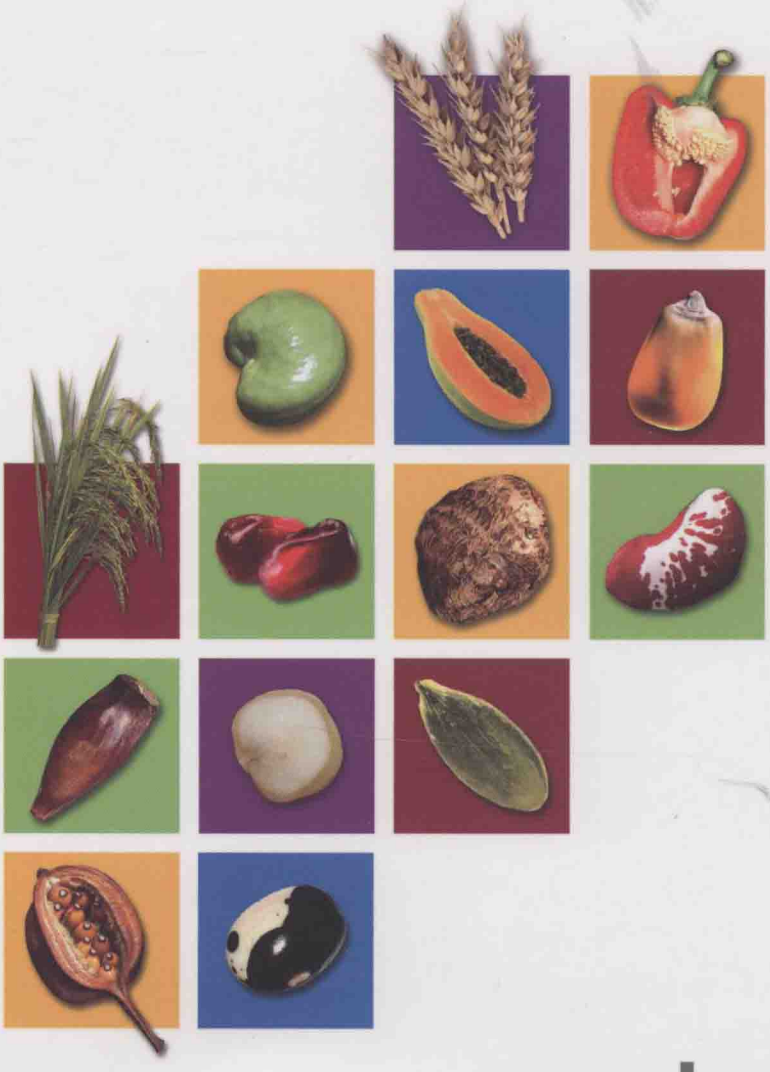
Genebank Standards

for Plant Genetic Resources for Food and Agriculture



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Genebank Standards

for Plant Genetic Resources for Food and Agriculture

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Species featured on cover:

from left to right, beginning with the top row
Triticum spp.
Capsicum annuum
Anacardium occidentale
Carica papaya
Zea mays
Oryza sativa
Punica granatum
Colocasia esculenta
Phaseolus vulgaris
Araucaria angustifolia
Chenopodium quinoa
Cucurbita maxima
Brachychiton populneus
Phaseolus vulgaris

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Foreword

Plant genetic resources are a strategic resource at the heart of sustainable crop production. Their efficient conservation and use is critical to safeguard food and nutrition security, now and in the future. Meeting this challenge will require a continued stream of improved crops and varieties adapted to particular agro-ecosystem conditions. The loss of genetic diversity reduces the options for sustainably managing resilient agriculture, in the face of adverse environments, and rapidly fluctuating meteorological conditions.

Well-managed genebanks both safeguard genetic diversity and make it available to breeders. The *Genebank Standards for Plant Genetic Resources for Food and Agriculture*, prepared under the guidance of the FAO Commission on Genetic Resources for Food and Agriculture, and endorsed at its Fourteenth Regular Session in 2013, lay down the procedures that need to be followed for conservation of plant genetic resources. The Commission recognizes them as being of universal value in germplasm conservation throughout the world.

The voluntary *Standards* cover both seeds in genebanks and vegetatively propagated planting material, including in the field genebanks. They set the benchmark for current scientific and technical best practices, and reflect the key international policy instruments for the conservation and use of plant genetic resources. They are an important tool in implementing the *International Treaty on Plant Genetic Resources for Food and Agriculture*, and a supporting component of the *Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture*. The world's 7.5 million genebank accessions are largely of the crops on which humans and livestock most rely for food and feed, including important wild relatives and landraces, but others are of crops of local importance and underutilized species.

The *Standards* encourage active genebank management, and provide for a set of complementary approaches. They will help genebank managers strike a balance between scientific objectives, resources available, and the objective conditions under which they work, recognizing that the world's over 1750 genebanks differ greatly in the size of their collections and the human and financial resources at their disposal. The challenge that many developing countries face in ensuring secure long-term conservation, in the face of limited capacities and inadequate infrastructure, makes this a challenging task.

The value of conserving crop genetic resources is realized only through their effective use. This requires strong linkages along the chain from *in situ* resource conservation and collection, through storage in genebanks, through research and breeding, to farmers and their communities, and ultimately consumers. Genebank curators, breeders, and national programmes must work hand in hand to ensure the efficient and sustainable conservation of the plant genetic resources for food and agriculture on which humanity depends. I call for adequate provision to be made at national and regional level, so that these crucial international Standards can fulfil their objective of underwriting food security.

Ren Wang
Assistant Director-General
Agriculture and Consumer Protection Department

Preface

Genebanks play a key role in the conservation, availability and use of a wide range of plant genetic diversity for crop improvement for food and nutrition security. They help bridge the past and the future by ensuring the continued availability of genetic resources for research, breeding and improved seed delivery for a sustainable and resilient agricultural system. An efficient management of genebanks through application of standards and procedures is essential for the conservation and sustainable use of plant genetic resources.

The *Genebank Standards for Plant Genetic Resources for Food and Agriculture* (Genebank Standards) provide international standards for ex situ conservation in seed banks, field genebanks and for in vitro and cryopreservation. The Seeds and Plant Genetic Resources Team prepared the Standards under the guidance of the Commission on Genetic Resources for Food and Agriculture. During the preparatorwy phase, standards for orthodox seeds were updated and others developed for field genebanks and for *in vitro* and cryopreservation in consultation with the CGIAR, in particular Bioversity International. Genebank managers, relevant academic and research institutions, national focal points for plant genetic resources for food and agriculture have been instrumental in providing valuable feedback. This was also true for the Secretariats of the International Treaty on Plant Genetic Resources for Food and Agriculture and the International Plant Protection Convention. At its Fourteenth Session in 2013, the Commission endorsed the *Genebank Standards* and urged their universal adoption.

The aim of the Genebank Standards is the conservation of plant genetic resources under conditions that meet recognized and appropriate standards based on current and available technological and scientific knowledge. All the standards are founded on underlying principles that are common to all the different types of genebanks. They also take into account the changes in seed management and techniques due to advances in molecular biology, and bioinformatics. They incorporate the developments in the field of documentation and information systems that are increasingly becoming central to improving genebank management and optimization of resources. A narrative describing the context, technical aspects, contingencies and selected references on technical manuals and protocols as appropriate, supports each standard in the document.

The Genebank Standards are generic enough to be applicable to all genebanks and should be used in conjunction with species-specific information. These is especially true for plants producing non-orthodox seeds and/or are vegetatively propagated as it is difficult to establish specific standards that are valid for all those species given their different seed storage behaviours, life forms and life cycles. The standards are nonbinding and voluntary and stress the importance of securing and sharing material along with related documentation in line with national and international regulations. It will be useful for the standards to be reviewed periodically taking into account the changing policy and technical landscapes.

Conserving and increasing the sustainable use of plant genetic resources is a necessary for achieving food security and addressing nutritional requirements of present and future generations. Therefore, it is vital to conserve the diversity of plant genetic resources so that it is available to the global community. However, genebank maintenance can be expensive. Many scientific advances, such as cryopreservation, come at a cost, especially when used for large-scale testing. Maintenance of field genebanks is equally demanding in terms of labour and cost. Therefore, the emphasis should be on proactive management of genebanks by adopting a complementary approach, and striking an optimal balance between scientific considerations, available personnel, infrastructural and financial resources under prevailing conditions. In many countries, the availability of trained personnel and adequate resources to maintain genebank collections in a sustainable manner remains a challenge. Long-term partnerships at national, regional and global levels together with resources for capacity development will be necessary to apply the standards.

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Chapter 1

Introduction

Genebanks around the world hold collections of a broad range of plant genetic resources, with the overall aim of long-term conservation and accessibility of plant germplasm to plant breeders, researchers and other users. Plant genetic resources are the raw materials utilized in crop improvement and their conservation and use is critical to global food and nutrition security. Sustainable conservation of these plant genetic resources depends on effective and efficient management of genebanks through the application of standards and procedures that ensure the continued survival and availability of plant genetic resources.

The *Genebank Standards for Plant Genetic Resources for Food and Agriculture* arises from the revision of the FAO/IPGRI *Genebank Standards*, published in 1994. The revision was undertaken at the request of the Commission on Genetic Resources for Food and Agriculture (CGRFA) in light of changes in the global policy landscape and advances in science and technology. The main policy developments that impact the conservation of plant genetic resources for food and agriculture (PGRFA) in genebanks lie within the context of availability and distribution of germplasm arising from the adoption of various international instruments. These include the Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources (ITPGRFA), the International Plant Protection Convention (IPPC) and the WTO Sanitary and Phytosanitary Agreement (WTO/SPS). In 2010, the CBD adopted the Nagoya Protocol on Access to Genetic Resources and Equitable Sharing of Benefits Arising from their Utilization, which has potential for impact upon germplasm exchange. On the scientific front, advances in seed storage technology, biotechnology and information and communication technology have added new dimensions to plant germplasm conservation.

The *Genebank Standards for Plant Genetic Resources for Food and Agriculture* is intended as a guideline for genebanks conserving plant collections (seeds, live plants and explants). They were developed based on a series of consultations with a large number of experts in seed conservation, cryopreservation, *in vitro* conservation and field genebanks worldwide. The standards are voluntary and nonbinding and have not been developed through standard-setting procedure. They should be viewed more as targets for developing efficient, effective and rational *ex situ* conservation in genebanks that provides optimal maintenance of seed viability and genetic integrity, thereby ensuring access to, and use of, high quality seeds of conserved plant genetic resources.

It is important that these Genebank Standards are not used uncritically as there are continuous technological advances in conservation methods, much of it species-specific, as well as in the context of the purpose and period of germplasm conservation and use. It is recommended that the Genebank Standards should be used in conjunction with other reference sources, particularly with regards to species-specific information. This is especially true for plants producing non-orthodox seeds and /or are vegetatively propagated, of which there exist different seed storage behaviours, life forms (herbs, shrubs, trees, lianas/vines) and life cycles (annual, biennial, perennial) for which it is difficult to establish specific standards that are valid for all species.

This document is divided into two parts. The first part describes underlying principles that underpin the Genebank Standards and provide the overarching framework for effective and efficient management of genebanks. The key principles at the core of genebank operation are the preservation of germplasm identity, maintenance of viability and genetic integrity, and the promotion of access. This includes associated information to facilitate use of stored plant material in accordance with relevant national and international regulatory instruments. The underlying principles are common to all the different types of genebanks.

The second part provides the detailed standards for three types of genebanks namely: seed banks, field genebanks and *in vitro*/cryopreservation genebanks. The standards cover all the major operations carried out in genebanks and a selective list of references is provided for all standards. While key technical information is provided for the standards, it is important to note that appropriate technical manuals should be consulted for procedures and protocols. The seed bank standards (Chapter 4) deals with the conservation of the desiccation-tolerant orthodox seeds, i.e. can be dehydrated to low water content and are responsive to low temperatures. Lowering moisture and temperature decreases the rate of metabolic processes, thus