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Optimizing efficiencies and economics of solid-set subsurface drip and overhead mechanized systems with flat-planted cropping systems

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Project Summary

While various forms of subsurface drip irrigation (SDI) have largely replaced surface irrigation methods in a number of cropping contexts throughout the San Joaquin Valley's (SJV) Westside region in recent years (Personal communication, T. Turini and D. Munk), interest also exists throughout the area in the potential of overhead mechanized irrigation systems to further enable precise water application, provide labor savings from reduced maintenance and repair needs commonly associated with drip, and permit automation.

Overhead irrigation (OH) is currently the most prevalent form of irrigation nationwide (NASS, 2008), and recent surveys in Nebraska, a region similar to California in terms of the general need for irrigation for crop production, indicate that precision overhead systems and recent technological advances in overhead equipment are now rapidly and completely replacing gravity irrigation because of the ability that these systems provide to apply precise water amounts and to increase productivity (Pfeiffer and Lin, 2009). The possible benefits of overhead for SJV systems have been recognized by a number of farmers in recent years throughout the area (Warnert, 2011) as a means for sustaining profitability, increasing competitiveness, and preserving the productive capacity of the region.

Research Program

The goals of this proposed project are:

1. To compare flat-planted minimum tillage cropping systems under overhead mechanized irrigation and solid-set subsurface drip irrigation in terms of water use efficiency, profitability, soil salinity, and drainage volumes,
2. To determine the effects of tillage and surface residues on soil evaporation, and
3. To extend information developed by this project widely throughout California's production regions

The goals of this project have been to evaluate the potential of mechanized overhead irrigation as an alternative to subsurface drip irrigation for no-till cotton production in California's San Joaquin Valley (SJV) and to characterize management benefits and issues of the overhead irrigation system as a potentially cheaper, water use efficient alternative to both surface and drip irrigation. The project is being conducted in an 8 acre field at the University of California West Side Research and Extension Center in Five Points, CA, in western Fresno County. The first cotton experimental crop was grown in 2011 and the second crop has recently emerged. The study is laid out in a randomized complete block design with four replications of each irrigation treatment as shown in Figure 1.

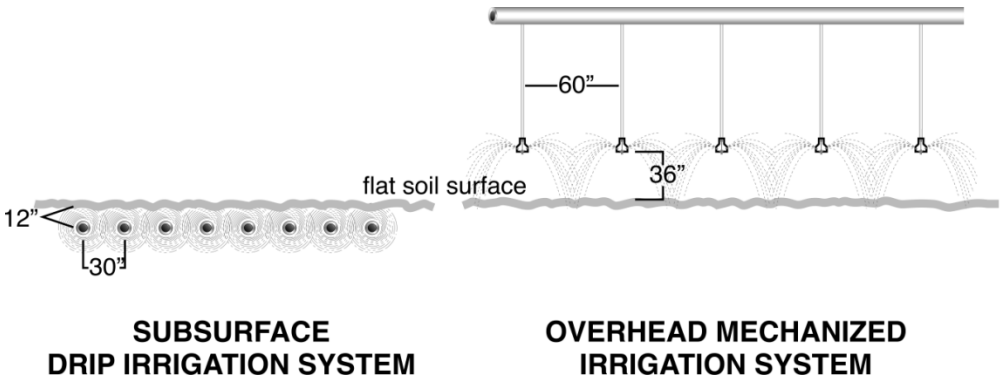

Figure 1. Schematic description of solid-set subsurface drip and overhead mechanized irrigation systems with emitter and nozzle spacings

In conjunction with this study, we have also been quantifying the relative amounts of soil water under residues relative to under bare soil. A publication stemming from this work was recently published in the University of California's *California Agriculture* April – June 2012 (Volume 66:2) issue (http://ucce.ucdavis.edu/files/repositoryfiles/ca6602p55-93537.pdf). This work indicated that over an estimated summer crop season, the use of no-till and surface residues may serve to reduce soil evaporation losses by about 4 inches, or 13% of the ET for a typical summer crop in the SJV.

Major preliminary findings from our first year (2011) work include the following:

1. Similar amounts of irrigation water (about 24”) were applied to both systems in 2011
2. There were no significant differences in light interception, indicating that canopy development was similar for both treatments.
3. Overhead had significantly more moisture ($p<0.0001$) than SDI, both in and between rows, consistently throughout the season.
4. OH significantly more chlorophyll ($p<0.05$) than SSDI on 6 of 9 sampling dates.
5. SDI had a significantly higher ($p<0.0001$) temp 6 inches deep, in row on all 10 sampling dates
6. There was an average of 37 mites per leaf in SDI compared to 1 mite per leaf in OH. This was a statistically significant difference ($p<0.0001$). Figure 2.
7. Significantly more weeds ($p<0.05$) in OH than in SDI. Figure 3.
8. No significant differences between the treatments in yield

This study is significant, we believe, because it is coupling two potentially quite promising crop production technologies: overhead mechanized irrigation and no-tillage planting techniques. In the coming year, we will continue the field comparison work and also integrate an economic analysis of the production costs associated with these alternative irrigation and water use efficient tillage systems.

National Agricultural Statistics Service. 2008 Farm and Ranch Irrigation Survey. www.agcensus.usda.gov

Pfeiffer, Lisa and C.Y. Cynthia Lin. 2009. Incentive-based groundwater conservation programs: Perverse consequences. Agricultural and Resource Economics UPDATE. 12(6):1-4.

Warnert, J. 2011. The body of CT research knowledge continues to grow. http://ucanr.org/sites/ct/?blogpost=5760&blogasset=14128

Information Transfer/Outreach Program

This project has provided the backdrop for an ambitious extension education program during the course of our work. On September 8, 2011, we held a public, evening open house event at the site that attracted over 120 participants and was also featured in a press release that was distributed to news outlets throughout the Central Valley. We also filmed a half-hour video segment, 'Rainmakers,' that was aired on KAIL (Channel 59) in the Fresno area, that involved aspects of this work and that also included experts and farmer research partners on this work. One of the students working on this project, Joy Paloutzian, also made a presentation based on her MS thesis work associated with this work at the 2012 California Weed Science Society Conference and received the Society's award for "top student paper' for her effort. Because of the 'new' nature of this work and the fact that overhead irrigated no-till production approaches are not at all widely currently used in the San Joaquin Valley, we also host many informal visitor groups at the study field throughout the year. This work will also be featured as part of our 2012 Twilight Overhead Irrigation and Conservation Agriculture Systems extension education event in September.

Links for examples of outreach associated with our September 8, 2011 public event are provided below.

http://ucanr.org/sites/ct/?blogasset=14128&start=6

http://ucanr.org/sites/ct/?start=11&blogasset=14128