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INFLUENCE OF FERTILIZER SOURCE, RATE, AND APPLICATION METHOD ON GROWTH OF *BRASSAIA ACTINOPHYLLA* AND *VIBURNAM ODORATISSIMUM*

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Abstract. **Two 8x3x3 factorial experiments were established 1 May 1984 to determine the effects of 8 fertilizer sources: Osmocote 13-13-13 and 18-6-12, 8 to 9 month release at 21°C; Customblen 17-7-12, 16-month release at 21°C; Customblen 13-13-13, 8 to 9 month release at 21°C, Customblen 13-13-13, 6 to 8 month release at 32°C, Customblen 17-7-12, 6 to 8 month release at 32°C, Customblen 16-7-12, 12-month release at 32°C and SREF 20-4-10, 3 to 4 month release. Each was supplied at 3 N rates; 1.2, 1.8, and 2.4 kg N/m³ and was applied to the surface, dibbled beneath the liner, or incorporated. Treatments were applied to *Brassaia actinophylla* Endl. (schefflera) in 63% shade (63% light attenuation) or *Viburnum odoratissimum* Ker-Gawl. (sweet viburnum) in full sun. Schefflera was grown for 11 months and viburnum for 12 months on a single fertilizer application applied at the beginning of the experiment. Scheffleras with highest grades at termination of the experiment were grown with Osmocote 13-13-13 and 18-6-12, 8-9 month at 21°C and Customblen 17-7-12, 16 month at 21°C. Schefflera grade was also highest when 2.4 kg N/m³ was incorporated. By the end of the experiment, grades for sweet viburnum were on the low side, but in January, Osmocote 13-13-13, 8-9 month at 21°C and Customblen 17-7-12, 16 month at 21°C were the best sources. There was no effect of rate on sweet viburnum and dibble and incorporated application methods were better than surface. Some slow-release fertilizer sources satisfactorily supplied nutrients for 11 months under 63% shade, but not in full sun for 12 months.**

Labor constitutes about 35% of potted plant production costs in Central and South Florida foliage nurseries (10, 11). In comparison, fertilizer and lime contributed slightly less than 1% to production costs. These data indicate that the potential for significant savings in production costs are much greater for factors that influence labor than with costs of fertilizer components.

Considerable research has been conducted on use of Osmocote as a slow-release fertilizer source on foliage plants in Florida since the original work by Waters and Llewellyn (13). Numerous experiments have been conducted using Osmocote as a fertilizer source alone or in comparison with liquid fertilizer or other slow-release sources (2, 3, 4, 5, 7, 9). On *Philodendron,* use of 786 kg N/ha/3 months from 18-6-12 Osmocote produced better plants than those receiving liquid fertilizer or MagAmp at equivalent or other rates (2). Subsequent research on *Chamaedorea, Howea* and *Philodendron* indicated liquid fertilizer at equivalent rates was slightly better than Osmocote (7) and the same results occurred on *Philodendron* and *Chrysalidocarpus* in another experiment (9). Recently, plant producers and researchers became interested in longer-term slow-release fertilizers and their potential for labor savings. Swanson et al. (12) tested 11 slow-release fertilizers with various release rates against liquid fertilizer on woody plants and obtained excellent results with 18-6-12 Osmocote. Method of application for slow-release fertilizers was examined by Blessington et al. (1) who found that surface application of Osmocote 18-6-12 was better than incorporation on *Rhododendron obtusum.*

This research was initiated to determine the effects of a single annual application of slow-release fertilizer on plant growth of a sun and a shade grown plant to determine whether high quality plants could be produced under these conditions.

Materials and Methods

Two 8x3x3 factorial experiments in randomized block design with 4 replicates were established utilizing 8 fertilizer sources, 3 rates, and 3 methods of application on 1 May 1984 utilizing *Brassaia actinophylla* (schefflera) and *Viburnum odoratissimum* (sweet viburnum). The schefflera experiment was terminated 4 Apr. and sweet viburnum 29 Apr. 1985. Schefflera was grown under 63% polypropylene shade (63% light attenuation) and sweet viburnum in full sun. Ten-cm tall liners of each species from 7.5-cm pots were potted into 7.6-liter black containers and spaced 40 cm on center on black ground-pac. Sweet viburnum received 1.25 cm of irrigation water daily and schefflera was irrigated 3 times weekly with 1.25 cm of water. The potting medium was composed of sedge peat moss:mason sand, 3:1 v/v, amended with 0.7 kg MicroMax and 4.2 kg dolomite/m³. Outdoor temperatures for sweet viburnum were ambient, while schefflera under shade were maintained at a minimum of 6°C.

Treatment variables included 8 fertilizer sources with varying analyses and temperature dependent release rates (Table 1); 3 application rates, 1.2; 1.8; and 2.4 kg N/m³, and 3 application methods, surface applied, dibble (fertilizer applied at bottom of planting hole immediately beneath the liner at a depth of approximately 10 cm); and incorporated. All fertilizer rates were calculated on the nit-

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Table 1. Fertilizer sources, ratios, and estimated release rates at listed average soil temperature.

Name[z]	Ratio N-P_2O_5-K_2O	Ratio N-P-K	Estimated release period (months)	Avg. release soil temp °C
Osmocote	13-13-13	13-5.7-10.8	8-9	21
Osmocote	18-6-12	18-2.6-10	8-9	21
Customblen	17-7-12	17-3.1-10	16	21
Customblen	13-13-13	13-5.7-10.8	6-8	32
Customblen	13-13-13	13-5.7-10.8	8-9	21
Customblen	17-7-12	17-3.1-10	6-8	32
Customblen	16-7-12	16-3.1-10	12	32
SREF	20-4-10	20-1.8-8.3	3-4	—

[z]Osmocote and Customblen are manufactured by Sierra Chemical Co., Milpitas, Calif. and SREF by O. M. Scott & Sons, Marysville, Ohio.

rogen component with the middle rate equivalent to recommended annual application rate (6).

Plant grade and height were determined every 2 months; grades ranged from 1 = poor, not acceptable to 5 = excellent quality, highly acceptable (plants graded 3 or above were considered salable). Soil temperatures were measured weekly at 8 and 10 AM, 12 Noon, and 2 and 4 PM.

Results and Discussion

Schefflera growth was rapid with some of the original 10-cm tall plants reaching 50 cm within 2 months (Table 2). During the first 6 months, tallest plants were obtained in treatments receiving the standard 8 to 9-month, 21°C, Osmocote 13-13-13. However, by the end of 11 months, tallest plants were present in the 8 to 9-month, 21°C, Osmocote 13-13-13, 8 to 9-month, 21°C, Customblen 13-13-13 and 16-month, 21°C, Customblen 17-7-12. Height is often not the best measurement to utilize for schefflera, since plants receiving marginal levels of fertilizer often grow tall, without proper color or shape. Plant grade is the best indicator of customer preference and, after 6 months, 8 to 9-month, 21°C, Osmocote 13-13-13 or 18-6-12 sources produced plants with highest grades. Even though plants continued to increase in height, plant grade did not increase and by the 11th month was slightly below 6-month ratings. The same Osmocote sources produced the best plants after 11 months as did the 16-month 21°C, Customblen 17-7-12. There were indications that fertilizer sources were depleted, as new terminal leaves were slightly chlorotic.

Fertilizer rate had no effect on schefflera height for the first 6 months; whereas, plants receiving the two higher rates were taller during the last 5 months. Rate affected plant grade much more than height, with no differences after 2 months but consistently better grade with increasing rates thereafter. Interactions of source and rate were not observed.

Application method had no effect on height of schefflera or on grade for the first 4 months. However, at 6, 8, and 10 months, plants receiving the surface application were poorest. Incorporation was best after 8, 10, or 11 months of growth, which is not in agreement with a previous report (1). However, an estimated 5% of surface applied fertilizer was observed on the ground pak after several heavy thunderstorms during the first month of growth.

Scheffleras produced on a single application of several of the fertilizer sources were generally of excellent quality with good size, color, and density of foliage after 11 months. No problems were observed with plant damage from excess soluble salts where the highest rates were applied.

Growth of sweet viburnum was observed to be slow; only 12-15 cm during the first 2 months (Table 3). After 6 months growth, tallest plants were observed in treatments receiving 8 to 9-month, 21°C, Osmocote 13-13-13; 16-month, 21°C, Customblen 17-7-12; 8 to 9-month, 21°C, Customblen 13-13-13; and 6 to 8-month, 32°C, Customblen 13-13-13. After the November measurement, plants were pruned to improve shape and they had not regrown to their original height by 7 Jan. 1985. A severe freeze occurred on 20 and 21 Jan. 1985 with air temperatures as low as −9°C. Severe damage occurred to leaves and wood of sweet viburnum. Plants had not fully regrown by the last height measurement, 29 Apr. 1985, when there was little treatment difference except for the 3 to 4-month

Table 2. Influence of fertilizer source, rate, and application method on growth of *Brassaia actinophylla*.

Source and ratio	Release period (months)	Plant height (cm) 2 July	7 Sept.	9 Nov.	17 Jan.	6 Mar.	4 Apr.	Plant grade[z] 12 July	4 Sept.	14 Nov.	8 Jan.	1 Mar.	4 Apr.
OSM 13-13-13	8-9	48.6c[y]	95.1e	126.6f	151.7d	161.6d	169.6c	3.5b	4.8e	4.8e	4.6e	3.7d	4.3f
OSM 18-6-12	8-9	46.1c	85.5c	113.1cd	133.3c	142.9b	158.0b	3.3b	4.5d	4.7e	4.5e	3.7d	4.2ef
CB 17-7-12	16	45.6bc	87.4cd	115.2d	135.6c	146.0bc	161.0bc	3.4b	4.4d	4.4d	4.3d	3.6cd	4.2ef
CB 13-13-13	6-8	42.4b	78.6b	104.5b	119.6b	130.8a	138.8a	2.9a	3.3b	3.5b	3.5b	3.2b	3.8bc
CB 13-13-13	8-9	47.1c	89.9d	121.0e	139.6c	153.2c	162.1bc	3.4b	4.4d	4.2d	4.2c	3.4c	3.9cd
CB 17-7-12	6-8	52.5d	87.8cd	113.8cd	132.3c	142.8b	153.0b	3.4b	4.0c	4.3d	4.2c	3.5cd	4.0de
CB 16-7-12	12	39.0a	73.8a	96.0a	112.3a	126.8a	135.8a	2.7a	3.0a	3.2a	3.5a	3.1b	3.6b
SREF 20-4-10	3-4	46.8c	85.7c	109.2bc	123.1b	128.7a	140.6a	3.5b	4.3d	3.9c	3.7b	2.6a	2.9a
Rate (kg N/m^3)													
1.2		46.7a	84.7a	111.1a	126.8a	138.0a	147.3a	3.2a	3.9a	3.8a	3.8a	3.0a	3.3a
1.8		45.1a	85.9a	113.0a	132.5b	143.0b	154.5b	3.3a	4.1ab	4.2b	4.1b	3.4b	4.0b
2.4		46.3a	85.8a	113.2a	133.6b	143.9b	155.3b	3.3a	4.3b	4.4c	4.4c	3.7c	4.3c
Application													
Surface		46.9a	85.3a	112.0a	130.6a	141.1a	151.3a	3.4a	4.0a	3.9a	3.9a	3.2a	3.8a
Dibble		45.0a	85.1a	112.4a	131.3a	142.4a	153.3a	3.2a	4.1a	4.2b	4.1b	3.3b	3.8a
Incorporated		46.1a	86.0a	113.0a	130.9a	141.3a	152.6a	3.3a	4.2a	4.3b	4.2c	3.5c	4.0b

[z]1 = poor, unsalable; 3 = good, salable and 5 = excellent, highly salable.
[y]Mean separation in columns and category by Duncan's new multiple range test, 5% level.

Table 3. Influence of fertilizer source, rate, and application method on growth of *Viburnum odoratissimum*.

Source and ratio	Release period (months)	Plant height (cm)					Plant grade[z]				
		2 July	7 Sept.	9 Nov.	7 Jan.	29 Apr.	12 July	4 Sept.	14 Nov.	8 Jan.	29 Apr.
OSM 13-13-13	8-9	25.0d[y]	38.7cd	44.7cd	32.8d	35.1b	2.7cd	3.1de	4.0e	4.4de	3.2cd
OSM 18-6-12	8-9	22.7ab	36.2bc	39.8b	30.9b	34.2b	2.5bcd	2.9cd	3.4d	3.9bc	2.9bc
CB 17-7-12	16	24.2cd	39.9b	46.2d	33.2d	36.2b	2.9d	3.4e	4.1e	4.5e	3.4d
CB 13-13-13	6-8	21.8a	33.9ab	42.2bc	31.0b	36.8b	2.2a	2.3a	3.2c	4.1cd	3.2cd
CB 13-13-13	8-9	23.6bc	37.0c	42.3bc	31.8c	35.8b	2.5bcd	2.6bc	3.5d	4.2cd	3.0cd
CB 17-7-12	6-8	22.1a	33.5a	40.3b	31.3bc	35.4b	2.4abc	2.5ab	3.3cd	4.1cd	3.0cd
CB 16-7-12	12	21.9a	33.0a	39.8b	30.8b	34.5b	2.2a	2.3a	2.8b	3.7b	2.5ab
SREF 20-4-10	3-4	23.2abc	32.2a	33.8a	28.8a	28.3a	2.5bcd	2.4ab	2.4a	3.0a	2.7a
Rate (kg N/m³)											
1.2		22.7a	35.2a	40.8a	30.6a	33.7a	2.4a	2.6a	3.2a	3.8a	2.8a
1.8		23.3a	35.6a	40.8a	31.1a	35.0a	2.4a	2.7ab	3.2a	3.9b	2.9a
2.4		23.2a	35.9a	41.9a	32.2a	35.0a	2.5a	2.8b	3.6b	4.2c	3.0a
Application											
Surface		23.3a	36.4b	40.6a	31.0ab	32.9a	2.5b	2.7b	3.4b	4.0b	2.5a
Dibble		22.6a	32.9a	39.3a	30.4a	35.2b	2.4a	2.4a	3.0a	3.8a	3.1b
Incorporated		23.3a	37.4b	43.4b	32.5b	35.6b	2.5b	2.9c	3.7c	4.2c	3.1b

[z]1 = poor, unsalable; 3 = good, salable and 5 = excellent, highly salable.
[y]Mean separation in columns and category by Duncan's new multiple range test, 5% level.

SREF 20-4-10, which had the shortest release period and was poorest. Fertilizer rate had no effect on plant height but incorporation yielded plants with better height than surface or dibble in November and better than dibble in January.

Plant grades increased consistently until 8 Jan. 1985 with the 16-month, 21°C, Customblen 17-7-12 and 8 to 9-month, 21°C, Osmocote 13-13-13 providing best quality. Several other fertilizer sources including 8 to 9-month, 21°C Customblen 13-13-13; 6 to 8-month, 32°C, Customblen 13-13-13; and 6 to 8-month, 32°C, Customblen 17-7-12 also produced good sweet viburnum after 8 months growth. There were no differences in plant grade due to rate after 2 months but at 4, 6, or 8 months, plants receiving the higher rate were better. Dibble application was the poorest application method at 2-, 4-, 6- and 8-month ratings, with incorporation better than surface application at 4, 6, and 8 months after application.

Data for the last quality rating, on 29 Apr., showed reduced grades from all sources, no effect of rate, and surface application to be the poorest method. Some of these differences were due to the January freeze but others appeared to be due to fertilizer depletion. Some fertilizer depletion with surface applications was due to losses caused by heavy thunderstorms during the first month of growth, which knocked an estimated 10 to 15% of granules out of the containers.

Growth of schefflera was considered excellent and several of the fertilizer sources used with this plant lasted longer than expected based on their 21°C release curves. Research by Harbaugh and Wilfret (8) has shown that temperature is the key to use of Osmocote. They suggested plotting soil temperature as a guide to Osmocote use based on published release times and temperatures. Schefflera soil temperature under 63% shade ranged from a low of 12.8°C to a high of 30°C (Fig. 1). The soil temperatures shown represent the average lowest temperature and the average highest temperature for months listed.

The average temperature for the 11-month growing period was 22.4°C, which is very close to the estimated release curves. However, the experiment was initiated in the summer when highest temperatures occurred; therefore, 60% or more of the fertilizer may have been released during the first 4 months based on the estimated 21°C release curve (8). Why fertilizer sources with 32°C release curves did not provide better growth cannot be explained from the data, but it is possible that the release was not rapid enough for growth of schefflera during the summer where average soil temperatures were 25.5 to 26.6°C.

Growth of sweet viburnum was less than expected and this may have been caused by excessive soil temperatures during the initial 4 months of the experiment (Figure 1).

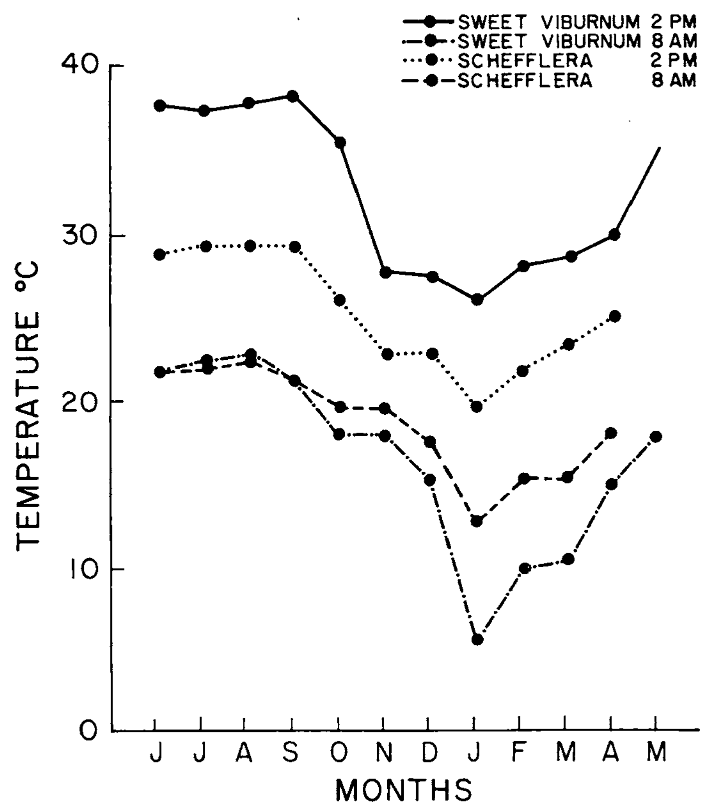

Fig. 1. Monthly average maximum and minimum soil temperatures from schefflera and sweet viburnum. Temperatures were measured at 135 degrees from true north at a depth of 4 inches and 1 inch inside the container wall.

Soil temperatures in this full sun experiment ranged from a low of 5.6°C to a high of 39.4°C. The average temperature for the 12-month growing period was 25°C, considerably above the estimated release curve for 21°C fertilizer sources. However, the excessively high soil temperatures probably caused rapid release of both 21°C and 32°C sources and most nutrients may have been expended by fall when temperatures were lower. Data show that none of the sources supplied sufficient nutrients to allow regrowth in the spring.

Data from both species indicate there is potential for a single annual slow-release fertilizer application under shade, but not in full sun with the sources utilized when soil temperatures may be excessive. Because of the extremely high soil temperatures observed in full sun, it would appear that spacing full sun plants is not wise until they have sufficient canopy to shade at least part of the container surface.

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EFFECTS OF IRRIGATION REGIME, ANTITRANSPIRANTS, AND A WATER ABSORBING POLYMER ON THE SURVIVAL AND ESTABLISHMENT OF TRANSPLANTED LIVE OAKS

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Abstract. **Sixty-four 4-inch caliper live oaks (*Quercus virginiana* Mill.) were transplanted in Aug. 1984 from 1 area of a tree nursery in Oak Hill, Fla. to an adjacent area using a 44-inch tree spade. Trees were either sprayed with water, Wilt-Pruf (1:10 dilution), or Cloud Cover (1:2 dilution) the day before transplanting, or 6 oz of Terra-Sorb (water-absorbing, starch polymer) was added to the sides of the planting hole. Thirty-two trees were irrigated with 18 gal of water daily and 32 trees were irrigated 7 days after a 1-inch rain or the last irrigation (weekly). There was no interaction of irrigation rate with other treatments on survival of the live oaks. Fifty-five % of trees watered weekly and 65% of trees watered daily survived. Visual ratings after 21 and 37 days were greater if trees were watered daily than those watered 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. Terra-Sorb resulted in greater mean branch elongation in the spring of trees irrigated daily.**

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When the quantity of water transpired exceeds the ability of a plant to take water from the soil, water stress occurs and plant growth and quality is reduced. When plants are dug from a field nursery, construction site, or an undisturbed native habitat, the loss of a substantial portion of the root system predisposes the plant to water stress. This is especially true during hot, dry periods. It is often essential to move trees in Florida during the summer months to meet demands for larger landscape materials not commonly grown in containers or to coincide with development and construction. Antitranspirants and soil additives have been suggested as possible means of reducing water loss during establishment of transplanted trees and shrubs.

Antitranspirants reduce water loss from leaf surfaces by either coating the leaf with an impermeable film or inducing stomatal closure through alteration of some metabolic process. Wilt-Pruf, Cloud Cover, and Vapor Gard are among the resin type antitranspirants that limit water loss by coating the leaf surface. Wilt-Pruf increased visual rating of semiballed *Camellia sasanqua* dug during the summer in Georgia, but did not alter the visual rating of *Osmanthus fortunei, Ilex crenata* and Kurume hybrid azaleas (4). It was concluded that careful digging and fre-