Assessment of New Rootstocks and Planting Systems

International Cherry Symposium Vignola
22 – 23 Maggio 2019

Martin Balmer, Dienstleistungszentrum Ländlicher Raum Rheinpfalz
Commercial Sweet Cherry Orchards (Survey of Fruit Trees 2017)

<table>
<thead>
<tr>
<th>Region</th>
<th>Hectares</th>
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<tbody>
<tr>
<td>Bad.-Württemberg</td>
<td>2,756</td>
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<tr>
<td>Rhineland/Hessen</td>
<td>989</td>
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<tr>
<td>North</td>
<td>687</td>
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<tr>
<td>Bavaria</td>
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<tr>
<td>Brandenburg</td>
<td>381</td>
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<tr>
<td>Sachsen/S.-Anhalt, Thürig.</td>
<td>689</td>
</tr>
<tr>
<td>total</td>
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</table>
Sweet Cherries in Germany:
Surface and Average Planting Density

<table>
<thead>
<tr>
<th>Year</th>
<th>Surface (ha)</th>
<th>Trees/ha</th>
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<tbody>
<tr>
<td>1997</td>
<td>6069</td>
<td>259</td>
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<tr>
<td>2002</td>
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<td>332</td>
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<td>392</td>
</tr>
<tr>
<td>2012</td>
<td>5258</td>
<td>482</td>
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<tr>
<td>2017</td>
<td>6066</td>
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The German “Spindle Tree”
– Many Variations

Production for fresh market:
900 - 1,500 trees / ha
Wages of Seasonal Workers Including Additional Costs for the Employer

Employers costs, €/h

Standard wage (netto/gross wage per hour) for the employer

<table>
<thead>
<tr>
<th>Year</th>
<th>4.80/6.18</th>
<th>5.50/6.94</th>
<th>6.40/8.03</th>
<th>7.00/8.76</th>
<th>7.30/9.11</th>
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<th>8.00/9.96</th>
<th>8.50/10.66</th>
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<td>7.90</td>
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<td>9.20</td>
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<tr>
<td>2015</td>
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<td>7.30</td>
<td>7.90</td>
<td>8.20</td>
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<td>8.90</td>
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<tr>
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<td>6.70</td>
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<td>9.10</td>
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<tr>
<td>2017</td>
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<td>8.90</td>
<td>9.50</td>
<td>10.00</td>
<td>10.60</td>
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</table>

Rate of increase
Reference year 2008

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Characteristics of a Planting System

- Site, Soil, Climate
- Row and Tree Distance
- Intensity of Management
- Rootstock & Cultivar
- Tree Training

Economic conditions
Rootstocks
# Rootstock Trial Sweet Cherries

**Planting:** January 2013  
**Varieties:** 'Bellise' and 'Regina'

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Breeding Station</th>
<th>Planting</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weigi 1</td>
<td>Uni Weihenstephan</td>
<td>2013</td>
<td>W 11 x <em>P. avium</em> ',Woodring Bing’</td>
</tr>
<tr>
<td>Weigi 2</td>
<td>Uni Weihenstephan</td>
<td>2013</td>
<td>W 10 x (<em>P. avium</em> nana x <em>P. canescens</em>)</td>
</tr>
<tr>
<td>Weigi 3</td>
<td>Uni Weihenstephan</td>
<td>2013</td>
<td>W 10 x (<em>P. avium</em> nana x <em>P. canescens</em>)</td>
</tr>
<tr>
<td>Weigi 4</td>
<td>Uni Weihenstephan</td>
<td>2013</td>
<td>W 11 x (<em>P. avium</em> nana x <em>P. canescens</em>)</td>
</tr>
<tr>
<td>Weiroot 720</td>
<td>Uni Weihenstephan</td>
<td>2013</td>
<td>Selection from W 72 (<em>P. cerasus</em>)</td>
</tr>
<tr>
<td>Gisela 3</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. cerasus</em> ',Schattenmorelle’ x <em>P. canescens</em></td>
</tr>
<tr>
<td>Gisela 5</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. cerasus</em> ',Schattenmorelle’ x <em>P. canescens</em></td>
</tr>
<tr>
<td>Gisela 5 high grafted</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. cerasus</em> ',Schattenmorelle’ x <em>P. canescens</em></td>
</tr>
<tr>
<td>Gisela 12</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. canescens</em> x <em>P. cerasus</em> ',Leitzkauer’</td>
</tr>
<tr>
<td>Gisela 13</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. cerasus</em> ',Schattenmorelle’ x <em>P. canescens</em></td>
</tr>
<tr>
<td>Gisela 17 (318/17)</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. canescens</em> x <em>P. avium</em></td>
</tr>
<tr>
<td>G 196/4</td>
<td>Uni Gießen</td>
<td>2013</td>
<td><em>P. canescens</em> x <em>P. avium</em> 'Hedelfinger’</td>
</tr>
<tr>
<td>Piku 1</td>
<td>JKI Dresden-Pillnitz</td>
<td>2013</td>
<td><em>P. avium</em> x (<em>P. canescens</em> x <em>P. tomentosa</em>)</td>
</tr>
</tbody>
</table>
Experimental Site of Oppenheim

- 209 m of altitude
- 525 mm of annual precipitations
- Annual average temperature: 10.7 °C,
- Soil: Loessic loam
- Date of planting: January 2013
- Spacing: 4.50 m x 2.20/3.00 m
- Design replanting plot: 2 trees by 3 replic.
- Design new land: 3 trees by 1 replic.
- Cultivars: ‘Bellise‘ and ‘Regina‘
2 Experimental Sites

Oppenheim (Rheinhessen):
Experimental orchard „Am Schlittweg“
Loessic loam, 525 mm of annual prec.,
10.7 °C, 209 m of altitude
Date of planting: January 2013
Spacing: 4.50 m x 2.20/3.00 m
Design replanting plot: 2 trees by 3 repl.
Design new land: 3 trees by 1 repl.

Koblenz (Lower Moselle)
Exp. orchard „Schiesser Weg“ (ORK)
Loamy sand, 30% pumice stone,
652 mm of annual precipitations,
10.9 °C, 155 m of altitude
Date of planting: February 2013
Spacing: 4.50 m x 2.20/2.50 m
Design replanting plot: 3 trees by 2 repl.
Ranking Tree Vigour Summer 2018
Oppenheim, MV 'Bellise' and 'Regina', 6\textsuperscript{nd} Leaf, Replanted
Vigour Summer 2018, Oppenheim ‘Regina’, Replanted and New Land

TCSA cm²

Replanted  New Land

W 720  Gisela 3  Gisela 5  Weigi 2  PiKu1  Gisela 5  MEAN VALUE  Gisela 17  G 196/4  Gisela 12  Gisela 13  Weigi 1  Weigi 3  Weigi 4

-11% +11% -23% +3% +17%
c.v., Bellise‘, Oppenheim
Cumulative Yield [kg/tree] 2015-2018
c.v. ‘Bellise’, Oppenheim
Grading >28 mm (%) and Yield Efficiency 2018
c.v.‘Regina’, Oppenheim
Cumulative Yield [kg/tree] 2015-2018
c.v. ‘Regina’, Oppenheim
Grading >28 mm (%) and Yield Efficiency 2018
Root Suckers
Location: Gräb Nurseries, Kettig, 10/2017,
Cultivar: 'Regina', n=3, Valuation Grade 1-9
Tree Vigour and Gummosis
Location: Gräb Nurseries, Kettig, 10/2017,
Cultivar: 'Regina', n=3, Valuation Grade 1-9


<table>
<thead>
<tr>
<th>W 720</th>
<th>Gisela 3</th>
<th>Gisela 5</th>
<th>Gisela 5 hg</th>
<th>Gisela 12</th>
<th>Gisela 13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gisela 17</td>
<td>Weigi 1</td>
<td>Weigi 2</td>
<td>Weigi 3</td>
<td>Weigi 4</td>
<td>PiKu 1</td>
</tr>
</tbody>
</table>
Summary:

Preliminary assessment of the rootstocks currently available for the growers in Germany

**Gisela Group**
- Gisela 5 is a combination of favourable properties: vigour, longevity, yield efficiency, fruit size, ... High grafting positive.
- Gisela 3 only on best soils for rain-covered orchards. Other Gisela numbers: mostly too vigorous, only for poor soils

**Weigi Group**
- Only Weigi 2 able to compete with Gisela 5 in terms of vigour, fruit quality and yield efficiency. More advantages in warmer climates?

**PiKu 1**
- Vigour and yield efficiency unratable, not frost hardy, not suitable for heavy soils. **Declining significance**

**Weiroot 720**
- Bad anchorage, highly productive, rootsuckers. **Not really a good solution**
Vigour of Available Rootstocks in Germany, % (Estimation)

- *P. avium*
- *P. mahaleb*
- Maxma 60 Colt
- Gisela 12
- Gisela 13
- Gisela 17
- Weigi 3
- Gisela 6
- PiKu 1
- Gisela 5
- Weigi 2
- Gisela 3
- W 720
Comparison of Training Systems
Oppenheim Experimental Orchard

522 mm of precipitation, average temperature 10.6 °C, 209 m above sea level

Cultivars: 'Samba' and 'Sweetheart'
Rootstock: PiKu 1
Date of planting: January 2009
Planting distance: 5.00 m x 3.52 m
Design: 2 cultivars by 4 variants by 6 trees
Fertile loess soil, 70 points (from 100), new land
Var. 1: Spindle

Var. 2: UFO

Var. 3: Spanish Bush, only hedging

Var. 4: Flat canopy, manual pruning
2012-2016: Cumulative yield per tree [kg] and yield efficiency [kg/cm²]
Yield [kg/tree] and Picking Performance [kg/hour], last year of the trial

For Samba:
- Kg/tree: 12.4, 13, 13.7, 13.7
- Kg/hour: 7, 9.1, 13.2, 9.9

For Sweetheart:
- Kg/tree: 14.9, 16.6, 32.2, 23.4
- Kg/hour: 16.8, 19.4, 19.7, 20.5
Grading 2016
(percents of overall weight)

Samba

Sweetheart
Mechanical Pruning
Trial 2:
Comparison of Training Systems with 'Samba' and 'Korvik'

Location: Experimental orchard of the local growers' association of Koblenz, loamy sand, drip irrigation, replanting

Planting: February 2012

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Variants</th>
<th>Rootstock</th>
<th>Spacing</th>
<th>Design</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Spindle, Knip-tree</td>
<td>Gisela 5</td>
<td>4.25 x 2.0 m</td>
<td>2 x 7</td>
</tr>
<tr>
<td>2</td>
<td>Fruiting wall, years 1+2 moderate hand pruning, from year 3 on only hedging in August</td>
<td>Gisela 5</td>
<td>4.25 x 1.0 m</td>
<td>2 x 12</td>
</tr>
<tr>
<td>3</td>
<td>KGB (Kym-Green-Bush), stem height 60 cm</td>
<td>Gisela 13</td>
<td>4.25 x 2.5 m</td>
<td>2 x 6</td>
</tr>
<tr>
<td>4</td>
<td>UFO (Upright Fruiting Offshoots), trellis training</td>
<td>Gisela 13</td>
<td>4.25 x 3.0 m</td>
<td>2 x 5</td>
</tr>
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</table>
Variant 1: Spindle
Variant 2:
Fruiting Wall
Fruiting Wall (1.0 m) – Summer Pruning Mid-August
Fruiting Wall, c.v. 'Samba'
February 2018
2014-2018: Cumulative Yield per Hectare [t/ha] and Yield Efficiency [ø kg/cm² 2015-2018]

**Samba**

- Spindle: 0.15 kg/cm², 20 t/ha
- Fruiting wall: 0.15 kg/cm², 30 t/ha

**Korvik**

- Spindle: 0.25 kg/cm², 30 t/ha
- Fruiting wall: 0.15 kg/cm², 40 t/ha
2018:
Anteil Größe > 28 [mm] und durchschn. Pflückleistung [kg /Std], nach Korrekturschnitt

[Samba Diagram with values 23.5% >28 mm and 21.8 kg/Std]

[Korvik Diagram with values 24.9% >28 mm and 22.7 kg/Std]
Spindle and hedged fruiting wall: Fruit weight and yield efficiency

**Samba**

<table>
<thead>
<tr>
<th>Year</th>
<th>Spindle g/fruit</th>
<th>Fruiting wall g/fruit</th>
<th>Spindle g/cm²</th>
<th>Fruiting wall g/cm²</th>
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<td>10.4</td>
<td>9.5</td>
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<td>13.3</td>
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<td>10.3</td>
<td>9.5</td>
</tr>
<tr>
<td>2016</td>
<td>12.6</td>
<td>11.5</td>
<td>12.4</td>
<td>11.3</td>
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<td>2017</td>
<td>12.6</td>
<td>11.5</td>
<td>12.4</td>
<td>11.3</td>
</tr>
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<td>2018</td>
<td>11.6</td>
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<td>12.5</td>
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**Korvik**

<table>
<thead>
<tr>
<th>Year</th>
<th>Spindle g/fruit</th>
<th>Fruiting wall g/fruit</th>
<th>Spindle g/cm²</th>
<th>Fruiting wall g/cm²</th>
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<td>10.4</td>
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<td>11.6</td>
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<td>2018</td>
<td>12.5</td>
<td>13.1</td>
<td>12.5</td>
<td>13.1</td>
</tr>
</tbody>
</table>

*Note: Hand pruned in dormancy*
High Density Trials
Comparison of Training Systems for High Density (Peter Hilsendegen)

Rootstock: Gisela 5®, date of planting: January 2013

- **Spindle (4.5 x 2.2 m)**
  - 909 trees/ha

- **BiBaum® (3.0 x 1.4 m)**
  - 2143 trees/ha

- **SSA (3.0 x 0.54 m)**
  - 5555 trees/ha
SSA, Bibaum®, Spindle
Tree Vigour [TCSA, cm²] 2018

TCSA 2018

<table>
<thead>
<tr>
<th>Variety</th>
<th>TCSA cm²</th>
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</thead>
<tbody>
<tr>
<td>Kordia SSA</td>
<td></td>
</tr>
<tr>
<td>Kordia Bi</td>
<td></td>
</tr>
<tr>
<td>Regina SSA</td>
<td></td>
</tr>
<tr>
<td>Regina Bi</td>
<td></td>
</tr>
<tr>
<td>Regina Spindle</td>
<td>130</td>
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</table>
SSA, Bibaum®, Spindle
Yields

Yield per tree

Yield per hectare
SSA, Bibaum®®, Spindle
Yield Efficiency

kg/cm² 14-18

Kordia SSA  Kordia Bi  Regina SSA  Regina Bi  Regina Spindle
Percentage under/over 28 mm

- Regina SSA: 45.79% <28 mm, 40.53% >28 mm
- Regina Bi: 45.79% <28 mm, 40.53% >28 mm
- Regina Spindle: 31.95% <28 mm, 31.95% >28 mm
• Dwarfing rootstocks help to improve management of high plant densities. Despite intensive pruning, too dwarfing rootstocks can produce smaller fruit size (e.g. Weiroot 720, Gisela 3, Gisela 5 high grafted).

• The standard rootstock Gisela 5 that is common in Germany mostly provides a balanced growth at the experimental sites. Alternative with slightly reduced vigour: Weigi 2.

• Mechanical pruning also increases productivity, but must always be combined with manual pruning in order not to lose any fruit size and to obtain a good picking performance.
• As an alternative training form to the spindle, the hand-pruned flat canopy is an option for more extensive orchards.

• In the early years SSA and Bibaum® show a significantly higher yield per hectare than the spindle and also a slightly better grading result.

• **Attention**: increased risk (investment, losses due to frost, longevity of the orchard).
... a system that meets all requirements? ...

Difficult, but …

It is allways good to have big goals
Thank you for your attention ....

and for the support of my colleagues:

- Team Oppenheim
- Anje Hamann-Kraut
- Helga Nitzgen (Gräb Nurseries)