



Potential of Collected Storm Water and Irrigation Runoff for Foliage and Bedding Plant Production¹

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Florida's worst drought in decades, coupled with increasing population and urbanization and loss of aquifer recharge area have led to heavy competition between the public and agriculture for potable water. In early 2001, The St. Johns River Water Management District (SJRWMD) Governing Board passed an order that restricted ground and surface water withdrawal in Lake, Marion, Orange, Polk, Seminole, and Volusia counties (SJRWMD, 2001). Since the ornamental plant industry is traditionally a heavy user of potable water with an annual average of 30 to 100 inches per acre applied as irrigation, Water Management Districts have been more scrupulous of water use in nursery crop plant production. Growers now concur that the "biggest issue" currently faced by Florida's nursery industry is water (Allen, 2000), and the industry is constantly looking at alternative sources of water for reducing groundwater withdrawals in nursery crop production.

Basically, there are five primary sources of water that may be used for irrigating nursery crops (Biernbaum, 1993): (1) groundwater from wells, (2) municipal water, also known as reclaimed water, supplied by a city, county, or municipality, (3)

surface water from creeks, streams, rivers, or large lakes, (4) drainage pond water collected from irrigation water runoff, and (5) rainwater or storm water collected from greenhouse or building roofs and held in cisterns. Groundwater has been the primary source of irrigation for nursery plants but is more rigidly regulated by the Water Management Districts. Reclaimed water, surface water, and collected water from irrigation runoff and rainfall have been used in landscape ornamental plant production (Skimina, 1986; Yeager, 1989) but are not commonly used for greenhouse containerized crop production.

Since Florida has generally abundant rainfall and overhead irrigation is still common in nursery plant production, storm water and irrigation runoff could be captured and used for crop production. However, there have been no previous reports on the use of storm water and irrigation runoff for greenhouse production. Thus, research has been carried out for two years to study the potential of collected water for the production of greenhouse foliage and bedding plants.

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Water Collection and Plant Cultural Management

A collection basin was excavated at the Mid-Florida Research and Education Center, Apopka. Concrete was used to form the walls, and 3 layers of black polyethylene sheets were used to line the basin where irrigation runoff from a landscape plant production bed and storm water from a greenhouse roof were collected. Collected water (pond water), filtered through a micro screen (120 mesh) filter, and well water (160-foot depth) were delivered to containers of greenhouse-grown foliage and bedding plants through overhead sprinkler and ebb-and-flow systems.

Over a 2-year period, a total of 18 foliage and 8 bedding plant species/cultivars were evaluated, of which the same cultivars of *Hedera*, *Philodendron*, *Schefflera*, and *Syngonium* were evaluated twice, respectively (Table 1). Bedding plants were potted in 4-inch pots; foliage plants were potted in 6-inch pots containing 60% peat, 20% vermiculite, and 20% perlite (Verlite Co., Tampa, FL) and grown in a shaded greenhouse under 1,500 foot candles. Temperatures ranged from 65 to 90°F, and relative humidity ranged from 50 to 80%.

Plants irrigated overhead were top-dressed with 2 g per 4-inch pot or 5 g per 6-inch pot of Scott's controlled-release fertilizer (Osmocote® 18N-6P₂O₅-12K₂O with micronutrients, 8 to 9 month duration). Plants grown in ebb-and-flow were fertigated with a solution containing Peter's water-soluble fertilizer 24N-8P₂O₅-16K₂O including micronutrients. The reading of electrical conductivity of the solution was about 1.0 dS/m and maintained at this level throughout the experiment. The frequency of 4-inch pots flooded in the ebb-and-flow system was 50% less than that of 6-inch pots.

Plant growth was closely monitored for any growth disorder problems. When marketable size was reached, plant height and width were measured, and overall quality was graded. The plant shoots then were cut, and fresh and dry weights were determined.

Water Quality

Both pond and well waters were sampled on September 22 and December 7 of 1999, May 30, June 7, and August 21 of 2000. Alkalinity, electrical conductivity (EC), pH, dissolved oxygen, turbidity, hardness, and concentration of nutrients such as nitrate, ammonium, phosphorus, calcium, magnesium, iron, copper, zinc, and sulfate were measured. All the tested parameters were within the desired level for the production of greenhouse crops except pH, which ranged from 9.3 to 10.3 in pond water. Dissolved oxygen content and turbidity of the pond water were also higher than those of the well water throughout the sampling period. The high pH, dissolved oxygen, and turbidity were attributed to the growth of algae in the pond water.

When medium pH was monitored, however, the values were well within the desired levels. They varied between 6.0 to 7.0, independent of water sources. This means that the pH in pond water did not affect the pH of the growing medium due to the pond water's low alkalinity and medium's high buffer capacity. Algae in the pond water were an unsightly problem, both outside and on the ebb-and-flow trays. However, algae did not cause clogging of the irrigation pipeline and also did not grow on the surface of container medium.

Plant Production

All plants at the time of finishing were of marketable size and salable quality, independent of water source. All evaluated plants irrigated with the pond water, regardless of irrigation methods, exhibited higher or at least equal growth index, fresh and dry weight accumulation compared to those irrigated with the well water (Table 1). No disease incidents were observed throughout the 2-year production period. The only growth disorders noticed consisted of small, yellowish spots on the leaves of *Philodendron* 'Black Cardinal'. The cause of this problem was unknown but unrelated to water sources since all of the *Philodendron* 'Black Cardinal' plants exhibited the symptom.

Irrigation methods, however, affected plant growth for several species, independent of water source. Fresh and dry weights of *Aglaonema* 'Maria',

as well as growth index, fresh weight, and dry weight of *Ficus benjamina* 'Common', were higher when the plants were irrigated using ebb-and-flow than when they were irrigated by overhead. On the other hand, the growth index and fresh and dry weights of *Dieffenbachia maculata* 'Perfection Compacta' were significantly higher for plants irrigated overhead than for those watered by ebb-and-flow. These differences are likely due to the effects of plant species, irrigation methods, fertilizer types, or interactions among the three.

Although high quality plants were produced using collected irrigation runoff and storm water, it is not known whether or not pH could become a problem for plant growth, algae could eventually clog pipelines, or plants could be infected by potential pathogens from the pond water if this experiment were continued. Currently, technologies such as ozonization, ultraviolet irradiation, or sulfur dioxide injection are available for collected water treatments, but more simple and affordable methods need to be developed. Growers should be fully aware of these problems while using irrigation runoff and storm water for foliage and bedding plant production.

Literature Cited

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Table 1. Plant species/cultivars evaluated and their potentials for being grown using storm water and/or irrigation runoff as the sole source for irrigation.

Species/cultivar evaluated	Ebb-and-flow		Overhead sprinkler	
	negative	positive	negative	positive
Bedding plants				
<i>Antirrhinum majus</i> 'Floral Show Mix'		X		X
<i>Begonia</i> 'Ambassador Scarlet'		X		X
<i>Catharanthus roseus</i> 'Cooler Peppermint'		X		X
<i>Catharanthus roseus</i> 'Pacifica Lipstick'		X*		X
<i>Catharanthus roseus</i> 'Pacifica Pink'		X		X
<i>Impatiens</i> 'Accent Red'		X*		X
<i>Impatiens</i> 'Super Elfin Pink'		X*		X
<i>Impatiens</i> 'Super Elfin White'		X**		X
Foliage plants				
<i>Aglaonema</i> 'Maria'		X**		X
<i>Anthurium</i> 'Cotton Candy'		X*		X
<i>Cordyline terminalis</i> 'Baby Doll'		X		X*
<i>Cissus rhombifolia</i> 'Grape Ivy'		X		X*
<i>Chrysalidocarpus lutescens</i>		X		X
<i>Dieffenbachia maculata</i> 'Perfection Compacta'		X		X*
<i>Dieffenbachia</i> 'Snowflake'		X		X
<i>Dracaena marginata</i> 'Bicolor'		X		X
<i>Dracaena marginata</i> 'Tricolor'		X		X
<i>Epipremnum aureum</i> 'Golden Pothos'		X		X
<i>Ficus benjamina</i> 'Common'		X*		X
<i>Hedera helix</i> 'Pia' (evaluated twice)		X		X
<i>Nephrolepis exaltata</i> 'Bostoniensis Compacta'		X		X
<i>Nephrolepis exaltata</i> 'Blue Bell'		X		X
<i>Philodendron</i> 'Black Cardinal' (evaluated twice)		X		X
<i>Schefflera actinophylla</i> 'Amate' (evaluated twice)		X*		X
<i>Spathiphyllum</i> 'Petite'		X		X
<i>Syngonium podophyllum</i> 'Pink Allusion' (evaluated twice)		X		X
*This system produced plants larger than the other irrigation system, regardless of water sources.				
**This system produced plants larger than the other irrigation system, in which plants irrigated with pond water were larger than those irrigated by well water.				