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Effect of Nutrient Regimes and Minor Elements on the Growth and Tissue Composition of Poinsettia Cultivars in Soilless Mediums

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ABSTRACT

Poinsettias were grown in a soilless medium in which Osmocote 14–14–14 and minor elements were incorporated. A liquid feed program added 100 ppm each of N and K_2O to selected combinations while others received water only. The height, inflorescence diameter, and number of breaks were greater for the combinations of liquid feed and Osmocote than for water and Osmocote. The addition of minor elements also improved growth over treatments lacking them. The concentration of minerals in the plant tissue was satisfactory in all treatments.

Additional key words: slow-release fertilizer, trace elements, tissue analysis.

INTRODUCTION AND PROCEDURE

It has become evident with the adoption of soilless mediums that attention must be given to the nutrition of plants in these substrates. The experiment reported here was designed using slow-release Osmocote 14–14–14 at both the recommended rate and half of it, with and without supplemental liquid fertilization, and with two sources of minor elements at two rates. Leaf analyses were made, and the relationships between growth, fertilization rate, and elemental content of the tissues were examined.

The Maui Research Station at Kula was used because a night temperature of 60 to 65°F could be maintained. The soilless medium was a 1:1 mix of wood shavings and a native volcanic cinder similar to volcanite. To this mix were added treble superphosphate and lime, at rates of 2 and 6 oz/ft^3, respectively. The liquid feed supplied 100 ppm nitrogen (N) and potash (K_2O) with each watering.

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Table 1. Schedule of nutrient treatments

Primary regime (oz/ft^3)				Secondary regime[x] (g/ft^3)	
Osmocote 14-14-14	6	+	liquid feed		
Osmocote 14-14-14	3	+	liquid feed		
Osmocote 14-14-14	6				
Osmocote 14-14-14	6	+	liquid feed	SM	16
Osmocote 14-14-14	3	+	liquid feed	SM	16
Osmocote 14-14-14	6			SM	16
Osmocote 14-14-14	6	+	liquid feed	SM	32
Osmocote 14-14-14	3	+	liquid feed	SM	32
Osmocote 14-14-14	6			SM	32
Osmocote 14-14-14	6	+	liquid feed	FTE	2
Osmocote 14-14-14	3	+	liquid feed	FTE	2
Osmocote 14-14-14	6			FTE	2
Osmocote 14-14-14	6	+	liquid feed	FTE	4
Osmocote 14-14-14	3	+	liquid feed	FTE	4
Osmocote 14-14-14	6			FTE	4

[x]SM = Soil Minel formulation; FTE = Peters Fritted Trace Elements No. 503.

The nutrient treatment schedule appears in Table 1. Both the Osmocote and the minor element fertilizers were incorporated before planting. The rates used were based on

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manufacturers' recommendations. Cuttings of poinsettia cultivars 'Annette Hegg Supreme' and 'White Annette Hegg' were received September 13, 1973, and promptly potted, two per 6-inch pot. About a week later, the established cuttings were pinched. Normal short days prevailed throughout the experiment. There were five single-pot replicates of each treatment arranged in a Randomized Block Design.

By December 1, all plants had reached a salable stage. On December 10, data were taken on height (in inches, from soil surface to plane of the top inflorescence), number of breaks per pot, and diameter (in inches) of the five largest inflorescences. Leaf samples were collected on November 13 and December 10; the second and third leaves below the colored bracts were used as the samples, dried and ground, and then submitted to Brewer Chemical Company, Honolulu, Hawaii, for analysis. The data were subjected to an analysis of variance and the means were separated by Duncan's Bayesian LSD procedure.

RESULTS AND DISCUSSION

Growth measurements appear in Table 2, and tissue analyses appear in Tables 3, 4, 5, and 6.

In comparing the three nutrient regimes, it is apparent that a combination of Osmocote and liquid feed is superior to Osmocote alone (see Kiplinger and Tayama, 1970). Liquid feed was as satisfactory with half the recommended rate of Osmocote as with the full rate, and, in many cases, was superior. Statistical analysis showed that the heights and diameters of both cultivars were significantly affected by the three nutrient regimes; the minor elements, also, generally had a significant effect when compared with the treatments without.

The Soil Minel formulation generally produced taller plants than either the Peters Fritted Trace Elements No. 503 (FTE) or treatments using no minor elements. Interestingly, the tissue content of phosphorus (P) was lower in the Soil Minel treatments than for FTE and no trace element treatment on both sampling dates for both cultivars, but this did not hold for FTE, possibly because the amount of FTE incorporated was very low. The highest potassium (K) contents were usually associated with applications of one-half the Osmocote rate + liquid feed, and the highest calcium (Ca) content was associated with treatments using the full rate of Osmocote + liquid feed. The 'White Annette Hegg' showed some deviation from these trends, differing at the full Osmocote rate without liquid feed for both elements. Both Ca and P were somewhat depressed on both sampling dates where the minor elements were added. The magnesium (Mg) levels showed little deviation, usually being about one-third to one-half the Ca levels. Although no analysis was made for N, it may be assumed to parallel K inasmuch as, in the form supplied, it was similarly soluble and mobile. Normal practice is to reduce N as the bracts begin to show color (Boodley, 1970).

If these values are to be used as a guide to poinsettia fertilization, a mid-November sampling would allow more time than a December sampling to correct nutritional problems. The November values, then, allow some leeway for the observed decrease in mineral content since the December values, except for Ca, were generally slightly lower than the November values.

Table 2. Growth of poinsettia cultivars in response to nutrient regimes and minor element applications

Nutrient regime		Minor element		'Annette Hegg Supreme'[z]			'White Annette Hegg'[z]		
Osmocote 14-14-14 (oz/ft^3)	Treatment[x]	Source[y]	Rate (g/ft^3)	Height (inches)	No. breaks/pot	Diameter (inches)	Height (inches)	No. breaks/pot	Diameter (inches)
6	LF	–	–	10.8ef	9.8a	10.5a	11.2ef	11.8a	11.2a
3	LF	–	–	11.5de	12.2a	11.2a	11.4e	12.6a	10.4bc
6	W	–	–	10.3fg	10.8a	9.5a	10.7fg	11.4a	9.8cd
6	LF	SM	16	10.8ef	11.0a	10.9a	12.8cd	11.4a	10.8ab
3	LF	SM	16	13.5ab	10.8a	11.3a	14.3ab	12.4a	11.3a
6	W	SM	16	10.3fg	10.2a	8.4a	12.5d	11.8a	10.8ab
6	LF	SM	32	13.1bc	10.0a	11.5a	13.2c	12.2a	11.3a
3	LF	SM	32	14.2a	10.8a	11.8a	13.8b	11.6a	12.4a
6	W	SM	32	10.7ef	10.6a	9.7a	11.4e	11.4a	9.9cd
6	LF	FTE	2	12.8bc	10.6a	10.4a	12.7cd	10.8a	11.3a
3	LF	FTE	2	12.3cd	10.4a	11.4a	14.6a	12.6a	11.3a
6	W	FTE	2	9.2h	10.8a	7.9a	10.0h	9.8a	9.2d
6	LF	FTE	4	12.5c	10.4a	10.7a	14.1ab	11.4a	11.0ab
3	LF	FTE	4	12.7bc	11.8a	11.7a	14.5a	11.8a	11.6a
6	W	FTE	4	9.8gh	10.2a	8.7a	10.3gh	11.6a	9.1d

[x]LF = liquid feed; W = water only.

[y]SM = Soil Minel formulation; FTE = Peters Fritted Trace Elements No. 503.

[z]Mean separation by Duncan's Bayesian LSD procedure. Means in the same column followed by the same letter are not significantly different at the 5% level.

Table 3. Tissue analysis of 'Annette Hegg Supreme' sampled November 13, 1973

Treatment				Percent				ppm				
Osmocote 14-14-14	Liquid feed[x]	Minor elements[y]	Rate (g/ft^3)	P	K	Ca	Mg	Cu	Fe	Zn	B	Mn
6	X	–	–	0.87	2.79	1.39	0.48	9	113	34	23	163
3	X	–	–	0.68	2.85	1.13	0.47	8	96	31	21	100
6	–	–	–	0.65	2.21	1.24	0.52	7	104	32	23	137
6	X	SM	16	0.59	2.81	1.04	0.46	12	125	74	56	231
3	X	SM	16	0.56	2.94	0.86	0.44	16	124	155	52	147
6	–	SM	16	0.41	2.43	1.00	0.41	10	78	86	84	345
6	X	SM	32	0.57	2.65	0.98	0.40	13	269	100	72	218
3	X	SM	32	0.54	2.71	0.95	0.46	14	111	79	84	175
6	–	SM	32	0.49	2.70	1.13	0.54	13	104	135	179	361
6	X	FTE	2	0.75	3.18	1.08	0.44	10	126	56	25	167
3	X	FTE	2	0.76	2.72	1.02	0.44	10	108	34	27	124
6	–	FTE	2	0.50	2.58	0.85	0.49	10	78	29	29	218
6	X	FTE	4	0.81	2.82	1.22	0.48	9	108	37	27	168
3	X	FTE	4	0.70	3.57	0.98	0.44	9	96	36	27	124
6	–	FTE	4	0.50	2.04	0.90	0.38	10	99	28	26	133

[x]An X indicates treatment was included; a dash indicates no treatment.
[y]SM = Soil Minel formulation; FTE = Peters Fritted Trace Elements No. 503.

Table 4. Tissue analysis of 'Annette Hegg Supreme' sampled December 10, 1973

Treatment				Percent				ppm				
Osmocote 14-14-14	Liquid feed[x]	Minor elements[y]	Rate (g/ft^3)	P	K	Ca	Mg	Cu	Fe	Zn	B	Mn
6	X	–	–	0.72	1.98	1.47	0.33	6	99	31	14	110
3	X	–	–	0.75	2.04	1.31	0.41	6	140	32	15	85
6	–	–	–	0.76	1.92	1.62	0.35	6	74	23	18	114
6	X	SM	16	0.55	2.01	1.06	0.36	9	90	46	49	177
3	X	SM	16	0.56	2.22	1.04	0.35	12	274	60	45	148
6	–	SM	16	0.33	1.24	0.97	0.25	6	67	52	56	173
6	X	SM	32	0.52	2.19	1.13	0.36	13	111	73	65	183
3	X	SM	32	0.54	2.17	1.13	0.35	11	96	70	59	169
6	–	SM	32	0.42	1.75	1.24	0.37	10	72	94	167	266
6	X	FTE	2	0.75	2.42	1.15	0.41	10	114	39	16	158
3	X	FTE	2	0.80	2.46	1.18	0.39	9	113	33	20	133
6	–	FTE	2	0.49	1.63	1.18	0.43	8	54	29	25	215
6	X	FTE	4	0.70	1.93	1.23	0.38	7	104	32	16	144
3	X	FTE	4	0.75	2.57	1.19	0.40	10	98	33	23	117
6	–	FTE	4	0.59	2.04	1.42	0.40	9	67	24	26	135

[x]An X indicates treatment was included; a dash indicates no treatment.
[y]SM = Soil Minel formulation; FTE = Peters Fritted Trace Elements No. 503.

Table 5. Tissue analysis of 'White Annette Hegg' sampled November 13, 1973

Treatment				Percent				ppm				
Osmocote 14-14-14	Liquid feed[x]	Minor elements[y]	Rate (g/ft^3)	P	K	Ca	Mg	Cu	Fe	Zn	B	Mn
6	X	–	–	0.84	2.68	1.32	0.42	8	113	36	23	114
3	X	–	–	0.72	3.13	1.02	0.34	8	87	31	22	82
6	–	–	–	0.73	2.72	1.26	0.56	8	99	34	25	128
6	X	SM	16	0.59	3.01	0.99	0.49	15	120	80	76	250
3	X	SM	16	0.60	3.14	1.06	0.42	12	104	100	52	271
6	–	SM	16	0.51	2.59	0.95	0.69	13	125	117	90	420
6	X	SM	32	0.63	2.73	0.94	0.43	13	117	77	108	189
3	X	SM	32	0.68	2.71	1.17	0.48	13	110	107	103	309
6	–	SM	32	0.50	2.82	0.91	0.55	11	91	117	208	326
6	X	FTE	2	0.73	2.87	0.87	0.46	8	116	30	23	142
3	X	FTE	2	0.75	2.97	0.99	0.47	9	101	33	27	157
6	–	FTE	2	0.48	2.30	0.68	0.52	7	74	25	25	209
6	X	FTE	4	0.77	2.88	1.11	0.42	9	103	29	25	149
3	X	FTE	4	0.63	3.14	1.05	0.47	9	107	31	31	151
6	–	FTE	4	0.54	2.37	0.73	0.48	7	87	33	27	139

[x]An X indicates treatment was included; a dash indicates no treatment.
[y]SM = Soil Minel formulation; FTE = Peters Fritted Trace Elements No. 503.

Table 6. Tissue analysis of 'White Annette Hegg' sampled December 10, 1973

Treatment				Percent				ppm				
Osmocote 14-14-14	Liquid feed[X]	Minor elements[Y]	Rate (g/ft^3)	P	K	Ca	Mg	Cu	Fe	Zn	B	Mn
6	X	–	–	0.77	1.61	1.45	0.37	6	100	24	13	95
3	X	–	–	0.76	2.30	1.29	0.24	7	89	25	15	81
6	–	–	–	0.75	1.79	1.38	0.42	7	80	20	17	95
6	X	SM	16	0.57	2.12	1.11	0.51	14	121	69	61	201
3	X	SM	16	0.52	2.25	1.07	0.23	10	85	45	37	174
6	–	SM	16	0.46	2.32	1.24	0.59	11	94	111	115	501
6	X	SM	32	0.58	2.02	1.00	0.39	14	112	76	114	186
3	X	SM	32	0.56	2.40	1.12	0.30	12	101	80	84	209
6	–	SM	32	0.46	2.24	1.11	0.48	10	72	119	271	253
6	X	FTE	2	0.84	2.06	1.02	0.42	9	103	33	16	146
3	X	FTE	2	0.78	2.31	1.12	0.32	9	96	31	19	132
6	–	FTE	2	0.47	1.75	1.04	0.50	7	62	26	27	206
6	X	FTE	4	0.71	2.11	1.21	0.40	8	108	32	19	124
3	X	FTE	4	0.66	2.48	1.18	0.35	10	102	35	23	116
6	–	FTE	4	0.54	1.99	1.21	0.43	8	55	22	31	156

[X]An X indicates treatment was included; a dash indicates no treatment.
[Y]SM = Soil Minel formulation; FTE = Peters Fritted Trace Elements No. 503.

The trace elements, copper (Cu), iron (Fe), zinc (Zn), boron (B), and manganese (Mn), varied somewhat in relation to their concentrations in both minor element sources (Table 7). In general, amounts found in the tissues of plants treated with the minor elements were greater than in plants without treatment. Soil Minel produced greater tissue concentrations of Zn, Mn, and B than did FTE. The full rate of Osmocote, with and without liquid feed, showed the highest Fe and Mn levels, while the half rate + liquid feed was usually lower.

The difference in solubility in the two minor element sources—together with the different rates—makes it difficult to determine which is the better source. Previous experience, however, suggests that the ready solubility of Soil Minel may be a disadvantage at higher rates, while higher levels of FTE may be more effective than the ones tested. All the minor element tissue concentrations are adequate and close to published concentrations (Carlson and Sink, 1967; Boodley, 1970; Ecke and Matkin, 1976).

Table 7. Composition of minor element sources, Soil Minel formulation (SM)[X] and Peters Fritted Trace Elements[Y] No. 503 (FTE)

Minor element	SM (%)	FTE (%)
Fe	3.47	18.0
Mn	3.60	7.5
Zn	3.24	7.0
Cu	3.49	3.0
Mg	3.45	–
B	0.34	3.0
Mo	0.29	0.2

[X]Donation of Brewer Chemical Company, Honolulu, Hawaii.
[Y]Donation of Peters Fertilizer, Allentown, Pennsylvania.

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