Deficit Irrigation with Alfalfa: What are the Economics?

Mike Ottman and Dan Putnam
Yield increases with water applied (to a point)
Reduced irrigation strategies

- Less water per irrigation (sprinkler or drip)
- One irrigation per cut instead of two
- Alternate one and two irrigations per cut
- No irrigation during one or more cutting cycles (irrigation cutoff)
Profitability of deficit irrigation

- Income
  - Yield
  - Hay price
- Costs
  - Irrigation amount
  - Water cost
  - Other costs
Pest control implications of deficit irrigation

- Increased costs
  - Insects attracted to water-stressed alfalfa
    - Lygus bugs
    - Potato leaf hopper

- Decreased costs
  - Insects not attracted to water-stressed alfalfa
    - Alfalfa caterpillar
    - Beet armyworm
  - Weed growth reduced more than alfalfa by water stress
Hay quality and deficit irrigation

- Hay quality increase if stress mild
  - Stem growth reduced more than leaf growth
- Hay quality decrease if stress severe
  - Leaf loss
Residual effects of deficit irrigation

- Yields may not recover for a few cuttings after irrigation return to normal
  - Moderate irrigation termination
- Yields may never recover due to stand loss
  - Long irrigation termination
  - Hot summer areas
  - Sandy soils
Irrigation water use efficiency (IWUE)

- Amount of hay produced per amount of water applied (tons hay/foot water applied)
- Usually highest in the spring when yield and hay prices high
- Deficit irrigation most economical when IWUE low such as summer
Study at Holtville, CA

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (T/A)</th>
<th>Water (ft)</th>
<th>IWUE (T/A/ft)</th>
<th>Revenue change ($/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>5.44</td>
<td>4.10</td>
<td>1.33</td>
<td>0</td>
</tr>
<tr>
<td>1 irrigation/cut</td>
<td>4.84</td>
<td>3.97</td>
<td>1.22</td>
<td>-85</td>
</tr>
<tr>
<td>Jul-Aug cutoff</td>
<td>3.84</td>
<td>3.32</td>
<td>1.16</td>
<td>-202</td>
</tr>
<tr>
<td>Jul-Sep cutoff</td>
<td>3.16</td>
<td>2.80</td>
<td>1.13</td>
<td>-278</td>
</tr>
</tbody>
</table>

Assumptions: Hay price = $200/ton, water cost = $50/acre-ft, harvest cost = $50/acre

(Robinson et al., 1995)
Study at Powell, WY

<table>
<thead>
<tr>
<th>Treatment (%ET)</th>
<th>Yield (T/A)</th>
<th>Water (ft)</th>
<th>IWUE (T/A/ft)</th>
<th>Revenue change ($/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>7.75</td>
<td>1.52</td>
<td>5.09</td>
<td>0</td>
</tr>
<tr>
<td>75%</td>
<td>6.06</td>
<td>1.18</td>
<td>5.11</td>
<td>-238</td>
</tr>
<tr>
<td>50%</td>
<td>3.81</td>
<td>0.86</td>
<td>4.43</td>
<td>-559</td>
</tr>
<tr>
<td>25%</td>
<td>1.98</td>
<td>0.52</td>
<td>3.79</td>
<td>-816</td>
</tr>
</tbody>
</table>

Assumptions: Hay price = $200/ton, water cost = $50/acre-ft, harvest cost = $50/acre

(Carter et al., 2013)
## Studies where less water profitable

<table>
<thead>
<tr>
<th>Location</th>
<th>Reference</th>
<th>Treatment</th>
<th>Revenue change ($/A)</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yuma, AZ</td>
<td>Ottman et al., 1996</td>
<td>Nov-Feb cutoff</td>
<td>123</td>
<td>Winter rain</td>
</tr>
<tr>
<td>Las Cruces, NM</td>
<td>Currier et al., 1986</td>
<td>Aug-Oct cutoff</td>
<td>160</td>
<td>Lack of root rot with reduced irrigation</td>
</tr>
<tr>
<td>Tucumcari, NM</td>
<td>Lauriault et al., 2009</td>
<td>Not winter irrigated</td>
<td>75</td>
<td>Winter irrigation not necessary regardless of alfalfa dormancy class</td>
</tr>
</tbody>
</table>
Water application effect on returns over water and harvest cost with variable hay price (Pinal Co., AZ)

Assumptions: Yield = 8.49 T/A, number of cuts = 8, hay price = $200/ton, harvest cost = $50/acre, water cost = $50/acre-ft, Non harvest and water costs = $736/acre.
Water application effect on returns over water and harvest cost with variable water cost (Pinal Co., AZ)

Assumptions: Yield = 8.49 T/A, number of cuts = 8, hay price = $200/ton, harvest cost = $50/acre, water cost = $50/acre-ft, Non harvest and water costs = $736/acre.
Conclusions

- Deficit irrigation does not pay if considering the alfalfa crop only.
- Deficit irrigation may be warranted if:
  - Water limited
  - Water used for a more profitable purpose:
    - Another crop e.g. almonds, cotton
  - Water transfer