Irrigation water alkalinity, not pH, affects substrate pH

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Introduction

Substrate pH of container-grown crops is predominantly affected by irrigation water alkalinity, and much less so (if at all) by irrigation water pH. Despite this issue having been discussed in numerous extension and trade publications, there still seems to be widespread confusion among nursery growers as to how irrigation water should be managed to maintain optimum substrate pH.

While irrigation water pH and alkalinity can be related, a survey of 192 Ohio groundwater samples showed no correlation between the two variables ($R = -0.1077, P = 0.1369$). High irrigation water pH does not necessarily result in high alkalinity, and vice versa. The objective of this study was to provide nursery growers and extension educators with a simple demonstration of how irrigation water pH and alkalinity affect substrate pH.

Materials and Methods

There were three substrate treatments. All treatments were 15-cm diameter pots filled with a substrate composed of 80 pine bark : 20 peatmoss. One treatment was fallow. The second treatment included the same substrate amended with a controlled release fertilizer (Osmocote 15-9-12) incorporated at 7.7 kg m$^{-3}$. The third treatment included the same substrate and fertilizer potted with a single liner of rose (Rosa ‘Radrazz’). Containers were irrigated with either reverse osmosis (RO) water, a 0.0001 mM KOH solution in RO water, or a 0.005 M KHCO$_3$ solution in RO water. There were six replications per treatment combination. Substrate pH was recorded monthly over 3 months using the pour-through procedure.

Results

- Substrates irrigated with KHCO$_3$ had higher pH throughout the study.
- Substrates irrigated with RO or KOH had similar (and lower than KHCO$_3$) pH values throughout the study.
- Substrates containing roses and fertilizer had slightly lower pH compared to fallow substrates.
- These data demonstrate that irrigation alkalinity, and not irrigation pH, affect substrate pH in fertilized and non-fertilized container substrates over time.

Figure 1. Relationship between water pH and alkalinity in 192 wells throughout Ohio.

Table 1. Irrigation water treatments used to generate solutions with high and low pH and alkalinity.

<table>
<thead>
<tr>
<th>Water source</th>
<th>pH</th>
<th>Alkalinity (mg L$^{-1}$ CaCO$_3$)</th>
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</thead>
<tbody>
<tr>
<td>RO water</td>
<td>6.26</td>
<td>3.4</td>
</tr>
<tr>
<td>0.0001 mM KOH</td>
<td>8.23</td>
<td>10.0</td>
</tr>
<tr>
<td>0.005 M KHCO$_3$</td>
<td>8.28</td>
<td>275.0</td>
</tr>
</tbody>
</table>

Figure 2. Substrate pH response to reverse osmosis (RO) water, 0.0001 mM KOH solution, and 0.005 M KHCO$_3$ solution in containers with substrate only (top), substrate and a controlled release fertilizer (middle), or substrate with fertilizer and a rose plant.