Adding Air Adds Yield

Injecting Air into Irrigation Lines Shows Promise

by Patrick Cavanaugh, editor

Kevin Johnston with Johnston Farms in Edison, Calif. has found that injecting air through his subsurface drip tape enhances the growth and yield of his bell pepper plants.

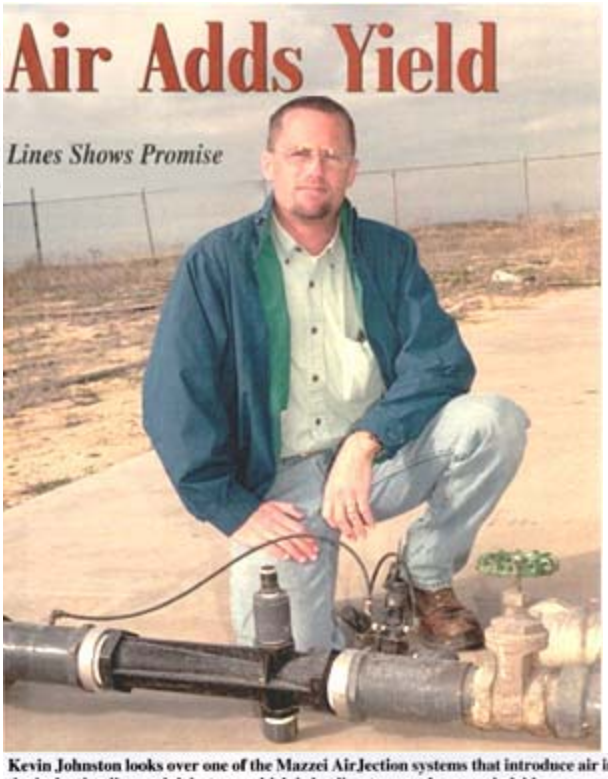
Backing up Johnston is research taking place on his operation by the Center of Irrigation Technology (CIT), based at California State University, Fresno.

The experiment is using the Mazzei AirJection Irrigation system, which supplies air to the irrigation water at the rate of 12 percent air by volume. The Bakersfield-based Mazzei injector company has a patent on the system.

Past research has shown that increasing air into the soil pores around the roots will influence crop growth and yield based on the plants needs of the air along with water. "Soil that is well-aerated will favor increased root respiration and aerobic microbial activity," said David Zoldoske, CIT Director. "Conversely, in soils where the pores are filled with liquid, or waterlogged soils typical of poor drainage, anaerobic conditions prevail."

Oxygen is essential for root respiration. However, immediately after the roots are surrounded by water, they can no longer respire normally. The liquid impedes diffusion of metabolites such as carbon dioxide and ethylene. Researchers have found that this causes the plant to be stunted because ethylene is a growth inhibitor. But, when air is injected into the root zone, many of the ethylene gases diffuse away from the roots into the air within the root zone.

This increased diffusion rate should result in improved growing conditions. That is what Johnston has found in his bell peppers, which he produces along with carrots, potatoes and various citrus crops.



Kevin Johnston looks over one of the Mazzei AirJection systems that introduce air into the irrigation line and drip tape, which is leading to some increased yields.

His total vegetables production is on about 1000 acres, of which 120 acres are devoted to bell peppers. "The market has been tough because there has been a lot of new acres going in with the crops we grow and some bumper crops," said Johnston. Despite the marketing challenges, Johnston tries to always grow good quality to optimize tonnage. They pack most of their crops and do some marketing as well.

He's experimenting with the injectors to allow him to increase yield, thereby reducing the amount of acreage he needs to plant. "With the yield increases that we've been seeing we can get the cost down by kicking the acreage down," Johnston said.

Most of the bell pepper crop is for fresh market, but toward the end of the season, when the fresh quality is gone, the crop goes into processing.

Planting normally spans from late February to early March, while harvest begins in mid-May and it stretches all the way to August.

He started using the air-injector system about four years ago. "The first few years we did not see much of a difference compared to control plots, most likely because we needed to work the bugs out," said Johnston. "But the last two seasons have shown some big improvements.

"We have fields in many different areas and found that the aerators work better on lighter soils than on heavier soils," said Johnston.

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Adding Air

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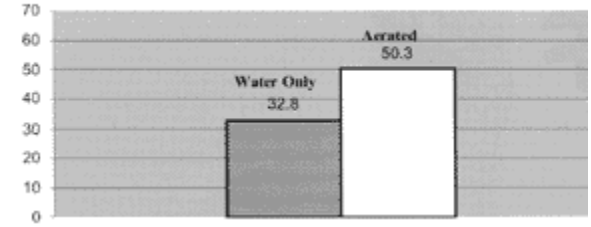
He plants transplants over the drip tape, which is set about 4-5 inches underground with no plastic mulch. The beds are 40 inches apart with the plant spacing about seven inches apart down the bed.

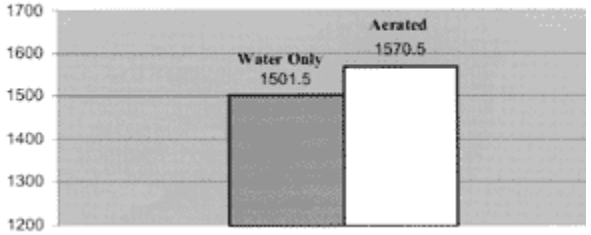
Johnston is on canal water and the air injectors are tied into the distribution laterals in the field, past the pumps and filters. "If you put the oxygen in too far away from the beds then it will dissipate before it reaches the field," said Johnston. "You can regulate how much air goes into the lines and it seemed that 12 psi was good."

The oxygen is taken in from the air into the injector, which uses backpressure coming off the water. The pressure differential of the water moving down the pipe creates a vacuum and enables the flow of air into the water. It works off the same principle as basic injectors at filter

Total dry weight (grams) of roots of mature bell pepper plants.



Total dry weight (grams) of stems and leaves of mature bell pepper plants.



injected plots produced 814 cartons—an increase of 12.8 percent.

The processed bell pepper yields saw an increase of 8.1 percent.

The 92 additional cartons per acre in the premium crop equates to $460 per acre (at $5 per carton) and the additional processed yield of 63 cartons per acre at a carton price of $1.25 equates to $78.75 per acre, or a total increase in income of $538.75 per acre.

The cost of one of the three-inch injector assemblies and other related equipment (which will do five acres) is approximately $1,000 "That's on the high side," said Angelo Mazzei, company owner. "Keep in mind that these injectors can easily last ten years or more, giving the grower plenty of time to amortize their cost. The pay back will be less than one year."

"We saw it as something we could try without it hurting anything," said Johnston. "You can pipe in air all day long and there would be no adverse effect to the crop. So it was safe."

Johnston said the extra oxygen to the roots enables the plants to have extra foliage. "We noticed a definite distinction last year between the treatment and controls."

"We will keep using the air injectors for this year and future crops, because it definitely helps and in no way has adverse effects," said Johnston. "It's a novel idea." VW

Kevin Johnston, partner in Johnston Farms, is planting 120 acres of peppers and will use AirJection on 80 of them for the 2001 season.

Irrigate to kill bugs

Here's a switch: Deficit irrigation of vines has successfully and significantly reduced the populations of western grape leafhopper, based on research at the California Agricultural Technology Institute, California State University, Fresno.

The trials, which took place in the summer of 2000, featured deficit irrigation treatments on Cabernet Sauvignon grapevines at vineyards in the Firebaugh and Paso Robles, Calif., area. In each case where water applications were reduced, numbers of leafhopper nymphs were reduced.

In the Firebaugh vineyard, on the west side of the San Joaquin Valley, the treatment was 40% of standard for the area. In Paso Robles, located in the eastern foothills of the Coast Range, the deficit irrigation treatment was 20% of standard.

At Firebaugh, the brix and color intensity level of the berries increased only slightly, while yields were reduced by nearly 2 tons per acre. At Paso Robles, however, brix increased from 20.8 to 22.8, while yields decreased from 6.6 to 5.7 tons per acre.

The increase in color intensity and brix levels offers the potential for improved wine quality, despite the yield losses, reports Michael Costello, viticulture researcher who conducted the study.

"It is also possible that at each site, increasing the cluster load in the deficit irrigation treatment could compensate for smaller berry size," Costello says. ◆

the system, you will have less effect as you move further away from injecting the air," he says.

Mazzei believes the system holds promise for a variety of crops. Representatives of TORO Agriculture Division, a division of TORO Corp. in Minneapolis, agrees. The company has marketing rights for the new product and is gearing up for a worldwide effort to sell the AirJection in the United States, Canada, Mexico, Europe, Africa and the Middle East.

Jan Carlo DiPaola, TORO Ag's managing director, says the product offers a way for Toro to differentiate itself in irrigation products — something he says it is difficult to do. By offering the Mazzei Injectors and the AirJection system, DiPaola believes growers will be attracted to its "total solution" capability. He also believes it will be useful on a variety of crops in many areas of the world where drainage hampers production.

Goorahoo feels the product holds promise for other crops and has plans to test it on melons, tomatoes and vegetables.

"If you can aerate your air root zone you will create a friendlier environment for crop growth and production," he says. ◆

— Brookhart is a farm writer based in Bakersfield, Calif.