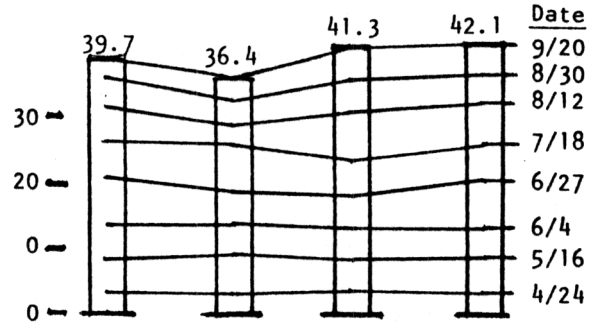
USE OF EVAPORATION PANS TO IMPROVE IRRIGATION EFFICIENCY

P. Dean Smith, Farm Advisor
University of California Cooperative Extension
Inyo & Mono Counties

Three years of field studies in Inyo County on the D. L. Tatum & Sons, Los Angeles Department of Water & Power ranch lease at Bishop, demonstrate that evaporation from a free water surface is correlated to alfalfa evapotranspiration (water use) and that evaporation can be used as a guide to irrigation scheduling and application.

Figure #1
Comparison of Seasonal Crop Water Use With Evaporation Pan Loss

CIMIS* Bishop Automatic Weather Station	Crop ET	U. S. Weather Bureau Class A Evaporation Pan	#2 Washtub Evaporation Pan
Accumulated Seasonal Use (Inches)			



*California Irrigation Management Information System

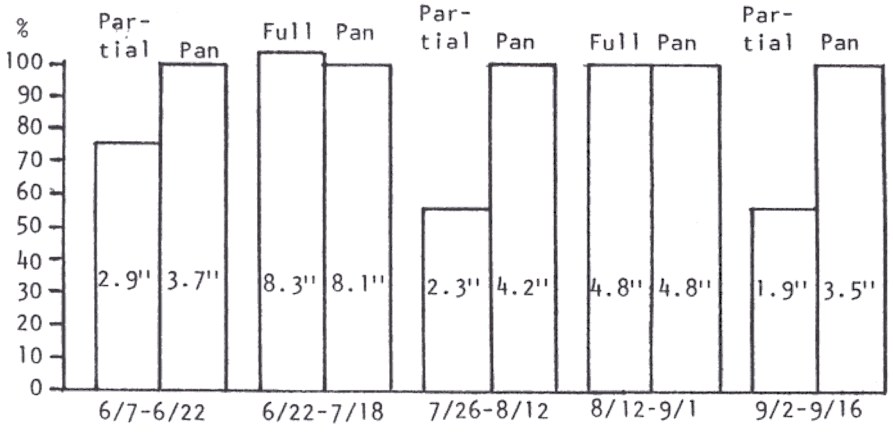
The ranch uses a side roll sprinkler system, which allowed for accurately controlling water application rate and amounts during this trial.

Alfalfa ET (evapotranspiration) was determined, using a neutron probe calibrated to the water holding capacity of the sandy loam soil and converting the probe readings to inches of water in the soil profile. Readings were taken at one foot depths to nine (9) feet from six (6) replicated permanent holes, 1) 24 to 48 hours after each irrigation (soil water at field capacity) and 2) 24 hours before the following irrigation (soil water depletion reading). Subtracting the before irrigation soil water content from the soil water at field capacity gave the inches of water used by the crop during the growing interval (between each irrigation).

Concurrently, crop ET was compared to evaporation use from a U. S. Weather Bureau Class A evaporation pan and a #2 washtub. Trials by Montana State University have shown that washtubs used as evaporation pans, give comparable results to the Class A pan.

Estimated soil water depletion due to ET loss was calculated from evaporation pan loss and replenished by irrigation on the 1 1/2 acre test area. This was compared with the farmer's normal irrigation practice on a similar 1 1/2 acre area next to it.

Figure #2
Comparison of ET As A Percentage of Evaporation Pan Loss Under Partial Vs Full Canopy



Comparison of alfalfa crop ET with the two evaporation pans showed season differences of 4.9" & 5.7", respectively. The number 2 washtub compared favorably with the Class A pan (Figure #1).

Figure #2 shows how actual crop ET compared with evaporation pan losses during partial crop canopy growth (1st two weeks after cutting) and full crop canopy growth (two

weeks to harvest). Under full canopy growth, actual ET equaled 90% to 104% of evaporation pan losses. Under partial canopy growth, actual ET varied between 53% and 76% of evaporation pan losses. The alfalfa crop uses less water during the first two weeks of growth because there isn't as much leaf area to transpire water as during the growth period when the crop completely covers the soil (full canopy).

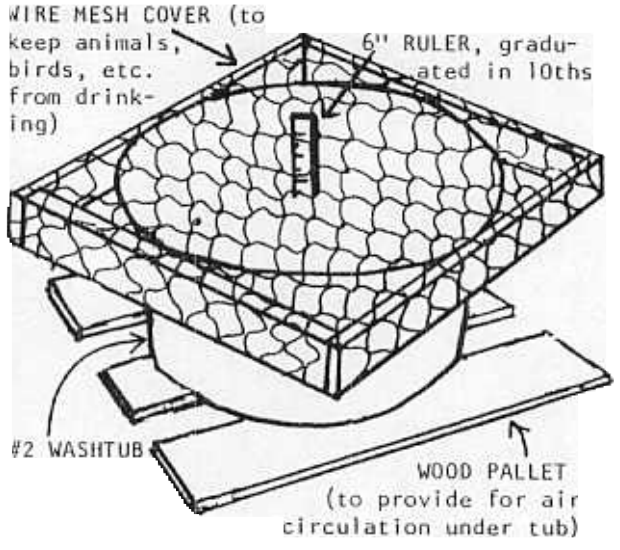
Multiplying the evaporation pan loss by .6 estimates crop ET during the partial canopy growth period, while using the total evaporation pan losses, estimates crop ET during the full canopy growth period.

A #2 washtub placed in the farmer's alfalfa field so that it is completely surrounded by the crop, will accurately record evaporation and can be used to estimate crop ET with reasonable accuracy. Figure #3 shows the washtub set-up.

Figure #3
#2 WASHTUB SET-UP

Attach ruler 1 inch from top rim, using water proof adhesive like silicone.

Water surface should not be allowed to recede below 6" graduation on ruler.



If the crop ET loss is known for the period since the previous irrigation, the amount of water needed to replenish the soil water loss can be calculated.

If the crop has grown under partial canopy, multiplying the evaporation pan loss during this period by .6 is an estimate of the ET loss. If the crop has grown under full canopy, the total evaporation pan loss can be used to estimate ET loss.

Dividing the ET loss by the efficiency of the irrigation system will determine irrigation requirement (IR).

Example:
1. Evaporation pan loss = 4.8 inches.
2. Side roll sprinkler system efficiency = 75% (.75).

IR (Partial Canopy) = .6 X 4.8 ÷ .75 = 3.8"

IR (Full Canopy) = 4.8 ÷ .75 = 6.4"

IRRIGATION SYSTEM EFFICIENCIES	
Type System	Efficiency %
Sprinkler	70 - 80
Leveled Border Flood:	
Ditches	60 - 70
Ditches + Return	75 - 80
Main Pipeline	65 - 75
Main Pipeline + Return	75 - 85

In Inyo & Mono Counties, it is possible for some farmers to save 1/2 to 1 acre foot/acre of water per season by improving application efficiency. Most all farmers there pressurize water for sprinklers. Many also lift water 100 to 150 feet from wells. The savings in electric energy can vary from 90 to 300 kwh's/acre foot. At 7.7¢ per kwh, this converts to savings of $1.25 to $3.75 per ton of alfalfa, figuring 6 tons per acre.

Using the evaporation pan to estimate alfalfa crop ET is a simple concept which can be used to check and/or improve irrigation efficiency. Most farmers will find that savings can be made during the cooler parts of the growing season.

The trial work was done in Inyo County cooperatively with Dr. Dave Goldhamer, Soils & Water Specialist, University of California Cooperative Extension; Russell Rawson, Ranch Land Manager, City of Los Angeles Department of Water & Power; and Leonard Jolley, District Conservationist U. S. Soil Conservation Service, Inyo & Mono Counties.