Irrigation for Wine and Juice Grapes: Differences and Similarities

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A winemaker’s dream…

…or a juice grape grower’s nightmare?
• Eastern WA: 5 – 10” (0.4 – 0.8 acre-ft) from rainfall per year
• Temperature and canopy size drive water use
• Irrigation water demand is highest from fruit set to veraison:

<table>
<thead>
<tr>
<th>Water use</th>
<th>Grape type</th>
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<tbody>
<tr>
<td></td>
<td>Juice</td>
</tr>
<tr>
<td>Annual (mm)</td>
<td>600 – 750</td>
</tr>
<tr>
<td>Annual (inches)</td>
<td>25 – 30</td>
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<tr>
<td>Annual (acre-feet)</td>
<td>2 – 2.5</td>
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<tr>
<td>Budbreak – fruit set (%)</td>
<td>10</td>
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<tr>
<td>Fruit set – veraison (%)</td>
<td>50 – 60</td>
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<tr>
<td>Veraison – harvest (%)</td>
<td>20</td>
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<tr>
<td>Harvest – leaf fall (%)</td>
<td>15 – 25</td>
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</tbody>
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(Refill top 3 ft of soil for freeze and start-up insurance.)
Juice grapes: Irrigation for crop size

• Concord irrigation trial in WSU-IAREC vineyard
  ➢ 7 irrigation regimes (50% ET – 150% ET), 2011 – 2016

• Soil moisture threshold: <15% v/v → $\Psi_s$ declines
  ➢ $\Psi_s$ = Stem water potential = Measure of plant water status
  ➢ Vines do not feel water-stressed above threshold
  ➢ More irrigation = Waste of water

• 50% ET irrigation preveraison
  ➢ 31% less water than 100% ET
  ➢ 15% smaller canopy
  ➢ 10% fewer clusters
  ➢ 8% smaller berries
  ➢ 14% lower yield
    (6-year avg.: 15.7 vs. 18.2 t/a)

• 75 – 150% ET irrigation
  ➢ No consistent differences
Juice grape irrigation: Lessons learned

- **Preveraison irrigation:** Less water → Smaller berries
  - Yield is 14% lower with 31% less water at 50% ET, but not at 75% ET
  - No gain in yield with 150% ET despite 32% more water

- **Postveraison irrigation:** No effect on berry size and yield
- Berry size is determined before veraison
- Compensation during ripening for preveraison water shortage is not possible

- **Seasonal variation and pruning trump irrigation:**
  - Yield varied only 15% among irrigation regimes, but more than 3-fold among 6 years (due to 2-fold, independent variation in clusters/vine and berries/cluster, but only 10% in berry weight)
  - Temperature, and less so crop load, determine Concord fruit composition, but irrigation has little effect
Wine grapes: Irrigation for berry size

- Less water before veraison → Smaller berries
- Berry size is determined before veraison
- Skin stiffens at veraison → Berry would rather split
- It is difficult to manipulate berry size after veraison

Keller (2015); Keller et al. (2015)
Keep in mind: Vines do compensate

- Too little crop can lead to larger berries
- Compensation happens before, not after, veraison
- Prevention requires more severe preveraison water deficit

Keller et al. (2008)
More water before veraison increases berry size

More water after veraison decreases berry shrinkage

Irrigation dilutes fruit quality – really?
All grapes: Less water means more control

- Less water $\rightarrow$ Lower vigor, canopy density $\rightarrow$ Less hedging
- Open canopy $\rightarrow$ More sun exposure $\rightarrow$ Less leaf removal
- Less water $\rightarrow$ Less weed growth $\rightarrow$ Less herbicide, tilling
It’s not just about berry size

- Water deficit → Small berries, low vigor
  → Open canopy, restricted shoot growth
  → High cluster sun-exposure (light and temperature!)

- Exposed berries are **warm** berries

- Optimize color, tannin, flavor, aroma

Keller et al. (2016)
How to RDI for wine grapes

RDI = Regulated deficit irrigation

- Available soil moisture
- Evapotranspiration (ET)
- Soil moisture when irrigation = ET
- Soil moisture with RDI

Shift deficit windows up or down depending on variety and production goals.
**How to RDI for juice grapes**

- **RDI** = Regulated deficit irrigation

**Graph:***
- **Available soil moisture**
- **Evapotranspiration (ET)**
- **Soil moisture when irrigation = ET**
- **Soil moisture with RDI**

**Legend:**
- **Dry down**
- **No irrigation**
- **Maintain (irrigation)**

**Axes:**
- **Soil moisture**
- **Weeks after budbreak**

**Annotations:**
- **Deficit window**
- **Winter precipitation**
- **Fall/spring irrigation**

**Equation:**
- **ET** = Vineyard evapotranspiration = Water evaporation from plants and soil

**Explanation:**
- After budbreak, the soil moisture decreases as evapotranspiration increases. The deficit window indicates the period when irrigation is needed to maintain the soil moisture at a certain level. RDI is used to regulate the deficit, ensuring optimal grape growth and juice quality.
Matching strategies: Wine vs. juice grapes

- Timing and extent of water deficit depend on production goals

- **Red wine grapes:** Low to moderate yields and small, sun-exposed berries are desirable
  → Moderate to severe preveraison water deficit (25 – 50% ET)
  → Big, bold red wines (less stress for lighter wine styles)

- **White wine grapes:** Moderate yields are desirable, but berry size and sun exposure are less important (white skins do tan!)
  → Mild preveraison water deficit (50 – 75% ET)
  → Elegant, crisp white wines (less stress for fruitier wine styles)

- **Juice grapes:** High yields and big berries are desirable, but sun exposure is less important (heat stops color!)
  → No to mild preveraison water deficit (75 – 100% ET)
  → Plentiful, fruity juice concentrate

**Do’s for all grapes:**
- Some postbloom drydown (canopy control)
- Mild postveraison deficit (ripening)

**Don’ts for all grapes:**
- Early stress (productivity)
- Late stress (shriveling)