WATER CONSERVATION WITH SUBSURFACE DRIP IRRIGATION

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Some of the most advanced irrigation technology is subsurface drip irrigation (SDI). SDI is the slow, frequent application of small amounts of water to the soil through emitters located on a delivery line placed beneath the soil surface. SDI allows for highly productive crop production without leaching or runoff. Only the amount of water needed by the crop on a daily, or other very frequent basis need be diverted from a stream or reservoir, thus helping to also protect water quality.

Gravity irrigation is one of the most common irrigation methods currently being used in the Treasure Valley. Problems with gravity irrigation systems that can be substantially reduced with SDI include erosion within the field, loss of nutrients and sediment from the field to drains or streams, washing of bacteria from fields into runoff water, and deep percolation of water and dissolved chemicals toward ground water. Runoff water from gravity irrigation is often enriched in sediment and phosphate. The incremental amount of water added at each surface irrigation is usually large compared to sprinkler or low-flow systems, so the risk of leaching of nitrate is greater with gravity irrigation.

Some of the benefits of SDI which have been identified by researchers are:
§ Increased water use efficiency
§ Reduced water percolation through the root zone
§ Reduced runoff from the tail end of a field
§ Reduced evaporation from the soil surface
§ Increased water distribution uniformity throughout a field
§ Reduced energy usage
§ Reduction of moisture stress to plants because of frequent irrigation resulting in an increase in crop quality

Water Use Efficiency (WUE) is defined as crop yield per unit of applied water. In a SDI study conducted on cotton, Phene et al. (1992) found that out of eight irrigation methods SDI had the highest WUE. Lamm et al. (1992) conducted a SDI study on field corn and found that maximum yields were achieved at 75 percent of evapotranspiration (ET). ET is the combined loss of water by evaporation from the soil surface and by transpiration from the plant's leaf surfaces. In another study, Phene et al. (1992) found that yields of tomatoes were nearly doubled over conventional irrigation methods when SDI and proper fertilization practices were followed.

Phene et al. (1992) also conducted experiments related to the environmental aspects of SDI. On a clay loam soil with drip tubes placed .45 meters below the soil surface, their data indicate that except for directly beneath the drip tubes the direction of the soil hydraulic gradient is upward. In other words, soil water remains in the root zone for utilization by growing plants, not lost to deep percolation. In a study conducted on alfalfa by Hutmacher et al. (1992), soil water data suggest little or no potential for deep percolation losses. Additionally, Phene et al. (1992), found that after 3 years of raising tomatoes (high users of nitrogen fertilizers) and cantaloupes, some accumulation of nitrate-nitrogen occurred at the soil surface. Only a small amount leached below the root zone. Since soil water remains in the root zone groundwater contamination and runoff from non-point sources containing agricultural contaminants is reduced if not eliminated entirely.

Studies have been conducted in Nevada to determine the amount of water needed to produce a ton of alfalfa hay. Jensen and Miller (1988) conducted a study near Wadsworth, Nevada during the 1984 and 1985 growing seasons. Their work indicates it takes from 6.1 to 8.4 inches of water to produce a ton of alfalfa. Unpublished work I conducted in Nevada in 1997 and 1998 with a three acre SDI system showed it can take as little as 1.94 to 2.33 inches of water to produce a ton of alfalfa hay.

Table 1. shows the results of work conducted on the Nevada Nile Ranch at Lovelock, Nevada when alfalfa seed is grown with SDI. As seen in this table, the Nevada Nile was able to increase their seed yields using SDI. Unfortunately, they were not monitoring the amount of water used to produce these yields. I am currently undertaking a collaborative project funded by the Idaho Alfalfa and Clover Seed Commission, the U.S. Bureau of Reclamation, and Netafim Irrigation Company in which eight acres of alfalfa seed is being irrigated on a Caldwell, Idaho farm with a SDI system. The main items being investigated in this project are yield, water use, and soil moisture status. In addition, Dr. Clint Shock, Superintendent of the Oregon State University Malheur Experiment Station at Ontario, Oregon is conducting work to determine the optimum amount of water needed to produce a pound of alfalfa seed with a SDI system.

Table 1. Alfalfa Seed Yields from the Nevada Nile Ranch at Lovelock, Nevada

	<---------- **SDI** ---------->		<------- **FLOOD** ------->	
Year	Field Size (ac)	Production (lbs/ac)	Acres	Production (lbs/ac)
1998	10.7	1498	890	859
1999	20	1743	896	1028
	20	1423		
2000	40	1201	812	897
	30	1011		
	[illegible]	[illegible]		

There are many opportunities for SDI in the Pacific Northwest, but the technology has not yet been adapted to its fullest potential. For Idaho's irrigated crop acreage in 1998 (4,104,600 acres), gravity irrigation was utilized on 38.3%, sprinkler irrigation was used on 61.5%, and low flow systems (all types of drip and micro sprinkler systems) accounted for only 0.2%. For Oregon's irrigated crop acreage in 1998 (1,833,000 acres), gravity irrigation was utilized on 46.6%, sprinkler irrigation systems of all types were used on 52.4%, and low-flow systems accounted for only 1.0%. (Anon. A., 1999). The 1997 Census of Agriculture reports lower total irrigated acres with similarly low proportions of drip-irrigated crops (Anon. C., 1998).

Given the economic importance of the many high value seed crops in southwest Idaho, the need to increase irrigation efficiency, and increasing environmental concerns, SDI needs further research and demonstration as a possible irrigation alternative for our producers.

Literature Citation

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