Regulated Deficit Irrigation of Alfalfa

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Deficit irrigation of alfalfa in July and August is being investigated as a source of water for nonagricultural uses during water short years by reducing the seasonal crop evapotranspiration. Results of 2005 showed deficit irrigation reduced the seasonal crop evapotranspiration by 289 mm, but also reduced yield of the last two harvests by 41 to 65% of fully irrigated alfalfa.

Alfalfa is California's single largest agricultural water user due to its large acreage and long growing season, using 494,000 to 679,000 ha-m (4 to 5.5 million-acre feet) of water each year. The California Department of Water Resources is interested in deficit irrigation of alfalfa as a strategy for providing water for transfer elsewhere. Irrigation would be terminated during July and August when yields are relatively small and the "saved" water used elsewhere. The amount of transferable water is the difference in the evapo-transpiration (ET) between fully-irrigated and a deficit-irrigated conditions; however, no information exists on this difference.

Evapotranspiration was determined in a commercial field using the eddy covariance and surface renewal energy balance methods in a fully irrigated part of the field, and the surface renewal method in the deficit irrigated part of the field. In addition, alfalfa yield, applied water, canopy coverage and plant height measurements were made in both parts of the field.

The fully-irrigated alfalfa was irrigated according to the irrigator's normal practices. The 2005 deficit-irrigated treatments consisted of no irrigation during August with no fall irrigation, and no irrigation during August followed by a September irrigation. A new site was selected for the 2006 project. The 2006 deficit-irrigated treatment (ongoing until December 2006) consists of no irrigation during July and August with no fall irrigation. Each treatment consisted of three alfalfa checks with border checks between the irrigated and deficit irrigated treatments. The border checks were necessary to prevent water flow through cracks in the soil from the irrigated treatments into the deficit irrigated treatments. The field scale approach was used to obtain the field-wide conditions experienced by commercial agriculture. A randomized replicated experimental design was not feasible because of the constraints caused by the use of a commercial field.

Deficit irrigation greatly reduced alfalfa yield in 2005 (Table 1). Yield reductions due to deficit irrigation generally ranged from 41 to 65% of the fully-irrigated treatments. However, yield of the 7th harvest recovered due to the September irrigation. Yield data of 2006 are currently being analyzed.

Cumulative ET_c in 2005 (no fall irrigation) was 1,222 mm (48.1 inches) for the fully-irrigated treatment. Deficit irrigation (no irrigation) started on July 25. Cumulative ET_c between July 25 and December 6 (end of measurement period) was 528 mm (20.8 inches) for the fully irrigated treatment and

289 mm (11.4 inches) for the deficit irrigated treatment for a difference of 239 mm (9.4 inches). Differences in ET_c for July 2006 were 65 mm (2.6 inches).

Table 1. Treatment yields of 2005. The 6th and 7th harvests occurred on August 23 and October 6, respectively. The numbers in the parenthesis are the yield reduction in percent of the full yield.

	Yield (Mg/ha)			
	6th Harvest	7th Harvest	Total	Yield Reduction
Full	1.46	0.98	2.42	
Deficit (no Sep. irrig.)	0.51 (65)	0.58 (41)	1.37	1.05
Deficit (Sep. irrig.)	0.72 (51)	1.16	1.90	0.51

Professional Presentations

Putnam, Dan, Steve Orloff, Blaine Hanson, Harry Carlson. Field Studies on Deficit Irrigation of Alfalfa. 2006 California Plant and Soil Conference, Visalis, CA, Febrary 2006.

Hanson, Blaine, Dan Putnam, Rick Snyder. Deficit Irrigation of Alfalfa as a Strategy for "Saving" Water for Nonagricultural Uses, Soil and Water Conservation Society, Keystone, CO, July 2006.

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