Key Innovations for Food and Water Security

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Achieving the SDGs is fraught with a long list of constraints and barriers. The Least Developed countries are those most vulnerable to climate change, will see the greatest increases in population growth and experience the greatest threats to water and food security. The challenge is not only to increase food production in these 49 countries, but to provide generalizable and replicable, professional systems that can be adapted to local conditions. This paper posits that there are no shortcuts to achieving the goal of food and water security and that key innovations such as those detailed below should and can be adopted.

Sub-surface drip irrigation (SDI) is the most water-use efficient irrigation system commercially available today. SDI offers opportunities to reduce N20 emissions, to reduce overall fertilizer application rates and to reduce weed growth and use of herbicides. It virtually eliminates evaporative losses while significantly increasing transpiration. This research illustrates how the benefits of SDI can be further augmented by one application of a hygroscopic humectant at the beginning of the first irrigation cycle and by injecting oxygen and nitrogen through the irrigation system throughout the growing season. These two augmentations to SDI reduce the amount of water, nutrients, herbicides and pesticides when compared to traditional furrow or drip systems, and provide more robust root development and healthier produce with longer shelf lives and reductions in waste.

This study examined the performance of the AirJection system on SDI us in a cantaloupe field of 1497 acres (606 hectare). One hydraulic, venturi-type, injector with one air snorkel was installed at each lateral. There were four alternating replications: each replication was seven beds wide to accommodate harvest regimens. The drip system consisted of one dripperline per bed at a depth of 30 centimeters and a spacing of 1.5 meters width and 50 centimeter spacing between emitters. Air was injected at a rate of 15% by volume. Pressure in the system was between 1-1.7 bars.

The results after the first year are as follows: The increase in yield in the AIrJection sections were, mean average, 34% greater than in the control. The return on the investment of the AirJection system was $996,772 over the 1497 acres or $6,678/acre ($16,496/hectare). The farm expanded the use of the AirJection system over the next seven years and averaged an increase, over 12,000 acres (4856 hectare) of between 12%-35% in yield. The farm experienced less maintenance of the drip system in the AirJection sections than in the control sections. The energy cost per box (about 12 cantaloupes) for the AirJection system was approximately $0.02. The average price to the farmer for a box of cantaloupes is approximately $3.00. So the percentage of energy cost to captured income is 0.067. Subsequently, this system has been successfully used in peppers, strawberries, tomatoes and corn.

The Mazzei AirJection system has other positive implications. The system is powered by the pressure of the irrigation system; no outside source of energy is required. The system injects only air from the atmosphere so no chemicals or amendments need be shipped, stored or applied.

The second augmentation is the injection of liquid Hydretain. Hydretain¬ is an inexpensive, biological agent with a food-based USDA label, and is also labeled for use in Europe, Africa, Asia and Latin America. Hydretain¬ attracts free water molecules from the air and soil matrix, essentially converting water from its vapor form back to a liquid state, making water, which has evaporated or run-off, available to the plant in the rhizosphere. This paper summarizes reliable and valid case studies illustrating a range of 47-75% water and nutrient savings in beans, broccoli, potato, cauliflower, bell peppers, tomatoes and cucumbers with higher net weights, reductions in wilting and more robust root development.

Each augmentation can be applied independently. The Hydretain product can be applied with all irrigation systems, not only SDI. The position of this paper is that the temporal urgency of improving production within the context of climate-smart agriculture demands the adoption of best available technologies.