# DRIP IRRIGATION STUDIES IN ALFALFA – KEARNEY AG. CENTER

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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.

**The Objectives of the Kearney Trial are:**

- To quantify the water productivity, forage quality, and yield of alfalfa in SDI vs. Surface irrigation.
- Understanding the impact of deficit irrigation on yield, quality, stand.
- To determine use of infrared thermometry and other imagery to assist in management
- Assessing spatial-Temporal yield variation as affected by wheel traffic

The treatments are

- $T_1$ (CF check flood under current common practice)
- $T_2$ (SDI 50% Deficit, Midseason cutoff)
- $T_3$ (SDI 25% Deficit, cutoff in mid-August),
- $T_4$ (SDI 25% Gradual deficit to 25% irrigation),
- $T_5$ (SDI Full irrigation to 100% of ET).

Soil water status (figure 2 and 3) is being monitored using the soil water sensors (IRROmesh water marks and DeltaT moisture sensors). The IRROmesh water marks are placed in two sets (5” and 15”) from the drip tape at three different depths (12”, 24” and 48”) in each set within the plot while DeltaT moisture

*Figure 1 Deficit 50%- 15" from drip tape, irrigation cutoff in mid-July*

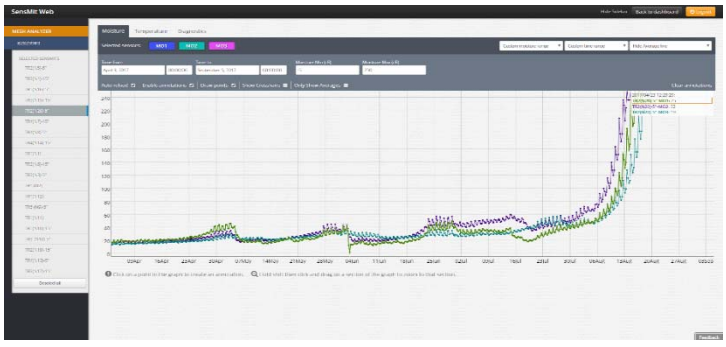


*Figure 2 Deficit 50%- 5" from drip tape, irrigation cutoff in mid-July*

sensors are placed at a depth of 12", 24" and 36". Irrigation scheduling is done using the reference ET ($ET_o$) from the CIMIS Station 39 Parlier, which is close to the experimental site. The flood irrigation is applied following the common grower practice of two irrigations per growth cycle while the drip irrigation to the treatments is turned on every other day as soon as the bales are removed till two days before the next harvest. The crop is harvested every 28 days and data on harvest yield, forage quality and water use is recorded.

A subsample is collected from different spots within each plot for recording fresh weight and dry weights of the samples. These samples are then used for determining forage quality using NIR spectroscopy with a protocol developed by Martin et al. (1989). Infrared thermometer is used to assess the difference in canopy temperature and air temperature (Crop Water Stress Index)

***Preliminary Data (2017)***

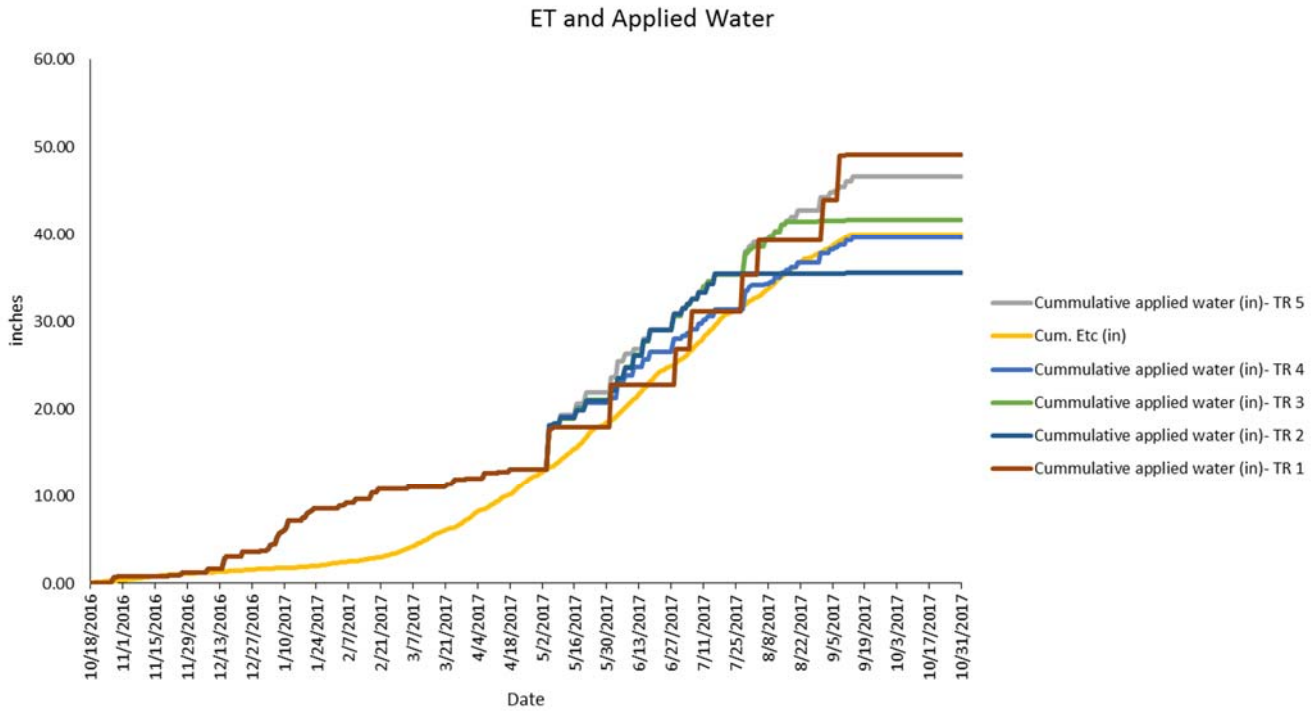



Figure 3 Seasonal Evapotranspiration and applied water to each treatment

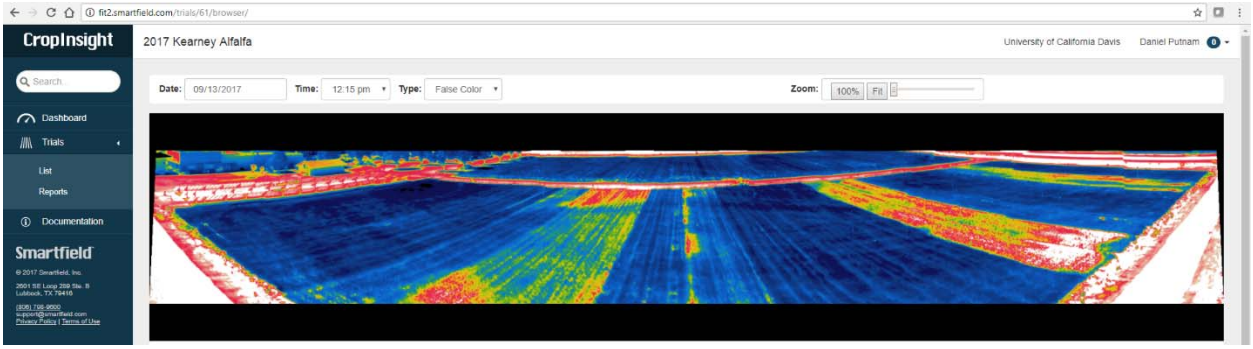
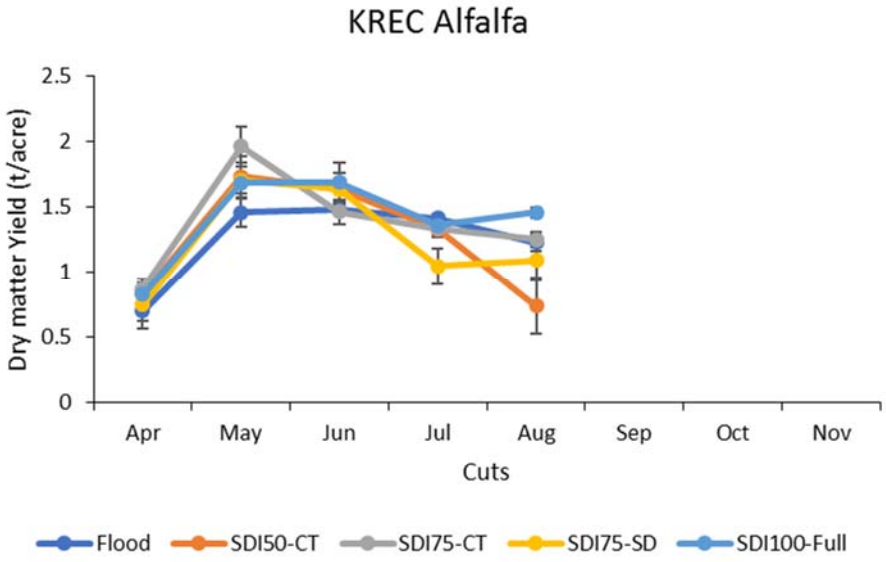
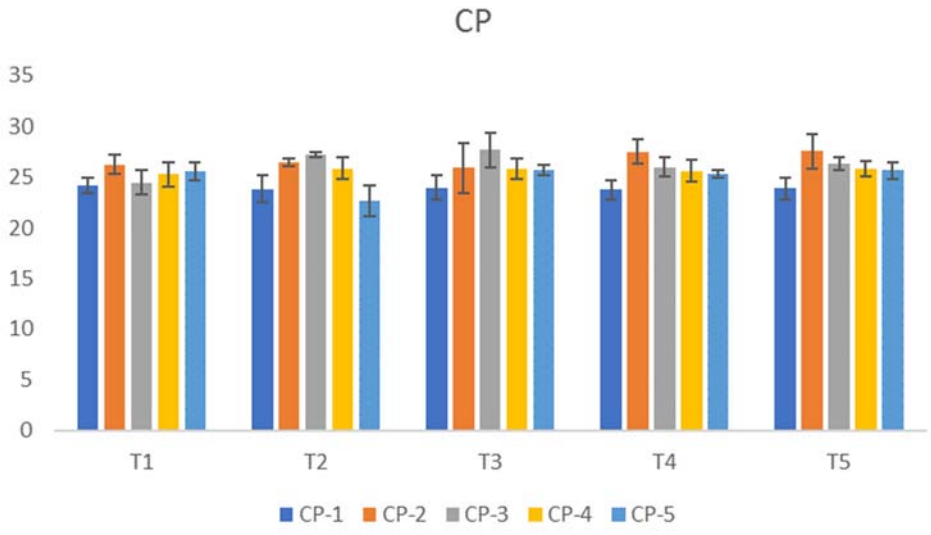



*Figure 4 Canopy temperature at noon time measured using the SmartCrop infrared camera. The difference between the stressed and non-stressed plots is clearly visible (September 13, 2017).*



## WHAT ARE THE ADVANTAGES OF SDI 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.

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

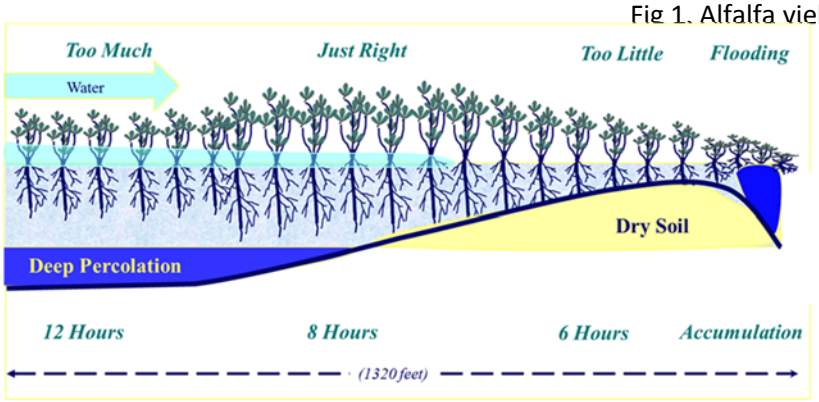
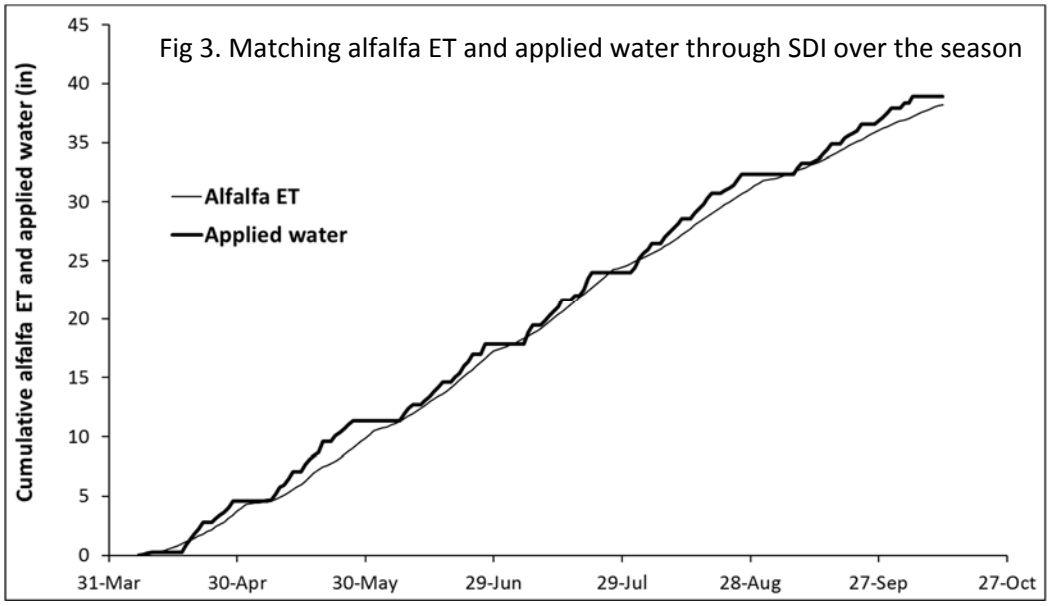



Fig 2. Waster distribution the entire field (surface irrigation)

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

Fig 3. Matching alfalfa ET and applied water through SDI over the season



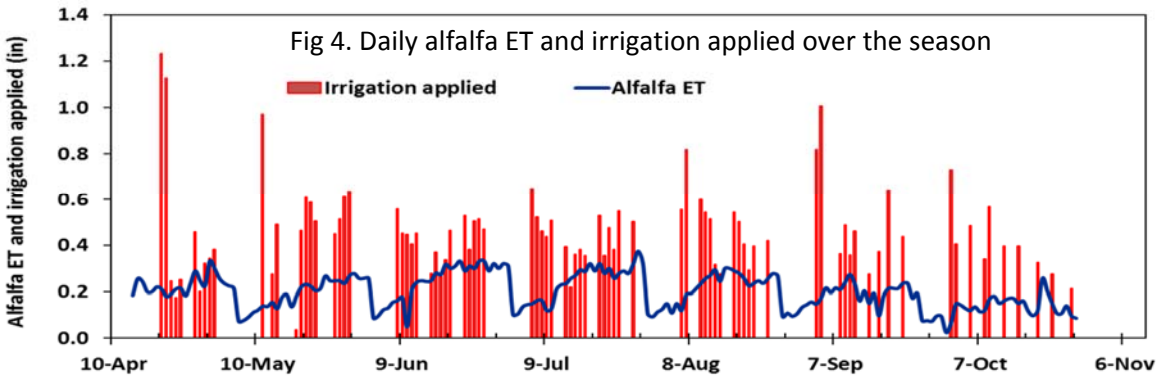



Fig 4. Daily alfalfa ET and irrigation applied over the season

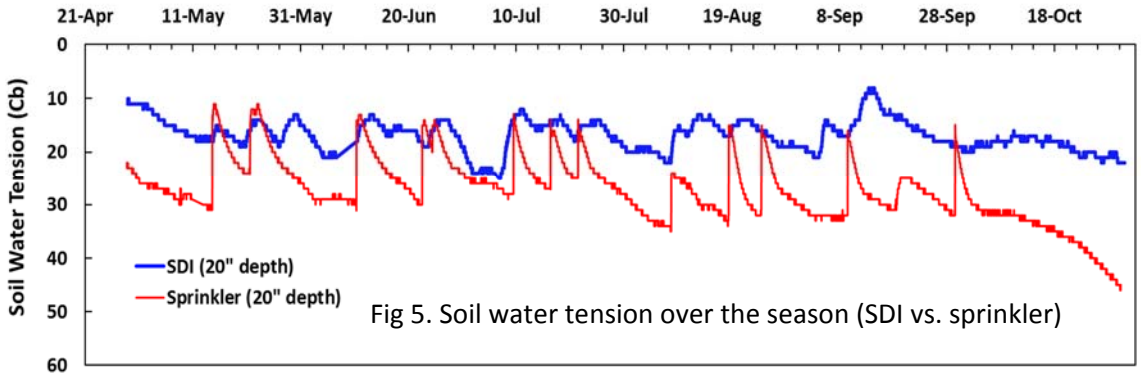



Fig 5. Soil water tension over the season (SDI vs. sprinkler)

***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

Fig 6. Wireless soil moisture monitoring network

**<u>The key limitations of SDI include cost of installation and rodent damage.</u>**

**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-

or SDI-irrigated alfalfa is an ideal habitat for gophers. High levels of management are required to manage rodents.

Fig 7. Leaks & drip tape damage due to rodents

**Gopher control?**

**Flood irrigation**

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

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.

**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.**