Optimizing Cherry Production: Varieties, Rootstocks, and Physiology-Based Management

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[Image of cherries and related text and logos]
Total Cherry Acreage

1. MI: 35,000 acres
2. WA: 26,000 acres
3. CA: 25,000 acres
4. OR: 11,000 acres
5. UT: 3,500 acres

¹USDA, 1999-2001
U.S. Cherry Production 2011

Total Cherry Acreage\(^1\)

- **#1:** WA 35,600 acres
- **#4:** OR 13,150 acres
- **#3:** CA 29,000 acres
- **#5:** UT 3,800 acres
- **#2:** MI 33,000 acres

\(^1\)USDA, 2009-2011
Sweet Cherry Acreage

#1: WA 34,000 acres
#2: CA 29,000 acres
#3: OR 12,500 acres
#4: MI 6,500 acres
#5: ID 900 acres

1USDA, 2009-2011
Globally Competitive Production through Advanced Germplasm, Technologies, and Physiology-Based Production Knowledge
Rain Covers in Chile
Rain Covers in Norway
Rain Covers in Switzerland
Semi-Mechanical Rain Covers in Netherlands

Crank-down covers

Hand-pull covers
Vented Covers (VOEN) in Germany, Italy, Switzerland
- Protection from rain and hail; passive venting of heat in summer
High Tunnels (Haygrove) in the United Kingdom

- Protection from rain, hail, and wind; greater heat retention in spring
High Tunnels in the United States
- Protect from rain, hail, wind, frost; reduce some diseases, and promote earlier ripening
Half-Tunnels in China

Chinese structures range from bamboo tunnels to 28 ft high steel greenhouses.
Greenhouse Cherries in Spain
- Promote early harvest for high value, off-season markets

“World’s Most Expensive Cherries” $35 to $150 per kg
Computer-Programmable Retractable Roof (Cravo)
Roof Panels Open and Close in Response to Rain, Wind, and High and Low Temperature Set-Points to Optimize Growing Conditions
2011 Research: 80,000 BTU Propane Heaters, every 100 ft, added ~6°F when outside temperatures were 17 to 27°F
Chelan

- Parents: Stella x Beaulieu
- Early ripening, 10-12 days before Bing
- Precocious, moderately upright, highly productive tree (rootstocks, stress)
- Less rain cracking than Bing
- Graft incompatible w/ mahaleb, sensitive to stress, limb-bending?
Santina

- Parents: Stella x Summit
- Self-fertile
- Firm, large size
- Blooms mid-season, ripens 8 days before Bing
- Moderately tolerant to rain cracking
BlackPearl is the best cherry it's season, ripening 10 days before Bing, with Chelan. (-10) It has exceptional flavor and is extremely firm and crunchy. The fruit is medium size with 20% sugar. BlackPearl has amazing storage qualities and keeps better than almost any other cherry. It is hardy and canker resistant with low cracking. Early season bloom, S4 unknown.
RadiancePearl™ is a Rainier type cherry that ripens 7 to 10 days ahead of Bing (-7-10) and has exceptional flavor and quality. The fruit averages 11g with 20% sugar and has exceptional flavor and low rain cracking. It has a vigorous, hardy and productive tree. RadiancePearl™ has an early mid-season bloom, S1 Unknown. It is perfect for fresh market and u-pick operations.
Tieton

- Firm, very large fruit (11-13 g, 28-32 mm), excellent stems, early season premium

- Blooms mid-season, ripens 6-8 days before `Bing’, incompatible with `Chelan’, `Burlat’

- Very vigorous, upright growth, light to moderate cropping, well-suited to dwarfing rootstocks (i.e., Gisela 5)
A large, high quality, very firm, crack resistant cherry with a tough, grower friendly tree. BurgundyPearl ripens 3 to 5 days before Bing. (-3) It has large, firm, crunchy, 12g fruit with 20.5% sugar. The tree is vigorous, productive, and canker resistant. BurgundyPearl has superior quality, storability and excellent crack resistance, averaging 4% cracking with 1” of rain in 2008. Early midseason bloom,S3S4
EbonyPearl™ NY 32

EbonyPearl is a large, very high quality cherry that ripens 3 days ahead of Bing. It has excellent crack resistance, averaging 4% cracking with 1” of rain in 2008. The tree is hardy, vigorous and canker resistant. Very large fruit averages 9.5 row, 11.6g with exceptional flavor and quality and has long, firmly attached stems. EbonyPearl has a early mid-season bloom. S1S4.
Benton (Columbia)

- Parents: Stella x Beaulieu

- Self-fertile

- Firm, large fruit size

- High sugar, excellent flavor

- Blooms late, ripens with Bing

- Excellent cropping, moderately spreading growth habit

- Less susceptible to rain cracking
Sandra Rose

- **Parents:** (Star x Van) x Sunburst
- **Medium firm, large fruit size**
- **Self-fertile**

- Blooms mid-season, ripens 3 days after Bing
- Tolerant to rain cracking
- Precocious, spreading growth habit
Kordia (Attika)

- From Czechoslovakia
- Blooms late, ripens 10 days after Bing, not self-fertile
- Very firm, large, heart-shaped fruit, excellent flavor
- Vigorous and productive tree
- Less susceptible to rain cracking; more to frost
- Compatible with Van, Stella, Hedelfingen, Sam, Lambert
Skeena

- Parents: (Bing x Stella) x (Van x Stella)

- Very firm, large fruit size
- Self-fertile
- Blooms mid-season, ripens 15 days after Bing
- Very susceptible to rain cracking (not “tolerant”)
- Precocious, spreading growth habit
Rootstock Traits

*Vigor* – high, semi-vigorous, dwarfing, or very dwarfing

*Precocity* – early flowering, high productivity

*Adaptation to Soil Conditions* – silty loam, sandy (well-drained, quick to dry, warm) or heavy clay (wet, prone to Phytophthora, cold in spring)

*Adaptation to Climatic Conditions* – temperate/moderate; hot, sunny, and/or windy with high daily water demand; cool and cloudy with less photosynthesis
Precocity and the Basic Cherry
Fruiting Units

2-Yr-old growth    Last year’s growth    New growth

Fruiting spurs    A few nonspur fruit    Larger leaves
Non-fruiting spurs

The first fruit to appear on trees on precocious rootstocks are spur fruit on the leader (trunk) and nonspur fruit on the first lateral shoots (branches)

Ayala and Lang, 2004
Rootstock Influence on Cropping in Early Years

Hedelfingen NC-140
Michigan spring 2000 (3rd Year)
High Vigor, Low Precocity Rootstocks

**Mazzard** (*Prunus avium*)
- seedling
- F12/1, Charger, others

**Mahaleb** (*Prunus mahaleb*)
- seedling
- SL64, SL405
- CT500, CT 2753, Korponay, others

**MxM series** (Mazzard x Mahaleb)
- 2, 14 (MaxMa 14), 39, 60
- **Colt**: Mazzard x *P. pseudocerasus*
NC-140 Rootstock Research

- The NC-140 Rootstock Research Project is ~30 scientists across N. America (US, Canada, Mexico)
- NC-140 Project evaluates rootstock performance in many climates and soils, characterizing productivity, disease susceptibility, etc.
Gisela Hybrid Rootstock Series, Giessen, Germany

1987/1998 NC140 Trial  
- Gisela 1 (172-9)*  
- Gisela 3 (209-1)  
- Gisela 4 (473-10)*  
- Gisela 5 (148-2)  
- Gisela 6 (148-1)  
- Gisela 7 (148-8)*  
- Gisela 8 (148-9)*  
- Gisela 10 (173-9)*  
- Gisela 11 (195-1)*  
- Gisela 12 (195-2)  

* indicates varieties with special characteristics or performance.

Werner Gruppe  
Justus Liebig University  
- Hanna Schmidt  
- Sabina Franken-Bembenek

Sweet or sour cherry x  
*P. canescens or P. fruticosa*

- 318-17, 154-4*, 154-7*  
- 169-15, 196-4, 148-20  
- 195-20*
Other Somewhat Dwarfing Hybrids

Gembloux (Belgium):
- Inmil (GM 9)*: incisa x serrulata
- Damil (GM 61-1): Prunus dawykensis
- Camil (GM 79)*: Prunus canescens

Krymsk 5*, 6*, others (Russia)

PiKu 1, 3, 4, others – sweet cherry x canescens, tomentosa, kurilensis, pseudocerasus, incisa (Germany)

P-HL A, B, C (sweet cherry x sour cherry) (Czech)
Rootstocks Based on Sour Cherry

- Stockton Morello

- **CAB6P**, others (Bologna, Italy)

- **Tabel Edabriz** (France)

- **Weiroot 10*, 13*, 53*, 72, 154*, 158** (Germany)

- **Michigan State University** series (some are sour cherry x *canescens*): still experimental
~13 years research on sour cherry-based candidates (Began with ~96 genotypes, screened for virus sensitivity, propagation, graft compatibility); currently 9 genotypes, most sucker profusely. Key traits: precocity, range in size from Gi5 to somewhat smaller than Gi6, lower flower numbers.

Iezzoni, Whiting
Management for Success with New Rootstocks

Match light-bearing, vigorous cultivars like Tieton and Regina to dwarfing productive rootstocks like Gi 5 or 12

Match highly-productive cultivars like Sweetheart to more vigorous rootstocks like Colt
Do Dwarfing Rootstocks Yield Small Fruit?

Rainier / Gisela 7 - Bud Thinning, Yield, Fruit Quality

<table>
<thead>
<tr>
<th>Bud Per Spur</th>
<th>Process / Cull</th>
<th>Fresh / Export</th>
<th>Total Yield</th>
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<tbody>
<tr>
<td>Control</td>
<td>8.7</td>
<td>7.6</td>
<td>16.1 mt/ha</td>
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<tr>
<td>3 buds/spur</td>
<td>6.5</td>
<td>10.9</td>
<td>17.4 mt/ha</td>
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<tr>
<td>2 buds/spur</td>
<td>3.2</td>
<td>12.0</td>
<td>15.2 mt/ha</td>
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<tr>
<td>1 bud/spur</td>
<td>2.2</td>
<td>10.9</td>
<td>13.1 mt/ha</td>
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Lang and Whiting, 1999
Fertilization: Focus on Producing Fruit, not Trees
Nitrogen Fertilization Strategies: Demands and Sources

WHEN is Nitrogen most needed during the cherry tree’s development cycle?  
*e.g., bloom, leaf expansion, fruit set, fruit growth, shoot elongation, root growth, flower bud formation, cold acclimation?*

WHERE does the Nitrogen needed for these plant demands come from - soil uptake vs. tissue storage?

WHAT application forms are best to optimize N use efficiency for fruiting?
**Fall to Leaf Drop (Michigan)**

Leaf N declined 50% during the month before leaf drop; fruiting spur N concomitantly increased ~50%; premature defoliation decreased spur N

Small trees on Gisela 5 rootstock

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**Dormancy (Michigan)**

Fruiting spur N levels did not change during dormancy in winter, then increased rapidly (80%) during budswell with remobilization from other tissues

Small trees on Gisela 5 rootstock
Timing of Spur and Shoot Leaf Area Formation

Ayala, 2004

N moves into the plant from the soil solution:
until new leaves form and evapotranspirational demand begins,
very little N is taken up from spring fertilizer applications.
# Cherry Growth & Cropping Timeline, Part 1

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- **Stage of Development:**
  - Flower Bud Induction
  - Flower Organ Differentiation

- **Physiological Processes:**
  - Photosynthesis
  - Soil Nitrogen Uptake

- **Important Effects:**
  - Fruiting
  - New Shoot Growth
### Cherry Growth & Cropping Timeline, Part 1

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#### Stage of Development:

#### Flower Organ Differentiation

![Images of flower organ differentiation](image-url)
<table>
<thead>
<tr>
<th>Northern Latitude:</th>
<th>Flower Bud Induction</th>
<th>Flower Organ Differentiation</th>
<th>Autumn Leaf Fall</th>
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<tbody>
<tr>
<td>Southern Latitude:</td>
<td>May (Nov)</td>
<td>Jun (Dec)</td>
<td>Oct (Apr)</td>
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<td>Jul (Jan)</td>
<td>Aug (Feb)</td>
<td>Nov (May)</td>
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**Stage of Development:**
- Flower Bud Induction
- Flower Organ Differentiation
- Autumn Leaf Fall

**Physiological Processes:**
- Photosynthesis
- Soil Nitrogen Uptake
- Carbon and Nitrogen Mobilization to Reserve Tissues

**Important Effects:**
- Fruiting
- New Shoot Growth
- Building of Storage Reserves for Spring Growth; Cold Acclimation
Cherry Growth & Cropping Timeline, Part 2

- **Stage of Development:** Final Bud Differentiation
- **Physiological Processes:** Mobilization of C and N Reserves To Growing Points
- **Important Effects:** Fruit Set, Fruit Cell #, Spur Leaf Size

### Northern Latitude
- Dec/Jan/Feb (Jun/Jul/Aug)
- Mar (Sept)
- Apr (Oct)
- May (Nov)
- Jun (Dec)
- Jul (Jan)

### Southern Latitude
- Jun (Dec)
- (Jan)

- **Bloom**
  - Dividing
  - Elongating
- **Fruit Cells**
- **Harvest**
- **Photosynthesis**
- **Soil N Uptake**
- **Fruit Size, Firmness, and Sweetness**
Training video clips at:  
www.giselacherry.com

www.cherries.msu.edu