Description of pome fruit genetic resources in Switzerland.

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National inventory on the genetic resources of all fruit and small fruit species by the NGO Fructus in collaboration with Agroscope Changins-Wädenswil and partner organizations

- questionnaires were sent to land owners having fruit trees
- about 12‘000 land owners responded (~20%)
- 195‘000 trees (accessions) mentioned
- more than 2‘000 endangered accessions saved in collections
Conservation of fruit genetic resources in Switzerland

- Introduction orchards
- Primary collections
- Duplication collections

Decentralised approach

Primary collection Höri operated by Fructus
NAP project: Agronomical and pomological description (2004-2007)

Project of the NGO Fructus in collaboration with Agroscope Changins-Wädenswil (ACW)

- Descriptors for the main fruit species defined considering ECP/GR descriptors and European Database requirements
- Handbooks with descriptors established
- Several 100 accessions documented incl. pictures
- Variety identification (pomological)
Apple descriptors
NAP project 'Description of Fruit Genetic Resources BEVOG' (2007-2010)

- Pomological description: 2000 fruit samples
- Molecular characterization:
  - 1037 apple and 452 cherry accessions
- Susceptibility to diseases:
  - scab, mildew: 600 accessions
  - fire blight: 160 accessions
- processing (juice, brandy) and fruit quality
Morphological Description and variety identification

Morphological description

• Phenology
• Tree characters
• Fruit characters

 Variety identification

• Classical (pomological knowledge)
• Molecular analysis (set of SSR markers)
Pictures of the accessions
Meeting with different collection holders at Roggwil (Thurgau)
Test of susceptibility to *V. inaequalis*, *P. leucotricha* and *E. amylovora*

**Scab and powdery mildew**
- 600 apple accessions 2 trees each
- 1st leaf 2008
- References: Jonathan, Boskoop, Bohnapfel, Berlepsch, Discovery, Berner Rosen, Sauergrauench, Goldparmäne
- Controls: Gravensteiner (*P. leucotricha*), Golden Del. (*V. inaequalis*)
- *No fungicides from 2nd leaf onward*

**Fire blight**
- 114 apple and 20 pear accessions
- Around 10 trees per accession
Plot design

Randomisierte Pflanzung im Frühjahr 2010
1200 Versuchsbäume
Pflanzabstand 0.7 x 3.5m
Systematische Verteilung von Gravensteiner / Golden Del.
Reduziertes Fungizid - Programm im Pflanzjahr
Scoring of *V. inaequalis* and *P. leucotricha* incidence

- Scoring made in June 2009 and June 2010 (for scab additionally in August 2010)
- Scale derived from Lateur and Populer (1993)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>No visible symptoms.</td>
</tr>
<tr>
<td>2</td>
<td>1% of organs on close scrutiny</td>
</tr>
<tr>
<td>3</td>
<td>1-5% of organs, directly apparent</td>
</tr>
<tr>
<td>4</td>
<td>Intermediate</td>
</tr>
<tr>
<td>5</td>
<td>About 25% of organs infected</td>
</tr>
<tr>
<td>6</td>
<td>Intermediate</td>
</tr>
<tr>
<td>7</td>
<td>Heavy infection of 50% of organs</td>
</tr>
<tr>
<td>8</td>
<td>Intermediate</td>
</tr>
<tr>
<td>9</td>
<td>Very heavy infection, more than 90% of organs infected</td>
</tr>
</tbody>
</table>
V. inaequalis June 2010
Distribution of incidence

<table>
<thead>
<tr>
<th>Variety</th>
<th>Nb. of accessions</th>
</tr>
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<tbody>
<tr>
<td>(Gravensteiner) 2</td>
<td>251</td>
</tr>
<tr>
<td></td>
<td>196</td>
</tr>
<tr>
<td>3</td>
<td>89</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>(Golden Del.) 7</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>

ECPGR Malus/Pyrus Meeting, Weggis, 2012
Markus Kellerhals
**P. leucotricha** June 2010: Distribution of incidence

![Graph showing the distribution of incidences for different cultivars, with 'Golden D' 2 having the highest incidence at 380, followed by 'Gravenstein' 5 at 59, and others at much lower numbers.]

**Nb. of accessions**

- **Golden D**: 380
- **2**: 6
- **3**: 82
- **4**: 23
- **5**: 59
- **6**: 6
- **8**: 25
- **9**: 1
- **10**: 1

ECPGR Malus/Pyrus Meeting, Weggis, 2012

Markus Kellerhals
Fire blight glasshouse screening: criteria for accessions selection

- Literature
- Significance of accession in the landscape
- Results of processing experiments incl. sensory evaluation
- Repetition in case of promising result

Material and Methods

- 12 trees per accession on M9vf (apple) and seedling rootstock (pear)
- Pre-cultivation: about 5 weeks at 18°C
- No fertilizer, plant protection in case of necessity
Fire blight glasshouse test

Concentration $10^9$ cfu/ml
Glasshouse shoot test pear 2007

Lesion length in % of total shoot length

- % LL1
- % LL2
- % LL3

Varieties:
- Trübler
- Harrow Sweet
- Reinholzbinne
- Heulampen
- Zuger Rötel
- Metzer Brabbinne
- Sülbinne
- Happerswiler
- Affeltrangl
- Blutbinne
- Ottenbacher Scheller
- Helegger
- Welschbergler
- Valerc
- Mockenholzbinne
- Schweizer Hose
- Zürcher Zuckerbinne
- Schweizer Brabbinne
Glasshouse shoot test apple 2008

- % LL1
- % LL2
- % LL3

Lesion Length in %

- Ohio Rte. (9)
- Schneiderapfel (9)
- Heimenhofer (8)
- Waldhofer (9)
- Danziger Kantapfel (9)
- Schweizer Orangnapfel (9)
- Winterapfel (8)
- Stärner Rosert (8)
- Glockenapfel (8)
- Aargauer Jubiläum (5)
- Winterlinde (8)
- Aargauer (8)
- Oberdiecke Rte. (5)
- Kanada Rte. (9)
- Chuserrainer (9)
- Sternessmil (9)
- Söldiapfel (9)
- Melchnauer Sonntagsapfel (8)
- Goldrte. v. Blenheim (7)
- Leuchtenapfel (5)
- Leuchtenapfel (5)
- Mehlbrücker Rte. (7)
- Osnabrücker Rte. (8)
- Bükler Erbapfel (8)
- Ananas Rte. (6)
- Gala (8)
- Bänziger (9)
- Bramleys Samling (9)
- London Pippin (7)
- Baumanns Jägerapfel (8)
- Aargauer Jägerapfel (8)
- Champagner Rte. (4)

ECPGR Malus/Pyrus Meeting, Weggis, 2012
Markus Kellerhals
Glasshouse shoot test BEVOG II 2011

Lesion length in % of total shoot length

- nach 1 Woche
- nach 2 Wochen
- nach 3 Wochen

Species:
- Alant
- Enterprise
- Birmapfel
- Hütter
- Samling
- Kaiser Jäger
- Rosenapfel
- Balgacher Reinette
- Pomme tricolor
- Sonnenwirts
- Boutilch
- Muttech
- Gala
- Spitz
- Schüsseler
- unbekannt
- Jakober
- Rosenapfel
- Galmiz Gauwiler
<table>
<thead>
<tr>
<th>Variety</th>
<th>Use</th>
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<tbody>
<tr>
<td>Chüsenrainer</td>
<td>juice</td>
</tr>
<tr>
<td>Heimenhofer</td>
<td>Juice, also for altitude</td>
</tr>
<tr>
<td>Niederhelfenschwiler Beeriapfel</td>
<td>Table apple, medium quality</td>
</tr>
<tr>
<td>Schneiderapfel (3n)</td>
<td>Useful for standard trees, well represented</td>
</tr>
<tr>
<td>Södliapfel</td>
<td>hochwertiger Mostapfel</td>
</tr>
<tr>
<td>Alant</td>
<td>Table apple, low vigour</td>
</tr>
<tr>
<td>Bramleys Sämling</td>
<td>Cooking apple,</td>
</tr>
<tr>
<td>Champagner Reinette</td>
<td>Table apple, cooking</td>
</tr>
<tr>
<td>Edelchrüsler</td>
<td>Table apple, cooking</td>
</tr>
<tr>
<td>Jakob Lebel</td>
<td>Cooking</td>
</tr>
<tr>
<td>Usterapfel</td>
<td>Sweet apple, cooking, drying</td>
</tr>
</tbody>
</table>

**Top 5 as potential sources in breeding, resistance loci?**
Fire blight (*Erwinia amylovora*) resistance in apple varieties associated with molecular markers

Sehic J.1, Nybom H.1, Garkava-Gustavsson L.1, Patocchi A.2, Kellerhals M.2, Duffy B.2


<table>
<thead>
<tr>
<th>Variety</th>
<th>Origin</th>
<th>AE10-375 GE-8019</th>
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<tbody>
<tr>
<td>Aila</td>
<td>Russia</td>
<td>+</td>
</tr>
<tr>
<td>Alexander</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Alfa 68</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Alice*</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Ananas Reinette</td>
<td>Netherlands</td>
<td>+</td>
</tr>
<tr>
<td>Annero</td>
<td>Sweden</td>
<td>+ +</td>
</tr>
<tr>
<td>Aroma*</td>
<td>Sweden</td>
<td>+ +</td>
</tr>
<tr>
<td>Arvidsäpple</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Aspa</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Astrakan, Gylenkroks</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Astrakan, White</td>
<td>Russia</td>
<td>+</td>
</tr>
<tr>
<td>Astrakan, Red</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Astrakan, Stor Klar</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Belle de Boskoop</td>
<td>Netherlands</td>
<td>+</td>
</tr>
<tr>
<td>Birgit Bonnier*</td>
<td>Sweden</td>
<td>+</td>
</tr>
<tr>
<td>Blenheim Orange</td>
<td>England</td>
<td>+</td>
</tr>
<tr>
<td>Boiken</td>
<td>Germany</td>
<td>+</td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>------------------</td>
</tr>
</tbody>
</table>
Characterization for future use

Fruit quality
- Screeing Fruit quality with ‘Pinmprenelle‘ robotic machine

Juice
- Production of true to type juices
- Sensory scoring by experts
- Analyses of the samples in the laboratory

Brandy
- Production of true to type brandies
- Sensory scoring and description by experts
Analytical results for cv 'Leuenapfel'

<table>
<thead>
<tr>
<th>Year</th>
<th>° Brix</th>
<th>Acidity g MA/l</th>
<th>Glucose</th>
<th>Fructose</th>
<th>Saccharose</th>
<th>Sorbit</th>
<th>Folin</th>
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<tbody>
<tr>
<td>2007</td>
<td>13.08</td>
<td>3.88</td>
<td>19.58</td>
<td>81.34</td>
<td>28.77</td>
<td>8.12</td>
<td>780.17</td>
</tr>
<tr>
<td>2008</td>
<td>12.10</td>
<td>3.40</td>
<td>15.60</td>
<td>72.20</td>
<td>23.40</td>
<td>5.19</td>
<td>601.00</td>
</tr>
<tr>
<td>2009</td>
<td>13.60</td>
<td>3.84</td>
<td>22.62</td>
<td>83.94</td>
<td>25.53</td>
<td>6.40</td>
<td>572.00</td>
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Top scoring for 'Heimchenhofer'

<table>
<thead>
<tr>
<th>Visuell</th>
<th>P 1</th>
<th>P 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>goldfarben, brilliant</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Geruch</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>aromatisch, ausgeprägt fruchtig, edel, rein</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Geschmack</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>gehaltvoll, ausgewogenes Zucker-Säureverhältnis, leicht herb</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Harmonie</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>recht harmonisch, Säure gut eingebunden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gesamtpunkte</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>
Production of true to type brandies

- 2007: 40
- 2008: 85
- 2009: 40
- 2010: 30

→ 155 plum and prune brandies
→ 24 pear brandies
→ 16 cherry brandies
Sensory evaluation
**Accession 60186, unknown pear**

<table>
<thead>
<tr>
<th>Nr</th>
<th>ID</th>
<th>Name</th>
<th>Output</th>
<th>Cleanness</th>
<th>Odour</th>
<th>Flavour</th>
<th>Overall</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>124/09</td>
<td>60186</td>
<td>unknown</td>
<td>4.8</td>
<td>clean</td>
<td>Clean, beautiful and typical pear odour</td>
<td>Good pear flavor, slightly bitter, a bit short lasting</td>
<td>Well processed, pear flavor, good, slightly adstringent</td>
<td>18</td>
</tr>
</tbody>
</table>
Use of biodiversity in fruit breeding

The pedigree of Milwa-Junami® with cv. Fraurotacher as great-grandfather
Use of 'old' varieties in ACW apple breeding (crosses 2006 and 2007)

<table>
<thead>
<tr>
<th>Mother</th>
<th>Father</th>
<th>Seeds</th>
<th>Nb in step 1</th>
</tr>
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<tbody>
<tr>
<td>ACW 12556</td>
<td>Sternapi</td>
<td>468</td>
<td>10</td>
</tr>
<tr>
<td>Dülmener Rosenapfel</td>
<td>ACW 12309</td>
<td>141</td>
<td>21</td>
</tr>
<tr>
<td>ACW 11309</td>
<td>Roter Herbstcalville</td>
<td>96</td>
<td>-</td>
</tr>
<tr>
<td>Rucliva</td>
<td>Gelber Bellefleur</td>
<td>644</td>
<td>370</td>
</tr>
<tr>
<td>Milwa</td>
<td>Krimskoe</td>
<td>1167</td>
<td>50</td>
</tr>
<tr>
<td>Milwa</td>
<td>Korastojnka</td>
<td>979</td>
<td>40</td>
</tr>
</tbody>
</table>
Summary and conclusions

- Coordinated description of Swiss Fruit Genetic Resources is under way
- Molecular analysis allows to make work more efficient
- Promising accessions with overall good results can be used directly for consumption and/or processing
- Promising accessions can be used in breeding
- Data are introduced in National Database www.bdn.ch
Acknowledgements

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