Investigating the potential of deficit irrigation strategies to improve the efficiency of water use in irrigated temperate pastures

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Deficit Irrigation

Background:

Dairy Farm Survey 2007:

- 76% farms with irrigation
- 20% of farms normally run out water
- 49% of farms ran out of water in season 2006/07

Question - Am I better to irrigate a small area fully or a larger area less effectively?
What is deficit irrigation?

The deliberate and systematic under-irrigation of a crop, which is commonly practiced by either irrigating at the same frequency, but applying less water at each irrigation, or maintaining the amount of water per irrigation but increasing the interval between irrigations (Ganji et al. 2006).
Start-up and interval been shown to be critical

What about applying a smaller amount at the same interval?

Comparison of 50% vs 100% irrigation - An average loss of 2t DM/ha each season for half the watering
Yearly average application for the fully irrigated treatment was approx **5.0 ML/ha**

**Farm scenario – A 50 ha farm with 125 ML available**

**Option one** - irrigated 25ha (5ML/ha) dryland 25ha

**Option two** - irrigated 50ha (2.5 ML/ha)
Deficit Irrigation

Using the following average figures

- Fully Irrigated 18t DM/ha
- Half Irrigated 16 t DM/ha
- Dryland 10t DM/ha

Farm production

Option one – 25ha*18t DM/ha + 25ha*10t DM/ha = 700t
Option two – 50ha*16t DM/ha = 800t

Aim - To investigate the potential of deficit irrigation and to develop recommendations for those farmers where water is a limiting resources.
Deficit Irrigation Trial

The trial consists of five irrigation treatments

When the rainfall deficit (rainfall - potential evapotranspiration) equals 20mm either

- 20mm (100% Treatment)
- 16mm (80% Treatment)
- 12mm (60% Treatment)
- 8mm (40% Treatment) or,
- 0mm (Dryland) of irrigation is applied
Deficit Irrigation Trial

Irrigation or rainfall (mm/day)

Accumulated deficit (mm)

Irrigation Rainfall Accumulated deficit

The experimental site is located at ERDS 2ha perennial ryegrass paddock

Each irrigation treatment consists of four K-line pods

*The trial is replicated four times*

- Pasture growth rates are assessed weekly and pasture utilised calculated by pre and post grazing assessment.
- Daily soil moisture levels are monitored using a series of soil moisture logging equipment
The sensors give higher readings for dry soil conditions and lower readings for wet conditions.

The first irrigation should occur when soil water potential reaches 35 centibars.

Reference - http://www.mkhansen.com
Deficit Irrigation Trial

Soil water potential (cb)

0\% (45cm)
40\% (45cm)
60\% (45cm)
80\% (45cm)
100\% (45cm)

Deficit Irrigation Trial

- The first irrigation occurred on the 25th October 2007
- A total of 21 irrigations events (4.2 ML/ha)
- Total rainfall for the experimental period 412mm
- There were six grazing events (Nov, Dec, Jan, Feb, March, April)

Table 1. Utilisation (t DM/ha at each grazing event)

<table>
<thead>
<tr>
<th></th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>1.71</td>
<td>0.67</td>
<td>1.21</td>
<td>0.09</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>40%</td>
<td>2.03</td>
<td>1.43</td>
<td>1.71</td>
<td>0.73</td>
<td>0.51</td>
<td>0.48</td>
</tr>
<tr>
<td>60%</td>
<td>2.03</td>
<td>1.62</td>
<td>1.71</td>
<td>0.99</td>
<td>0.77</td>
<td>0.53</td>
</tr>
<tr>
<td>80%</td>
<td>2.10</td>
<td>1.95</td>
<td>1.76</td>
<td>1.35</td>
<td>1.20</td>
<td>0.55</td>
</tr>
<tr>
<td>100%</td>
<td>2.05</td>
<td>1.94</td>
<td>1.65</td>
<td>1.60</td>
<td>1.27</td>
<td>0.65</td>
</tr>
</tbody>
</table>
## Deficit Irrigation Trial

### Rainfall for experimental period 412mm

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pasture consumption (t DM/ha)</th>
<th>Irrigation (ML/ha)</th>
<th>GPWUI (t DM/ML)</th>
<th>IWUI (t DM/ML)I</th>
<th>MIWUI (t DM/ML)I</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>9.16 ± 0.49</td>
<td>4.20</td>
<td>1.10 ± 0.06</td>
<td>2.18 ± 0.12</td>
<td>1.29 ± 0.14</td>
</tr>
<tr>
<td>80%</td>
<td>8.92 ± 0.30</td>
<td>3.36</td>
<td>1.19 ± 0.07</td>
<td>2.65 ± 0.16</td>
<td>1.54 ± 0.05</td>
</tr>
<tr>
<td>60%</td>
<td>7.64 ± 0.61</td>
<td>2.52</td>
<td>1.15 ± 0.09</td>
<td>3.03 ± 0.24</td>
<td>1.55 ± 0.12</td>
</tr>
<tr>
<td>40%</td>
<td>6.89 ± 0.56</td>
<td>1.68</td>
<td>1.19 ± 0.05</td>
<td>4.10 ± 0.18</td>
<td>1.87 ± 0.13</td>
</tr>
<tr>
<td>0%</td>
<td>3.74 ± 0.49</td>
<td>0.00</td>
<td>0.91 ± 0.12</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Deficit Irrigation Trial

\[ y = 0.8367x + 0.1349 \]

\[ R^2 = 0.9299 \]
Other Activities

- CSIRO Sensor Network Technology
- Hydro Tas Adjenti Units
- Janice Perry (Honours student)
- Meisha Holloway-Phillips (PhD student)

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