Quality Standards in Genebanks – Improvement of Sustainability of Plant Genetic Resources

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• Crop Collections World-wide
• Why Quality Standards and Quality Management Systems?
• Improvement of Sustainability of Plant Genetic Resources
Ex situ Collections world-wide

7.4 Million accessions world-wide
### Ex situ Collections world-wide

The 10 largest world-wide germplasm collections by crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>Genus</th>
<th>Accessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td><em>Triticum</em></td>
<td>857.940</td>
</tr>
<tr>
<td>Rice</td>
<td><em>Oryza</em></td>
<td>773.947</td>
</tr>
<tr>
<td>Barley</td>
<td><em>Hordeum</em></td>
<td>470.470</td>
</tr>
<tr>
<td>Maize</td>
<td><em>Zea</em></td>
<td>327.931</td>
</tr>
<tr>
<td>Bean</td>
<td><em>Phaseolus</em></td>
<td>262.369</td>
</tr>
<tr>
<td>Sorghum</td>
<td><em>Sorghum</em></td>
<td>235.711</td>
</tr>
<tr>
<td>Soybean</td>
<td><em>Glycine</em></td>
<td>229.947</td>
</tr>
<tr>
<td>Oat</td>
<td><em>Avena</em></td>
<td>148.260</td>
</tr>
<tr>
<td>Groundnut</td>
<td><em>Arachis</em></td>
<td>128.461</td>
</tr>
<tr>
<td>Cotton</td>
<td><em>Gossypium</em></td>
<td>104.780</td>
</tr>
</tbody>
</table>
### Ex situ Collections world-wide

<table>
<thead>
<tr>
<th>Institution</th>
<th>Country</th>
<th>Collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCGRP</td>
<td>USA</td>
<td>508.994</td>
</tr>
<tr>
<td>ICGR</td>
<td>China</td>
<td>391.919</td>
</tr>
<tr>
<td>NBPGGR</td>
<td>India</td>
<td>366.333</td>
</tr>
<tr>
<td>VIR</td>
<td>Russia</td>
<td>322.238</td>
</tr>
<tr>
<td>NIAS</td>
<td>Japan</td>
<td>243.463</td>
</tr>
<tr>
<td>CIMMYT</td>
<td>Mexico</td>
<td>173.571</td>
</tr>
<tr>
<td>IPK</td>
<td>Germany</td>
<td>148.128</td>
</tr>
<tr>
<td>ICARDA</td>
<td>Syria</td>
<td>132.793</td>
</tr>
</tbody>
</table>
National Bureau of Plant Genetic Resources, Gene Bank, New Delhi, India
The German Genebank in Gatersleben

<table>
<thead>
<tr>
<th>Inventory</th>
<th>Total number of acc.</th>
<th>Cultivation/no of accessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals and Grasses</td>
<td>65,009</td>
<td>2,494</td>
</tr>
<tr>
<td>wheat</td>
<td>27,773</td>
<td>769</td>
</tr>
<tr>
<td>barley</td>
<td>23,192</td>
<td>771</td>
</tr>
<tr>
<td>Legumes</td>
<td>27,907</td>
<td>1,436</td>
</tr>
<tr>
<td>beans (Phaseolus)</td>
<td>8,959</td>
<td>283</td>
</tr>
<tr>
<td>peas</td>
<td>5,286</td>
<td>193</td>
</tr>
<tr>
<td>Vegetable</td>
<td>18,471</td>
<td>2,556</td>
</tr>
<tr>
<td>tomatoes</td>
<td>3,369</td>
<td>90</td>
</tr>
<tr>
<td>onions</td>
<td>3,225</td>
<td>1,421</td>
</tr>
<tr>
<td>beet/Beta</td>
<td>2,312</td>
<td>180</td>
</tr>
<tr>
<td>Oil/Fibreplants</td>
<td>7,981</td>
<td>928</td>
</tr>
<tr>
<td>rapeseed</td>
<td>2,460</td>
<td>134</td>
</tr>
<tr>
<td>flax</td>
<td>2,321</td>
<td>104</td>
</tr>
<tr>
<td>Medicine/Spice Plants</td>
<td>8,320</td>
<td>1,476</td>
</tr>
<tr>
<td>Mutants</td>
<td>1,780</td>
<td>266</td>
</tr>
<tr>
<td>Forage crops</td>
<td>12,406</td>
<td>1,410</td>
</tr>
<tr>
<td>forage grasses</td>
<td>10,369</td>
<td>1,115</td>
</tr>
<tr>
<td>Potatoes</td>
<td>6,060</td>
<td>2,991</td>
</tr>
<tr>
<td>Total</td>
<td>149,849</td>
<td>13,557</td>
</tr>
</tbody>
</table>

Reference collections

- 415,888 herbarium sheets
- 100,096 seeds & fruits
- 52,249 cereal spikes
• Crop Collections Worldwide

• Why Quality Standards and Quality Management Systems?

• Improvement of Sustainability of Plant Genetic Resources
Why Quality Standards
and Quality Management Systems?

(1) to increase the customer satisfaction
(2) to create clear responsibilities
(3) to motivate the employees
(4) to reduce costs by avoiding errors
(5) to improve competitive ability
(6) to reduce risks
(7) to improve the image.
Procedures to get the certificate –
Documentation of a QM system

A quality management system is the documented classification system of a given institution.
Process Landscape of the German Genebank

Service Processes

- To provide qualitatively excellent seed and plant material
- To provide scientific knowledge
- To accomplish research projects
- To accomplish scientific education and further training

Supporting Processes

- Processes in Experimental Fields and Nurseries
- Personnel Processes
- Material and General Service Processes
- Financial Processes
- Processes of Technology Transfers
- Library Processes
- Engineering and Information Technology Processes

Management Processes

- Mission Statement of the Genebank
- Objectives of the Genebank
- Personnel Development
- Communication Processes
- Research Strategy and Management of the Genebank
- Continual Improvement
- Information Management
- Quality and Process Management

Stakeholders Processes

- Stakeholders Contact Management
- Stakeholders Satisfaction

Stakeholders Requirements

Objectives of the Genebank

- To provide qualitatively excellent seed and plant material
- To provide scientific knowledge
- To accomplish research projects
- To accomplish scientific education and further training
Service Process
Providing Seed and Plant Material

- Input
- Output
- Document
- Working instruction
- Database
- Interaction with users
- Process action, activity
- Decision
QM documents of the German Genebank
4 main service processes

19 procedure instructions for the genebank
34 working instructions for the genebank

13 procedure instructions for the administration
11 working instructions for the administration

6 procedure instructions especially for the QM system

Operational genebank manual of IPK (on AEGIS website)
Date of compilation 15.03.2011

Draft Updated Genebank Standards:
Minimum Standards for Conservation of Orthodox Seeds
Quality Management System

Certification according to ISO 9001:2008
• Crop Collections Worldwide
• Why Quality Standards and Quality Management Systems?
• Improvement of Sustainability of Plant Genetic Resources
## Protocol of Reproduction

<table>
<thead>
<tr>
<th>species</th>
<th>month of sowing</th>
<th>preculture</th>
<th>life form</th>
<th>pollination</th>
</tr>
</thead>
<tbody>
<tr>
<td>winter wheat</td>
<td>September/October</td>
<td>not necessary</td>
<td>winter annual</td>
<td>self</td>
</tr>
<tr>
<td>spring wheat</td>
<td>March</td>
<td>not necessary</td>
<td>summer annual</td>
<td>self</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>species</th>
<th>isolation</th>
<th>location</th>
<th>floor space</th>
<th>protection from birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>winter wheat</td>
<td>not necessary</td>
<td>field</td>
<td>1 – 4 m²</td>
<td>cannon/kite</td>
</tr>
<tr>
<td>spring wheat</td>
<td>not necessary</td>
<td>field</td>
<td>1 – 4 m²</td>
<td>cannon/kite</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>species</th>
<th>method of harvest</th>
<th>first cleaning</th>
<th>second</th>
<th>third</th>
</tr>
</thead>
<tbody>
<tr>
<td>winter wheat</td>
<td>hoisting</td>
<td>threshing</td>
<td>thieving</td>
<td>hand sorting</td>
</tr>
<tr>
<td>spring wheat</td>
<td>hoisting</td>
<td>threshing</td>
<td>thieving</td>
<td>hand sorting</td>
</tr>
</tbody>
</table>
Seed Reproduction

- Options for sowing (germination rate, seed amount)
- Preparation of sowing (providing seeds, labeling)
- Planning of cultivation (location, necessary floor space)
- Sowing (time, preculture)
- Characterisation (agronomic and morphological data, descriptors)
- Botanical Control (taxonomical determination)
- Harvest (yield, labeling)
- Cleaning of seeds (threshing, sieving, hand sorting)
- Harvest control (comparing with seed pattern of first reproduction)
- Seed storage (thousand seed weight, germination test)
Svalbard Global Seed Vault

Storage of safety duplicates of the German genebank

22,350 accessions

Studies of germinability for different crops (intraspecific variability)

Hordeum vulgare L.

Nagel et al., Euphytica 170, 2009
Avoiding Contamination of Genebank Material with GMOs

- Strong rules for cultivation of GMOs
- Documented distances between genebank material and GMOs

Humming Bird - made of chilly and celery leaf
Customer Satisfaction

- Did the material arrive in good condition?
- Does the interval between order and receipt meet your expectation?
- Do you consider the information supplied with the material as adequate?
- Do you agree with the received quantity?
- How do you assess the quality of the online information offered by the genebank?

Address:
Leibniz-Institute of Plant Genetics and Crop Plant Research (IPK)
Secretary Genebank – Mrs Ballhausen
Corrensstrasse 3
D-06466 Gatersleben
Phone: +49 - (0)38482 - 5109
Fax: +49 - (0)38482 - 5165
Email: ballhaus@ipk-gatersleben.de
## Customer Satisfaction

### 39% completed questionnaires

<table>
<thead>
<tr>
<th></th>
<th>1 (very good)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6 (bad)</th>
<th>no answer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Condition</strong></td>
<td>92%</td>
<td>5%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Interval</strong></td>
<td>72%</td>
<td>17%</td>
<td>7%</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Information</strong></td>
<td>35%</td>
<td>35%</td>
<td>14%</td>
<td>7%</td>
<td>3%</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Quantity</strong></td>
<td>66%</td>
<td>23%</td>
<td>8%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Online</strong></td>
<td>42%</td>
<td>28%</td>
<td>12%</td>
<td>4%</td>
<td>2%</td>
<td>0%</td>
<td>12%</td>
</tr>
</tbody>
</table>
Special Advantages for the Genebank

1. to perpetuate the long standing experience and knowledge of the employees
2. to avoid contamination of genebank material with genetic modified organisms
3. to increase the satisfaction of the customers (stakeholders)
4. to improve the internal genebank management
5. to accomplish excellent scientific research
6. to maintain the plant genetic resources and to optimise the conservation and utilisation
History of QM

Code of Hammurabi
1760 BC

“If a builder build a house for some one, and does not construct it properly, and the house which he built fall in and kill its owner, then that builder shall be put to death”.

Source: http://en.wikipedia.org/