



## Sustaining Water Resources in Agriculture

# Breathing Room: Aerating Soil & Water

By Jim Lauria

Most irrigation experts think in terms of water. Most agronomists think in terms of soil. However, to help farmers make the most of their growing environments, we need to expand our thinking — not just in terms of considering both soil and water, but to also include ancient elements: air. (The ancient Greeks also included fire on that list of elements; in terms of modern agriculture, we can look at fire as energy.)

The aerobic soil ecosystem is an environment that author Evan Eisenberg describes as a bustling marketplace, “a Casbah, a flea market, an economic free-for-all in which each buyer and seller pursues his or her own interest, and in which every scrap of merchandise — second-hand, seventh-hand, busted, salvaged, patched — is mined for its last ounce of value.”

Like the human-scale world atop the soil, Eisenberg’s buried marketplace is fueled by oxygen (and nitrogen, which is the building block for protein in us and the plants we cultivate). In fact, oxygen and nitrogen are inextricably linked in the soil. The balance of microbes beneath the surface dictates whether nitrogen will be fixed in the soil from the atmosphere, converted to plant-friendly nitrate or ammonium, or denitrified and bled off as gas into thin air.



A Mazzei Venturi injector uses water flowing through the irrigation system to draw air into the line, allowing the drip tape to deliver air, as well as water, to the crop’s roots.

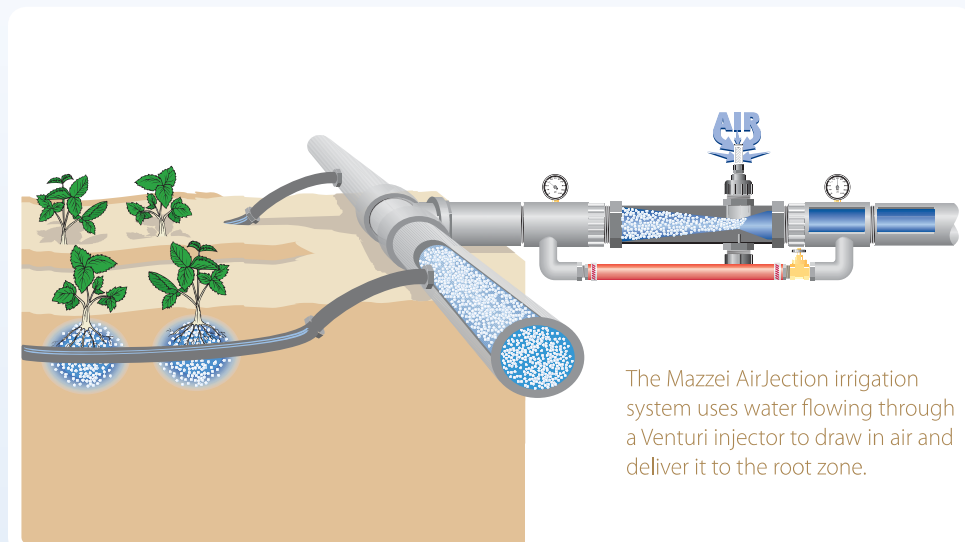
### Proven Yield Boost

One of the most exciting approaches to aerating the soil environment integrates injectors with buried drip lines to add approximately 15 percent air by volume into irrigation water. Because the system uses a vacuum created by the flow of water through the injector to introduce air to the stream, it’s a very low-energy operation and the only moving part required is the pump pushing the water into the drip system. So, we’re back to those four ancient

elements: connecting earth, water and air while using less energy — fire — to do it.

The process has been demonstrated to improve yields significantly in vegetables and fruit. One major San Joaquin Valley farm compared 1,500 acres outfitted with a locally manufactured air injection system against rows with conventional buried drip tape for eight years. They recorded a 23 percent average increase in yield in cantaloupes, as well as increases in honeydew, sweet corn and peppers. The yield boost in cantaloupes ranged from 12 to 34 percent over the study period.

In other trials, tomato yields increased by 21 percent in normal soils and 38 percent in saline soil as a result of aerated subsurface irrigation water; watermelon yields have been demonstrated to nearly double, while soluble solids increased by 4 percent.



The Mazzei AirJection irrigation system uses water flowing through a Venturi injector to draw in air and deliver it to the root zone.

### New Technology, New Insights

A team of scientists from Canada and the United States — Dr. Adrian Unc and Crystal McCall of Memorial University of Newfoundland, Canada, and Dr. Dave Goorahoo and Josue Samano Monroy of the Center for Irrigation Technology at



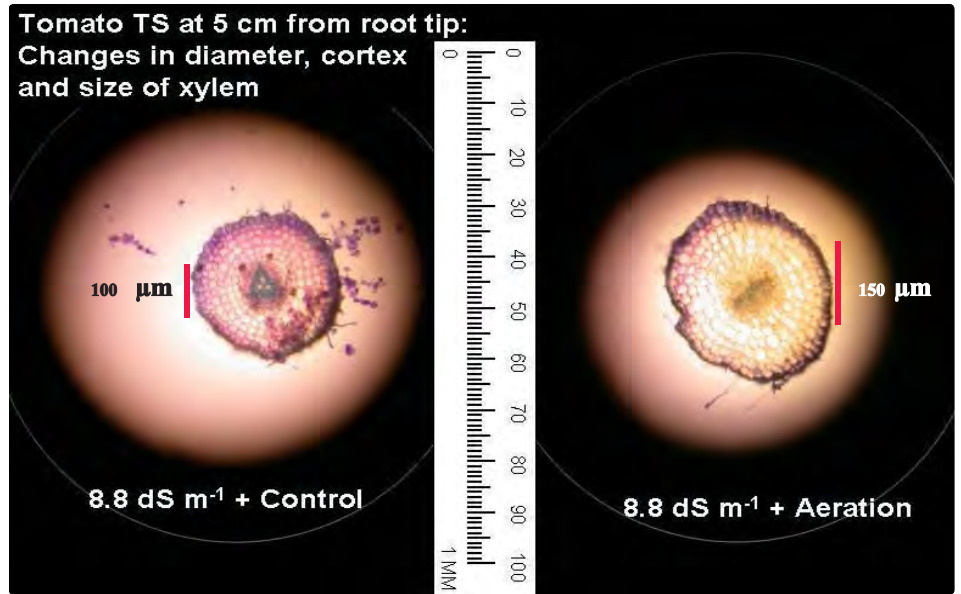
Aerating drip irrigation water (inset) has been demonstrated to improve yield and quality in strawberries and other fruits.

California State University, Fresno — used sophisticated DNA analysis and a growing understanding of the soil ecosystem to study the impact of the root aeration system on soil microbial populations in a replicated trial. Their experiment focused on the DNA of the microbes in their samples, which allowed them to measure the relative intensity — or a rough proportion — of various nitrogen-fixing and denitrifying-genetic material found in each treatment.

They found that the portion of the field irrigated with the air injection system had a microbial population that was less likely to produce volatile nitrous oxides and more likely to leave plant-available nitrate in the root zone.

### Who Will Save the World?

There's no question that irrigation is a lifeline that will help mankind weather an increasingly erratic climate and meet the mushrooming demand for food, fuel and fiber. Increasing the efficiency of irrigation and making every drop of water and every joule of energy count will be vital. One of the key lessons we're learning as we uncover the mysteries of the soil is just how complex the world of the root zone really is. By balancing water and oxygen in the soil and enhancing the environment for the microbial traders that give our crops the best possible deal, we can help farmers literally save the world.



This cross section of two young tomato roots shows the increase in diameter, cell size and cortex area of a root-supplied aerated irrigation water (right) compared to another root irrigated with unaerated water (left). Both roots were grown in saline conditions.

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