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# Efficacy of Wastewater Irrigation for Rooting of Ornamental Cuttings©

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## INTRODUCTION

Wastewaters from diverse sources including municipalities, composting farms, and anaerobic digesters have been used in crop production systems (Alam and Chong, 2006). The objective of this study was to propagate cuttings of different species in media irrigated with different sources and/or concentrations of wastewaters.

## MATERIALS AND METHODS

**Experiment 1.** Under mist and shade in summer, cuttings of common ninebark [*Physocarpus opulifolius* (L.) Maxim], potentilla (*Potentilla fruticosa* 'Pink Beauty' L.), and deutzia (*Deutzia gracilis* Siebold & Zucc.) were rooted in 100% perlite or peat and perlite medium (1 : 1, v/v) (Table 1). To prevent the mist from entering the media, cuttings were inserted and rooted through holes in styrofoam platforms, positioned over 15 cm long x 10 cm wide x 2.5 cm deep trays with the base of the cuttings protruding into the medium (Fig.1). Trays were soaked daily for $^1/_2$ h in deionized water (control) or in municipal compost tea (MCT), spent mushroom compost leachate (SMC), and anaerobic intra-process wastewater (AIP), each diluted to an electrical conductivity (EC, a measure of soluble salts concentration) of 0.20 $dS{\cdot}m^{-1}$ (Table 1), our previously recommended threshold for salt level in rooting media. This experiment was a split plot design with both media and wastewater as main plots and species as subplots. There were four replications and 10 cuttings per subplot treatment.

Analysis of variance (main plot effects, Table 2) indicated significantly more rooting (expressed in terms of percent rooting, mean root number per cutting, and length of longest root) in 100% perlite than in the peat and perlite medium (1 : 1, v/v). The wastewaters had marginal but significant effect only in root length. Cuttings irrigated with MCT wastewaters were comparable in length to those irrigated with SMC, but higher than those irrigated with AIP or water control. There were some variation in root number and root length responses due to species and media (S x M) interactions (Table 2).

**Experiment 2.** Under greenhouse (no mist) conditions in January, cuttings of wandering jew (*Tradescantia zebrina* hort. ex Bosse) were rooted similarly in 100% perlite, drenched daily with deionized water (EC = 0 $dS{\cdot}m^{-1}$), Plant Products 20.0N–8.7P–16.6K liquid fertilizer (PP) or the wastewaters described, each diluted to 0.25, 0.50, 0.75, and 1.00 $dS{\cdot}m^{-1}$. This experiment was a randomized complete block design with 4 replications and 10 cuttings per plot.

Regression analysis indicated that percent rooting was similar (98%) regardless of EC levels in MCT, SMC, and PP treatments (Fig. 2). With AIP, percent rooting was maximum (100%) at 0.29 $dS{\cdot}m^{-1}$, decreasing to 81% at 1.0 $dS{\cdot}m^{-1}$. Root number

**Table 1.** Chemical properties of two rooting media and of three wastewater irrigation sources at EC 0.2 $dS \cdot m^{-1}$ dilution.

| | Medium[z] | | Wastewater[y] | | |
|---|---|---|---|---|---|
| | 1:0 | 1:1 | MCT | SMC | AIP |
| pH | 8.0 | 4.0 | 7.1 | 7.7 | 8.2 |
| EC ($dS \cdot m^{-1}$) | <0.10 | 0.15 | 0.24 | 0.22 | 0.23 |
| **Macronutrients (ppm)** | | | | | |
| Nitrate-N | 1 | 2 | 7 | <0.5 | 1 |
| Ammonium-N | <0.5 | 2 | 1 | 6 | 14 |
| P | <1 | 1.5 | 1.2 | <1 | <1 |
| K | <1.0 | 3 | 20 | 27 | 6 |
| Ca | <1 | <1 | <1 | 1 | <1 |
| Mg | <1 | <1 | <1 | <1 | <1 |
| Na | 12 | 18 | 24 | 7 | 19 |
| Cl | 4 | 12 | 321 | 14 | 15 |
| $SO_4$ | 9 | 23 | 5 | 7 | <1 |
| **Micronutrients(ppm)** | | | | | |
| Fe | 0.07 | 0.19 | 0.50 | 0.09 | 0.05 |
| Mn | <0.01 | 0.06 | 0.02 | 0.01 | <0.01 |
| Zn | <0.01 | 0.03 | 0.02 | 0.01 | 0.01 |
| Cu | <0.01 | 0.03 | 0.01 | 0.02 | 0.01 |
| B | 0.02 | 0.04 | 0.02 | 0.02 | 0.05 |
| Mo | 0.15 | 0.56 | 0.03 | 0.01 | 0.01 |

[z]Medium: 1:0 = 100% perlite; 1:1 = 1 perlite: 1 peat (v/v).

[y]Wastewater: MCT = municipal compost tea; SMC = spent mushroom compost leachate; AIP = anaerobic intraprocess wastewater.

**Table 2.** Rooting of three species in response to two different media and three wastewater irrigation sources.

| Treatment | Rooting (%) | Root number | Root length (cm) |
|---|---|---|---|
| | | **Main plot effect** | |
| Media (M)[z] | ** | ** | ** |
| 1:0 | 94 A[x] | 21 A | 2.4 A |
| 1:1 | 81 B | 15 B | 0.9 B |
| Wastewater (W)[y] | NS | NS | * |
| MCT | | 1.9 A | |
| SMC | | 1.8 AB | |
| AIP | | 1.4 C | |
| Control | | | 1.5 BC |
| | | **Subplot effect** | |
| Species (S) | NS | ** | ** |
| Potentilla | | 10 b | 2.3 a |
| Ninebark | | 4 c | 1.5 b |
| Deutzia | | 40 a | 1.2 c |
| | | **Interactions** | |
| M × W | NS | NS | NS |
| S × W | NS | NS | NS |
| S × M | NS | * | * |
| Potentilla × 1:0 | | 12 c | 3.6 a |
| Potentilla × 1:1 | | 9 c | 0.9 d |
| Ninebark × Perlite | | 6 cd | 2.2 b |
| Ninebark × 1:1 | | 3 d | 0.7 d |
| Deutzia × Perlite | | 47 a | 1.4 c |
| Deutzia × 1:1 | | 33 b | 1.0 d |
| S × M ×W | NS | NS | NS |

[z]Medium: 1:0 = 100% perlite; 1:1 = 1 perlite: 1 peat (v/v).

[y]Wastewater: MCT = municipal compost tea; SMC = spent mushroom compost leachate; AIP = anaerobic intraprocess wastewater.

[x]Mean separation within columns and factors by Duncan multiple range test; **, * NS, significantly different respectively at 1%, 5% and not significantly different at the 5% level of probability

**Figure 1.** Rooted cuttings of ninebark, deutzia, and potentila.

decreased minimally with increasing EC levels in MCT, SMC, and PP (slope -0.3), but quite substantially with AIP (slope -1.6) (Fig. 2). Root length was unaffected by the treatments (data not shown).

## DISCUSSION

In previous studies (Chong et al., 2005), cuttings of three woody and one herbaceous species were rooted hydroponically in two wastewater sources used in this study (e.g., AIP and MCT). Optimal percent rooting, root number, and/or root length occurred at EC levels between 0.25 and 0.5 $dS \cdot m^{-1}$. Salt levels higher than 0.5 $dS \cdot m^{-1}$ were not tested.

With the three woody species (Experiment 1), the MCT wastewaters stimulated root length in comparison with SMC and AIP (Table 2). With the herbaceous species (Experiment 2), there was little sign of toxicity of the MCT and SMC wastewaters, e.g., marginal decrease in root number with increasing EC values (Fig. 1). In contrast, the AIP wastewater caused a moderate decline in percent rooting at EC levels $> 0.6$ $dS \cdot m^{-1}$, accompanied by a drastic reduction in root number over all EC levels.

## LITERATURE CITED

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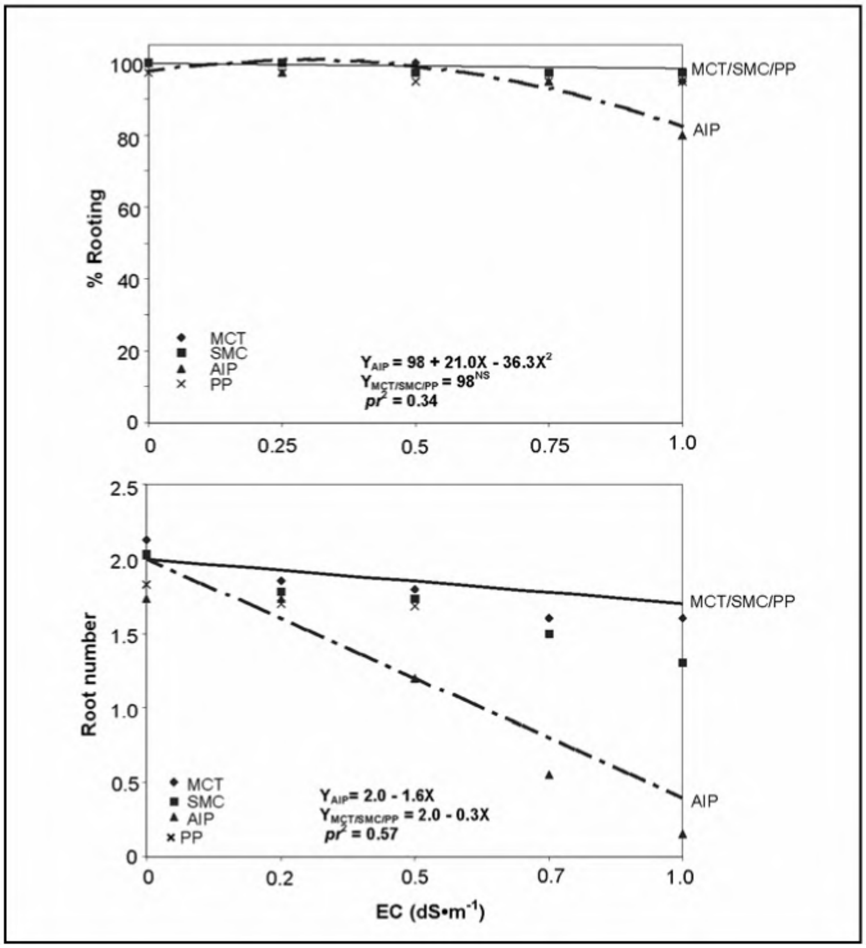


**Figure 2.** Percent rooting and mean root number of *Tradescantia zebrina* cuttings in response to increasing EC levels. Response was regressed over EC levels in Plant Products fertilizer source (PP) and in each of three wastewater sources (MCT, SMC, and AIP). A common regression was fitted when two or more curves were not significantly different. The coefficient of determination was expressed in terms of partial $r^2$ ($pr^2$) which measured the strength of the response relationships of all curves combined together, after removing replication effects. NS = not significantly different from horizontal.