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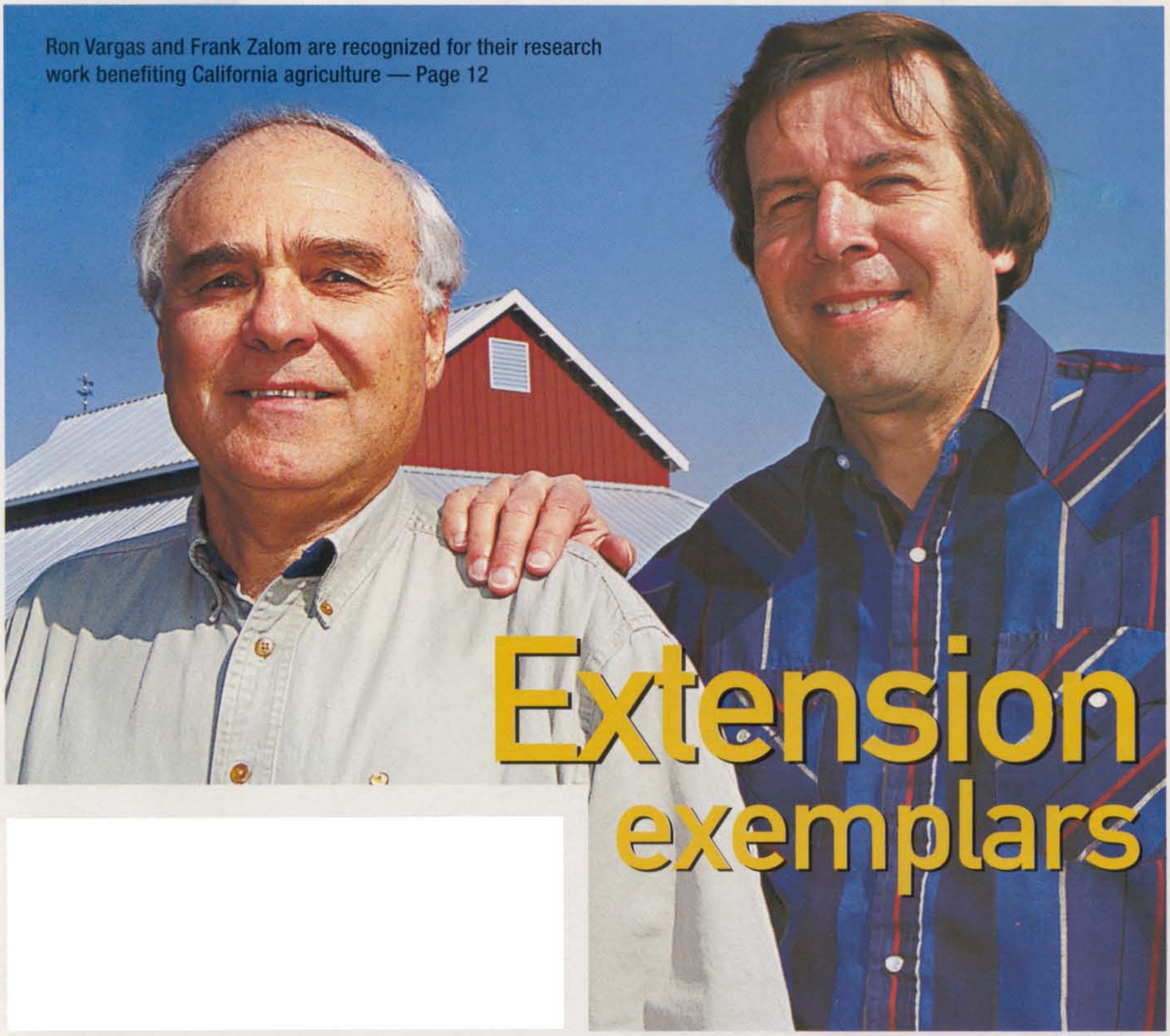

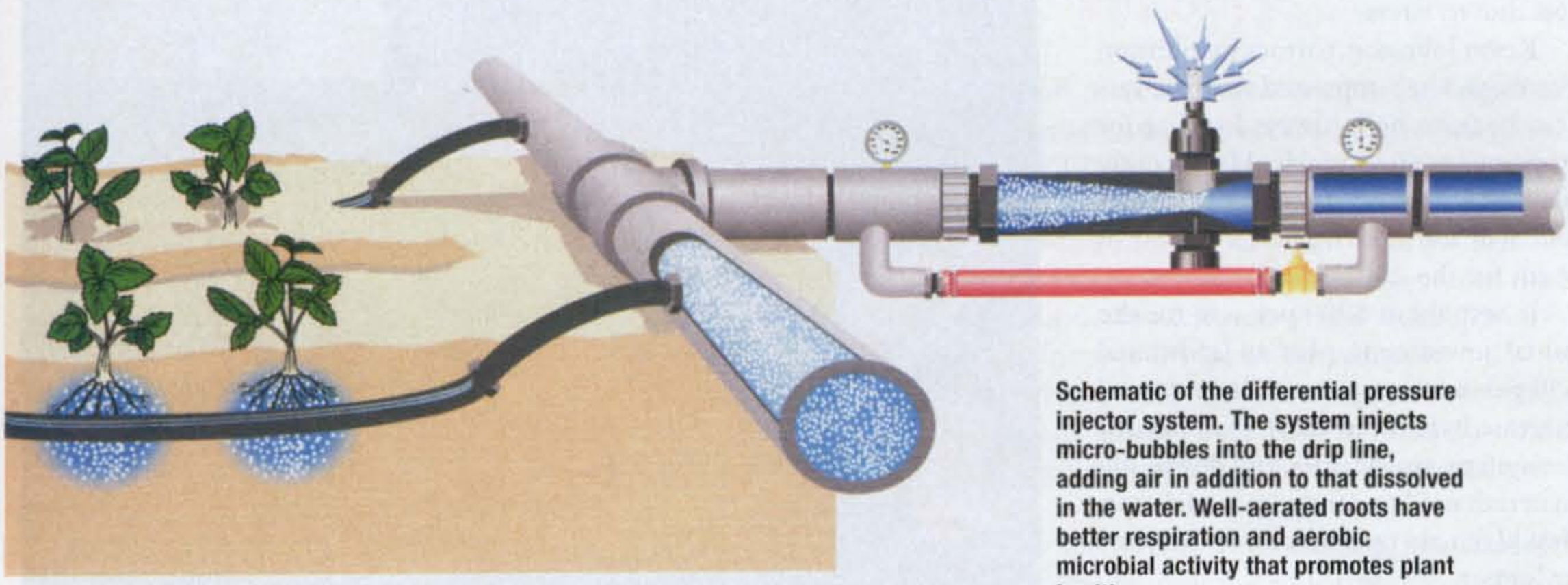

Schematic of the differential pressure injector system. The system injects micro-bubbles into the drip line, adding air in addition to that dissolved in the water. Well-aerated roots have better respiration and aerobic microbial activity that promotes plant health.

Tiny bubble machine

AirJection system pumps air into drip lines, giving an aerated yield kick to plant roots.

■ *By Beth Brookhart*

Plowing without a plow is the idea behind a newly patented method of entraining air bubbles into subsurface drip irrigation lines, a system recently released by Mazzei Injector Corporation of Bakersfield.

Initial tests have shown the device to deliver an increase of 10% to over 30% in yields.

Angelo Mazzei, president of Mazzei Injector, is known worldwide for the patented Mazzei Injector, a high-efficiency, venturi-type device for injecting liquids or gasses into pressurized water. In the mid-90s, he began experimenting with a way to use his injectors with subsurface drip irrigation to deliver air to plant roots with water as the carrier. Well aerated roots have better respiration and aerobic microbial activity that can provide a healthier growing environment.

Mazzei began looking at ways to entrain air in bubble form as an addition to the air dissolved in the water. He eventually developed a redesigned Mazzei Injector and a metering system that produces the micro-bubbles. Tiny mixing vanes help mix the bubbles, which travel with the water to plant roots. The new system is known as the Mazzei AirJection Irrigation system.

Tests were first done at Johnston Farms near Bakersfield on 40 acres in a field of 80 acres of bell peppers watered with subsurface drip. It took several years of experiments and adjustments but in 2000 the acreage yielded 10% more in the peppers using the AirJection than on those with water alone.

YIELDS CLIMB

Tests at Fresno State University's Center for Irrigation Technology (CIT) showed even stronger results with a 39% increase in yield. Bell peppers at CIT had a root mass increase of 54% with the AirJection system over plants receiving water only. Tests with an infrared stress monitor also indicate the stress level of plants under the system is lower. The enhanced root system holds the plant up in extreme tempera-

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tures, says Mazzei, so there is less yield loss due to stress.

Kevin Johnston, partner in Johnston Farms, says he's impressed with the system because he is always looking for ways to increase yields. He recently planted another 120 acres of peppers and will use the AirJection on 80 of them for the 2001 season.

It cost about $200 per acre for the initial investment, plus an additional $50 per acre to operate. The potential increased yield can more than pay for the system, says Mazzei, and due to the materials used to construct it, each unit should remain operational for five years or longer.

EARLY FRUIT AND MAYBE MORE OF IT

There is also some preliminary indication that the AirJection can prompt plants to yield fruit early. That's a major plus for farmers hoping to move products such as tree fruit or grapes on an early market. Mazzei plans to test the system in commercial almonds and grapes this year.

"From the initial study that has been done, it would show that from the point of view of using the technology to aerate water, it offers (potential) for crop production," says Dave Goorahoo, soil scientist for CIT. "There was, in fact, an increase in yield. Still we need to fully understand what is really happening. It does hold promise."

Bell peppers being planted at the Johnston Farms. Tests at Fresno State University's Center for Irrigation Technology showed that peppers grown under the AirJection system had increased yields by 39%.

Goorahoo says balancing the air/water ratio is critical to the success of the product. By introducing air to the roots, microbial activity is increased. But there is an economic trade-off, he says, in how much energy might be used to operate the AirJection. The ratio used in CIT tests and at Johnston Farms was 12% air by volume.

CIT test plots were harvested three times with individual bell peppers counted and weighed. In all three harvests, the aerated plots exceeded the nonaerated plots in both bell pepper count and total weight. Combining the three harvest data sets showed a 33% increase in bell pepper count and 39% increase in total weight.

There was also a correlation to the location of the plant along the drip tape. The aerated water positively affected production in the first 168 feet of the sampled bed length. Goorahoo says more study needs to be done to determine the exact correlation.

"It points to that ... unless you can maintain your flow velocity and pressure throughout the entire length of

Root zone test

Modifying root zones of plants has long been a subject of interest among growers and researchers, says Ed Norum, consulting engineer for CIT. Well aerated soil is known to provide a better environment for root development and plant growth, he observes. Unfortunately, single-purpose air injection systems have typically proven too costly for successful commercial application. With this advance in subsurface drip irrigation, this could be about to change.

"The concept of saturating the irrigation water with air has at least the potential for the air to move with water within the root zone more generally and affect crop growth," Norum says.

The experimental plot was approximately one-third acre. Soil cover over the drip line was 5 to 6 inches and plant rows were 190 feet. Treatment was subsurface drip with untreated water and drip with 11% injected air. Treatment plots consisted of two rows per treatment, with four replications of each treatment.

Materials used in the project included Toro-Ag blue strip drip tape rated 0.34 gallons per minute per 100 feet. It was under pressure of 8 pounds per square inch.

For air injection into the drip lines, a manifold was constructed using a Mazzei model 584 differential pressure injector. Once the stand was established, the crop was irrigated every seven days using reference Eto information.

In addition to yield data, researchers also measured dry weight and root mass of selected plants from the different treatments. Results indicated generally greater dry weight and larger root mass in those plants that had received aerated water. ◆