Potential of Collected Stormwater and Irrigation Runoff for Foliage and Bedding Plant Production[1]

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Agricultural irrigation accounted for 40% of the total freshwater withdrawn in Florida (Marella 2008). Water Management Districts have been more scrupulous of water use in nursery crop plant production because the ornamental plant industry is traditionally a heavy user of water; on average, 30 to 100 inches of potable water per acre per year may be applied as irrigation. Growers are aware of this pressure and are constantly looking for alternative sources of water to reduce groundwater withdrawals in nursery crop production.

Basically, there are five primary sources of water that may be used for irrigating nursery crops: (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 stormwater collected from greenhouse or building roofs and held in cisterns. Groundwater has been the primary source of irrigation for nursery plants but is the most 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 (Yeager et al. 1989) but are not commonly used for greenhouse containerized crop production.

Since Florida generally has abundant rainfall, and overhead irrigation is still common in containerized plant production, stormwater and irrigation runoff could be captured and used for nursery crop production. However, there is limited information on the use of stormwater 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 (Chen et al. 2003).

Water Collection and Plant Cultural Management

A collection basin was excavated at the UF/IFAS Mid-Florida Research and Education Center, Apopka. Concrete was used to form the walls, and 3 layers of black polyethylene were used to line the basin where irrigation water runoff from a landscape plant production bed and stormwater from a greenhouse roof were collected. Collected water (pond water), after passing through a filter (120 mesh), and water from an on-site well (well water) were used for irrigation of foliage and bedding plants, using 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

1. This document is ENH864, one of a series of the Environmental Horticulture Department, UF/IFAS Extension. Original publication date February 2002. Reviewed February 2019. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

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Reviewed: 02/2025

pants were potted in 4” pots; foliage plants were potted in 6” 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°F to 90°F, and relative humidity ranged from 50 to 80%.

Plants irrigated overhead were top-dressed with 2 g per 4” pot or 5 g per 6” pot of Scott’s controlled release fertilizer (Osmocote 18N-6P_2O_5-12K_2O 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-8P_2O_5-16K_2O 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” pots flooded in the ebb-and-flow system was 50% less than that of 6” pots. Actual nitrogen rates were 0.9 g for each 6” pot and about 0.4 g for each 4” pot regardless of water sources.

Plant growth was closely monitored, including initial plant height, width, and leaf numbers, as well as 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 water were sampled on September 22 and December 7, 1999, and May 30, June 7, and August 21, 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 that 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 measured, however, the values varied between 6.0 to 7.0, independent of water source, which were well within the desired levels. This means that the pH in pond water did not affect the pH of growing medium because of the pond water’s low alkalinity and the 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 better or at least equal overall plant quality, growth index, and fresh and dry weight accumulation compared to those irrigated with the well water (Table 1). No disease incidences were observed throughout the 2-year production period. The only growth disorder noticed was 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. Fresh and dry weights of *Aglaonema* ‘Maria’, *Impatiens* ‘Accent Red’, and *Schefflera actinophylla* ‘Amate’, as well as growth index, fresh and dry weights of *Ficus benjamina* ‘Common’, were higher when irrigated using ebb-and-flow than irrigated by overhead. On the other hand, the growth index, and fresh and dry weights of *Dieffenbachia maculata* ‘Perfection Compacta’ and *Cordyline terminalis* ‘Baby Doll’ were significantly higher when irrigated overhead than those watered by ebb-and-flow. Additionally, larger sized *Catharanthus roseus* ‘Pacifica Lipstick’, *Impatiens* ‘Super Elfin Pink’, and ‘Super Elfin White’ were produced by pond water than well water in ebb-and-flow irrigation. However, larger sized *Anthurium* ‘Cotton Candy’ was produced by well water than pond water when irrigated with ebb-and-flow. These differences are likely due to the effects of plant species, irrigation methods, fertilizer types, or interactions among the three.

Whether or not pH would become a problem for plant growth, algae might eventually clog pipelines, or plants would be infected by potential pathogens from the pond water if this experiment were continued are unknown. However, these problems can easily be resolved by ozonization, ultraviolet irradiation, or sulfur dioxide treatments. Collecting stormwater and irrigation runoff and using the collected water for greenhouse crop production should be a viable option in regions where fresh water shortage occurs.

Literature Cited

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Table 1. Plant species/cultivars evaluated and their potentials for being grown using stormwater and/or irrigation runoff (captured in a pond) as the sole source for irrigation.

Species/cultivar evaluated	Ebb-and-flow		Overhead sprinkler	
	Pond water	Well water	Pond water	Well water
Bedding plants				
Antirrhinum majus 'Floral Show Mix'	+	+	+	+
Begonia 'Ambassador Scarlet'	+	+	+	+
Catharanthus roseus 'Cooler Peppermint'	+	+	+	+
Catharanthus roseus 'Pacifica Lipstick'	*	+	+	+
Catharanthus roseus 'Pacifica Pink'	+	+	+	+
Impatiens 'Accent Red'	*	*	+	+
Impatiens 'Super Elfin Pink'	*	+	+	+
Impatiens 'Super Elfin White'	*	+	+	+
Foliage plants				
Aglaonema 'Maria'	*	*	+	+
Anthurium 'Cotton Candy'	+	*	+	+
Cordyline terminalis 'Baby Doll'	+	+	*	*
Cissus rhombifolia 'Grape Ivy'	+	+	+	+
Chrysalidocarpus lutescens	+	+	+	+
Dieffenbachia maculata 'Perfection Compacta'	+	+	*	*
Dieffenbachia 'Snowflake'	+	+	+	+
Dracaena marginata 'Bicolor	+	+	+	+
Dracaena marginata 'Tricolor'	+	+	+	+
Epipremnum aureum 'Golden Pothos'	+	+	+	+
Ficus benjamina 'Common'	*	*	+	+
Hedera helix 'Pia' (evaluated twice times)	+	+	+	+
Nephrolepis exaltata 'Bostoniensis Compacta'	+	+	+	+
Nephrolepis exaltata 'Blue Bell'	+	+	+	+
Philodendron 'Black Cardinal' (evaluated twice)	+	+	+	+
Schefflera actinophylla 'Amate' (evaluated twice)	*	*	+	+
Spathiphyllum 'Petite'	+	+	+	+
Syngonium podophyllum 'Pink Allusion' (evaluated twice)	+	+	+	+

+indicates that plant sizes were similar evaluted regardless of irrigation methods and water sources.
* indicates that plants sizes were much larger than +.