Tactical horticultural water decisions in northern Victoria: fruit tree irrigation options and economic responses

Bob Farquharson, Thiagarajah Ramilan, Ian Goodwin, and Mark O’Connell

Contributed presentation at the 60th AARES Annual Conference,
Canberra, ACT, 2-5 February 2016
Tactical horticultural water decisions in northern Victoria: fruit tree irrigation options and economic responses

Bob Farquharson, Thiagarajah Ramilan, Ian Goodwin, and Mark O’Connell
Issue

- For horticultural industries in northern Victoria, irrigation is essential
- But supply and traded prices have fluctuated
  - Millennium Drought, then floods!
  - But what about the future?
- Competing demand for water (e.g. environment)
- Tactical water options are available
  - Deficit irrigation management of trees, or
  - Trading of seasonal allocations
- What are potential benefits of these management options for orchardists?
1. Orchard irrigation management

- **Regulated deficit irrigation (RDI)**
  - Withhold water at start of growing season up to the start of rapid fruit growth, then apply to match crop water requirements

- **Post-Harvest Deficit Irrigation (PH)**
  - Cut back on water applied post-harvest, provided no effect on developing flowers and buds for the next season

- **Sustained Deficit Irrigation (SDI)**
  - A continuous irrigation deficit, maintain tree at constant water stress throughout the growing season

- **Severe water deficit (parking the tree) (P)**
  - Apply minimum irrigation for tree survival, so that subsequent production is not affected
Effects of Deficit Irrigation

<table>
<thead>
<tr>
<th>Drought strategy</th>
<th>Cost</th>
<th>Irrigation saving (%)</th>
<th>Yield penalty (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDI</td>
<td>Low</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>PH</td>
<td>Low</td>
<td>15 - 20</td>
<td>0</td>
</tr>
<tr>
<td>SDI</td>
<td>Low</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>P</td>
<td>Low</td>
<td>75</td>
<td>50</td>
</tr>
</tbody>
</table>

Effects of $\text{ET}_c$ and thinning

Goodwin and O’Connell 2016
2. Trade: Goulburn water allocation

- Victorian water register (Goulburn prices and trade)
  - $20 - $320/ML
- But Basin-wide prices 2007-08
  - $200 - $1200/ML
  (Mallawaarachchi & Foster 2009)
Estimating crop water requirements

Ramilan et al. 2011

- Pear
  - Full CWR
  - 90% CWR
  - 80% CWR
  - Post Harvest Deficit CWR
  - Regulated Deficit CWR

- Apple
  - Full CWR
  - 90% CWR
  - 80% CWR
  - 70% CWR
  - Post Harvest Deficit CWR
Ramilan et al. 2011

**Apple**

- Full CWR
- 90% CWR
- 80% CWR
- 70% CWR
- Postharvest_deficit

**Pear**

- Full CWR
- 90% CWR
- 80% CWR
- Postharvest_deficit
- Regulated_deficit

Estimating crop Gross Margins
Method

- A representative orchard for the district
- A profit objective
- Tactical management (decisions within a year)
- Water is limiting (consider a future dry year)
- Tactics: apply deficit irrigation management to trees and/or trade water
- Constrained optimisation (Linear Programming)
- Develop information for orchard decisions
### Pear variable costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Sources</th>
<th>Unit</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Hand harvesting</td>
<td><em>Plunkett’s P02</em></td>
<td>bins</td>
<td>96 @ $52/bin</td>
<td>4935</td>
</tr>
<tr>
<td>- Pruning</td>
<td><em>Plunkett’s P02</em></td>
<td>ha</td>
<td>1</td>
<td>3928</td>
</tr>
<tr>
<td>- Other wages</td>
<td><em>Plunkett’s P02</em></td>
<td>ha</td>
<td>1</td>
<td>2838</td>
</tr>
<tr>
<td>TOTAL WAGES</td>
<td></td>
<td>ha</td>
<td>1</td>
<td>11701</td>
</tr>
<tr>
<td>Water</td>
<td><em>Plunkett’s P02</em></td>
<td>MI/ha</td>
<td>7.0 @ $60/MI</td>
<td>422</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Weed, pest &amp; disease control</td>
<td><em>Plunkett’s P02</em></td>
<td>ha</td>
<td>1</td>
<td>2513</td>
</tr>
<tr>
<td>- Fertiliser &amp; lime</td>
<td><em>Plunkett’s P02</em></td>
<td>ha</td>
<td>1</td>
<td>656</td>
</tr>
<tr>
<td>- Machinery</td>
<td><em>Wilson and Stone 2014</em></td>
<td>ha</td>
<td>1</td>
<td>3919</td>
</tr>
<tr>
<td>- Pollination</td>
<td><em>Wilson and Stone 2014</em></td>
<td>ha</td>
<td>1</td>
<td>79</td>
</tr>
<tr>
<td>TOTAL OTHER</td>
<td></td>
<td>ha</td>
<td>1</td>
<td>7167</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td></td>
<td>ha</td>
<td>1</td>
<td>19290</td>
</tr>
</tbody>
</table>
Issues for the project

• Data from industry/growers/research
• Quantify bio-physical relationships
• Water supplies and prices vary
• Interaction with orchardists
  – Grower reference group
• Developing relevant information for orchardist decisions
• A model that can be re-used?
Pomefruit orchard at Shepparton