Winter 1-2014

2014 Update Mtg: Potential Water and Energy Savings in Cranberry Frost Cycling

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Potential Water and Energy Savings in Cranberry Frost Cycling

Peter Jeranyama, Faith Ndlovu, Jesica Sack, Alex Ward, Miles Hegedus, Bongani Jeranyama & Casey Kennedy
Water Management in Cranberry

- Over-watering; shallow roots, loss of fruit quality, root rot diseases, etc
- Under-watering; decreased fruit size, plant death, poor plant cover
- Growers have suggested 1 inch H₂O / week
1999

Average evaporation ("/week)

High = 1.65
Low = 0.47
Average = 0.92

High = 1.21
Low = 0.28
Average = 0.82

deficit or surplus following 1"/week rule

2000

Date

Jun  Jul  Aug  Sep  Jun  Jul  Aug  Sep
Too wet

Adequate
Water Retention Curve in the top 6 inches

\[ y = -9.692 \ln(x) + 30.188 \]

\[ R^2 = 0.9141 \]
Observations - Lampinen

• Most MA cranberry beds appear to be too wet during much of the season

• Evaporative demand study - for many weeks in the season, cranberries require less than 2.5 cm applied as irrigation
Objectives: Spring Frost Monitoring

(i) To evaluate the effects of Automated Intermittent Cycling (AI) & Conventional (CONV) Methods in frost protection, &
(ii) Quantify water & fuel usage with each method
Automated Intermittent Cycling

• Pump starts automatically, based on temperature settings

• Pumps then cycle on and off as temperature fluctuates
Materials and Method

• About 500 cranberry buds were collected from each cultivar under AI & CONV

• Buds were dissected under a microscope and assessed for damage
Materials and Method

• flowering and fruiting were also measured throughout the season
Bog temperature changes: April 15-17 in Carver, MA
Amount of Water Used in Frost Protection
Comparison of two systems

<table>
<thead>
<tr>
<th>Input</th>
<th>Conventional</th>
<th>Cycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Water Use (Gallons/Acre/night)</td>
<td>30,000</td>
<td>18,500</td>
</tr>
<tr>
<td>Average Fuel Use (Gallons/Acre/Season*)</td>
<td>53</td>
<td>21</td>
</tr>
<tr>
<td>Cost of Fuel ($/Acre/Season)</td>
<td>$164</td>
<td>$80</td>
</tr>
</tbody>
</table>

*Season = 24 frost nights
Bud damage on April 15

Percentage Damage (%)

<table>
<thead>
<tr>
<th></th>
<th>Early Black</th>
<th>Howes</th>
<th>Stevens</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>16</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CONV</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
Bud damage on April 26

<table>
<thead>
<tr>
<th></th>
<th>AI</th>
<th>CONV</th>
<th>AI</th>
<th>CONV</th>
<th>AI</th>
<th>CONV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Black</td>
<td>4.2</td>
<td>3.1</td>
<td>1.2</td>
<td>1.1</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Howes</td>
<td>2.0</td>
<td>2.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Stevens</td>
<td>5.0</td>
<td>5.0</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Percentage Bud Damage (%)
Vegetative meristem

Outer bud scales

Floral initial

Source: DeMoranville
Frost Protection Method and Cultivar Effect on Fruit Yield in 2013

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>AI</th>
<th>CONV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Black</td>
<td>250</td>
<td>160</td>
</tr>
<tr>
<td>Howes</td>
<td>200</td>
<td>180</td>
</tr>
<tr>
<td>Stevens</td>
<td>300</td>
<td>280</td>
</tr>
</tbody>
</table>
Summary

1. Cultivars were sensitive to frost protection methods especially Early Black and Stevens.
2. Frost damage was up to 12% under AI & less than 5% damage under CONV.
3. Most of the damage were on 1 or 2 floral initials.
4. Cultivars produce 4-6 floral initials so damage on 2 floral initials will likely have no noticeable impact on fruit yield.
5. Water savings of up to 33% are possible with cycling.
Acknowledgments