Fertilization of Four Indoor Foliage Plants With Osmocote or Nutricote[1]

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Abstract

Aphelandra, *Dieffenbachia*, *Pilea* and *Chamaedorea* grew equally in containers when fertilized with Osmocote or Nutricote incorporated or surface applied. There was slight indication that plants grew better at higher than recommended rate, but increased fertilizer costs and potential for ground water contamination suggest higher rates should not be used.

Index words: nutrition, fertilization, fertilizer

Species used in this study: Apollo zebra plant [*Aphelandra squarrosa* Nees], dumb cane [*Dieffenbachia maculata* (Lodd) G. Don 'Camille'], parlor palm [*Chamaedorea elegans* Mart.], silver tree pilea [*Pilea* Lindl. 'Silver Tree']

Introduction

Slow-release fertilizers have gained in popularity with tropical foliage plant producers. Previous research has shown that liquid or slow-release fertilizer under greenhouse conditions where pots are not subject to wind or excess rain and, consequently, loss of substantial quantities of the slow-release fertilizer give equally satisfactory results (4, 7, 8, 12, 13, 14, 17, 21, 25). Although slow-release fertilizers cost more per unit of fertilizer than liquid or granulated forms, they offer application advantages for producers of container-grown crops which offset these higher initial costs. With the proper selection of a slow-release fertilizer and its application rate, it can supply adequate nutrition for 3–12 months. Selecting an appropriate term slow-release fertilizer and then either incorporating it into the potting medium prior to planting or using surface application can eliminate further fertilizer applications for 3–12 month crops. Thus, reductions in amount of fertilizer used, labor and equipment can be realized.

Research at the Central Florida Research and Education Center-Apopka has studied fertilization requirements for *Aphelandra squarrosa* Nees, *Chamaedorea elegans* Mart. (parlor palm), *Dieffenbachia maculata* (Lodd) G. Don 'Camille,' *Pilea* Lindl. 'Silver Tree' and other foliage plants (1, 2, 3, 5, 6, 7, 9, 10, 15, 18, 19, 20, 21, 22, 23, 24, 26). The experiments reported here were conducted to compare the effects of Nutricote, a relatively new slow-release fertilizer, with Osmocote, an industry standard, on growth of these four plants. The fertilizers were incorporated or surface applied at three nutritional levels.

Materials and Methods

Plants were grown in a glasshouse either with 14N-6P-12K (14-14-14) Nutricote or 14N-6P-12K (14-14-14) Osmocote surface applied or incorporated at three rates. The rates utilized (see Tables) were based on current recommendations (11) and represent ½ the recommended rate, the recommended rate and 1½ times the recommended rate. Silver tree and aphelandra were planted April 5, 1984 in 10 cm (4 in) pots containing Florida sedge peat: builder's sand: cypress shavings (2:1:1 by vol) with 4 kg (7 lbs) dolomite and 1 kg (1.5 lbs) MicroMax per cubic m (yd) incorporated. Parlor palm and 'Camille' were planted April 2, 1984 in 15 cm (6 in) pots containing Vergro Container Mix with 0.6 kg (1 lb) per cubic m (yd) of MicroMax incorporated. Maximum light level was about 200 $\mu mols \cdot s^{-1} \cdot m^{-2}$ (1500 ft-c). Plants were watered to a depth of 1.3 cm (0.5 in) on the top of the pot 2–3 times weekly with well water diagnosed at 0.1 ppm P, 2 ppm K and 0.5

Table 1. Influence of Osmocote and Nutricote on growth of *Pilea* 'Silver Tree'.[z]

Treatment	Ht (cm)	Plant grade[y]	Root grade[x]	Fresh top wt (g)
Fertilizer source				
Osmocote	15.5	4.0	4.8	27.2
Nutricote	15.1	3.9	4.8	25.0
Significance				
Linear	NS[w]	NS	NS	NS
Application method				
Surface	15.0	3.9	4.6	28.8
Incorporated	15.7	4.0	4.9	23.4
Significance				
Linear	*	NS	*	**
g 14-14-14/ 4 in pot				
0.5	14.0	2.8	4.5	23.5
1.0	15.8	4.2	4.9	26.7
1.5	16.2	4.8	5.0	28.1
Significance				
Linear	**	**	**	*
Quadratic	**	**	NS	NS

[z]Experiment initiated April 5, 1984; terminated June 15, 1984.
[y]1 = not salable; 3 = good, salable; 5 = excellent quality.
[x]1 = 0–20% of soil ball covered with roots, 5 = 81–100%.
[w]** = significant at 5% level, ** = significant at 1% level, NS = not significant.

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Table 2. Influence of Osmocote and Nutricote on electrical conductivity (mhos × 10^{-5}) and pH of leachate on *Pilea* 'Silver Tree'.

Treatment	mhos × 10^{-5}					pH				
	4/20	5/4	5/17	5/31	6/13	4/20	5/4	5/17	5/31	6/13
Fertilizer source										
Osmocote	603	185	113	160	143	5.5	6.3	6.0	6.0	5.8
Nutricote	574	180	97	166	134	5.7	6.3	6.1	5.9	5.8
Significance										
Linear	NS[z]	NS	NS	NS	NS	*	NS	NS	NS	NS
Application method										
Surface	594	223	130	181	156	5.8	6.3	6.1	6.1	5.9
Incorporated	583	142	80	145	120	5.4	6.3	6.0	5.9	5.7
Significance										
Linear	NS	**	**	**	**	**	NS	NS	**	**
g 14-14-14/ 4 in pot										
0.5	520	182	118	168	141	5.7	6.3	6.1	6.0	5.9
1.0	551	167	101	165	140	5.7	6.3	6.1	5.9	5.7
1.5	694	199	95	156	134	5.4	6.3	6.1	6.1	5.8
Significance										
Linear	**	NS	*	NS	NS	**	NS	NS	NS	NS
Quadratic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]** = significant at 5% level, ** = significant at 1% level, NS = not significant.

ppm NO_3 and were grown under a temperature range of 21–35°C (70–95°F). Treatments were replicated 5 times with one pot as the experimental unit.

Data collected at the termination of the experiment included plant height, plant grade (1 = poor, 5 = excellent), root grade (1 = less than 20% of root ball covered with roots, 5 = 80–100% of the root ball covered with roots) and top fresh weight. Data were taken June 15, 1984 for *Aphelandra* and *Pilea*, August 16 for 'Camille' and September 27, 1984 for parlor palm. Soluble salts were determined at 2 or 4 week intervals from leachate obtained by adding 50–100 ml of deionized water to the surface of the potting medium so that about 50 ml of leachate was collected. Mature leaves were collected for elemental analyses and dried at 60°C (140°F) for 3 days (72 hours). Tissue was finely ground and analyzed for elements.

Results and Discussion

Pilea 'Silver Tree'. Height, root grade, plant grade and top fresh weight were not affected by fertilizer source (Table 1). Incorporation of fertilizer had no effect on plant grade, but top fresh weight was greater when fertilizers were surface applied. Height and root grade were greater when

Table 3. Elemental tissue content of *Pilea* 'Silver Tree'.

Treatment	Percent dry weight					Parts per million							
	N	P	K	Ca	Mg	Mn	Na	Fe	Cu	B	Zn	Mo	Al
Fertilizer source													
Osmocote	1.33	.29	.68	5.40	1.36	270	130	60	5.6	57.0	29.6	2.2	13.2
Nutricote	1.32	.22	.61	5.75	1.46	260	94	49	5.4	57.4	31.4	2.4	13.2
Significance													
Linear	NS[z]	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Application method													
Surface	1.26	.24	.63	5.67	1.41	250	138	55	5.5	54.2	29.9	2.5	14.4
Incorporated	1.39	.27	.67	5.49	1.41	279	86	55	5.5	60.3	31.0	2.1	11.9
Significance													
Linear	*	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	NS
g 14-14-14/ 4 in pot													
0.5	1.02	.19	.56	6.03	1.47	224	104	32	4.4	57.5	17.6	2.4	11.9
1.0	1.34	.26	.66	5.52	1.44	282	138	62	5.9	57.8	32.2	2.3	13.3
1.5	1.61	.32	.74	5.18	1.34	288	93	69	6.3	56.3	31.6	2.2	14.3
Significance													
Linear	**	**	**	NS	NS	NS	NS	NS	**	NS	*	NS	NS

[z]** = significant at 5% level, ** = significant at 1% level, NS = not significant.

Table 4. Influence of Osmocote and Nutricote on growth of *Aphelandra squarrosa* 'Dania'.[z]

Treatment	Ht (cm)	Plant grade[y]	Root grade[x]	Fresh top wt (g)
Fertilizer source				
Osmocote	10.4	3.4	3.5	35.6
Nutricote	10.1	3.1	3.5	32.8
Significance				
Linear	NS[w]	NS	NS	*
Application method				
Surface	10.8	3.4	4.3	33.4
Incorporated	9.7	3.1	2.7	35.0
Significance				
Linear	**	NS	**	NS
g 14-14-14/ 4 in pot				
1.25	9.8	2.9	3.4	26.2
2.50	10.5	3.4	3.5	36.0
3.75	10.6	3.4	3.7	40.4
Significance				
Linear	*	**	NS	**
Quadratic	NS	NS	NS	NS

[z]Fertilizer applied April 5, 1984; data collected June 15, 1984.
[y]1 = not salable; 3 = good, salable; 5 = excellent quality.
[x]1 = 0–20% of soil ball covered with roots, 5 = 81–100%.
[w]* = significant at 5% level, ** = significant at 1% level, NS = not significant.

fertilizer was incorporated. Increasing fertilizer rate improved all measurements.

Electrical conductivity and pH were similar for pots containing Osmocote and Nutricote (Table 2). Pots with surface applied fertilizer had higher soluble salts and pH. Tissue content of P was slightly higher in Nutricote fertilized plants, but all other elements were similar for both fertilizer sources (Table 3). N and P levels were higher in plants where fertilizer was incorporated, but differences were slight. Increasing fertilizer level increased tissue level of N, P, K, Cu and Zn, and plant height, grade and top fresh weight.

Aphelandra squarrosa. Plants grown with Osmocote had slightly more top fresh weight but other indices were the same for Nutricote and Osmocote produced plants (Table 4). Height of plants receiving surface applied fertilizer was slightly greater and root grade was considerably better in pots receiving surface fertilization. Increasing fertilizer increased height only slightly but considerably improved plant grade and top fresh weight.

Electric conductivity was about the same in pots receiving Osmocote or Nutricote (Table 5). Incorporation of fertilizer resulted in higher soluble salts readings. Increasing fertilizer level had a strong effect on increasing electrical conductivity of the leachate. The pH was similar for fertilizer source and incorporation method, and decreased slightly as fertilizer level increased. Tissue content of P and K was higher in plants grown with Osmocote while Na was higher in Nutricote grown plants (Table 6). Surface application decreased tissue content of K, but increased Mg, Mn, Fe, Zn and Mo. Increasing fertilizer level increased tissue content of N, P and K and decreased Mo.

Chamaedorea elegans. There was no difference between plants grown with Nutricote or Osmocote (Table 7), and there was also no effect of fertilizer rate. Surface application slightly improved height and root grades. Electrical conductivity of soil leachate with Osmocote was greater than pots with Nutricote after reapplication (Table 8). Incorporation resulted in higher conductivity and there was also a linear increase in conductivity with increasing fertilizer rate. Growth results indicate that fertilizer at these rates was not a factor. A comparison of elemental tissue content shows plants fertilized with Nutricote contain more P, Ca, Mg, Mn, Na, B, and less N and Al (Table 9). Plants that were surface fertilized contained more N, P, K, Ca, Mn and Al, and less Na and Fe.

Dieffenbachia maculata. Fertilizer source did not affect plant growth (Table 7). Incorporation of fertilizer slightly

Table 5. Influence of Osmocote and Nutricote on electrical conductivity and pH of leachate on *Aphelandra squarrosa*.

	mhos × 10^{-5}					pH				
Treatment	4/20	5/4	5/17	5/31	6/13	4/20	5/4	5/17	5/31	6/13
Fertilizer source										
Osmocote	674	454	137	551	381	5.3	5.9	6.2	6.0	5.9
Nutricote	645	264	162	576	482	5.6	6.2	6.2	6.0	5.9
Significance										
Linear	NS[z]	**	NS	NS	*	**	**	NS	NS	NS
Application method										
Surface	582	386	174	494	376	5.6	6.1	6.2	6.0	5.9
Incorporated	736	332	125	633	488	5.5	5.9	6.2	6.0	5.9
Significance										
Linear	**	NS	*	*	**	**	**	NS	NS	NS
g 14-14-14/ 4 in pot										
1.25	496	219	86	265	218	5.7	6.2	6.3	6.3	6.1
2.50	784	420	170	554	425	5.5	5.9	6.1	6.0	5.9
3.75	698	437	194	871	652	5.4	5.9	6.1	5.9	5.8
Significance										
Linear	**	**	**	**	**	**	**	**	*	**
Quadratic	**	*	NS	NS	NS	**	*	NS	NS	NS

[z]* = significant at 5% level, ** = significant at 1% level, NS = not significant.

Table 6. Elemental tissue content of *Aphelandra squarrosa*.

Treatment	Percent dry weight					Parts per million							
	N	P	K	Ca	Mg	Mn	Na	Fe	Cu	B	Zn	Mo	Al
Fertilizer source													
Osmocote	2.42	0.35	2.68	0.90	0.67	56	1152	123	7	95	26	2.0	43
Nutricote	2.44	0.24	2.28	0.89	0.72	52	1423	107	6	100	23	2.2	42
Significance													
Linear	NS[z]	**	**	NS	NS	NS	**	NS	NS	NS	NS	NS	NS
Application method													
Surface	2.42	0.29	2.30	0.93	0.77	65	1247	124	7	92	26	2.3	45
Incorporated	2.45	0.30	2.66	0.86	0.62	43	1328	106	5	102	22	1.9	39
Significance													
Linear	NS	NS	**	NS	**	**	NS	*	NS	NS	*	**	NS
g 14-14-14/ 4 in pot													
1.25	1.74	0.26	2.22	0.86	0.71	55	1265	100	9	100	22	2.4	44
2.50	2.66	0.31	2.63	0.90	0.70	53	1300	124	4	100	25	1.9	39
3.75	2.90	0.31	2.58	0.92	0.67	54	1297	120	6	92	25	1.9	43
Significance													
Linear	**	*	**	NS	NS	NS	NS	NS	NS	NS	NS	*	NS
Quadratic	NS	NS	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]** = significant at 5% level, ** = significant at 1% level, NS = not significant.

increased root grade and top fresh weight, but differences would not affect salability of the plant. Height, top fresh weight and plant grade increased with increased fertilizer rates, but root grade decreased. Although some variation in pH occurred, the responses were variable and not of sufficient magnitude to be important (Table 10). Electrical conductivity was greater for leachate from pots containing Osmocote at the last two measurement dates. Except for the first and second date, higher conductivity occurred with plants receiving surface application. In every case, there was a linear increase in conductivity with increasing fertilizer rates. Elemental contents of *Dieffenbachia* were similar among treatments but plants fertilized with Nutricote had slightly more Ca, Mn, Fe, Zn and Mo but less B (Table 11).

Table 7. Influence of Osmocote and Nutricote[z] on growth of *Chamaedorea elegans* and *Dieffenbachia maculata* 'Camille'.

Treatment	*Chamaedorea* September 27, 1984				*Diffenbachia* August 16, 1984			
	Ht (cm)	Plant grade[y]	Root grade[x]	Top fresh wt (g)	Ht (cm)	Plant grade	Root grade	Top fresh wt (g)
Fertilizer source								
Osmocote	46	3.9	4.3	81	43	4.6	4.6	302
Nutricote	46	4.1	4.3	79	43	4.4	4.5	287
Significance								
Linear	NS[w]	NS	NS	NS	NS	NS	NS	NS
Application method								
Surface	48	4.0	4.5	83	43	4.6	4.4	285
Incorporated[v]	45	4.0	4.1	78	42	4.5	4.8	304
Significance								
Linear	**	NS	**	NS	NS	NS	**	*
g 14-14-14/ 6 in pot								
6	45	3.9	4.2	76	41	3.9	4.9	253
10	46	4.2	4.3	82	43	4.7	4.4	296
14	46	4.0	4.4	82	44	5.0	4.4	334
Significance								
Linear	NS	NS	NS	NS	**	**	**	**
Quadratic	NS	NS	NS	NS	NS	**	NS	NS

[z]Nutricote applied April 2, 1984. Osmocote applied April 2 and June 30, 1984 at ½ listed rates.

[y]1 = not salable; 3 = good, salable; 5 = excellent quality.

[x]1 = 0–20% of soil ball covered with roots, 5 = 81–100%.

[w]** = significant at 5% level, ** = significant at 1% level, NS = not significant.

[v]Second Osmocote application surface applied.

Table 8. Influence of Osmocote and Nutricote[z] on electrical conductivity and pH of leachate of *Chamaedorea elegans*.

Treatment	µmhos × 10^{-5}						pH					
	4/27	5/23	6/20	7/18	8/16	9/13	4/27	5/23	6/20	7/18	8/16	9/13
Fertilizer source												
Osmocote	2765	1536	910	1624	2196	1276	5.1	5.4	5.4	6.1	6.0	6.3
Nutricote	2820	1498	1064	916	835	535	5.1	5.6	5.7	6.3	6.5	6.7
Significance												
Linear	NS[y]	NS	NS	**	**	**	NS	NS	NS	*	**	**
Application method												
Surface	2381	1192	746	1116	1300	661	5.1	5.7	6.2	6.5	6.5	6.7
Incorporated[x]	3204	1843	1228	1424	1732	1149	5.0	5.3	5.3	6.0	6.0	6.3
Significance												
Linear	**	**	**	**	**	**	NS	*	*	**	**	**
g 14-14-14/ 6 in pot												
6	1882	700	321	342	292	172	5.3	6.3	6.1	7.0	7.0	7.0
10	2935	1846	1275	1380	1549	952	5.0	5.2	5.2	5.9	6.2	6.4
14	3560	2005	1365	2088	2706	1592	5.0	5.4	5.6	5.7	5.6	6.0
Significance												
Linear	**	**	**	**	**	**	*	NS	NS	**	**	**
Quadratic	NS	**	**	**	NS	NS	*	*	*	**	NS	NS

[z]Nutricote applied April 2, 1984. Osmocote applied April 2 and June 30, 1984 at ½ listed rates.

[y]* = significant at 5% level, ** = significant at 1% level, NS = not significant.

[x]Second Osmocote application surface applied.

Significance to the Nursery Industry

There appears to be no advantage to choosing one of the slow-release fertilizers tested over the other, Osmocote and Nutricote performed equally when considering growth of the 4 plants. Nor does application method, incorporation or surface application, of the slow-release fertilizers tested make a consistent difference in growth of the 4 plants. With either fertilizer source and application method, tissue content of plants was usually within the range listed as providing good quality tropical plants (16). There does appear to be a slight growth benefit from the higher rate of fertilizer, but increased fertilizer costs and the potential for ground water contamination offset this slight increase in growth.

Table 9. Elemental tissue content of *Chamaedorea elegans*.

Treatment	Percent dry weight					Parts per million							
	N	P	K	Ca	Mg	Mn	Na	Fe	Cu	B	Zn	Mo	Al
Fertilizer source[z]													
Osmocote	3.2	0.23	1.7	0.75	0.27	204	403	111	4.1	43	16	2.1	19
Nutricote	2.8	0.26	1.8	0.82	0.30	250	476	111	4.5	51	14	2.2	16
Significance													
Linear	**[y]	**	NS	*	**	**	**	NS	NS	**	NS	NS	**
Application method													
Surface	3.1	0.26	1.8	0.81	0.28	256	384	100	4.3	49	13	2.0	19
Incorporated[x]	2.8	0.24	1.7	0.75	0.29	198	495	122	4.3	45	17	2.2	17
Significance													
Linear	*	**	*	*	NS	**	**	**	NS	NS	NS	NS	**
g 14-14-14/ 6 in pot													
6	2.5	0.19	1.6	0.87	0.31	172	513	133	4.0	48	15	4.0	20
10	3.3	0.26	1.7	0.74	0.28	247	449	108	4.6	46	17	1.4	16
14	3.2	0.29	1.9	0.74	0.27	262	357	93	4.2	48	13	1.0	18
Significance													
Linear	**	**	**	**	**	**	**	**	NS	NS	NS	**	NS
Quadratic	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	*

[z]Nutricote applied April 2, 1984. Osmocote applied April 2 and June 30, 1984 at ½ listed rate.

[y]* = significant at 5% level, ** = significant at 1% level, NS = not significant.

[x]Second Osmocote application surface applied.

Table 10. Influence of Osmocote and Nutricote[z] on electrical conductivity and pH of leachate on *Dieffenbachia maculata* 'Camille'.

Treatment	µmhos/cm					pH				
	4/27	5/23	6/20	7/18	8/16	4/27	5/23	6/20	7/18	8/16
Fertilizer source										
Osmocote	3330	1228	266	378	233	5.4	6.0	5.5	5.0	5.0
Nutricote	3664	1451	288	208	99	5.3	5.7	5.7	5.5	5.4
Significance										
Linear	NS[y]	NS	NS	**	**	NS	**	NS	**	**
Application method										
Surface	2663	1311	356	346	203	5.4	6.0	5.6	5.3	5.3
Incorporated[x]	4331	1369	199	241	129	5.3	5.7	5.5	5.2	5.2
Significance										
Linear	**	NS	*	**	*	NS	**	NS	NS	NS
g 14-14-14/ 6 in pot										
6	2690	837	184	167	86	5.5	6.4	5.6	5.2	5.3
10	3706	1309	278	276	137	5.4	6.0	5.5	5.4	5.2
14	4095	1874	370	437	274	5.2	5.6	5.6	5.2	5.1
Significance										
Linear	**	**	**	**	**	**	**	NS	NS	NS
Quadratic	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]Nutricote applied April 2, 1984. Osmocote applied April 2 and June 30, 1984 at ½ listed rate.

[y]* = significant at 5% level, ** = significant at 1% level, NS = not significant.

[x]Second Osmocote application surface applied.

Table 11. Elemental tissue content of *Dieffenbachia maculata* 'Camille'.

Treatment	Percent dry weight					Parts per million							
	N	P	K	Ca	Mg	Mn	Na	Fe	Cu	B	Zn	Mo	Al
Fertilizer source[z]													
Osmocote	3.1	0.56	3.7	2.2	0.91	310	2399	82	4.3	57	175	2.0	90
Nutricote	3.0	0.58	3.8	2.4	0.94	341	2391	106	5.0	51	205	2.4	89
Significance													
Linear	NS[y]	NS	NS	**	NS	*	NS	**	NS	*	**	**	NS
Application method													
Surface	3.0	0.59	4.0	2.4	0.94	342	2344	96	4.3	56	200	2.2	92
Incorporated[x]	3.1	0.55	3.6	2.2	0.90	309	2445	91	5.0	52	180	2.2	88
Significance													
Linear	NS	*	**	**	NS	**	NS	NS	NS	NS	**	NS	NS
g 14-14-14/ 6 in pot													
6	2.5	0.49	4.2	2.4	0.92	328	2604	97	4.4	54	215	2.4	89
10	3.2	0.57	3.6	2.2	0.95	333	2352	100	5.2	53	186	2.2	86
14	3.5	0.66	3.5	2.1	0.90	316	2229	84	4.4	54	170	2.1	94
Significance													
Linear	**	**	**	**	NS	NS	**	NS	NS	NS	**	*	NS
Quadratic	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]Nutricote applied April 2, 1984. Osmocote applied April 2 and June 30, 1984 at ½ listed rate.

[y]* = significant at 5% level, ** = significant at 1% level, NS = not significant.

[x]Second Osmocote application surface applied.

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