Evaluating Ways to Reduce the Harmful Effects of Irrigating Nursery Crops with Water High in Soluble Salts[1]

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Abstract

The effects of watering technique on container grown *Lonicera tatarica* L. 'Zabelii' and *Philadelphus* x *virginalis* Rehd. irrigated with water high in soluble salts were investigated during the 1982 and 1983 growing seasons. Hand, mini-sprinkling, and sprinkler irrigation were compared. The quality of irrigation water used in this experiment included: A) EC 0.12 mmhos/cm, pH 6.6, SAR 0.3 (city water); B) EC 1.42 mmhos/cm, pH 7.5, SAR 2.0; and C) EC 2.48 mmhos/cm, pH 7.8, SAR 2.9. Mini-sprinkling resulted in significantly greater growth of *Philadelphus* x *virginalis* when compared to sprinkler irrigation. This increase in growth was attributed to greater media moisture, prevention of leaf contact with irrigation water, and the possible leaching of salts by the spot-spitter type of mini-sprinkling utilized.

Index words: water quality, irrigation technique, container-grown

Introduction

Sprinkler irrigation adds to the salt injury observed when woody landscape plants are irrigated with water high in soluble salts (6, 7, 9). Furuta (8) reported that drip and trickle irrigation systems made salinity control possible in containers by permitting precise placement of a measured amount of water to the media.

During the production of woody landscape plants, salt injury can occur and is often associated with the use of sprinkler irrigation and water high in soluble salts (6, 7). In certain areas of the United States, nurserymen are experiencing salt injury on container grown woody plants (1, 6). This project was established to further evaluate this salt problem in relation to irrigation methods.

Materials and Methods

Bareroot, 38 to 45.7 cm (15 to 18 in) *Lonicera tatarica* 'Zabelii' (Zabel honeysuckle) and *Philadelphus* x *virginalis* (Virginal mockorange) were potted in #5 (trade gal) black plastic containers on March 20, 1982. The potting medium consisted of 5 parts native sedge peat, 3 parts decomposed sawdust and 1 part sand (by vol), with a pH of 5.4 and EC of 3.3 mmhos/cm. Initially, 9.1 kg (20 lb) ground limestone, 3.6 kg (8 lb) superphosphate, 0.9 kg (2 lb) potassium nitrate, 0.45 kg (1 lb) iron 330 (Fe EDDHA), and 113.4 g (¼ lb) sequestrene zinc (Zn EDTA) were added per 6.7 m^3 (8 yd) of potting media. In the spring of 1983, two agriform fertilizer tablets 20N-4.3P-4.2K (20-10-5) were applied to the soil surface of each container.

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Hand watering, mini-sprinkling, and sprinkler or overhead irrigation were evaluated in the watering technique experiment. Above ground medium flow spot-spitters (180 spray pattern) were used for the mini-sprinkling technique. One spot-spitter was placed at the edge of each container. Sprinkler irrigation was simulated with 0.92 m (36 in) Chapin automatic watering spray-stakes. Spot-spitters although classified as a mini-sprinklers were chosen to represent a watering technique because they also allow precise placement of a measured amount of water to the media. In this experiment, the amount of water applied was not varied, but the effects of different watering techniques and water qualities were evaluated. Honeysuckles and mockoranges were placed pot-to-pot with two spray-stakes in the center for each water quality treatment. Saturation of leaf surfaces occurred after 15 minutes; however, the container media remained dry. An additional 2 l (2.1 qt) of water was added by hand directly to these containers, predetermined to established media saturation. In the spring of 1983, spray-stakes were replaced by elevated spot-spitters as utilized in the mini-sprinkling treatment, to allow complete randomization of the water quality treatments. The spot-spitters were attached to wire, elevated 0.92 m (36 in) and placed in each

Table 1. Quantity of salts added to city water[z] to prepare irrigation water for salt levels B and C used in the leaching and the watering technique experiment.

	Water quality treatments			
	B		C	
Salts	meq/l	g/100 l	meq/l	g/100 l
$CaSO_4 \cdot 2H_2O$	6	51.9	12	103.9
$MgSO_4 \cdot 7H_2O$	6	73.9	12	147.8
$NaHCO_3$	4	33.9	8	67.9
$NaNO_3$	0.5	4.3	1	8.6
KCl	0.3	2.2	0.6	4.4
Final EC of individual treatments	1:42 mmhos/cm		2:48 mmhos/cm	

[z]City Water; EC = 0.12 mmhos/cm, pH = 6.6, and SAR = 0.3.

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container. To prevent spray drift, 0.92 m (36 in) tall galvanized steel cylinders (0.76 m in dia) were placed around each plant during watering. Saturation of leaf surfaces occurred after 5 minutes, and additional water was again applied by hand to a total of 2 l (2.1 qt). The three watering techniques were standardized to apply 2 l (2.1 qt) at each watering.

Frequency of watering was determined by plant weights (plant, media, and container). Mockoranges were watered when their weights reached an average of 12 to 13 kg (26 to 28 lb), and honeysuckles at an average of 13 to 14 kg (29 to 31 lb).

The experimental design in 1983 was a split plot with watering techniques as the main plot and water quality as the sub plots. Three watering techniques and three water quality treatments were compared using five replications during the 1982 and 1983 growing seasons (6-22-82 to 11-3-82 and 6-1-83 to 8-31-83). A plant type comparison was not desired, so honeysuckle and mockorange plants were analyzed as two experiments.

To determine pH and EC, soil samples were collected approximately every two weeks during both growing seasons from three replications within each watering technique. A 30.5 × 2.5 cm (12 × 1 in) soil core sampler was used to remove two soil cores from each container (midway between the plant and container side), which were then analyzed using the 2:1 ratio method (3). Plant visual ratings were also recorded every two weeks from all replications during both growing seasons. Visual ratings were based on a 5 to 1 qualitative scale. On September 6, 1983, plants were harvested for dry weight determination. Above ground plant parts were removed from the same three replicates from which soil samples had been taken.

Results and Discussion

Appearance is important when evaluating landscape plants for salability (1, 4); therefore, results and discussion for this experiment focus on visual observations at the end of the 1983 growing season and are substantiated with EC and dry weight measurements.

In this experiment, mockorange plants which were mini-sprinkled obtained a significantly greater dry weight when compared to sprinkler-irrigated plants (Fig. 1). This increase was attributed to the spot-spitter type of mini-sprinkler irrigation utilized, which applied water at a uniform rate over the entire media surface. This uniform distribution of water allowed for saturation of a greater volume of the container media and possible leaching of salts. There were no significant differences in size or dry weight of honeysuckle watered with the different techniques.

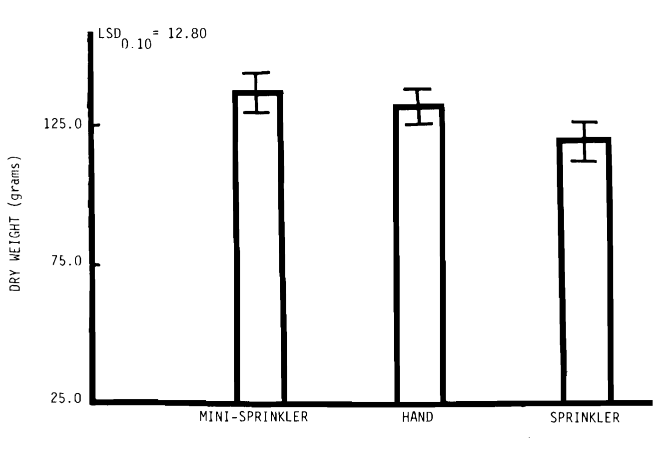

Fig. 1. **Dry weight of mockorange in response to irrigation with watering techniques.**

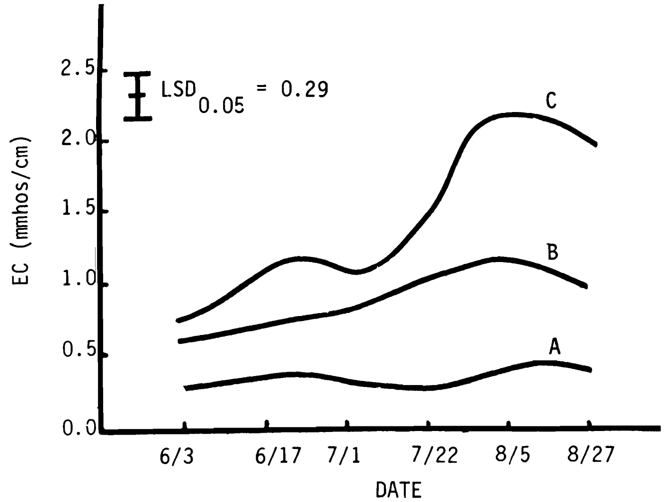

Fig. 2. **Electrical conductivity (EC) of the container media, over time and with each salt level, in which mockoranges were grown during the watering technique experiment in 1983.**

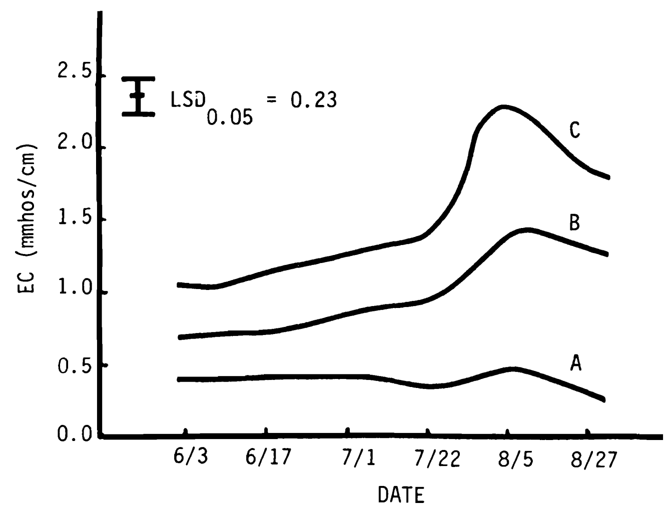

Fig. 3. **Electrical conductivity (EC) of the container media, over time and with each salt level, in which honeysuckles were grown during the watering technique experiment in 1983.**

Using the 2:1 soil test method, Davidson and Mecklenburg (3) consider an EC of greater than 1.5 mmhos/cm high for most container grown woody nursery crops. During the second season of growth in this experiment, EC levels increased in the container media of both the honeysuckle and mockorange plants. Electrical conductivity levels reached above 1.5 mmhos/cm in 1983 with water quality C (Fig. 2, 3). However, the EC levels reached during the 1983 growing season (Fig. 2, 3) did not result in visible salt injury. The lack of salt injury symptoms may be due to low levels of sodium and chloride in the irrigation water (A—water contained 0 meq/l of Na or Cl; B—4.5 meq/l of Na and 0.3 meq/l of Cl; and C—9 meq/l of Na and 0.6 meq/l of Cl). The Na and Cl levels were low in comparison to those used in other experiments evaluating salt tolerances of woody nursery crops (1, 4). Tip and marginal leaf burn have been found to occur on woody nursery crops at sodium and chloride levels of 0.5 and 1.5 to 2.5 percent, respectively, on a dry weight basis (1, 5, 6). Leaf Na contents of honeysuckle and mockorange plants from this experiment were lower than 0.5 level at which leaf injury was reported.

Some leaf injury due to salt accumulation was observed on mockorange leaves which were sprinkler irrigated. Water quality C (Table 1) resulted in some foliar injury due to salt accumulation on the leaves and some foliar necrosis was observed with water quality B (Table 1). Harding *et al.* (10) reported that 2 to 3 meq/l of Na and Cl in irrigation water caused severe injury associated with salt accumulation on leaf surfaces. Both salt levels B and C contained greater than 3 meq/l of Na (Table 1). Foliar injury due to salt accumulation or foliar necrosis due to salt was not observed on honeysuckle plants during this experiment. Differences in leaf characteristics between mockorange and honeysuckle plants could be the cause for this.

Significance to Nursery Industry

This experiment indicated that the spot-spitter type of mini-sprinkling increased the media moisture levels in comparison to sprinkler irrigation. Increasing the moisture levels also made possible the leaching of salts from the media. The spot-spitters also prevented possible accumulation of salt on the leaves by applying water below leaf surfaces. A third advantage of spot-spitters was a more efficient use of water by concentrating the water applied within the container and uniformly distributing it. Based on these results spot-spitters (mini-sprinkling) could be successfully implemented by nurserymen in their management program to reduce salt injury to nursery crops.

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Container Production of Comptie, *Zamia furfuracea* Ait.[1]

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Abstract

The effects of cultural factors on growth of comptie, *Zamia furfuracea* Ait., were evaluated. Plant growth was increased under 47% shade compared to 72% shade and when 1.2 kg m^{-3} (2 lb yd^{-3}) dolomitic limestone was incorporated into the medium compared to 4.7 kg m^{-3} (8 lb yd^{-3}). Nitrogen fertilization of 200 ppm and 300 ppm per week increased frond number compared to 100 ppm per week whereas container volume had no effect on plant growth.

Index words: nutrition, container size

Introduction

Comptie (*Zamia furfuracea* Ait. [*Z. pumila* L.]), is one of about 40 species of palm-like, dioecious cycads in the Zamiaceae family native to tropical and subtropical America (Fig. 1). Comptie has a trunk up to 15 cm (6 in) high or wholly underground. Leaves are pinnately compound, 0.6 m (2 ft) to 1.2 m (4 ft) long with 2 to 13 pairs of thick, leathery pinnae, 5.1 cm (2 in) to 20.3 cm (8 in) long, oblong-obovate in shape (6). As a group, cycads are tolerant of drought and grow in full sun or partial shade. They make attractive landscape plants, however, because of difficulty in germinating seed and a long cropping period (3 to 5 years for saleable plants), few nurserymen grow cycads and they are

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