Standards and best practices for genebank management

M. Ehsan Dulloo Ph.D.
Senior Scientist
Agricultural Biodiversity Conservation
Bioversity International, Rome, ITALY

Co-authors: Imke Thormann and Jan Engels (Bioversity)
Kakoli Ghosh (FAO)

European Plant Genetic Resources Conference 2011

To Serve and Conserve

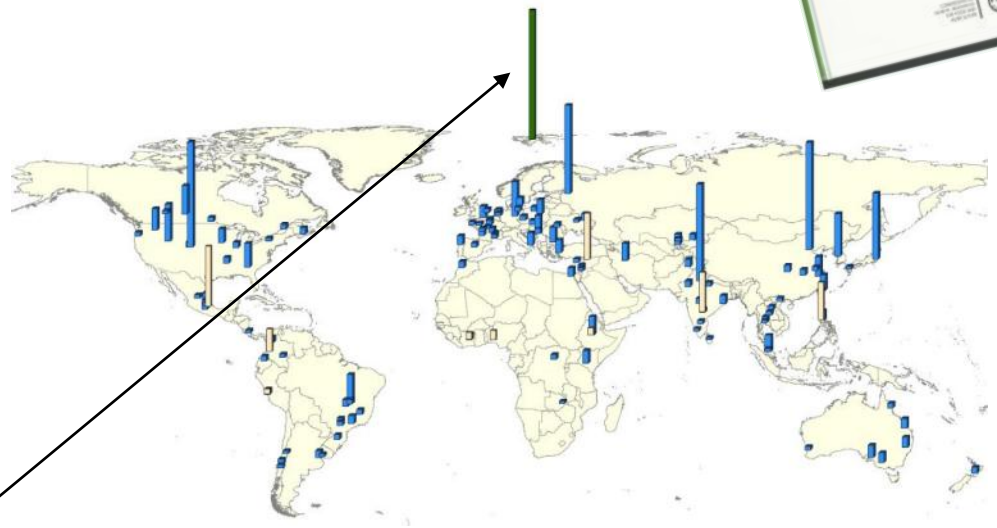
Wageningen, The Netherlands
5-7 April 2011

Outline

- Introduction
- Historical context
- Revision of genebank standards
- Best practices
- Summary

State of *ex situ* conversation of plant genetic resources

- Over 1750 genebanks exist world wide.
- About 7.4 million germplasm accessions conserved in *ex situ* collections,
- More than 70% of the genetic diversity of some 200-300 crops is already conserved in genebanks (SBSTTA, 2010)



- Establishment of the Svalbard Global Seed Vault, a last resort safety back-up repository of genetic resources to safeguard humanity.

- **Geographic distribution of genebanks with holdings of >10,000 accessions**
  - *Source:* WIEWS 2009; Country Reports; USDA-GRIN 2009, SOW2

Brief historical context of genebank standards

- Panel of Experts on Plant Exploration and Introduction (1975)
  - preferred and acceptable standard
- IBPGR Advisory Committee on Seed Storage (1985)
  - integrity of plant genetic resources collections but also the safety of staff working in genebanks
- FAO/IBPGR Experts Consultation Group on Genebank Standards (1992)
  - FAO/IPGRI Genebank Standards 1994

Process for revision of Genebank Standards 1

- The CGRFA at its 12th session agreed on the need for revising the *Genebank Standards* and requested FAO in in cooperation with the ITPGRFA, CGIAR and other international institutions, to undertake this review
- Bioversity and FAO prepared a first draft version together with GCDT, ITPGRFA and IPPC
- Inputs sought from genebank experts
- Expert consultation September 2010
- Revision of first draft and production of ‘draft revised Genebank Standards’

Process for revision of Genebank Standards 2

- Further inputs sought and received from National Focal Points for CGRFA, ITPGRFA and ECPGR
- Draft submitted for information to the 4th Governing Body of the ITPGRFA in Bali March 2011
- Same draft to be considered by ITWG-PGRFA of the commission in April
- Final draft will be considered at 13th session of CGRFA in July 2011 for endorsement

Structure of draft revised Genebank Standard

- Preamble
- Introduction
- Underlying principles
- Standards for
  - Acquisition
  - Viability monitoring
  - Storage conditions
  - Regeneration
  - Characterization
  - Documentation
  - Distribution
  - Safety duplication
  - Security/personnel
- Annexes

Underlying principles

- Identity of accessions
- Maintenance of viability and genetic integrity
- Maintenance of seed health
- Physical security of collections
- Availability and use of germplasm
- Availability of information
- Proactive management of genebanks

What's new and/or has changed?

1994 standards → Draft Revised standards

Definition of 'standard'

Acceptable standards – in many cases minimal but adequate

Preferred standards – a higher and thus safer standard

One standard –
The lowest level of performance of a routine genebank operation below which there is a high risk of losing genetic integrity

(e.g. a probability of 5% or more of losing an allele in an accession over the storage period)

New standards for acquisition

- All seed samples are acquired legally with technical documentation in line with Treaty
- Have a minimum of associated data (FAO/IPGRI multi-crop passport descriptors)
- Period between seed collecting and transfer is as short as possible.
- Minimum size of a seed sample must capture 95 percent of alleles in the sampled population.

New standards for characterization

- Around 95 percent of accessions are characterized within five years of acquisition or the first regeneration cycle.

- Characterization should be based on standardized internationally agreed descriptor lists and made publicly available.

Drying conditions

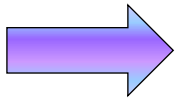
Drying at 10-25 ° C
and 10-15 % RH

Drying at 5-20 °C
and 15-25 % RH

- At a critical moisture level (CML), max longevity is attained and drying below this level does not increase seed longevity further
- Studies have shown that lowering storage temperature increases the critical moisture level, which suggest dangers of overdrying seeds if we dry at lower RH
- Various RH-temperature combinations for a given species. Important for genebank curators to clearly understand relationship to decide on best drying conditions.
- Still uncertainty among scientific community about lowest CML – more scientific studies required

Storage conditions

- Acceptable: Sub-zero temperatures (<0°C) with 3-7% seed moisture content (depending upon species).
- Preferred: - 18°C or cooler with 3-7% seed moisture content (depending upon species).
- Use of any type of sealed moisture-proof containers



- Long-term conditions : -18 ± 3°C (MOS & safety duplicates)
- Medium-term conditions : under refrigeration at 5-10°C.
- All seed samples sealed in a suitable air-tight container in storage environment RH 15±3%.

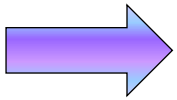
Viability monitoring

- Carried out at (or soon after) receipt and subsequently at intervals during storage.
- Initial germination test should be carried out on a minimum of 200 seeds drawn at random from the accession
- Germination should exceed 85% for most cereals & 75 % some vegetables and lower for some wild or forest species

- Conducted after cleaning and drying the accession or at the latest within 12 months after receipt of the sample at the genebank
- Viability monitoring test set at 1/3 of time predicted fro viability to fall to 85% of initial viability
- Germination should exceed 85% for most cereals & 75 % some vegetables and lower for some wild or forest species

Regeneration

- Viability falls to 85% of the initial value.
- It is desirable to use 100 plants or more for regeneration to avoid the probability of large losses of alleles.
- seeds used to plant material for regeneration should be as close as possible genetically to the original germplasm



- Viability drops below 85 % of the initial viability. The most-original-sample should be used to regenerate those accessions
- The sample size of the accession to-be-regenerated contains a minimum number of plants which capture at least 95 percent of alleles with a minimum frequency of 0.05
- Regenerated material should contain less than 1 percent of contamination
- 50 seeds of MOS is archived in long term storage

Other standards in brief

- **Documentation**:
  - Passport data of 100 percent of the accessions are documented, maintained in suitably designed databases and duplicate set maintained outside genebank
- **Distribution**:
  - in compliance with national laws and relevant international treaties and conventions; at least 95% of seeds and information are made available
- **Safety duplication**:
  - geographically distant area, under the same or better conditions than those in the original genebank
- **Security and personnel**:
  - risk management strategy in place ;follow local Occupational Safety and Health protocols.

Best Practices on genebank management 1

- Required for effective genebank management and are necessary to achieve the genebank standards
- Should be harmonized among genebanks
- Yet they are not easily available
- Need for crop specific best practices

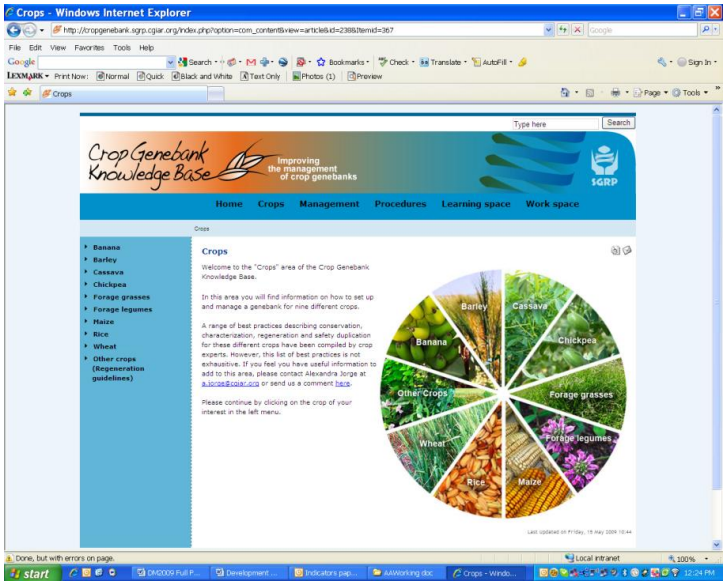
- These were the reasons for the development of the

Crop Genebank Knowledge Base

http://cropgenebank.sgrp.cgiar.org

Best Practices on genebank management 2

- Nine crop specific best practices
- Regeneration guidelines for 21 crops
- General procedures for genebank management
- Strategies (e.g. genetic diversity, risk management, STOGS etc.)
- Learning resources - extensive selection of publications, guidebooks, training manuals, photos, videos
- Used as a training material for courses on genebank management

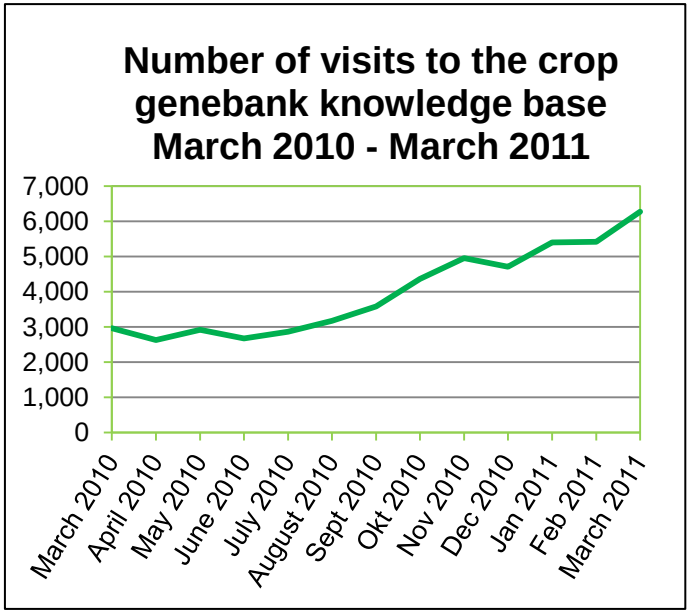


Best Practices on genebank management 3

- CGKB developed within World Bank funded project, coordinated by SGRP
- Collaborative effort with contributions from national and international genebanks and more than 100 individuals

Some further developments:

- New crop best practices (radish)
- Updated plant collecting guidelines
- Genebank documentation
- Core collection procedures



Summary

- There has been a great increase in the number of genebanks world wide
- Genebank standards are needed to ensure that genetic resources are maintained in the most effective and efficient manner across collections
- Genebank standards need to be based on sound scientific findings
- For many standards there is still lack of evidence – more research required
- Genebank standards also needed for other *ex situ* collections (Field GB, *in vitro*, cryo and DNA banks)

Bioversity International

Best practices are needed to ensure that genebank standards are met.

http://cropgenebank.sgrp.cgiar.org

THANK YOU FOR YOUR ATTENTION