Ogallala Aquifer
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Technological Advances in Irrigation

How efficient is Subsurface Drip Irrigation?

by Shelby Axtell

As the Ogallala Aquifer continues to decline, scientists and researchers are discovering new technologies and innovations to conserve water. United States Department of Agriculture-Agricultural Research Service (USDA-ARS) scientists are currently evaluating the efficient use of rainwater by crops grown using subsurface drip irrigation (SDI).

SDI is an irrigation system buried below the soil's surface and has become quite popular on the Texas High Plains. Each underground emitter on the SDI releases water directly into the soil, as opposed to traditional above-ground sprinkler systems such as Low Energy Precision Application (LEPA), which deposits water directly on the soil surface.

SDI applies water below the surface, thus reducing water loss by evaporation from the soil surface while enhancing root proliferation near the buried drip emitter. This is just one of the many advantages of SDI being underground; however, ARS scientists speculate with the limitations of surface roots in SDI irrigation systems, the plant's ability to uptake and make use of some of the rainwater stored in the upper levels of the soil might be diminished.

Effectiveness of Subsurface Drip Irrigation

Robert J. Lascano, professor of soil physics at the Texas A&M University Research and Extension Center at Lubbock, Texas, and adjunct professor in the department of plant and soil science at Texas Tech University, and Dr. James Mahan, USDA-Agricultural Research Service and adjunct professor in the department of plant and soil science at TTU, are working to discover SDI's efficiency.

Lascano believes SDI is a great invention but may be more efficient in a desert area with no rainfall.

"Our first goal is to use what is provided free, which is rainfall," Lascano said. "The strategy is to use irrigation-water as a supplement to rainfall."

Lascano indicated that after a period of little or no rain the top foot of the soil will remain hot and dry with SDI. Only the soil in the area around the drip emitter roots will be cool and wet. Because of this, scientists speculate under these conditions, SDI plants are less likely to uptake most of the rainfall received.

Rainfall which plants are unable to uptake in a SDI system becomes a loss of water through evaporation, runoff, or percolation below the root zone, Lascano said. With the High Plains main irrigation water source declining, water losses from rain is something farmers cannot afford.

Fingerprints of Water

In order for scientists to prove if SDI crops absorb rainfall, they must first be able to distinguish between rainfall and Ogallala Aquifer irrigation water. Through isotopic research, scientists are able to determine the origin of moisture SDI plants absorb.

"Water has specific isotopes of hydrogen and oxygen, which are like fingerprints," Lascano said.

Lascano and Mahan, along with B.L. McMichael, USDA-ARS and adjunct professor in the department of plant and soil science at TTU, Dr. Don Wanjura, USDA-ARS and adjunct professor in the department of plant and soil science at TTU, and Dennis Gitz, USDA-ARS, are all working on technological advances in isotopic research in order to find the origin of the water crops take up (rainfall or irrigation water).

Lascano notes the "fingerprint" project will be conducted through several cotton-growing seasons and is quite dependent on Mother Nature's cooperation. However, he is optimistic if they are successful in their predictions, this research will lead to irrigation technology and managements that can assist producers to become efficient in their use of irrigation water. Producers would be able to, not only, conserve the aquifer, but also cut pumping costs from their irrigation wells.

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Pros & Cons of Subsurface Drip Irrigation

Advantages

- No soil evaporation or surface runoff
- Less nutrient and chemical leaching due to deep percolation
- Better application uniformity
- Enhanced plant growth, crop yield, and quality
- Limited weed growth and reduced weed germination
- Field operations can occur during irrigation
- Reduced weather related application constraints, i.e. wind and freezing temperatures

Disadvantages

- High initial investment cost
- Few visual indicators making it difficult to evaluate system operation
- Reduced upward water movement
- Tillage options may be limited, depending on dripline placement
- Restricted plant root development
- System is spatially fixed, so annual crop spacing/orientation must be carefully matched
- Concerns about waste product (driplines) in subsoil if system is abandoned

For a complete list of advantages and disadvantages go to http://www.oznet.ksu.edu/sdi/News/Pros&Cons.htm