

Safe Salinity Levels for Irrigation of Two Ornamental Crops: *Hibiscus* and *Mandevilla*¹

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Introduction

South Florida's subtropical climate is favorable for growing a wide variety of subtropical and tropical ornamental crops year-round. Miami-Dade County ranks number one in ornamental crop production in the state. Florida dominates the foliage plants category with 74% of the total value of 2019 sales (NASS 2019). Commercial ornamental crops are irrigated with water from aquifers in south Florida, known to be shallow and highly permeable, making agriculture in south Florida vulnerable to sea level rise and saltwater intrusion. Many factors affect ornamental crop production, including salinity. Higher salinity levels in irrigation water have a negative impact on ornamental crop growth and yield. Large storm events could bring the storm surge along low-lying open coastal areas such as south Florida's shorelines and then result in seawater intruding onto the inland ground surface (Jiang et al. 2014; Park et al. 2011). The intruded saltwater could infiltrate into the porous soil layers and then further percolate into the freshwater aquifer. During Hurricane Maria in 2017, for example, many plant nurseries were concerned about saltwater intrusion in surface and subsurface water bodies and potential salt stress injury to their crops, particularly because there is little information on local ornamental plant responses to higher levels of salinity in irrigation water. Evaluating the effects

of salinity on the growth and quality of ornamental nursery crops in south Florida would provide valuable information for irrigation management in the face of changing salinity levels in south Florida's water supply. This publication introduces the findings from a recent study conducted to find safer levels of water salinity in the irrigation of two economically important foliage crops: *Hibiscus rosa-sinensis* and *Mandevilla splendens* (Yu et al. 2021). The information provided in this article is expected to help local ornamental plant growers, farmers, and Extension agents to understand both the current salinity levels of irrigation water and the sensitivity of these ornamental plants to the different irrigation water salinity levels. This information is to be released during soil and water Best Management Practices education to local Florida producers via UF/IFAS Extension workshops, field consultations, or other means of consultation.

Field Experiment

A field experiment was conducted at the UF/IFAS Tropical Research and Education Center (UF/IFAS TREC) in Homestead, FL (Figure 1a). Two main foliage crops, *Hibiscus rosa-sinensis* and *Mandevilla splendens*, were provided by a local nursery, Costa Farms® (<http://www.costafarms.com/>). The potting medium was the standard mix that the nursery

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used (Atlas Peat & Soil, Inc., Boynton Beach, FL 33472, US).



Figure 1. Visual comparison between plants treated with different irrigation water salinity concentrations. (a, b) *Hibiscus rosa-sinensis*; (c, d) *Mandevilla splendens*; (a, c) First experiment—Control: 0.5 dS/m; T1: 1.0 dS/m; T2: 1.5 dS/m; T3: 2.0 dS/m; (b, d) Second experiment—Control: 0.5 dS/m; T4: 4.0 dS/m; T5: 7.0 dS/m; T6: 10.0 dS/m. Credits: Young Gu Her, UF/IFAS

Hibiscus rosa-sinensis and *Mandevilla splendens* (Figures 1b and 1c) were each treated with seven different levels of irrigation water salinity, including 0.5 (control, which is the current level generally found in south Florida's irrigation water), 1.0, 1.5, 2.0, 4.0, 7.0, and 10.0 dS/m. Irrigation and management practices, including water application timing and rates, during the experiment were the same as those used by local nurseries.

The salinity levels of irrigation water were determined based on those of groundwater (or the source of irrigation water in south Florida) reported in the literature and a preliminary salinity analysis of local irrigation water (Hughes and White 2016; USGS 2019). A USGS groundwater salinity monitoring station close to the study area showed that the salinity of groundwater could increase up to 9.12 dS/m depending on the depths (from the ground surface to 30 m) and seasons (Miami-Dade County Board of County Commissioners 2016). Ten bottles (100 mL) of water were collected at the outlets of sprinklers located in a local nursery farm (Costa Farms in Homestead, FL), and a lab test showed that the irrigation water had a salinity level of 0.50 dS/m on average. Irrigation water used in the experiments was pumped out of a groundwater well located next to the study site at UF/IFAS TREC, and the salinity level of the well water was 0.55 dS/m.

Findings

Preliminary visual observations did not find apparent differences in the colors and growth characteristics among plants treated with the salinity concentrations equal to or less than 4.0 dS/m (Figures 1a and 1c). The differences in visible symptoms were clear between plants in the 7.0 dS/m and 10.0 dS/m treatments and plants in the other treatments with the different irrigation water salinity levels. *Hibiscus rosa-sinensis* exposed to higher-salinity treatments showed fewer leaves than those in the lower-salinity treatments, whereas the leaves and flowers of *Mandevilla splendens* were wilted and/or necrotic in the high-salinity treatments. Both crops were visibly wilted in the 10.0 dS/m treatment.

Hibiscus rosa-sinensis with the control treatment (with the current irrigation water salinity concentration of 0.5 dS/m) grew (in terms of height) the most quickly compared to others that were treated with higher salinity concentration rates. The growth rates of *Hibiscus rosa-sinensis* generally decreased as salinity concentration increased. When irrigation water with the salinity concentrations of 1.5 dS/m and 2.0 dS/m was applied, *Mandevilla splendens* grew more quickly than the control. The growth rates of *Hibiscus rosa-sinensis* and *Mandevilla splendens* substantially decreased when the salinity concentrations reached 4.0 dS/m and 7.0 dS/m, respectively, which were not seen in the visual assessment results (Figure 1).

The largest aboveground biomass of both plant species was in the control treatment, except for one case of *Hibiscus rosa-sinensis* treated using irrigation water with a salinity concentration of 4.0 dS/m. In general, the aboveground biomass decreased with increased irrigation water salinity concentrations, which was similar to the trends found for plant height. When the salinity concentration was equal to or greater than 7.0 dS/m for *H. rosa-sinensis* and 4.0 dS/m for *Mandevilla splendens*, the average aboveground biomass of the two crops declined quickly.

Ornamental plant crops have different salinity tolerance levels. A study showed that other ornamental plants (i.e., *Gazania rigens* and *Delosperma cooperi*) were tolerant to the irrigation salinity levels of up to 12 dS/m (Niu and Rodriguez 2006). However, *Penstemon* species and *Lavandula angustifolia* were not salt-tolerant, and died at 3.2 dS/m. Another study found that pomegranate plants were tolerant to salinity levels of up to 15 dS/m (Sun et al. 2018), and the visual quality of marigold was not substantially degraded at different irrigation water salinity levels of 3.0 dS/m and 6.0 dS/m, depending on the cultivar (Sun et al. 2018). The

salinity tolerance levels of tropical crops such as *Hibiscus rosa-sinensis* and *Mandevilla splendens* found in the present study are within the ranges of those observed in previous studies.

Summary

This article introduces an experiment demonstrating how the growth of two major foliage nursery crops in south Florida, *Hibiscus rosa-sinensis* and *Mandevilla splendens*, responded to the different levels of water salinity in their irrigation systems. The results show that the current average level (the control of 0.5 dS/m) of groundwater salinity is safe for both plant species. In general, *Hibiscus rosa-sinensis* was more tolerant to higher irrigation water salinity levels than *Mandevilla splendens*. The plant growth and vigorousness were significantly limited when the salinity concentrations increased to 7.0 dS/m or greater. This indicates that the reported maximum groundwater (irrigation water source) salinity concentration of 9.12 dS/m along the coastal areas of south Florida can result in salinity stress and damage to nursery crops. This study on salinity levels is crucial to share with Florida's ornamental growers and Extension agents to increase understanding of abiotic factors such as salinity levels that cause economic impact in ornamental plant commercial production across tropical and subtropical areas.

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