Proc. Fla. State Hort. Soc. 130:229–231. 2017.

Controlled-Release Fertilizer Demonstration on Container Production of *Ligustrum japonicum* in West Central Florida

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Additional index words. japanese privet, woody ornamentals, slow-release fertilizer, plant nutrition, input costs

Woody ornamental container growers seek to reduce inputs during production to minimize costs and increase profit margins. The use of controlled-release fertilizers (CRFs) for crop production can reduce labor costs and minimize nutrient leaching while growing high-quality plants. Growers have many choices of CRFs in the marketplace. A demonstration was conducted in Central Florida at the Gulf Coast Research and Education Center to compare the response of *Ligustrum japonicum* grown in number 3 nursery containers to six different fertilizer brand treatments. Fertilizer was dibbled below the liner at planting at a nitrogen rate of three pounds per cubic yard. The demonstration was a randomized complete-block design containing four blocks and six replications per block. Growth parameters, plant quality, and fertilizer costs were measured to support growers making CRF use decisions. Differences in growth were seen at eight months and continued to 12 months after planting. Quality was significantly different as measured by chlorophyll readings at 12 months. The results of this demonstration will inform growers for future fertilizer input decision making.

Florida is second in the United States for nursery stock production (USDA NASS, 2015), following only California in terms of production value. In Florida, 85.6% of ornamental plants are grown in containers (Hodges et al., 2011). Most container growers use controlled-release fertilizers (CRFs) (Thorp, 1995; Yeager et al., 2010) to provide the nutrient needs of their plants for extended production times. The CRFs reduce costs of hand labor associated with the application of granular fertilizer on a regular basis throughout the season. Growers have many choices to match production time with longevity of fertilizer for a one-time application (dibble, top-dress, or incorporation) into containers for labor savings and a slow release of plant nutrients available throughout the production time. It is important that growers match CRFs with local growing conditions due to the fact that temperature and rain can affect release the rates of nutrients (Clark and Zheng, 2015). In 2016, 8–12 month slow release CRFs were averaging about $56.00 to $60.00 per 50-lb bag or about $0.32 to $0.39 per number 3 nursery container at a 3 lb of nitrogen (N) application rate. In order to better assist management decisions of growers in the west central area of Florida, information on the response of woody ornamental crops (growth and quality) and economic factors would be beneficial in choosing CRFs for their growing needs. Demonstration plots subject to local conditions are one of the ways to address this need.

Thanks to Everris, Harrel's Fertilizer, and Lake Brantley Plant Corp, for donations of fertilizer for this demonstration. We would also like to thank Drew McClean for his assistance in irrigation maintenance related to this project.

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Materials and Methods

A demonstration plot was established at the University of Florida, IFAS Gulf Coast Research and Education Center in Wimauma, FL. The demonstration was conducted on a black polypropylene groundcover. Trade number 3 black plastic nursery containers were filled with a 45 Florida peat : 55 pine bark (2 cm) by volume, potting medium amended with 45 kg of dolomite and a 9 kg minor nutrient mix (Harrell's Fertilizer, Lakeland, FL) per yd^3 and dibbled under the liner plant at a standard rate of 3 lb/yd^3 of N at planting. Six different CRF fertilizer treatments were tested: 1) FLO-112.23 g, Florikan® 17–6–8 (17N–2.6P–6.6K), 12-month release (Florikan ESA LLC, Sarasota, FL); 2) SUN-126 g, Suncote® 15–8–11 (15N–3.5P–9K), 12 month release (ICL Fertilizer NA, St. Louis, MO); 3) NUT-105 g, Nutricote® 18–6–8 (18N–2.6P–6.6K), 12-month release (Florikan ESA LLC, Sarasota, FL); 4) OSM-126 g, Osmocote® 15–9–12 (15N–4P–10K), 8- 9-month release (ICL Fertilizer NA, St. Louis, MO); 5) EVE-118.2 g, Everris 16–6–8 (16N–2.6K–6.6K), 8- 9-month release (ICL Fertilizer NA, St. Louis, MO); and 6) HAR-126 g, Harrell's 15–6–11(15N–2.6P–9K), 12-month release (Harrell's Fertilizer, Lakeland, FL). Japanese privet (*Ligustrum japonicum)* was chosen for this project, as a model plant for a typical woody crop plant. Ligustrum liners were 4 inches tall, (60 cell, Rosales Nursery, Plant City, FL) and planted on 19 Feb. 2016. The demonstration design was a randomized complete-block design with four blocks of six plants per treatment. The plot was irrigated with four NaanDanJain impact sprinklers with a 28-ft radius, and 90° arc with the top of the irrigation spray nozzle at an average of 49.5 inches above the ground surface delivering approximately 1.2 inches/hour and a distribution uniformity of 91% over the plot area. Newly transplanted plants were irrigated with overhead irrigation for 10 minutes, three times a day for the first two days, and then reduced to 3 minutes, two times a day for the next week. Irrigation was then changed to provide two split applications at the times of 05:00 and 14:00. Irrigation was initially set at 5 minutes per event and then changed to 10 minutes per event when plants were spaced on 28 June 2016.

Plant growth index (GI) data were recorded as a measure of plant growth and calculated as GI = H × (W1 × W2)/2, where H is the plant height (cm), W1 is the widest width of the plant (cm), and W2 is the width perpendicular to the widest width (cm). GI data were taken at 8 months and 12 months of growth. Chlorophyll measurement data were taken at 12 months as a measure of plant quality with a SPAD 502 Meter (Spectrum Technologies, Aurora, IL). Chlorophyll measurements were the average of three measurements per plant of the most recent, fully developed mature leaf for a total of 18 measurements per treatment. Plants were pruned once for shape on 28 June 2016 to promote branching typical of nursery production.

Plants were sprayed with Conserve® SC, 2 mL/gallon on 21, July and Dipel® Pro DF at 2 lb/ac rate with backpack sprayer on 17, Aug. for olive shootworm (*Palpita persimilis*) control.

All data were subjected to an analysis of variance using JMP (version 13; SAS institute, Cary, NC). There were no significance differences between blocks, so data were combined. Mean values were compared with Tukey's honest significant difference test at the α = 0.05 level.

Results and Discussion

The plant growth index was evaluated eight months after planting. The differences were significant with the GI being highest in the following ranking: FLO, HAR, NUT, OSM, SUN, and EVE treatments (Table 1). At 12 months after planting, GI rankings were again significantly different between treatments with the greatest GI being NUT, HAR, FLO, OSM, SUN, followed by EVE treatments (Table 1). Plant dry weights were not measured; it was deemed unnecessary due to the significant differences in GI data.

Quality ratings of chlorophyll content taken 12 months after planting from SPAD readings ranked plants into two groups that were significantly different from each other. NUT, HAR, and FLO were significantly greater than OSO, EVE, and SUN (Table 1). SPAD measurements for treatments within each group were not different from each other.

Prices per 50-lb bag were HAR $56.00, SUN $57.00, EVE, OSM, and NUT $58.00, and FLO $60.00. Prices varied by cost at mix rate per yd³ and ranged from $19.32 to $23.19 (Table 2). Costs ranged from $0.24 to $0.28 per nursery number 3 container or $0.32 to $0.39 per full number 3 container (true three gallon container) (Table 2). When fertilizer costs were analyzed by cost per month of fertilizer release, differences between fertilizers were magnified. Costs ranged from $26.67 to $48.75 per 1000, full number 3 nursery containers (Table 2). It must be noted that in our study *Ligustrum* was used as the model plant and other species of plants may to respond to rates and types of fertilizer differently.

Table 1. Response of *Ligustrum japonicum* growth index (GI) eight months after planting and GI and relative chlorophyll content (SPAD measurements) 12 months after planting to different controlled release fertilizers dibbled at three pounds of N per cubic foot.

Treatment	Growth index[z] 8-month	Growth index[z] 12-month	SPAD units[x]
Florikan 17–6–8 (12 m)	855.85 a[y]	75904.3 ab	58.53 a
Suncote 15–8–11 (12 m)	566.32 bc	40751.3 bc	43.49 b
Harrell's 15–6–11 (12 m)	743.66 ab	87050.3 a	61.32 a
Nutricote 18–6–8 (12 m)	694.47 abc	96569 a	61.57 a
Osmocote 15–9–12 (8–9 m)	613.62 bc	45933.1 bc	44.93 b
Everris 16–8–12 (8–9 m)	509.26 c	33256.6 c	44.03 b
Significance[w]	***	***	***

[z]Growth index (GI) is calculated as GI = H × (W1 × W2)/2 where W1 is widest width and W2 is perpendicular width from W1 (measured in cm).
[y]Means with the same letters within a column are not significantly different at $P = 0.05$ (Tukey's honest significant difference test).
[x]Means of relative chlorophyll content of most recently mature leaf.
[w]*** Significant at $P \leq 0.001$ (F test).

Table 2. Controlled-release fertilizer costs based on demonstration prices and a dibbled rate of three pounds of N per cubic yard of potting media.

Treatment	N–P–K	Longevity (months)	g/pot	Cost per 50 lb	Cost per lb	Cost per lb N	Cost per yd³ soil	Cost per container Full #3	Cost per container Trade #3	Cost per 1000 #3 containers	Cost per month of 1000 #3 containers
FLO	17–6–8	12	111	$60.00	$1.20	$7.05	$21.15	$0.35	$0.25	$350.00	$29.17
SUN	15–8–12	12–14	126	$57.00	$1.14	$7.60	$22.80	$0.38	$0.28	$380.00	$31.67
HAR	15–6–11	12	126	$56.00	$1.12	$7.46	$22.38	$0.37	$0.27	$370.00	$30.83
NUT	18–6–8	12	105	$58.00	$1.16	$6.44	$19.32	$0.32	$0.24	$320.00	$26.67
OSM	15–9–12	8–9	126	$58.00	$1.16	$7.73	$23.19	$0.39	$0.28	$390.00	$48.75
EVE	16–8–12	8–9	118	$58.00	$1.16	$7.25	$21.75	$0.36	$0.26	$360.00	$45.00

[z]Prices are estimates from demonstration plot retail cost and may vary depending upon supplier, quantity, promotions and other factors.
[y]Cost based on an incorporation rate at 3 lb/yd³ of N.

No endorsements or discriminations are made with the mention of trade names or lack thereof in this study.

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