Training Options and Rootstock Choice for Modern Sweet Cherry Orchards

Martin Balmer, DLR Rheinpfalz
6 Reasons for Low Training Forms and Dwarfing Rootstocks:

- Steeply rising wages
- Mechanization of pruning and thinning
- Big companies, few specialist staff
- Need for protection (frost, hail, rain, flies)
- Poor availability of seasonal workers
- Better application of pesticides and leaf fertilizers
**Trial 15402:**
Training Trial for ‘Samba‘ and ‘Sweetheart‘

Location: Experimental Orchard Oppenheim, loam, vine-growing area
Planting: January 2009

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Variant</th>
<th>Rootstock</th>
<th>Distance</th>
<th>Tree-number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Spindle</strong>, planting material knip tree</td>
<td>PiKu 1</td>
<td>5,0 x 3,0 m</td>
<td>2 x 6</td>
</tr>
<tr>
<td>2</td>
<td><strong>UFO</strong> (Upright Fruiting Offshoots)</td>
<td>PiKu 1</td>
<td>5,0 x 3,0 m</td>
<td>2 x 6</td>
</tr>
<tr>
<td>3</td>
<td><strong>Spanish Bush</strong>, planting material whip</td>
<td>PiKu 1</td>
<td>5,0 x 3,5 m</td>
<td>2 x 6</td>
</tr>
<tr>
<td>4</td>
<td><strong>Flat Canopy</strong>, planting material branched 2 years old scion</td>
<td>PiKu 1</td>
<td>5,0 x 4,0 m</td>
<td>2 x 6</td>
</tr>
</tbody>
</table>
The German Spindle
(in US: Central Leader)

,Sweetheart'/PiKu1,
3rd leaf

,Samba'/PiKu1,
4th leaf
Training Trial Oppenheim
Planting: January 2009, Rootstock PiKu1, 5.0 by 3.0 m
The UFO-System
(Upright Fruiting Offshoots)

'Sweetheart'/PiKu1, 4th leaf
The “Spanish Bush”

'Sweetheart’/PiKu1, 4th leaf
Spanish Bush: Growth Response to Mechanical Pruning
The Flat Canopy

'Sweetheart'/PiKu1, 3rd leaf

'Sweetheart'/PiKu1, 8th leaf
Results until 2015
(P. Hilsendegen, M. Balmer, M. Wicke)
Yield per Tree 2012-2015 [kg/tree]  
Yield Efficiency 2014 [kg/cm²]
Oppenheim:
Yield per Tree [kg/tree] and Picking Rate [kg/hour] 2015 (Wicke and Paridon)

Samba
Sweetheart
Potential of the Super Slender Axis (SSA) on the Oppenheim Exp. Station (Peter Hilsendegen)

Cultivation System: SSA, Stefano Musacchi and Salvi Nurseries

Goal: Intensification with high planting density with regular yields and big fruit size – justifying the high investment

Planting Material: 1 year old whips
Planting Date: January 2013
Spacing: 3.00 m x 0.54 m (5,556 trees/ha)

Varieties: Axel, Ferrovia, Kordia, Regina (45 trees each)
Rootstock: Gisela 5

Cooperative project: Salvi/Ferrara, LVG Erfurt, DLR Rheinpfalz
SSA (Super Slender Axis)
SSA, Yield
kg per tree kg and tons/ha

<table>
<thead>
<tr>
<th>kg/tree 14</th>
<th>kg/tree 15</th>
<th>t/ha 14</th>
<th>t/ha 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axel</td>
<td>Ferrovia</td>
<td>Kordia</td>
<td>Regina</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
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<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Oppenheim
Vers. Nr.: 14419
Pj.: 1/2013
n = 45
3,00 x 0,50m
6000 B/ha
Trial 36314:
Training Trial for ‘Samba‘ and ‘Korvik‘

Location: Experimental Orchard of the local growers‘ association of the middle-Rhine valley, replanting situation

Planting: February 2012

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Variant</th>
<th>Rootstock</th>
<th>Distance</th>
<th>Tree-number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spindle, planting material 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>KGB (Kym-Green-Bush), stem hight 60 cm</td>
<td>Gisela 13</td>
<td>4,25 x 2,5 m</td>
<td>2 x 6</td>
</tr>
<tr>
<td>3</td>
<td>UFO (Upright Fruiting Offshoots)</td>
<td>Gisela 13</td>
<td>4,25 x 3,0 m</td>
<td>2 x 5</td>
</tr>
<tr>
<td>4</td>
<td>Fruiting wall, knip trees, slight hand pruning in year 1+2, from Jahr 3 only mechanical pruning in August</td>
<td>Gisela 5</td>
<td>4,25 x 1,0 m</td>
<td>2 x 12</td>
</tr>
</tbody>
</table>
Variant 2: Kym-Green-Bush

'Korvik'

'Samba'
Variant 4: Fruiting Wall ('Korvik', 5th leaf)
2015: Yield Efficiency \([g/cm^2]\)
(Yield per tree related to TCSA)

<table>
<thead>
<tr>
<th>Variety</th>
<th>S. Spindle</th>
<th>S. KGB</th>
<th>S. UFO</th>
<th>S. Fruiting Wall</th>
<th>K. Spindle</th>
<th>K. KGB</th>
<th>K. UFO</th>
<th>K. Fruiting Wall</th>
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</thead>
<tbody>
<tr>
<td>Samba</td>
<td>160</td>
<td>92</td>
<td>67</td>
<td>144</td>
<td>163</td>
<td>106</td>
<td>41</td>
<td>129</td>
</tr>
<tr>
<td>Korvik</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Yield, 2014+2015 [t/ha],
Picking Rate 2015 [kg/hour]
2015: Size Performance [% >28mm], Reject Rate [%]

Samba

Korvik
„In Germany: Is the Spindle still the best Training Form?“

- Yes, when tree height is limited consistently and the basic scaffold can be maintained vigorously.
- For the lower tree forms the flat canopy seems to be interesting, especially with regard to the picking rate.
- The natural habit of the variety is influencing the result.
- Super slender axis (SSA): positive until now, but: how do trees, tonnage and quality develop?
- Systems with mechanical pruning: without manual correction cuts heterogeneous quality (subsequent grading necessary/useful).
- For all training forms more experience is necessary taking into account economical calculations.
Another Path: Rootstock Choice

Requirements:

- Dwarfing or semi-dwarfing
- Good anchorage, no pole necessary
- Good precocity, inducing high yields and good fruit size
- Positive influence on branching, flat angles
- „Eternal“ compatibility
- Tolerant to virus and mycoplasm diseases
- Easy to propagate
- Frost hardy
- Not attractive for mice
- No (or only few) root suckers
- Suitable for replanted land
- ....
Rootstock Trial Mülheim-Kärlich

„Behaviour of dwarfing and semi-dwarfing cherry rootstocks under the pedoclimatic conditions of the Middle-Rhine-valley.“

**Rootstocks:**
- Gisela 3
- Gisela 5
- Tabel
- Weiroot 72
- PiKu 1
- PiKu 4
- Krymsk 5
- PHL-A
- PHL-C
- Victor

**Varieties:** 'Giorgia' und 'Regina'

**Planting:** December 2002, spacing 4.50 x 2.50 m

**Site:** loamy sand with 30% pumice stone, 600 mm yearly precipitation, new land

**Design:** 2 cultivars x 10 rootstocks x 3 replications with 3 trees
PiKu1 / Regina, 8 years

PiKu 4, 8 years, root suckers
Victor /Regina, 8 years

Krymsk 5 /Giorgia, 8 years
Vigour after 8 Years, Average
TCSA [cm²], 2003-2010

![Graph showing TCSA cm² for different varieties over years](image-url)
‘Giorgia’, Cumulative Yield per Tree
2005 – 2011, Mülheim-Kärlich
‘Regina’, Cumulative Yield per Tree
2005 – 2011, Mülheim-Kärlich

<table>
<thead>
<tr>
<th>Variety</th>
<th>kg 2005</th>
<th>kg 2006</th>
<th>kg 2007</th>
<th>kg 2008</th>
<th>kg 2009</th>
<th>kg 2010</th>
<th>kg 2011</th>
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<tbody>
<tr>
<td>Gisela 3</td>
<td></td>
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<tr>
<td>Gisela 5</td>
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<tr>
<td>PHL-A</td>
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<tr>
<td>PHL-C</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PI-KU 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI-KU 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tabel Edabriz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victor</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Krymsk 5</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Weiroot 72</td>
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</tbody>
</table>

kg per tree
'Regina‘ and 'Giorgia‘, 2010

Yield Efficiency

![Yield Efficiency Chart](chart.png)
## Fruit Weight [g] 'Giorgia' over 6 Years

Rootstock trial Mülheim-Kärlich

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>Gisela 3</td>
<td>9.7</td>
<td>10.6</td>
<td>8.9</td>
<td>11.3</td>
<td>10.4</td>
<td>9.2</td>
</tr>
<tr>
<td>Gisela 5</td>
<td>9.5</td>
<td>10.2</td>
<td>8.8</td>
<td>11.7</td>
<td>10.4</td>
<td>9.4</td>
</tr>
<tr>
<td>PHL-A</td>
<td>8.9</td>
<td>10.5</td>
<td>9.5</td>
<td>11.0</td>
<td>10.2</td>
<td>10.2</td>
</tr>
<tr>
<td>PHL-C</td>
<td>8.8</td>
<td>10.6</td>
<td>9.4</td>
<td>10.9</td>
<td>10.6</td>
<td>9.9</td>
</tr>
<tr>
<td>PiKu 1</td>
<td>9.3</td>
<td>10.1</td>
<td>9.3</td>
<td>11.5</td>
<td>10.7</td>
<td>10.0</td>
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<tr>
<td>PiKu 4</td>
<td>9.4</td>
<td>10.8</td>
<td>8.6</td>
<td>10.9</td>
<td>10.2</td>
<td>9.1</td>
</tr>
<tr>
<td>Tabel</td>
<td>8.9</td>
<td>10.6</td>
<td>8.5</td>
<td>10.9</td>
<td>9.5</td>
<td>8.8</td>
</tr>
<tr>
<td>Victor</td>
<td>9.1</td>
<td>10.6</td>
<td>9.2</td>
<td>11.1</td>
<td>10.0</td>
<td>10.2</td>
</tr>
<tr>
<td>Krymsk 5</td>
<td>8.4</td>
<td>10.1</td>
<td>9.2</td>
<td>10.9</td>
<td>10.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Weiroot 72</td>
<td>8.8</td>
<td>10.4</td>
<td>8.8</td>
<td>11.4</td>
<td>10.2</td>
<td>9.0</td>
</tr>
</tbody>
</table>
Tendancy to root suckers

- **Weiroot 72**
- **Krymsk 5**
- **Victor**
- **Tabel Edabriz**
- **PI-KU 4**
- **PI-KU 1**
- **PHL-C**
- **PHL-A**
- **GiSelA 5**
- **GiSelA 3**

Legend:
- 1 = none
- 3 = few
- 5 = medium
- 7 = high
- 9 = very high
## New Rootstock Trial since 2013
### Locations: Oppenheim, Koblenz, Erfurt

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Station</th>
<th>Planting</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weigi 1</td>
<td>Weihenstephan</td>
<td>2013</td>
<td>Weiroot-Selections x Gießen Sel. 482</td>
</tr>
<tr>
<td>Weigi 2</td>
<td>Weihenstephan</td>
<td>2013</td>
<td>Weiroot-Selections x Gießen Sel. 482</td>
</tr>
<tr>
<td>Weigi 3</td>
<td>Weihenstephan</td>
<td>2013</td>
<td>Weiroot-Selections x Gießen Sel. 482</td>
</tr>
<tr>
<td>Weigi 4</td>
<td>Weihenstephan</td>
<td>2013</td>
<td>Weiroot-Selections x Gießen Sel. 482</td>
</tr>
<tr>
<td>Weiroot 720</td>
<td>Weihenstephan</td>
<td>2013</td>
<td>Selection from W 72 (P. cerasus)</td>
</tr>
<tr>
<td>Piku 1</td>
<td>Dresden-Pillnitz</td>
<td>2013</td>
<td>P. avium x (P. canescens x P. tomentosa)</td>
</tr>
<tr>
<td>Gisela 3</td>
<td>Gießen</td>
<td>2013</td>
<td>P. cerasus ,'Schattenmorelle' x P. canescens</td>
</tr>
<tr>
<td>Gisela 5</td>
<td>Gießen</td>
<td>2013</td>
<td>P. cerasus ,'Schattenmorelle' x P. canescens</td>
</tr>
<tr>
<td>Gisela 5 high grafted</td>
<td>Gießen</td>
<td>2013</td>
<td>P. cerasus ,'Schattenmorelle' x P. canescens</td>
</tr>
<tr>
<td>Gisela 12</td>
<td>Gießen</td>
<td>2013</td>
<td>P. canescens x P. cerasus ,'Leitzkauer'</td>
</tr>
<tr>
<td>Gisela 13</td>
<td>Gießen</td>
<td>2013</td>
<td>P. cerasus ,'Schattenmorelle' x P. canescens</td>
</tr>
<tr>
<td>G 196/4</td>
<td>Gießen</td>
<td>2013</td>
<td>P. canescens x P. avium ,'Hedelfinger'</td>
</tr>
</tbody>
</table>
Ranking Tree Growth Autumn 2015
Average of 'Bellise' and 'Regina'
Generative Data ‘Bellise‘
Cumulated Yield [kg per tree] 2015+2016

kg per tree

- kg/tree 2015
- kg/tree 2016

Gisela 3
Gisela 5
Gisela 5, hoch
Gisela 12
Gisela 13
Gisela 17
G 196/4
Piku 1
Weigi 1
Weigi 2
Weigi 3
W 720
'Regina'
Yield per Tree and Yield Efficiency 2015

<table>
<thead>
<tr>
<th>Variety</th>
<th>kg/Tree</th>
<th>g/cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gisela 3</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>Gisela 5</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>Gisela 12</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>Gisela 13</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>Gisela 17</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>G 196/4</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Piku 1</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>Weigi 2</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Weigi 3</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Weigi 4</td>
<td>0.20</td>
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</tr>
<tr>
<td>W 720</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.44</td>
<td></td>
</tr>
</tbody>
</table>

kg/Tree vs kg per tree and g/cm² for various varieties.
Vigour of Available Rootstocks, % (Estimation)

- P. avium
- P. mahaleb
- Maxma 60 Colt
- Gisela 13
- Gisela 12 (PiKu 1)
- Gisela 6
- PiKu 1
- Weigi 1
- Gisela 5
- Weigi 2
- Gisela 3
- W 720
Thank you for your attention!

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