Improving Flood Irrigation Management in Alfalfa

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2010 CA Alfalfa & Forage Symposium
California

- Alfalfa is California’s single largest agricultural water user

- About 1 million acre of alfalfa

- About 4.0 - 5.5 million ac-ft of water
Imperial Valley (2009)

- Alfalfa: ~115,000 acres

- Alfalfa water use: 6.5-7 ac-ft/ac per year

- Total water use: Approximately 750,000 ac-ft/yr

- Surface and subsurface drainage water contains P and sediment (TMDL)
Colorado River Water
Upper basin states: 7.5 MAF
Lower basin states: 7.5 MAF
Mexico: 1.5 MAF
CA’s share 4.4 MAF (actual use as high as 5.2 MAF)
Surface Irrigation Systems

Applied water = Root zone storage + runoff + deep percolation

To Increase Efficiency: Reduce
1- Runoff
2- Deep Percolation
Sprinkler Irrigation Systems

Applied water = Root zone storage + runoff + deep percolation

To Increase Efficiency: Eliminate

1- Runoff
2- Deep Percolation
Drip Irrigation Systems

Applied water = Root zone storage + runoff + deep percolation?

To Increase Efficiency:
- Improve system uniformity (DU)
- Eliminate 1- Runoff
- 2- Deep Percolation
Practices for Efficient Irrigation

- Recycle Runoff Water (system)
- Minimize/eliminate Runoff or Tailwater (management)
- Reduce Deep Percolation (other than leaching): Utilization of shallow water table (GW)
- Sprinkler and drip irrigation system efficiency improvements
- Irrigation scheduling programs (BIS)
Practices for Efficient Surface Irrigation Systems

- Efficient irrigation practices conserve water and fertilizers
- Water/Nutrient Management for TMDL regulations
Tailwater Recovery

- Regulating the type and quantity of water return flows as a means of maintaining and improving irrigation efficiency
- Issues: Temperature, Salinity, Management
Surface irrigation (flood):

- Border (flat) irrigation
  *Runoff rate: 5-20%*

- Furrow (bed) irrigation
  Runoff rate: 15-30%

Average surface runoff (Imperial Valley): 17%

Application Efficiency (Imperial): ~70-80%
AE (CA) ~ 70%
Runoff Reduction

- Reducing surface runoff improves irrigation efficiency
- Method developed for clay soils to reduce surface runoff to less than 5% of applied water (need flow rate, advance time and distance)
- Runoff Reduction Handbook
- Irrigation Slide Chart developed by UCCE and USBR
- Available in English and Spanish
# Irrigation Cutoff Time Calculator for Clay Soils

**1.** Align the Advance Time with the Advance Distance.

**2.** Read the corresponding T1 for your Border Length. Write the Value of T1 in the designated Box on Side 2.

**3.** Align Flow Rate with the Width of your border/irrigation set. Read the corresponding T2 for your border length. Write the Value of T2 in the designated Box below.

**4.** Align the above value of T2 with the value of T1.

**5.** Read the corresponding Cutoff Time at arrow.

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### Flow Rate (cfs)

<table>
<thead>
<tr>
<th>T2 (hr/min)</th>
<th>0</th>
<th>0.20</th>
<th>0.30</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.70</th>
<th>0.80</th>
<th>0.90</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (hr/min)</td>
<td>0</td>
<td>0.50</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
</tbody>
</table>

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### Example:

- Advance Distance: 250 ft.
- Width of Set: 250 ft.
- Flow Rate: 9 cfs.
- Border Length: 1000 ft.

Starting on other side:

- Align 45 min. with 250 ft. in window 1. Go to window 2, read the corresponding T1 (3 hrs. 8 min.).
- For the 1000 ft. border, double the value of T1 in the designated T1 Box at the right.

Turn chart over. Align the 200 ft. width of your irrigation set with flow rate of 9 cfs. Read the corresponding T2 (37.5 min.) for the 1000 ft. border in window 3. Align the above value of T2 (37.5 min.) with the value of T1 (3 hrs. 8 min.) in window 4. In window 5, read the corresponding Cutoff Time (2 hrs. 32 min.) as arrow.

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* Cutoff Time is an estimate of irrigation time needed to obtain 5% runoff. The actual irrigation time could be adjusted to achieve runoff rates higher or lower than 5%.

For more accurate estimate of irrigation cutoff time for various conditions and crops, use the calculator available on:

http://tmdl.ucdavis.edu

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**RECLAMATION**

Managing Water in the West

University of California Cooperative Extension

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Runoff Reduction (clay soils)

- Applied on commercial alfalfa fields
- No significant reduction in alfalfa yield
- Water savings as much as 1 ac-ft/ac per year
- Runoff reduction with every irrigation or when P applied with irrigation water
Irrigation scheduling- ET based (Weather station, CIMIS)
ET Based Irrigation scheduling and Irrigation Efficiency

- Summer time: High water use, lower quality hay/yield
- Low water use efficiency (tons/ac-ft of applied water)

ETo (in/mo)

Month
Irrigation Management- Flow Rate

- Flow rate measurements (flumes and flow meters)- depth of irrigation events
- Pipe flows are less complex because pipes have same size (flow area) regardless of the flow rate. So the only effort is detecting velocity.
- Channels, are not accommodating, increasing in both size (flow area) and velocity with increased flow rate (mathematics more challenging)
Flow rate & average depth of application
Flow rate (cfs)
Volume ac-ft (12-hr runs)
Utilize shallow water table (summer time, good soil, site specific)
CONCLUSIONS

- Reducing surface runoff is a key factor in improving irrigation efficiency in desert alfalfa.

- Irrigation scheduling improves efficiency - (Crop coefficients are region specific (soil, climate, irrigation frequency, etc)

- Flood irrigation systems are efficient (drip and sprinkler systems are great, high cost, management, energy cost, etc)

- Automation of surface irrigation (future)
Thank You