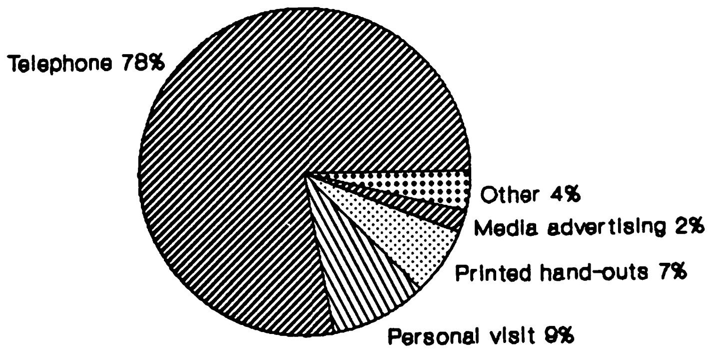

Fig. 6. Primary sales method.

mands of general business management. According to surveyed firms, the owner was the primary salesperson for 75 percent of all firms, and for 90 percent of small firms (Figure 5). Only 22 percent of firms employed the services of a professional salesperson, indicating a lack of understanding of the time and effort required to be effective at personal selling.

Sales methods were an important marketing consideration. The telephone was the primary channel of direct sales for 78 percent of firms, and for 89 percent of large and very large firms (Figure 6). Smaller firms tended to rely less on the telephone, which is a relatively expensive means of communication. Personal visits were a primary sales method for 10 percent of firms, and printed hand-out materials were used by 7 percent. Trade shows were another important sales tool. However, only 43 percent of firms attended a trade show, and only 19 percent attended two or more shows.

In the realm of advertising media, price lists were the main form for 79 percent of firms, trade publications were used by 14 percent, and 4 percent used local media (Figure 7). The high degree of dependence on price lists for advertising media is an indication that industry marketing is done on the basis of price rather than value.

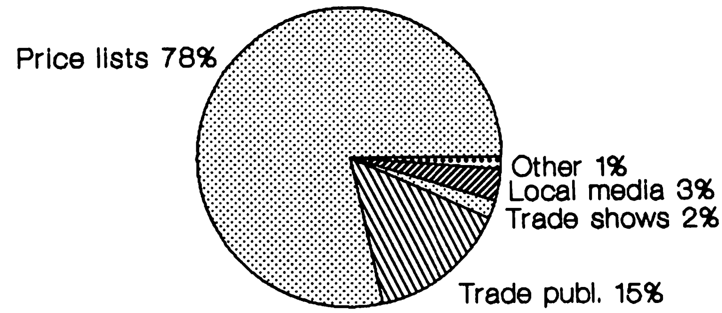

Fig. 7. Primary advertising method.

Conclusions

Florida's ornamentals industry faces great challenges to remain a sustainable and profitable industry. Many standard business practices were found to be lacking or absent entirely, according to results of a large survey of producers in southern Florida in 1985. Needs were emphasized for increased training of employees and management, more attention to employee fringe benefits programs, greater use of professional sales personnel, and more industry support of research and development activities.

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ORNAMENTAL PLANT GROWTH RESPONSES TO DIFFERENT APPLICATION RATES OF RECLAIMED WATER

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Abstract. **To determine the quantity of reclaimed irrigation water required to supplement normal rainfall and still produce optimum growth in ornameral plants, an experiment was set up in the landscape and turf areas of thirty private residences in the Colony Point area of St. Petersburg. Six different irrigation rates varying from 0.5 to 2.5 inches per week were applied throughout the experiment from January to August 1988. The growth of twelve replicates of each of twenty species of ornamental plants was monitored throughout the experimental period at each of the application levels. Using analyses of variance and Duncan's multiple means tests, Italian cypress (*Cupressus sempvirens*), asparagus fern (*Asparagus densiflorus*), yew podocarpus (*Podocarpus macrophyllus*), bird of paradise (*Strelitzia reginae*), juniper (*Juniper procumbens*), philodendron (*Philodendron williamsii*), croton (*Codiaeum variegatum*), schefflera (*Brassaia actinophylla*), yaupon holly (*Ilex vomitoria* 'Schellings'), and orange (*Cirus sinensis*) showed no significant growth response to different application rates, Natal plum (*Carissa grandiflora*), chrysanthemum (*Chrysanthemum morifolium*), privet (*Ligustrum japonicum*) and dracaena (*Dracaena dere-***

mensis) showed marginally significant responses and green *pittosporum* (*Pittosporum tobira*), hibiscus and hybrids (*Hibiscus rosa-sinensis* L. & *Hibiscus rosa-sinensis* L. (hybrid)), variegated pittosporum (*Pittosporum tobira* 'variegatum'), Boston fern (*Nephrolepis exaltata* and azalea hybrids (*Rhododendron* sp.) showed highly significant responses. Application rates between 1.0 and 1.5 inches per week produced optimum growth responses in ornamentals and are recommended for reclaimed water in St. Petersburg. Application rates in excess of 1.5 inches per week failed to produce significant growth increases and wasted the reclaimed water resource.

The development of a major urban reclaimed water reuse irrigation distribution system by the coastal City of St. Petersburg, Florida, represents a major breakthrough in reuse technology. Project "Greenleaf" (2) clearly demonstrates that this type of reuse system can significantly reduce potable water demand, is advantageous in promoting the growth of many salt tolerant ornamental plants (3), and reduces accelerated eutrophication of surrounding surface waters.

The growth experiments in Project "Greenleaf" (2) were all conducted on plants grown in plastic pots and the applied volume of irrigation water was not varied throughout the duration of these investations. It became clear that a larger field trial would be required to determine the precise amount of reclaimed irrigation water necessary to supplement natural rainfall and produce optimum plant growth. This trial would need to use ornamental species growing under natural conditions to produce the required irrigation level data.

For this type of field investigation, an area known as Colony Point Estates in the southeast corner of St. Petersburg was selected as it satisfied the following requirements:

a) No reclaimed water had been used in the area prior to the beginning of this experiment.
b) The area was compact, with 46 single family residences, each not more than 28 years old.
c) Most residences were on waterfront lots with high exposure to saltwater.
d) The majority of homes had well maintained gardens with a large variety of well established ornamental plants.
e) Most homes had automatic irrigation systems that were originally professionally installed and were in good condition and well maintained.
f) Well water in the area was too saline for irration so that the majority of irrigation systems were connected to the potable water supply prior to the installation of reclaimed water.
g) Residents were mostly homeowners who had an interest in maintaining a well kept garden and were thus eager to join the research project.
h) Records for potable water consumption prior to the beginning of the experiment were easily obtainable from municipal utility accounts.

The name given to the field trial was Project "Resource Management" and it was carried out under the joint financial sponsorship of the Southwest Florida Water Management District (SWFWMD) and the City of St. Petersburg.

Materials and Methods

Thirty residential homeowners signed contracts with the City of St. Petersburg allowing access to their landscaped areas to carry out the field trial. Reclaimed water supply was connected to each participant's existing irrigation system and a water meter was installed in the delivery line. All irrigation systems were repaired as necessary, defective spray heads were replaced and manual systems were converted to automatic operation.

The number of irrigation zones, and the number, type and position of each sprinkler head within each zone was recorded on a scale drawing of each residence. Areas covered by each zone were subdivided into turf, ornamental, shrub, flower bed and tree areas, and included on the scale drawings. Hardcore and any areas that were not irrigated at all were also noted and measured. Where irrigation zones overlapped, total spray areas for each zone were approximated by indivdual inspection of each occurrence.

Rain gauges from the St. Petersburg "Conservival" promotion were used to determine the uniformity of the spray pattern throughout each irrigation zone. Where variations of more than 50% occurred within one zone, modifications were made to the system until a uniform spray pattern was established. All irrigation systems were calibrated by operating each zone for 15 minutes and noting the total number of gallons that passed through the water meter.

Irrigation levels of 0.5 in., 0.75 in., 1.0 in., 1.5 in., 2.0 in. and 2.5 in. were used in the plant growth experiment. Five residences were randomly selected to create each of the 6 irrigation level groups.

A Lotus 1-2-3 spreadsheet was used to compute the number of minutes each irrigation zone should operate when selected numbers of irrigation events per week and required irrigation levels were entered for each residence. The automatic timers in each residence were then set to operate each zone for the calculated amount of time and number of events every week. Meters were read weekly to monitor consumption rates.

In order to eliminate the possibility that soil nutrient levels were different in each of the residential areas, known quantities of fertilizer were evenly spread on each garden before the beginning of the experiment in December 1987 and half way through in May/June 1988.

The positions, identifications and quantities of a total of 148 commonly occurring species of ornamental plants in each residential area were mapped. Twenty plant species which occurred commonly in residences in each irrigation group were chosen for the growth experiment as follows:

1. *Asparagus densiflorus* 'Sprengeri'	Asparagus fern
2. *Brassaia actinophylla*	Schefflera
3. *Carissa grandiflora*	Carissa boxwood (Natal plum)
4. *Chrysanthemum morifolium*	Chrysanthemum
5. *Citrus sinensis*	Orange
6. *Codiaeum variegatum*	Croton
7. *Cupressus sempervirens*	Italian cypress
8. *Dracaena deremensis*	Dracaena
9. *Hibiscus rosa-sinensis*	Hibiscus
10. *Hibiscus rosa-sinensis* (hybrid)	Hibiscus variety
11. *Ilex vomitoria* 'Schellings'	Yaupon holly
12. *Juniperus procumbens*	Juniper
13. *Ligustrum japonicum*	Ligustrum (privet)
14. *Nephrolepis exaltata* 'Bostoniensis'	Boston fern
15. *Philodendron williamsii*	Philodendron
16. *Pittosporum tobira*	Pittosporum (green)
17. *Pittosporum tobira* 'variegatum'	Variegated pittsporum

18. *Podocarpus macrophyllus* Yew podocarpus
19. *Rhododendron* sp. Azalea varieties
20. *Strelitzia reginae* Bird of paradise

Plant growth index determinations were made by summing plant height and average width in February, May and August 1988 on twelve replicates of each plant species in each of the 6 experiment irrigation level groups of residences. Plants were selected within a maximum and minimum predetermined size range so that initial measurements would not have an excessively large standard deviation. Total plant measurements were normally made, but where large tree species were used, such as *Citrus*, *Cupressus* and *Podocarpus*, a branch or particular part of the plant was selected for measurement rather than the complete plant.

Measurements were entered on a Lotus 1-2-3 spreadsheet which computed all growth indices, found the mean initial plant size index and calculated the standard deviation of each mean. Initial growth data were corrected to the overall mean value of the 6 individual means and subsequent growth data were also adjusted by the appropriate correction factors. The spreadsheet also produced graphical representations and executed analyses of variance and Duncan's multiple range tests (1) at the 5% confidence level.

Rainfall and maximum and minimum air temperature data were measured daily at the nearby Southwest Wastewater Treatment Plant. Reclaimed water was sampled and analyzed every 14 days from a specially installed faucet located at 200 Colony Point Road and mainline delivery pressure was monitored by a 7 day chart recorder.

Results and Discussion

During the experiment, the irrigation application rate had to be intentionally increased in the 0.5 in/week group due to severe drying out of the turf areas at these residences. Increases were made in the last three months of the experiment. Also, the 2.5 in/week levels had to be reduced towards the end of the experiment as large areas of the unsightly weed pennywort (*Hydrocotyle umbellata*) were growing in the turf. Thus, the ideal irrigation level fell within the experimental range as the lower level of 0.5 in/week proved to be insufficient and the upper end of 2.5 in/week proved to excessive.

The 20 experimental plants are listed in Table 1 in increasing order of the "F" value obtained from the analysis of variance on the August growth measurements. Values that exceed 2.35 indicate a significant difference between the 6 means. The Duncan's multiple means test (1) results are included on this table as lower case letters. Where the "F" value is less than 2.35, there is no significant difference between all 6 means and they are represented by the letter "a". Where the "F" value exceeds 2.35, means may be represented by different letters or combinations of letters. Only means which are represented by *different* letters are significantly different from each other. In other words, there is no significant difference between any means that are represented by any similar letter or set of letters.

Table 1 shows 10 ornamental plant species which exhibited no significantly different growth responses to different irrigation application levels over the six month period from February to August 1988. Three of these

Table 1. Mean separation for 20 plant species at 6 reclaimed water irrigation application rates by Duncan's multiple range test, 5% confidence level. Analysis of August 1988 growth indices.

Plant species	"F" Value[x]	Irrigation application rate (in/week) 0.5	0.75	1.0	1.5	2.0	2.5
Grade I No significant difference							
Cupressus sempervirens[y]	0.5	a[z]	a	a	a	a	a
Asparagus densiflorus	0.6	a	a	a	a	a	a
Podocarpus macrophyllus	0.8	a	a	a	a	a	a
Strelitzia reginae	0.8	a	a	a	a	a	a
Juniperus procumbens	1.0	a	a	a	a	a	a
Philodendron williamsii	1.0	a	a	a	a	a	a
Codiaeum variegatum	1.3	a	a	a	a	a	a
Brassaia actinopylla	1.6	a	a	a	a	a	a
Ilex vomitoria schellings	1.7	a	a	a	a	a	a
Citrus sinensis	1.9	a	a	a	a	a	a
Grade II Marginally significant difference							
Carissa grandiflora	2.4	a	ab	bc	bc	c	c
Chrysanthemum morifolium	2.5	a	ab	b	a	a	a
Ligustrum japonicum	2.5	a	a	a	b	b	b
Dracaena deremensis	3.8	a	a	a	b	ab	b
Grade III Distinct significant difference							
Pitosporum tobira	6.4	a	a	ab	bc	c	c
Hibiscus rosa-sinensis	7.7	a	a	a	b	b	b
Hibiscus hybrid	9.7	a	a	a	b	b	b
Pittosporum tobira "var"	10.8	a	a	ab	bc	c	c
Nephrolepis exaltata	18.2	a	a	b	b	b	b
Rhododendron sp.	29.4	a	a	a	b	c	c

[x]"F" value from the analysis of variance of the August 1988 growth indices (a value of 2.35 or greater indicates significant difference between means at P = <0.05.).
[y]For each plant species (i.e.) across each row, growth indices at different irrigation application rates are significantly different (P = <0.05) if letters are different.
[z]The letter "a" indicates the least growth in each species. Successive letters indicate increased growth indices.

species (*Cupressus*, *Podocarpus* and *Citrus*) were well established trees with roots that penetrated below the groundwater level, thus making them independent of irrigation application levels, except in severe droughts. *Asparagus* has water storage tubers on the root system and can survive long periods without irrigation. *Codiaeum*, *Ilex* and *Juniperus* are slow growing species that showed no significantly different growth responses in the short experimental period. The other 3 species, *Philodendron*, *Brassaia* and *Strelitzia* have uneven and irregular growth habits which resulted in growth indices with high standard deviations, making these plants unsuitable for this type of growth experiment.

Four species showed marginally significant differences in growth responses to different irrigation application rates. *Carissa* responded with significantly increased growth to increasing irrigation levels up to 1.0 in/week. There was no increase in the growth rate once irrigation levels exceeded 1.0 in/week. The soft stemmed *Chrysanthemum* is difficult to measure as it dies back after flowering and grows back from the base of the old plant. Irrigation applications of 1.0 in/week produced maximum growth. Levels above or below 1.0 in/week reduce the growth response. Both *Ligustrum* and *Dracaena* were good experimental species and required irrigation rates of 1.5 in/week to attain optimum growth.

Six ornamental plant species showed highy significant growth responses to different irrigation application levels. Both green and variegated forms of *Pittosporum* showed similar results with irrigation levels between 1.5 and 2.0 in/week producing maximum growth responses. For hedges and well established plants, lower irrigation rates will decrease growth, which is advantageous in any instances, as the need for excessive trimming is avoided. Common and hybrid *Hibiscus* varieties also showed similar results with irrigation levels of 1.5 in/week producing optimum growth responses. Highly significant differences between growth rates were apparent in May 1988, and, in August 1988, this significance increased. An irrigation rate of 1.5 in/week appeared to be ideal for these plants, as no further significant increase in growth rate occurred if watering was increased to 2.5 in/week. *Nephrolepis* showed minimal growth at irrigation application below 0.75 in/week. This fern also showed no significant increase in growth responses to irrigation rates exceeding 1.0 in/week. *Rhododendron* sp. (azaleas) showed increasing growth responses to irrigation application rates up to a maximum of 2.0 in/week. Above this application level there was no further significant increase in the growth response. "Greenleaf" experiments (1) showed that *Rhododendron* sp. were extremely sensitive to the extra salt levels in reclaimed water and suffered from leaf burn which lead to a slow deterioration and eventual death of the plant. Azaleas are thus not recommended for landscapes that are irrigated with reclaimed water.

This field trial showed that growth responses of half of the selected experimental species appeared to be independent of applied irrigation levels. The other 10 species show a gradation of increased growth responses to different irrigation application levels ranging from very slight to highly significant.

From these results it is recommended that an irrigation rate of 1.5 inches of reclaimed water per week be applied throughout the growing season from March to November to supplement natural rainfall. This rate can be cut back to 1 inch per week from December to February. These application rates will produce adequate growth in most commonly used landscape ornamentals in the Central Florida area.

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AZALEAS AND RECLAIMED WATER

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Abstract. **The growth and development of various cultivars of azaleas was investigated in four test plots at the Pasadena Golf and Country Club, Gulfport, Florida frcm March 1987 to May 1988. The plots received different irrigants or irrigation systems. Potable water from the public distribution system was applied by drip irrigation in one plot and overhead sprayed in another. Reclaimed water from the St. Petersburg distribution system was either drip irrigated or overhead sprayed in the remaining two plots. Monthly growth measurements and health data were recorded for all azalea plants. Analyses of variance and Duncan's multiple means tests were performed on the growth indices to determine statistically significant growth differences. Analyses of the two irrigants showed significantly higher nutrient and chloride levels in the reclaimed water. Southern Indian hybrids grew well when irrigated with potable water. Good growth but higher mortality occurred when these plants were drip irrigated using reclaimed water. Poor growth and high mortality resulted from overhead sprays of reclaimed water. Dwarf hybrids grew well when irrigated with potable water but declined and died when irrigated with reclaimed water regardless of the irrigation method utilized.**

Ever since their first introduction into the United States from Belgium in 1840, azaleas have become ideal landscape ornamental plants in both temperate and subtropical climates. Their evergreen foliage and magnificent flower clusters are responsible for their popularity. Ingram and Midcap (2) describe the main azalea varieties that grow well in Florida and include details on their general culture and requirements.

The City of St. Petersburg is situated at the southern tip of the Pinellas County peninsula and is surrounded by seawater on three sides. Local wells are highly saline and the City obtains it's potable water from wells over 60 miles away in neighboring counties. The City's four wastewater treatment plants process over 45 million gallons of influent wastewater per day and their clarified, disinfected product is known as reclaimed water. Over 20 million gallons of reclaimed water are pumped into a 200 mile irrigation distribution pipeline every day, to satisfy the landscape irrigation needs of city parks, schools, golf courses and over 5,000 residential users. This type of reuse of reclaimed water preserves groundwater supplies by saving potable water, protects surrounding surface waters from contamination and provides extra nutrients for lush vegetative growth of landscape ornamentals (3).

Throughout the growth and development of this reuse system, the Tampa Bay area community experienced climatic conditions which were highly abnormal between