and planting process, either by incorporating the herbicide in the upper soil, or by placing a treated layer on the top of the filling. This technique, applicable to nursery crops tolerant to Goal, will achieve adequate weed control within the containers, however, additional experimentation is still required to determine the persistance of the herbicidal activity.

(*Ed. note*: This paper reports the results of research only, and does not imply registration of a pesticide under amended FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

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Response of *Codiaeum variegatum* 'Gold Star' as Influenced by Slow-Release Fertilizer[1]

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Abstract

Codiaeum variegatum 'Gold Star' croton were grown at different nutritional levels of 3.3, 6.6, 9.9, 13.2, 16.5 and 19.8 g of slow-release 19N-3P-10K (19-6-12) per 12.5 cm (5 in) pot. Plant grade was highest with levels of 3.3–9.9 g per pot, with corresponding leachate electrical conductivity of approximately 200–1100 μmhos$\cdot$cm^{-1}.

Index words: croton, foliage plant, soluble salts, nutrient content

Introduction

Crotons are popular interior foliage plants because of their colorful foliage and tolerance of interior conditions. Research has been conducted in Europe to develop cultural procedures (1, 2, 3) under light intensities and temperatures lower, than that found in Florida.

Conover and Poole (4) produced *C. variegatum* 'Elaine' and 'Norma' cultivars under 30, 47 and 63% shade and found all acclimatized equally well to interior conditions, although 30% shade grown plants had slightly more leafdrop. Stock plants of 'Elaine' and 'Norma' grown in full sun produced slightly more cuttings than plants under 30% shade, but color was better on shade grown plants (5). In the same experiment, the highest fertilizer level of 16.8 kg N/ha-year (1500 lbs N/A-year) produced the highest number of cuttings.

Chemical composition of quality tropical foliage plants is described for some plants (7) but not croton. The work reported here was initiated to determine the best fertilization for crotons, optimum soluble salts of the growing medium and elemental concentration in tissues for producing croton.

[1]Received for publication August 1, 1988; in revised form November 8, 1988. Florida Agr. Expt. Sta. J. Series No. 8920.

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Materials and Methods

Plants 8–12 cm (3–5 in) tall with 10 to 15 leaves each were obtained from commercial producers as rooted cuttings and planted in a potting medium consisting of Canadian peat and pine bark (1:1 by vol). The medium was steam-treated at 90°C (194°F) for approximately 1.5 hr prior to these additions and then amended with 2.7 kg/m^3 (7.5 lb/yd^3) kg dolomite and 0.5 kg/m^3 (1.5 lb/yd^3) Micromax (Sierra Chemical Co., Milpitas, CA 95035) per cubic meter. Plants were top-dressed at the beginning of each experiment with Osmocote 19N-3P-10K (19-6-12, 3 month release fertilizer from Sierra Chemical Co.) at 3.3, 6.6, 9.9, 13.2, 16.5 and 19.8 g/12.5 cm (5 in) pot. Recommended rate for crotons under these conditions is 4 g/12.5 cm (5 in) pot (6). Plants were irrigated by hand as needed. Ten single pot replicates were included for each treatment. Tests were conducted during 1986 and 1987 in a glasshouse at the CFREC-Apopka, Florida.

The first test was conducted from November 25, 1986 to January 16, 1987 with temperatures of 18–30°C (65–86°F) and light levels near 140 μmol$\cdot$m^{-2}s^{-1}. The second test was conducted from April 6 to May 27, 1987 at temperatures of 22–32°C (72–90°F) at a light level of near 200 μmol$\cdot$m^{-2}s^{-1}. The third test was conducted from September 9 to December 3, 1987 and temperatures between 22–32°C (72–90°F) at a light level near 170 μmol$\cdot$m^{-2}s^{-1}.

Soluble salts were monitored monthly using the pour-through method (8). Deionized water was added to each pot until 100 ml of the resulting leachate was collected in a beaker beneath each pot. Leachate electrical conductivity (EC) were measured using a Hach Conductivity Meter #2511 (Hach Chemical Company, Ames, IA 50010). Plant responses to treatment were evaluated as fresh weight, number of leaves and shoots, height and plant grade. Plant grade was visually determined as: 1 = dead; 2 = poor, unsalable; 3 = marginal, salable; 4 = good, salable; and 5 = excellent, salable. Nutrient concentration of tissues was determined for each treatment in each test. Mature leaves were dried at 60°C (140°F) and ground. Tissue analyses were performed by A & L Southern Agricultural Laboratories, Pompano Beach, FL 33064 (8). Data were analyzed for significant effects and characterized using regression analyses.

Results and Discussion

Growth responses from the three test periods were slightly similar (Table 1). Two of the three tests showed a significant decrease in final plant height as fertilizer increased. Results from the non-significant test also indicate a decrease in height from increasing fertilizer levels.

Plant grade was affected by fertilizer levels (Table 2). Only Test 3 is depicted showing 9.9 g of Osmocote per 12.5 cm (5 in) pot as best. Other tests showed 3.3–9.9 g produced plants of similar quality. Mean fresh weight varied from 29.9 to 39.5 g but was not significantly affected by fertilizer level. Number of leaves and shoots showed similar trends as plant grade although they were highest at fertilizer rates of 9.9 to 16.5 g.

Leachate EC of about 1500–2200 μmhos·cm^{-1}, determined at the beginning or termination, produced the best plants. Table 3 illustrates nutrient analysis for all levels of Test 3. Suggested elemental tissue levels found in excellent quality crotons are nitrogen (3.5–5.5%), phosphorus (0.45–0.55%), potassium (3.2–3.7%), sulfur (0.2–0.3%), magnesium (0.4–0.6%), calcium (1.0–1.5%), iron (100–150 mg/Kg), manganese (200–500 mg/Kg), boron (30–70 mg/Kg), copper (10–15 mg/Kg), and zinc (250–350 mg/Kg).

Table 1. Plant height (cm) of *Codiaeum variegatum* 'Gold Star' as influenced by fertilizer level.

Osmocote	Experiment[z]		
(g/12.5 cm pot)	1	2	3
3.3	11	17	25
6.6	12	16	24
9.9	11	15	24
13.2	10	13	22
16.5	11	14	21
19.8	6	14	20
Significance[y]			
Linear	**	NS	**
Quadratic	**	NS	NS

[z]Experiments 1, 2, and 3 were conducted from November 25, 1986 to January 16, 1987, April 6 to May 27, 1987, and September 9 to December 3, 1987, resp.

[y]F values from ANOVA are denoted as not significant (NS) or significant at P = 0.01 (**) or P = 0.05 (*).

Table 2. Effect of fertilizer rate on growth of *Codiaeum variegatum* 'Gold Star' and on leachate conductivity of medium (Test 3).

Osmocote (g/12.5 cm pot)	Plant grade[z]	No. leaves[y]	No. shoots[x]	μmhos·cm^{-1}[w]
3.3	3.7	36.7	0.7	220
6.6	3.9	44.0	1.7	495
9.9	4.2	47.6	2.1	1085
13.2	3.8	46.7	2.6	1820
16.5	3.8	49.3	2.3	2210
19.8	3.6	44.3	1.5	2130
Significance[v]				
Linear	NS	NS	NS	**
Quadratic	*	*	*	NS

[z]Plant grade on December 1, 1987 was rated on the following scale: 1 = dead, 2 = poor, unsalable; 3 = moderate, salable; 4 = good, salable; and 5 = excellent, salable.

[y]Leaves longer than 2.5 cm (1 in) were counted (November 30, 1987).

[x]Shoots longer than 5 cm (2 in) were counted (December 2, 1987).

[w]Leachate electrical conductivity was measured on November 30, 1987.

[v]F values are denoted as not significant (NS) or significant at P = 0.01 (**) or P = 0.05 (*).

Table 3. Nutrient concentration of mature leaves of *Codiaeum variegatum* 'Gold Star' fertilized with various rates of Osmocote 19N-3P-10K (19-6-12) (Experiment 3).

Osmocote	Dry weight (%)						mg/kg				
(g/12.5 cm pot[z])	N	P	K	S	Mg	Ca	Fe	Mn	B	Cu	Zn
3.3	2.7	0.25	2.5	0.16	0.46	1.31	90	74	39	13	224
6.6	3.4	0.39	3.2	0.28	0.52	1.35	95	135	44	10	237
9.9	4.4	0.46	3.5	0.32	0.43	1.05	109	281	43	13	304
13.2	4.4	0.49	3.6	0.40	0.40	0.87	88	270	41	11	283
16.5	5.7	0.51	3.9	0.39	0.40	0.84	98	206	48	12	272
19.8	4.8	0.46	3.3	0.35	0.38	0.92	103	217	43	11	262
Significance[y]											
Linear	**	**	**	**	*	**	NS	**	NS	NS	NS
Quadratic	**	NS	**	**	*	NS	NS	**	NS	NS	*

[z]Fertilizer was applied once approximately 12 weeks prior to tissue harvest.

[y]Significant effects were partitioned into linear, quadratic, or residual character with the corresponding significance levels of P = 0.01 (**), P = 0.05 (*) or not significant (NS).

Significance to the Nursery Industry

Good quality crotons can be produced with an Osmocote 19N-3P-10K (19-6-12) at a rate of 9.9 g per 12.5 cm (5 in). Higher rates can result in slightly reduced plant height and plant grade as well as significantly higher leachate EC at cooler times of year. Since ground water contamination would be more likely at higher fertilizer rates, the minimum rate which results in good quality crotons should be used.

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Pruning Responses of Tissue-Cultured Plantlets of Rhododendrons[1]

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Abstract

Plantlets of *Rhododendron* 'Molly Ann', *R*. 'Paprika Spiced', and *R*. 'Travis L.', recently rooted from tissue culture, were grown in a greenhouse in individual containers. Plants pruned by pinching, top-pruning, or root-pruning were compared to unpruned plants. Growth, as measured by shoot height, shoot dry weight, root dry weight, and stem caliper, was generally reduced by pruning. Top-pruning and pinching induced branching in all cultivars tested and improved stem taper (ratio of basal to upper caliper) in two cultivars, including *R* 'Travis L.', which is particularly prone to develop weak stems when produced by tissue culture.

Index words: branching, caliper, pinching, root pruning, taper, tissue culture, *in vitro* propagation, micropropagation

Introduction

Rhododendron spp. adapt well to multiplication via tissue culture. Methods for culturing explants and for rooting microcuttings produced in tissue culture are well established (1, 8, 11). Cultural and management practices following rooting have not been thoroughly investigated.

Certain cultivars of *Rhododendron* and other genera that have been propagated by tissue culture develop a weak area at the base of the stem (10). This narrow stem area has resulted commercially in the loss of some young plants due to breakage and in the development of top-heavy plants. If simple manipulations, such as early pruning, were found to be effective in overcoming this problem, then more sturdy cultivars could be successfully produced via tissue culture.

Pruning induces branching and compactness (2, 4, 7), and both are desirable habits in these woody shrubs. This experiment was designed to test the effect of pruning on the development and stem taper of *Rhododendron* plantlets rooted from tissue culture.

Materials and Methods

Plantlets of *Rhododendron* 'Molly Ann', *R*. 'Paprika Spiced', and *R*. 'Travis L.' (heights of 2.8, 4.6, and 5.7 cm, or 1.1, 1.8, and 2.2 in, respectively), rooted from tissue culture and acclimated to greenhouse conditions, were potted individually on May 30 into 6 cm^2 (2.25 in^2) plastic pots filled with peat, pumice, and sand (12:7:1 by vol), amended with Osmocote 17N-3P-10K (17-7-12) at the manufacturer's recommended rate. Plants were grown in a shaded greenhouse with light intensities of 600 to 1100 $\mu mol \cdot s^{-1} m^{-2}$ (3000 to 5500 ft-c). Temperatures averaged 28°C (82°F) during the day and 14°C (57°F) at night. Plants were watered as needed to keep the medium moist.

After 7 weeks in the greenhouse, the following pruning treatments were performed: no growth removed ('unpruned'), top 1 cm (0.4 in) of the shoot tip removed

[1]Received for publication August 4, 1988; and in revised form November 8, 1988. Paper No. 88-22 of the Department of Horticulture and Landscape Architecture. Project No. 0695, College of Agriculture and Home Economics Research Center, Pullman, WA 99164. The authors express appreciation to Bruce Briggs, Briggs Nursery, Inc., Olympia, WA 98501, for donating plants. This research was partially supported by a grant from the Washington State Nursery and Landscape Association.

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