Modelling the effect of delaying irrigation start-up date on pasture utilisation.

R Rawnsley.

DairyMod was used to explore the effect of delaying the start-up date for irrigation by 7, 14, 21 or 28 days after soil moisture levels became limiting to pasture growth. Six dairy districts were examined, using district climate data from the Bureau of Meteorology and the soil physical parameters of the major soil type for the region.

The simulations were set up as cutting studies with the following parameters:
- the post-grazing residual was set at 1.5 t DM/ha,
- the pasture was cut on the last day of every month,
- all cuttings were removed with nutrients returned as dung and urine,
- urea was applied following each defoliation so that N was non-limiting,
- the baseline simulation was undertaken from July 1997 to May 2007 (3 year lag phase), with no irrigation applied.

From the baseline simulation, the 2000/01 to 2006/07 seasons’ soil moisture levels (measured in terms of a GLF) were graphed to examine whether low soil moisture over the spring would have limited pasture growth. For example, Figures 1a and 1b illustrate the GLF for Togari and Elliott in the 2003/04 season. At Togari, soil moisture became substantially limited from mid-November until mid-December 2000, before rain returned the soil moisture profile back to a GLF of 1 (1 = non-limited, 0 = fully limited). At Elliott, soil moisture was severely limited from early November until several rainfall events raised the profile to a GLF of 1 in mid-December.

Figure 1. The water GLF for Togari (a) and Elliott (b) in the 2003/04 season, showing the trigger point for irrigation start-up.

The next stage was to identify which of the 7 simulation years would have experienced pasture growth limitations if no irrigation was applied. For most districts, seasons 2000/01, 2002/03, 2003/04 and 2006/07 experienced the greatest restrictions to pasture growth. For each district and year, the trigger point was identified as the date when moisture limitations became evident.

Simulations were then undertaken from July to April for each of these seasons. The first simulation was parameterised with irrigation applied from the trigger point forward (25 mm applied every 7 days) to determine the monthly pasture utilisation when soil moisture was non-limiting. The second simulation was parameterised so that irrigation was not applied until 7 days after the trigger point, the third simulation 14 days, the fourth simulation 21 days, and the fifth simulation 28 days after the trigger point.
During the 2006/07 season in Ringarooma, the trigger point for irrigation start-up was the 16th of November. When water was non-limiting, the peak in monthly utilisation occurred in November at approximately 2.9 t DM/ha. Each weekly delay in start-up further lowered the monthly utilisation for November and December. Delaying start-up by 28 days reduced pasture growth to almost nil in December. By January 2007, irrigation was shown to refill the soil profile, resulting in the same amount of pasture being utilised from January onwards, regardless of irrigation start-up date (Figure 2).

Figure 2. The effect of delaying irrigation by 7, 14, 21 and 28 days after reaching the trigger point on monthly pasture utilisation at Ringarooma during the 2006/07 season.

The difference in monthly pasture utilisation between the non-limited water treatment and the delayed water treatments was calculated for each season, with a mean ‘loss’ of pasture utilisation calculated across all simulations for each district. These overall means were then graphed to calculate the daily loss of pasture utilisation when irrigation start-up was delayed (Figures 3a to 3f).
The mean daily ‘lost’ pasture was assumed to be pasture that was unavailable to be conserved as silage over spring. Using the assumptions that each 1t of pasture was equivalent to 4 bales of silage and that the silage purchase cost was $70 per bale, an economical value was calculated. The average cost across all districts was $22.78/ha/day delayed, with Ringarooma exhibiting the greatest cost at $29.60/ha/day and Togari the lowest cost at $20.02/ha/day. While these amounts are small, if the amount of area available for irrigation is 100 ha, the cost of delaying irrigation is substantial (Table 1).

Table 1. Cost of a seven day delay in irrigation start-up for a 100 ha area across six dairying districts.

<table>
<thead>
<tr>
<th>District</th>
<th>$ lost due to a 7 day delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringarooma</td>
<td>20,720</td>
</tr>
<tr>
<td>Deloraine</td>
<td>16,387</td>
</tr>
<tr>
<td>King Island</td>
<td>15,300</td>
</tr>
<tr>
<td>Elliott</td>
<td>15,148</td>
</tr>
<tr>
<td>Bushy Park</td>
<td>14,091</td>
</tr>
<tr>
<td>Togari</td>
<td>14,014</td>
</tr>
</tbody>
</table>

This modelling activity illustrates that there can be substantial gains in terms of pasture utilisation and profit when the importance of irrigation scheduling is realised on-farm.