Drip Irrigation Studies in Alfalfa

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In California, about 80-85% of alfalfa production is accomplished utilizing surface irrigation systems, 15% using sprinkler systems of various types. Approximately 2-3% utilize subsurface drip currently, a number that was very close to zero 6 years ago. However, there is strong interest in more water-use efficient application systems, given the dynamics of water supply and the potential to improve yields.

Over the past 3-year period, we have been observing and surveying installation of subsurface drip irrigation (SDI) systems on 23 farms in California and Arizona, and conducting controlled studies on the University Research Farms. This has been a tremendous learning experience – we are learning from growers as they learn how to adapt this technology, and providing suggestions on how its success might be improved. It is an ongoing learning curve for all of us.

Yield. It is quite likely that alfalfa yields may improve utilizing SDI in alfalfa vs. flood irrigation. Growers in the long-seasoned environment of Central and Southern California and Arizona have reported yields averaging 3 ton/acre over their check-flood fields, at least in the first several years. Experimental data has reported 20-35% increases in yield vs. surface systems in controlled studies.

SDI trial at Kearney Research and Extension Center. SDI has the capacity to improve yields and improve water use efficiency in alfalfa.
Better water distribution Uniformity over Space. Check flood systems have built-in limitations in uniformity due to different times available for water infiltration at different places in the field. Often, water in flooded fields needs to move more than 1,300 feet, which takes 10-14 hours – so different amounts of water are provided in different sections (Figure 2). One of the key advantages of SDI systems is to apply water more uniformly across a field.

Better water distribution Uniformity over time. SDI has the ability to quickly apply a uniform irrigation to an entire field. This is not possible with most surface systems. Depending upon flow rates, many surface systems require from 3-12 days irrigating 80-100 acre field. Thus, one side of the field may get water much later than the other side, limiting yields.

In a well-designed and properly managed SDI, there is less soil evaporation, more crop transpiration, no runoff, and no/less-deep percolation. Water saving potential!

Fig 1. Alfalfa yields (SDI vs. conventional check flood)

Fig 2. Water distribution the entire field (surface irrigation)

Fig 3. Matching alfalfa ET and applied water through SDI over the season
The key limitations of SDI include cost of installation and rodent damage. Rodent damage, particularly the potential for gopher damage, is probably the key practical disadvantage and main barrier of adaptation of SDI currently. Some growers have ‘walked away’ from large investments due to rodent infestations. Alfalfa, particularly sprinkler-

Two more advantages of SDI: (1) Prevention of wetting-drying cycles (prevents cracking clays from damaging roots, common on heavy soils. Oxygen to roots may improve depending upon soil and management); (2) Longer potential stand life and less weed pressure

ET-based irrigation scheduling: following crop ET and monitoring soil moisture status

Fig 4. Daily alfalfa ET and irrigation applied over the season

Fig 5. Soil water tension over the season (SDI vs. sprinkler)

Fig 6. Wireless soil moisture monitoring network
or SDI-irrigated alfalfa is an ideal habitat for gophers. High levels of management are required to manage rodents.

SDI systems have the promise of reduced labor requirements, and this has been demonstrated on several farms. Certainly, a well-designed system can be nearly fully automated, compared with many surface systems, which require full time irrigators. However, additional labor is likely to be required for scouting for rodent infestations and fixing leaks.

Gopher control?
- Gopher Fence
- Setting Traps
- Burrow Fumigation (aluminum phosphide, Carbon monoxide)
- Baiting (Strychnine)
- Continual Monitoring and Removal Efforts

Costs. The cost of SDI installations has been a major disadvantage of SDI systems in alfalfa historically. System installations may cost between $1,000/acre and 2,600/acre depending upon specifics of the farm. However, these costs can be justified if yields are improved and/or price of the product is sufficient to cover costs. We have estimated the yield required to justify the cost at between 0.5 ton/acre and 1.5 tons/acre depending upon specific costs and the price of hay.

UC web resources for SDI can be found at: http://alfalfa.ucdavis.edu

Positive profitability of SDI for the long-season regions, but perhaps not for the short-season Intermountain areas.