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.

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# EFFECTS OF COMMERCIAL FLORAL PRESERVATIVES ON FOUR TYPES OF CUT FLOWERS


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*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, water pH and soluble salts, bacterial count, quality of flowers and leaves and longevity of the flowers.

### Materials and Methods

The experiment was conducted for 14 days from July 11, 1990 to July 24, 1990 and repeated from August 14, 1990 to August 27, 1990. Fresh cut flowers were purchased from a wholesaler in Miami, Florida. In this experiment, four types of flowers were used: Alstroemerias, Mini Carnations, Chrysanthemums (Pompoms) and Roses. The flowers were of regular quality that is supplied to retailers.

For each type of flower, a specific number of stems was chosen and observations were made based upon the number of stems, not on the number of individual flowers. A 4 x 5 factorial experimental format was used, with testing units of ten stems per vase for Alstroemeria, Mini Carnations and Roses, and seven stems per vase for Chrysanthemums.

Five different commercial floral preservatives were used: Chrysal, Floralife, Rogard, Vitabric Commercial Label and Vitabric End User Label. The following amounts of preservatives were used in the experimental vases: one packet each of Chrysal, Floralife and Rogard, 1/4 label per vase of the Vitabric Commercial Label and one Label per vase of the Vitabric End User Label.

Four sets of one liter beakers were used for the test. Each set contained six beakers filled with 500 ml of tap water and commercial cut flower preservatives prepared according to the manufacturer's specifications. All selected flowers were cut under water, three to five inches from the bottom, in order to remove air-blocked parts of the stems and to prevent additional blockage of the stems (1,2). The vases were placed on a table near a window. No supplemental light was provided. The temperature of the room was 76-78°F (26°C), and the room was air conditioned. The water in all of the vases was refilled after three days by adding water mixed with proper additives at the labeled concentrations.

The pH and soluble salts of all the solutions were measured at the beginning and at the end of the test. The bacterial count of the solutions was taken with Hach's Paddle Tester. Changes in the water clarity were observed in all vases. Quality and longevity of the four different types of flowers were observed and evaluated.

### Results and Discussion

The test was conducted for 14 consecutive days. Visual observations of fresh cut flowers in different types of preservatives were conducted daily and the changes were noted. The following parameters were tested:

a. pH and soluble salts
b. Water clarity
c. Bacteria count
d. Quality of flowers, stems and leaves
e. Longevity of the flowers

The pH is a very important parameter in the longevity of fresh cut flowers. According to Prince (3), a pH between 3.5 and 5.0 is most beneficial to cut flowers because water intake is at its highest. Three of the preservatives tested had a pH in that range: Chrysal, Floralife and Rogard. The pH of control, tap water, was 7.9. The Vitabric solutions had a pH of 7.7. It is also noted that the pH of the Vitabric solutions tended to drop with time.

The soluble salts were highest in Chrysal at 1.36 mmhos/cm, and lowest in the vases with tap water and Vitabric at 0.18 mmhos/cm. At the end of the experiment, concentrations of soluble salts changed the most in the bases with Chrysal, where 1.36 mmhos/cm dropped to 0.55 mmhos/cm. This suggests that the cut flowers were absorbing ions in the Chrysal solution. All solutions were clear at the beginning of the test with the exception of the Chrysal, which was cloudy from the start. Over 14 days of testing, water clarity changes were significant and dependent upon the type of floral preservative and flower type. The water stayed clear for 12 days in the bases of Mini Carnations and the Vitabric Commercial Label.

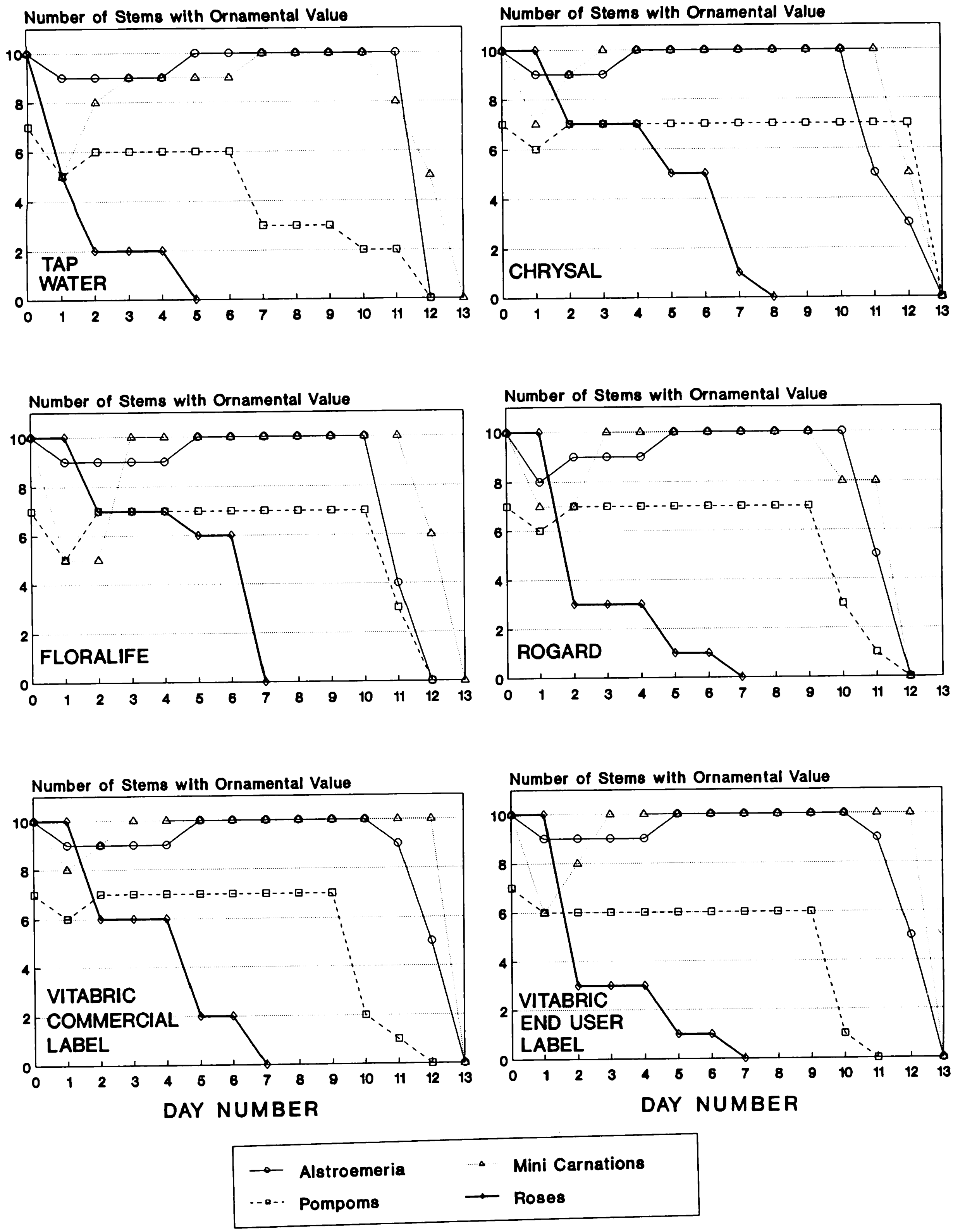
The quickest changes of water clarity were observed in vases with Pompoms and Vitabric End User Label solutions. We suspect that the relatively faster changes in water clarity were because of the presence of sucrose in the solution, with the resulting intense growth of bacteria.

It is very important to control the growth of microbial population in the water/preservative solution (3,4). Most of the floral preservatives contain some form of bactericide to reduce the bacterial population in the vase solutions (1,2).

Total bacteria, coliform and other gram negative bacteria were not present in the vases with the Alstroemeria at the beginning of the experiment. Some bacteria were present in the vases with the other flowers. The highest bacterial counts were present in the vases of Pompoms. A possible explanation is that the texture of the stems and leaves of Pompoms are more conducive to and accumulate more bacteria than other types of flowers. The different floral preservatives regulated microbial growth by releasing biocide into the solution. The best of all floral preservatives tested, in terms of controlling bacterial growth, were the two Vitabric Labels, the Commercial and End User Labels. When the bacterial counts were conducted at Day 7, the growth of the microbes was practically unrestricted in all of the vases and preservatives with the exception of the vases containing the Vitabric solutions. Bacterial counts ranged from higher than $10^7$ in the bases with water to $10^4$ in vases containing the Vitabric solutions (both the Commercial and End User Labels). The comparison of tap water and other floral preservatives Vitabric Labels provided the best control of bacterial growth.

The quality of the different types of flowers treated with the different floral preservatives varied among the types of flowers. Firmness of the petals, color and development of the closed buds into open flowers varied with the different preservatives and types of flowers.

Alstroemerias treated with different preservatives showed good quality at flower opening and good color and firmness of petals with each of the preservatives from Day 0 through Day 10. Deterioration of the flowers came very quickly after Day 10. The flowers lost their petals regardless of the type of preservative, although the flowers traeted with the Vitabric solutions held their petals longer and had better color. The Alstroemeria leaves developed chlorosis fairly early. The leaves tended to turn yellow or light brown and dry up. The foliage quality was better in the vases treated with Vitabric.




The flower quality of the Mini Carnations was best with both Vitabric treatments. Flowers opened very well and held their ornamental value for 12 days. The floral preservative Rogard tended to dehydrate the stems and leaves, which made the flower heads droop thus causing the flowers to lose their ornamental value. Dryness of the calyx appeared in flowers treated with the Vitabric solutions. Dryness of stems, leaves and calyx could be caused by an accumulation of bactericide in parts of the flowers and/or by an accumulation of gases in the water (1,3).

The Pompoms had the best flower quality with the Chrysal treatment. The flowers lasted longer with the best condition in the Chrysal solution than with any other treatment. The leaves showed chlorosis and dehydration early, and after four days they were dry and brown. As the leaves and stems already had shown some symptoms of dehydration at the beginning of the experiment, it is inconclusive that the further dehydration was caused by a preservative treatment. Deterioration of water quality in the Pompoms in all solutions was quicker than the other flowers tested. It is possible that this was caused by a higher accumulation of bacteria in the velvety hair on the stems and leaves.

The Roses had a tendency to lose turgor quickly after they were cut, perhaps due to air blockage in the stems. Longevity of the Roses did not exceed seven days, with maximum development on Days 1 through 4. Symptoms of drooping flower heads (bent neck) and drying of petals began on Day 4, but was not severe. Drooping of the flower heads could have been caused by air blockage (1,2). The process of cutting the flower stems under water helps to prevent this blockage problem somewhat, but frequently it is not enough to prevent bent neck. Longevity of the Roses was increased slightly with Floralife, but not enough to give preference to that floral preservative. Longevity of four types of the flowers treated with different floral preservatives is illustrated in Figure 1.

As shown in Figure 1, the Alstroemerias and Mini Carnations held their ornamental value for nine days, while the Roses and Pompoms declined fairly quickly in the vases with only tap water. Flowers in vases which contained the Chrysal preservative showed improved longevity over control. Pompoms in Chrysal held their ornamental value for up to 12 days while the Roses showed improved longevity over the tap water.

Floralife increased the longevity of Roses over Roses treated with Chrysal and tap water. There were not significant changes in the longevity of the other types of flowers with Floralife. The preservative Rogard improved the longevity of the four types of flowers over the tap water control, but not significantly over the Chrysal and Floralife solutions. The longevity of Alstroemerias and Mini Carnations was greatly improved with the two Vitabric solutions over the same types of flowers placed in the tap water control and other floral preservatives. The longevity of the Pompoms was increased with the Vitabric, while the vase life of the Roses was better than the control, but still very short.

The increased longevity and ornamental value of the Pompoms with Chrysal was probably due to a higher concentration of nutrients in that solution as Pompoms apparently absorb substantial amounts of nutrients from the solution.

The Alstroemerias and Mini Carnations had better quality flowers and longer life with Vitabric than any other preservative tested, probably due to an increased control of bacterial growth combined with better control of gases in the solution (3,4).

The Roses did not show major improvement over the control sample in any of the preservatives except Floralife. However, this increase was not substantial enough to give preference to that particular preservative.

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