The Effect of Oxygenation of Water on Dissolved Oxygen Measurements in Irrigation Water and Container Substrate

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Oxygen injection systems are an option to increase dissolved oxygen (DO) in irrigation water. Two experiments evaluated (1) the persistence of super-saturated DO in irrigation lines, and (2) the DO level in container substrates irrigated with super-saturated water. An optical oxygen sensor was used to measure DO. In the first factorial experiment, there were two water types [“oxygenated” (26.0 mg·L⁻¹) or “ambient” (6.3 mg·L⁻¹) tap water], and three water delivery points [a holding tank immediately after the oxygen injector or tap (“source”), after being pumped 4.7 m to an outlet (“hose end”), or through a propagation emitter (“mist nozzle”)]. Water type and delivery point interacted in their effect on DO (P<0.0001). Oxygenated water decreased slightly from the source (26.0 mg·L⁻¹) to the hose end (24.6 mg·L⁻¹), but decreased greatly to 8.7 mg·L⁻¹ at the mist nozzle. Ambient water did not differ between the holding tank (6.3 mg·L⁻¹) and hose end (7.0 mg·L⁻¹), but increased to 8.7 mg·L⁻¹ at the mist nozzle. The DO at the mist nozzle was equal for both water types, and close to saturation (8.9 mg·L⁻¹). In a second experiment, two different sized containers (20 cm³ “cells” and 400 cm³ “pots”) were filled with a 60:40 (by volume) peat: perlite substrate and irrigated to container capacity with ambient water. Water type was then poured onto the substrate at 0, 25, 50, 100, or 200% of container volume. Increasing the applied water volume with ambient water did not affect substrate-DO in either container size. However, at a 1-cm depth in the cells, substrate-oxygen increased from 8.6 mg·L⁻¹ to 12.3 mg·L⁻¹ (a 46% increase in oxygen) as applied oxygenated water increased from 0 to 200% of container volume. A diminishing returns relationship between substrate-oxygen and applied volume of oxygenated water was observed in both the cells and pots. In the pots, substrate-oxygen increased by 68% and 79% at the 2-cm and 4-cm depths, respectively, as applied oxygenated water volume increased from 0 to 200%. Substrate-oxygen was 1.3 mg·L⁻¹ lower at 4-cm compared with 2-cm depth with ambient water, and 2.3 mg·L⁻¹ lower with oxygenated water. In conclusion, passing irrigation through a mist nozzle caused DO to reach an equilibrium saturated level in irrigation water, regardless of whether oxygen was injected. In the substrate, a large volume of oxygenated water was required to increase DO in the substrate.