Evaluating nutrient and irrigation BMPs in a palm field nursery in southern Florida

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The **goal of this study** was to compare royal palm (*Roystonea elata*) production using tensiometer automated irrigation and reduced nitrogen and phosphorus applications to traditional grower practices considering water savings, nutrient inputs, crop yield, and an economic analysis

INTRODUCTION

Tensiometer

The Florida Best Management Practice (BMP) program identifies a list of practices that have been shown to result in water conservation when implemented in agricultural production systems. However, many of these practices have not been scientifically evaluated for their water conservation benefits considering the soil, climate, and hydrology of Miami-Dade County, southeastern Florida.

A BMP that has shown substantial water quality and quantity benefits in many locations with various production systems is the use of soil moisture sensors, such as tensiometers, to schedule irrigation. Although tensiometer automated irrigation systems have been shown to reduce leaching of agrochemicals (Paramasivam et al., 2000), reduce water volumes used (Steele et al., 2000; Muñoz-Carpena et al., 2005), and not hinder crop production (Steele et al., 2000; Muñoz-Carpena et al., 2005); the tensiometer automated irrigation system has not been tested or commonly implemented in field nursery production in southeast Florida.

Switching tensiometer installed in palm field nursery

METHODS

- The study consisted of six treatments:

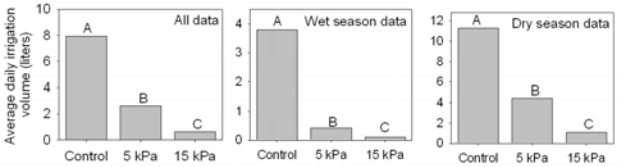
1) control (e.g., a commercial grower's irrigation and nitrogen (N) and phosphorus (P) fertilizer rates);
2) irrigation automated to water when soil water suction exceeded 5 kPa with the commercial grower's N and P rates;
3) irrigation automated to water when soil water suction exceeded 15 kPa with the commercial grower's N and P rates;
4) irrigation automated to water when soil water suction exceeded 15 kPa with 50% of the commercial grower's N and P rates;
5) grower irrigation with 75% of the commercial grower's N and P rates; and
6) grower irrigation with 50% of the commercial grower's N and P rates.

Weather station

- Each treatment was replicated four times, with each replicate consisting of 4 palms
- All treatments received irrigation through drip irrigation
- A weather station and tipping bucket was installed and used to monitor weather data
- Data was collected from 3 March 2006 to 5 October 2007; data collection stopped due to palms reaching marketable size and being sold by the commercial grower
- The follow data was collected: water volume applied, palm diameter and height, soil nutrients, and plant tissue nutrients
- Data was evaluated statistically using SAS software

RESULTS

Water volume results



- Significant differences observed among treatments for water volume applied (different letters indicate significant differences ($p \leq 0.05$) according to a Waller-Duncan test)

Plant measurement results

Palm final measurements presented as means with standard deviations for each treatment

Treatment	Diameter at 30.5 cm with standard deviation (cm)	Diameter at 61.0 cm with standard deviation (cm)	Height with standard deviation (cm)
1	68.4 ± 8.7	54.5 ± 9.8	478.2 ± 28.9
2	66.7 ± 13.7	53.9 ± 13.3	462.9 ± 61.5
3	71.2 ± 6.7	56.7 ± 6.8	467.7 ± 33.3
4	66.8 ± 6.2	53.9 ± 6.8	465.2 ± 30.6
5	70.4 ± 4.2	57.2 ± 5.2	483.3 ± 34.9
6	68.1 ± 7.7	57.4 ± 9.3	453.2 ± 30.0

- No significant differences observed among treatments for diameters and heights considering initial values, final values, and change in size during the study

Plant tissue results

Carbon (C), nitrogen (N), and phosphorus (P) tissue concentration means and standard deviations for each treatment

Treatment	C with standard deviation (kg/kg)	N with standard deviation (g/kg)	P with standard deviation (mg/kg)
1	0.445 ± 0.008	1852 ± 202	1380 ± 294
2	0.442 ± 0.006	1926 ± 153	1467 ± 223
3	0.444 ± 0.006	1999 ± 332	1439 ± 206
4	0.445 ± 0.005	1804 ± 225	1411 ± 145
5	0.446 ± 0.005	1949 ± 157	1397 ± 156
6	0.444 ± 0.008	1826 ± 183	1454 ± 206

- No significant differences observed among treatments

Soil sample results

Inorganic carbon (IC), total carbon (TC), and total phosphorus (TP), total nitrogen (TN), ammonium-nitrogen (NH_4-N), and nitrate-nitrogen (NO_3-N) soil concentration means and standard deviations for each treatment

Treatment	IC with standard deviation (kg/kg)	TC with standard deviation (kg/kg)	TP with standard deviation (mg/kg)
1	0.096 ± 0.006	0.128 ± 0.001	2145 ± 1526
2	0.097 ± 0.004	0.128 ± 0.004	2248 ± 748
3	0.097 ± 0.004	0.128 ± 0.001	2561 ± 1066
4	0.097 ± 0.003	0.128 ± 0.001	2180 ± 1088
5	0.100 ± 0.004	0.128 ± 0.001	2346 ± 1287
6	0.098 ± 0.003	0.128 ± 0.001	2792 ± 134

Treatment	TN with standard deviation (g/kg)	NH_4-N with standard deviation (mg/kg)	NO_3-N with standard deviation (mg/kg)
1	2220 ± 41	3.17 ± 1.08	147 ± 182
2	2200 ± 23	3.14 ± 1.56	194 ± 137
3	2410 ± 50	3.33 ± 1.52	176 ± 203
4	2250 ± 34	3.32 ± 1.33	139 ± 139
5	2200 ± 27	3.26 ± 0.86	152 ± 204
6	2220 ± 24	3.70 ± 1.22	114 ± 151

- No significant differences observed among treatments

SUMMARY

- Significant differences were observed among the irrigation treatments, with the greatest water savings occurring in the 15 kPa tensiometer treatment.
- These results were particularly meaningful since no significant differences were found among the treatments for palm size, nutrient element concentration in soil, or nutrient element content in palm leaves.
- Lower irrigation rates and lower N and P fertilizer rates resulted in no significant change in palm production. Economic analysis also indicated that these practices would provide a monetary savings to the grower.
- While this study focused on royal palm production in south Florida, results should be relevant to many other ornamental plant species under similar environmental conditions.

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