in July, utilization of auxin had little or no effect on rooting percentages, but in all cases influenced the quality and quantity of roots. Plants so treated were clearly superior, having a higher rating than the untreated controls.

A comparison of rooting percentages for approximately the same time period, March of 1986 and 1987 reveals an interesting and noteworthy phenomenon. Winter of 1985-86 was dry and cold, while that of 1986-87 was relatively warm and wet. Cuttings taken in March of 1987 had significantly better rooting than those taken in 1986 (*cf.* Table 8). This agrees with Dehgan et al. (5) that cuttings collected from plants in moist soil yield higher rooting percentage than those collected from dry soil. Although in this case warmer weather may have also influenced the rooting success, turgidity of the plants no doubt played a significant role. This is further substantiated by studies of Grange and Loach (13), who studied the effect of light intensity on rooting of *V.* X *bodnantense* and concluded that reduction in rooting is caused by the decrease in leaf water potential which resulted in high accumulation of solutes.

Viburnum obovatum (Table 9, Fig. J). The best rooting in this species occurred in May rather than in July, as was the case with *V. nudum.* The differences in morphology of these species probably affected their rooting potential. The preponderance of small leaves and woodier stem structure in Walter's viburnum plausibly resulted in lower rooting capacity. The effect of flowering (in March) on rooting is also apparent in this taxon. IBA treatments profoundly affected both percentage of cuttings that rooted as well as root quality and quantity.

Studies of Tarasenko et al. (19) which indicated fall as the best season for rooting of viburnums do not agree with our findings, at least for the Florida native taxa. In general, vegetative propagation of various viburnum species is common practice in the nursery industry and not considered difficult. The same cannot be said of seed propagation. In fact, *Viburnum* seeds are considered among the most difficult to germinate. According to Gill and Pogge (12) most taxa have an embryo dormancy and posses an imperme-

Table 8. Effect of IBA concentration and time of year on cutting propagation of *Viburnum nudum* L.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
03/04/87	04/13/87	FCM	Control	9.33 ± 5.33	<2.0
03/04/87	04/13/87	FCM	2,500 IBA	22.67 ± 16.65	<2.0
03/04/87	04/13/87	FCM	5,000 IBA	22.67 ± 19.14	<2.0
04/23/87	06/10/87	FCM	Control	73.33 ± 17.69	3.5
04/23/87	06/10/87	FCM	2,500 IBA	65.33 ± 15.43	3.0
04/23/87	06/10/87	FCM	5,000 IBA	73.33 ± 19.78	3.5
05/08/86	06/18/86	FCM	Control	69.33 ± 17.18	3.0
05/08/86	06/18/86	FCM	2,500 IBA	65.33 ± 18.09	3.0
05/08/86	06/18/86	FCM	5,000 IBA	73.33 ± 21.91	3.0
07/21/86	09/17/86	FCM	Control	94.67 ± 4.99	4.0
07/21/86	09/17/86	FCM	2,500 IBA	93.33 ± 5.96	4.0
07/21/86	09/17/86	FCM	5,000 IBA	96.00 ± 3.27	4.5
10/27/86	12/22/86	FCM	Control	34.67 ± 13.60	<2.0
10/27/86	12/22/86	FCM	2,500 IBA	45.33 ± 12.93	2.5
10/27/86	12/22/86	FCM	5,000 IBA	32.00 ± 11.47	2.0

*<2: Unacceptable
2: Inferior
3: Good-Acceptalbe
4: Very Good
5: Excellent
FCM = Four Corners Mine

Table 9. Effect of IBA concentration and time of year on cutting propagation of *Viburnum obovatum* Walt.

Date stuck	Date rated	Collection site	Treatment (ppm)	Mean % rooting	Root condition*
03/04/87	06/11/87	FCM	Control	8.00 ± 7.77	<2.0
03/04/87	06/11/87	FCM	2,500 IBA	2.67 ± 3.27	<2.0
03/04/87	06/11/87	FCM	5,000 IBA	0.00 ± 0.00	<2.0
05/09/86	06/29/86	FCM	Control	61.33 ± 21.25	3.0
05/09/86	06/29/86	FCM	2,500 IBA	64.00 ± 31.72	2.5
05/09/86	06/29/86	FCM	5,000 IBA	74.67 ± 34.36	3.5
07/22/86	11/01/86	FCM	Control	18.67 ± 9.80	<2.0
07/22/86	11/01/86	FCM	2,500 IBA	28.00 ± 6.53	<2.0
07/22/86	11/01/86	FCM	5,000 IBA	36.00 ± 8.00	<2.0
09/11/86	12/22/86	FCM	Control	26.67 ± 7.30	<2.0
09/11/86	12/22/86	FCM	2,500 IBA	45.33 ± 10.67	2.5
09/11/86	12/22/86	FCM	5,000 IBA	60.00 ± 25.65	3.0
11/27/86	02/23/87	FCM	Control	20.00 ± 11.16	<2.0
11/27/86	02/23/87	FCM	2,500 IBA	29.33 ± 14.97	<2.0
11/27/86	02/23/87	FCM	5,000 IBA	48.00 ± 19.50	2.0

*<2: Unacceptable
2: Inferior
3: Good-Acceptalbe
4: Very Good
5: Excellent
FCM = Four Corners Mine

able seed coat, requiring scarification and stratification. Some success with seed germination of *V. obovatum* has been reported by the nursery industry (pers. comm.).

As a general rule, based on this and the previous reports, it appears that Florida native plants should not be propagated immediately prior to or during flowering periods. Turgidity of the plants as related to available soil moisture is also a determining factor in root initiation and development. It is therefore highly recommended that, when possible, the mother plants be irrigated a few days priot to taking of cuttings. The length of time required for root initiation varies from as little as 3-4 weeks to as long as 3-4 months, depending on time of year, rainfall, flowering season, and other environmental factors. The effectiveness of IBA concentrations greater than 5,000 ppm varies with species. In some it may enhance while in others inhibit root initiation.

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VEGETATIVE PROPAGATION OF FLORIDA NATIVE PLANTS: IV. *QUERCUS* SPP. (OAKS)

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Abstract. **The difficulty in vegetative propagation of oaks and erratic seed production are known facts. Thus, successful propagation of oaks by cuttings is a desirable goal, not only to maintain some degree of uniformity in selected plants but to continue production when acorns are not available. Of the five native Florida plants studied, *Quercus laurifolia* Michx. (diamond-leaf oak) and *Q. virginiana* Mill. (live oak), produced extensive callus but did not initiate roots, irrespective of time of the year or treatment. However, *Q. geminata* Small (sand-live oak) *Q. hemisphaerica* Bartr. (Laurel oak), and *Q. nigra* L. (water oak) exhibited a definite time specificity with respect to root initiation which coincided with the first or second flush of active growth. The positive effect of IBA and/or NAA were most pronounced in *Q. hemisphaerica Q. nigra*, but not in *Q. geminata.* Based on our studies the best time of year for taking cuttings of *Q. geminata* and *Q. nigra* is in July and June, respectively, whereas that of *Q. hemisphaerica* is in April.**

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Although oaks can be propagated by seed easily, their vegetative propagation is notoriously difficult and has been the subject of research by many authors, often without positive results. Two factors in particular contribute to the