Table 3. Effect of relative humidity during seed storage at 5°C on germination of Formosan lily seeds. Data are the means of 400 seeds.

Seed Storage		Germination (15°C)		
Period (months)	RH (%)	Percent	T_{50}[y]	T_{90}-T_{10}[x]
0		98 a[z]	14.2 b	8.0 b
3	11	98 a	15.3 ab	8.2 b
	52	100 a	11.0 c	5.4 d
	75	99 a	14.2 b	8.9 b
	95	97 a	11.5 c	7.5 bc
6	11	96 a	16.0 ab	10.1 ab
	52	99 a	11.2 c	6.9 cd
	75	99 a	13.1 bc	8.3 b
	95	61 b	13.7 b	7.8 bc
9	11	99 a	16.5 a	12.0 a
	52	100 a	11.4 c	6.5 cd
	75	95 a	14.6 b	7.1 cd
	95	0 c	—	—

[z]Mean separation in columns by Duncan's multiple range test, 5% level.
[y]Days to 50% of final germination.
[x]Days from 10% to 90% germination.

Literature Cited

1. Bewley, J. D. and M. Black. 1986. Seeds: physiology of and germination. Plenum Press. New York.
2. Copeland, L. O. 1976. Principles of seed science and technology. Burgess, Minneapolis, Minn.
3. Chou, T. S. 1983. The distribution and variation of *Lilium formosanum* Wall. and *L. longiflorum* Thumb. in Taiwan. N. Amer. Lily Soc. Yearbook 36:48-51.
4. Emsweller, E. 1951. The effect of age and temperature on germination of seed of *Lilium speciosum rubrum*. N. Amer. Lily Soc. Yearbook 4:49-52.
5. Furutani, S. C., B. H. Zandstra, and H. C. Price. 1985. Low temperature germination of celery seeds for fluid drilling. J. Amer. Soc. Hort. Sci. 110:153-156.
6. Griffiths, D. 1930. The production of lily bulbs. U.S.D.A. Circ. 102:1-56.
7. Guy, C. L. and J. V. Carter. 1984. Characterization of partially purified glutathion reductase from cold hardened and nonhardened spinach leaf tissue. Cryobiology 21:454-464.
8. Post, K. 1949. Florist crop production and marketing. Orange-Judd, New York.
9. Roberts, A. and L. Blaney. 1967. Varieties and breeding. In: Easter Lilies. Eds. D. C. Kiplinger and R. W. Langhans. New York and Ohio Lily Schools.
10. Zu, B. M. and Y. Y. Long. 1987. A study of the optimum temperature for seed germination. Plant Physiology Communications 2:34-37.

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FERTILIZATION OF *ARAUCARIA HETEROPHYLLA* [SALISB.] FRANCO AND *CHRYSALIDOCARPUS LUTESCENS* H. WENDL

R. T. Poole and C. A. Conover
University of Florida, IFAS
Central Florida Research and Education Center-Apopka
2807 Binion Road, Apopka, FL 32703

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Abstract. **_Araucaria heterophylla_ (Norfolk Island pine) and _Chrysalidocarpus lutescens_ (Areca palm) were placed in 15-cm plastic pots containing 6 parts Florida peat: 3 parts pine bark: 1 part builder's sand by volume on 2 June 1989 and 26 April 1989, respectively. Containers received periodic applications of Osmocote 19N-2.6P-10K 3-month release rate fertilizer at one of ten fertilizer levels (4.3, 8.6, 12.9, 17.2, 21.5, 25.8, 30.1, 34.4, 38.7 or 43.0 g/15-cm pot). Electrical conductivity (μmhos/cm) and pH of growing medium, determined by the pour-through nutrient extraction method, and plant height were recorded initially and monthly thereafter for the duration (one year) of the experiment. Plant grade was determined at 3-month intervals. Norfolk Island pine receiving fertilizer application rates of 4.3, 8.6, and 12.8 g/15 cm-pot were taller, had higher plant grades than other rates tested, and no tipburn was observed on foliage. Electrical conductivity at termination of the experiment for the leachate from these media were 286, 477, and 581 μmhos/cm and final pH readings obtained were 7.6, 5.3 and 3.4. Areca palms receiving fertilizer application rates of 25.8, 30.1, 34.4, 38.7 and 43.0 g/15-cm pot were taller and scored higher plant grades than the five lower fertilization levels tested. Electrical conductivity and pH of leachate from growth media of best quality Areca palms at termination of experiment were 671, 620, 722, 767 and 1439 μmhos/cm and 6.8, 6.9, 5.9, 6.7 and 5.7.**

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Monitoring of soluble salts levels of the potting medium is now commonly used as a method of determining medium fertility (2,4,5,6,8). Four methods for measuring soluble ions in potting media currently exist, the volume:volume of water:soil method, usually 2:1, the saturated paste method, the weight:weight method (not generally used for artificial media) and the pour-through method. Although many tables suggesting soluble salts ranges for best growth of a wide variety of foliage plants have been printed in trade publications and textbooks, they mainly list the first three methods of soluble salts determination mentioned above, although the pour-through method has been used to report electrical conductivity and pH (3,9,10,11,12). The pour-through method is the easiest of the above mentioned tests for soluble salts determination to perform and thus has the most potential of being widely utilized by foliage producers in monitoring programs. The pour-through nutrient extraction method consists of pouring a measured amount of deionized water through the container medium to be tested and collection of the leachate from which soluble ion levels are then measured with a solubridge (11). Previous research with foliage plants has indicated that while many species can be grown profitably under greatly varying fertilization levels, some species require a very narrow range of fertilization levels in order to produce a salable crop (1,7). The following experiment was initiated to examine the use of the pour-through method of soluble salts determination in finding the optimum fertilization ranges of the two foliage plants tested.

Materials and Methods

Norfolk Island pine and Areca palm seedlings were placed in 15-cm plastic containers on 2 June 1989 and 26 April 1989 respectively, using medium composed of Florida peat: pine bark: builder's sand (6:3:1 by volume), amended with 4 kg dolomite and 1 kg Micromax/yd (Sierra Chemical Co., Milpitas, CA 95035). Plants were placed in a shadehouse where they grew under 5,000 ft-c maximum natural illumination, temperature ranges of 65 to 95°F and an irrigation schedule of two to three times per week as needed. Osmocote 19N-2.6P-10K 3-month release rate fertilizer (Sierra Chemical Co., Milpitas, CA 95035) was surface applied initially and at 3-month intervals until termination of experiment. Fertilizer application rates compared were 4.3, 8.6, 12.9, 17.2, 21.5, 25.8, 30.1, 34.4, 38.7 and 43.0 g/15-cm pot. Electrical conductivity, pH and plant height were recorded monthly and plant grade was determined using a scale of 1 to 5 with 1 = poor quality, unsalable, 3 = fair quality, salable and 5 = excellent quality plant material, when research was concluded on 8 June 1990 for Norfolk Island pine and 23 April 1990 for Areca palm. Tipburn of Norfolk Island pine was also recorded at termination of the experiment.

Results and Discussion

Norfolk Island pines receiving the three lowest fertilizer levels tested, 4.3, 8.6, and 12.9 g/15-cm pot, grew taller and had higher plant grades than the seven higher application rates tested, with 12.9 g/15-cm pot producing the best quality plant material (Table 1). Tipburn of Norfolk Island pine foliage did not develop until fertilization levels reached 17.2 g/15-cm pot and became more severe as application rates above the 12.9 g/15-cm pot optimum causing increasingly stunted growth. Final micromhos/cm and pH of the leachate from Norfolk Island pine growing media receiving the three lowest application rates tested were 286, 477 and 581 mhos/cm and 7.6, 5.3, and 3.4. Leachate from media of shorter plants with tipburn damage had mhos/cm and pH readings of 865 to 2489 and 3.1 to 2.8 (Tables 1 and 2).

Areca palms grew taller and had increasingly higher plant grades as fertilizer application rates rose from 4.3 to 25.8 g/15-cm pot (Table 3). Further increases in application rate did not produce taller palms or improve plant quality (Table 3). The five highest application rates tested, 25.8, 30.1, 34.4, 38.7 and 43.0 g/15-cm pot, produced the tallest, best quality Areca palms, with not much difference in height or plant grade. Final micromhos/cm and pH

Table 1. Fertilization effects on Norfolk Island pine height, plant grade, tipburn and pH of the medium. 1989-1990.

Fertilizer rate g/pot[x]	Height, cm Initial 21 June	Final 25 May	Plant grade[z] 8 June	Tipburn[y] 8 June	pH Initial 8 June	Final 23 May
4.3	24.3	59.2	4.4	1.0	6.7	7.6
8.6	23.1	67.0	4.5	1.0	6.7	5.3
12.9	23.1	70.3	4.6	1.0	6.7	3.4
17.2	24.2	66.6	3.9	1.2	6.7	3.1
21.5	23.8	61.6	3.9	1.1	6.7	2.9
25.8	24.3	63.6	3.8	1.2	6.6	2.0
30.1	25.7	57.6	3.4	1.2	6.6	2.9
34.4	24.1	52.5	3.0	1.8	6.5	2.9
38.7	23.8	57.8	2.9	2.1	6.2	2.8
43.0	24.7	55.3	2.7	2.2	6.3	2.8
Significance[w]						
linear	ns	**	**	**	**	**
quadratic	ns	ns	ns	*	*	**

[z]Plants were graded on a scale of 1 = poor quality, not salable, 3 = fair quality, salable, 5 = excellent quality plant material.
[y]Tipburn of foliage was graded on a scale of 1 = no injury, 3 = some injury but still salable, 5 = severe tipburn, unsalable.
[x]Osmocote 19-2.6P-10K 3-month release rate fertilizer was surface applied 2 June, 23 August, 21 November 1989 and 15 February 1990.
[w]ns, *, **; Nonsignificant, or significant at P = 0.05 or 0.01, respectively.

Table 2. Fertilization effects on electrical conductivity of leachate from medium containing Norfolk Island pine. 1989-1990.

Fertilizer rate g/pot[z]	Micromhos/cm 21 Jun	16 Aug	11 Oct	12 Dec	31 Jan	28 Mar	23 May
4.3	156	182	327	644	516	378	286
8.6	187	185	591	1343	979	993	477
12.9	240	240	760	1584	1515	1733	581
17.2	282	218	949	1721	1904	2205	865
21.5	278	311	1125	2378	2524	3081	1042
25.8	266	273	910	2854	2799	3237	879
30.1	310	332	1443	3489	3964	5061	1568
34.4	376	329	1508	3829	4110	4219	2698
38.7	418	365	1238	4053	4095	4860	2206
43.0	329	421	1644	4808	5513	4799	2489
Significance[y]							
linear	**	**	**	**	**	**	**
quadratic	ns	ns	ns	ns	ns	*	**

[z]Osmocote 19N-2.6P-10K 3-month release rate fertilizer was surface applied 2 June, 23 August, 21 November 1989 and 15 February 1990.
[y]ns,*,**; Nonsignificant or significant at P = 0.05 or 0.01, respectively.

Table 3. Influence of fertilization rate on Areca palm height, plant grade and pH of the growing medium. 1989-1990.

Fertilizer rate g/pot[y]	Height, cm Initial 19 May	Final 17 Apr	Plant grade[z] 23 Apr	pH Initial 17 May	Final 18 Apr
4.3	32.1	84.2	2.8	6.8	7.4
8.6	35.4	86.6	3.1	6.9	7.4
12.9	34.2	84.9	3.2	6.9	7.2
17.2	34.6	89.8	3.5	7.0	7.3
21.5	35.2	91.7	3.6	7.0	6.9
25.8	35.0	91.4	4.0	7.0	6.8
30.1	34.7	87.9	3.8	7.0	6.9
34.4	35.2	86.6	4.0	6.9	5.9
38.7	34.5	88.6	4.1	6.9	5.7
43.0	35.4	89.7	4.0	6.9	5.7
Significance[x]					
linear	ns	*	**	ns	ns
quadratic	ns	*	*	ns	ns

[z]Plants were graded on a scale of 1 = poor quality, unsalable, 3 = fair quality, salable, 5 = excellent quality plant material.
[y]Osmocote 19N-2.6P-10K 3-month release rate fertilizer was surface applied 26 April, 23 August, 20 October 1989, 8 January and 4 April 1990.
[x]ns,*,**; nonsignificant or significant at P = 0.05 or 0.01, respectively.

readings of the leachate from media of best quality Areca palms ranged from 580 to 1439 and 6.8 to 5.7 (Tables 3 and 4).

Results indicate Norfolk Island pines grow best when given low to moderate fertilization rates, 8.6 to 12.9 g/15-cm pot. The decrease in pH and increase in micromhos/cm observed in Norfolk Island pine media leachate over a year's time indicates the need to monitor the growing medium periodically. Areca palms grew best when supplied higher fertilization rates and tolerated a much wider range of fertilization levels. Since the five highest fertilization rates tested (25.8, 30.1, 34.4, 38.7, and 43.0 g/15-cm pot) produced excellent quality Areca palms, the 25.8 g/15-cm pot rate is the most economical rate for commercial production.

The pour-through method, like the other three methods of soluble salts determination mentioned above, produces variable readings from pots receiving the same fertilization rates. Soluble salts and pH of the leachate of media is affected by irrigation water, medium composition, pesticide and fungicide treatments, and fertilizer formulation as well as by fertilizer application rates. Therefore, when utilizing any method of soluble salts determination for timing fertilizer applications and determining rates of application, soluble ion concentrations should be examined monthly or bi-monthly to establish a producer's individual limits of variability.

Table 4. Fertilization effects on electrical conductivity of leachate from medium growing Areca palm. 1989-1990.

Fertilizer rate g/pot[z]	Micromhos/cm						
	17 May	12 Jul	7 Sep	1 Nov	27 Dec	21 Feb	18 Apr
4.3	179	141	146	152	164	201	187
8.6	131	144	197	285	200	288	339
12.9	134	135	266	297	258	368	547
17.2	138	162	313	457	265	261	464
21.5	134	147	267	440	263	539	543
25.8	145	145	311	549	416	590	671
30.1	141	146	425	688	424	529	620
34.4	153	142	328	760	436	706	722
38.7	164	176	429	948	514	706	767
43.0	179	188	457	936	500	1159	1439
Significance[y]							
linear	ns	**	**	**	**	**	**
quadratic	ns	ns	ns	ns	ns	ns	ns

[z]Osmocote 19N-2.6P-10K 3-month release rate fertilizer was surface applied 26 April, 23 August, 20 October 1989, 8 January and 4 April 1990.
[y]ns,*,**; Nonsignificant or significant at P = 0.05 or 0.01, respectively.

Literature Cited

1. Conover, C. A. and R. T. Poole. 1990. Light and fertilizer recommendations for production of acclimatized potted foliage plants. Fol. Dig. 13(6):1-6.
2. Henley, R. W. 1975. Back to basics - soluble salts. Fla. Fol. Grow. 12(3):1-4.
3. Hipp, B. W., D. L. Morgan, and D. Hooks. 1979. A comparison of techniques for monitoring pH of growing medium. Commun. Soil Sci. Plant Anal. 10:1233-1238.
4. Ingram, D. and R. W. Henley. 1984. Measuring soluble salts in container media. Fl. Nurseryman 31(8):20-21.
5. Manaker, G. H. 1984. Monitoring soluble salts. Interior Landscaping Industry. Feb. 1984:55-59.
6. Poole, R. T. 1981. Soluble salts interpretation. Fol. Dig. 4(6):11-13.
7. Poole, R. T. and A. R. Chase. 1986. Growth of six ornamental plants and soluble salts of the growing media. Proc. Fla. State Hort. Soc. 99:278-280.
8. Poole, R. T., C. A. Conover, and A. R. Chase. 1985. Soluble salts interpretation for ornamental crop production. Proc. Trop. Reg. Amer. Soc. Hort. Sci. 27:33.
9. Poole, R. T. and R. W. Henley. 1981. Constant fertilization of foliage plants. J. Amer. Soc. Hort. Sci. 106(1):61-63.
10. Sanderson, K. C., W. C. Martin, L. Shu, C. E. Evans, and R. M. Patterson. 1985. Fertilizer and irrigation effect on medium leachate and African violet growth. HortScience 20(6):1062-1065.
11. Wright, R. D. 1986. The pour-through nutrient extraction procedure. HortScience 21:227-229.
12. Yeager, T. H., R. D. Wright, and S. J. Donohue. 1983. Comparison of pour-through and saturated pine bark extract N, P, K and pH levels. J. Amer. Soc. Hort. Sci. 108:112-114.

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EFFECTS OF COMMERCIAL FLORAL PRESERVATIVES ON FOUR TYPES OF CUT FLOWERS

ANNA J. DAN
A & L Southern Agricultural Laboratories, Inc.
1301 W. Cpans Road—Bldg. D
Pompano Beach, Florida 33064

LYNN P. GRIFFITH JR.
A & L Southern Agricultural Laboratories, Inc.
1301 W. Copans Road—Bldg. D
Pompano Beach, Florida 33064

Abstract. **Five different commercial floral preservatives were tested on four different cut flower varieties. The parameters studied include flower quality, longevity, water clarity, pH and bacterial growth. Flower quality and longevity of Alstroemeria and Mini Carnations were highest with two formulations of Vitabric. Pompoms displayed the greatest flower quality and longevity in Chrysal. The vase life of Roses was short; however, the greatest flower quality and longevity were observed with Floralife.**

The production and sales of fresh cut flowers are one of the fastest growing branches of horticulture in the Caribbean and Latin America. It is very important to growers, wholesalers and retailers that fresh cut flowers sustain their quality and stay valuable for long periods of time, especially when exported. Until the mid-seventies, very little attention was paid to the relationship between water quality and longevity of fresh cut flowers (3).

All floral preservatives can be divided into two groups: pulse or conditioning preservatives and vase solution preservatives (4). Pulse or conditioning preservatives are used mostly by growers to increase the quality of fresh cut flowers during transportation and distribution to retailers. The second group of floral preservatives, vase solutions, are mostly used by distributors and retailers of fresh cut flowers as well as consumers.

In this study, observations of the effects of commercial floral preservatives on four different types of cut flowers were made. The parameters measured were water clarity,