# Contribution of standards to developing networks and providing access to plant genetic resources

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## Abstract

The world is continually faced with the need to increase crop productivity, and to develop new varieties better adapted to face environmental and biological challenges or to meet the needs of local communities. To meet these needs and challenges, farmers and breeders must have access to a wide range of plant genetic resources (PGR) and to the essential information about those PGR and traits they possess to facilitate their utilization.

The value of PGR is dependent upon the information available. Accurate characterization and evaluation data promote use, especially if it is available in a standard format. Through the production of descriptors in collaboration with National Agricultural Research Systems, CGIAR centres, and crop research institutes and networks, Bioversity aims to stimulate the characterization and evaluation of PGR collections by providing uniform and unambiguous guidelines for the description and exchange of information on germplasm.

Crop descriptors and derived standards are essential for the scientific documentation of PGR. They are an important tool that permits the international PGR community to exchange information in a 'common' language. This in turn helps to develop active PGR Networks because data exchange is easy and enhances collaboration. Furthermore, these networks can be assembled into a global partnership whereby access to information and use of germplasm are further facilitated, which supports the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

**Keywords:** Standards, Descriptors, Characterization, Evaluation, Access, Information, Utilization, Plant Genetic resources.

## Introduction

This paper explores how standards contribute to establishing databases and developing networks and in this way, provide access to plant genetic resources information to further its utilization. It also provides and insight of the history of descriptor lists —scientific standards for documenting plant genetic resources— which have been developed by Bioversity International (formerly IPGRI) since 1976.

We can not manage what we do not know. In the same way, we can not use genetic resources if we do not know them, or if we do not know where we can obtain them. Germplasm accessions without information do not have any value, like books without a title.

There is a huge amount of plant genetic resources already conserved in genebanks worldwide, but all the associated information is of limited use because data are maintained in unlinked documentation systems, or simply because documentation is lacking. Although most genebanks have developed their own information system according to their needs, there are just a few examples of linkages among them. These constraints prevent breeders and users from effectively searching for desired crop specific genetic traits within all of the genebanks around the world.

Bioversity has been working since its inception to support the use and conservation of plant genetic resources through the development of scientific standards for crops. The idea for developing standardized methodologies for describing germplasm accessions was debated around 1976, as it was apparent that a universally understood methodology was essential for any global system of conservation and networks of genebanks to operate effectively (Gotor *et al.*, 2008).

Initially, there was not capacity of partners to understand characterization and evaluation data on crops common to them, leading to exchange of information and utilization of plant genetic resources. Furthermore, crop specific descriptors were not available and they were developed through experiences and observations about the crop. Only when many researchers are working on the same crop, they realize that there is a need to standardize the way they describe a characteristic or a trait, so that they can review and compare data from different sources. There are still cases where different genebanks measure the same trait of the same crop in different ways, giving totally different values for the same characteristic.

This lack of compatibility in documentation systems for describing plant genetic resources seriously affected data exchange between genebank collections. This was the reason behind the need to develop a methodology that had international approval and that could be easily used within a country and among different countries as well.

To be effective, the methodology needed to unambiguously and correctly describe an accession in order to discriminate between them within the same collection, thus, nurturing collaboration among scientists working in different countries.

A comprehensive and standardized description of a crop allows better compatibility between documentation systems and facilitates the exchange of information. This also reflects the value attached to traits by plant genetic resources researchers and users.

An accurate characterization and evaluation data promote and increase the use of plant genetic resources, particularly if it is available in a standard format, because information is the link between conservation and use. Conservation and use of plant genetic resources for food and agriculture are crucial for ensuring adequate food supply worldwide. Particularly nowadays, when the continuous improvement of crop plants is essential for agriculture mainly due to climate changes, and relies on the use of genetic variability through breeding.

In collaboration with partners throughout the world, Bioversity aims at building the knowledge base needed to ensure effective use of diversity to increase sustainable agricultural production, improve livelihoods and confront the challenge of climate change. The development of standards is one way to achieve its mission since the value of conserved plant genetic resources is dependent upon the information utilized to promote their use.

## Contribution to crops description

The development of standardized descriptors began in 1976, when a universal system was essential for global efforts in plant genetic resources conservation and for crop networks and genebanks to operate effectively. Bioversity in collaboration with CGIAR centres, crop networks, research organizations and national programmes, has developed descriptors for more than 100 crops in different languages.

Each crop descriptor list represents an important methodology and provides an internationally agreed format and universally understood language for plant genetic resources data, particularly regarding characterization and evaluation information. The adoption of this tool (and in some cases, a conversion method to Bioversity format), helped to create an efficient and reliable instrument for information exchange, storage and retrieval to facilitate the utilization of germplasm.

The Bioversity crop descriptors published so far represent 3.5 millions accessions held in genebanks worldwide and cover the 90% of the crops listed in the Annex I of the International Treaty. They also represent a 95% of the CGIAR mandate crops.

Descriptors contribute to increase knowledge and facilitate research not only on mandate crops, but also on crops that have limited attention by the research community but which are often crops preferred by the poor. The 35% of crop descriptors deal with Neglected and Underutilized crops.

In addition to the use of these traditional crop standards made by the majority of plant genetic resources workers, they are being used as 'best practices' and most of them have been adopted by the Crop Genebank Knowledge Base (which is a product of the System-wide Genetic Resources Programme). Furthermore, the current activities on controlled vocabularies, such as the Trait Ontology Consortium, or the Generation

Challenge Programme have adopted most of the text included in the crop standards or use them as data templates.

## Impact of passport standards

When germplasm collections were integrated into multicrop collections at the national level, it was evident that common descriptors were required to be more consistent across different crops. As a result, Bioversity jointly with the Food and Agriculture Organization of the United Nations (FAO), with substantial contributions from European countries and CGIAR Centres, published a standard for passport data, the List of Multi-crop Passport descriptors (FAO/IPGRI, 2001).

This subset of passport information provides an international standard across crops to facilitate information exchange on passport data in research institutions worldwide. It constitutes the basis for a standardized documentation system. Each descriptor incluyes suggested field names to assist in a computerized exchange of data and a brief explanation on how to record the information.

This standard has had a huge impact, especially in Europe where the European Search Catalogue of Germplasm Accessions (EURISCO) with passport information on *ex situ* collections maintained in Europe has been developed based on the passport standard. This European Catalogue contains information on around 30 countries representing more than 1.0 million accessions from Europe. Additionally, this standard for passport data is being used as a basis for the development of many of the central crop databases belonging to the European Cooperative Programme for Plant Genetic Resources (ECPGR).

Same applies to the FAO-WIEWS Directory of Germplasm Collections, which includes passport data fields matching this standard. Also, almost all CGIAR centres follow, whenever possible, the format and content proposed, making it easier to retrieve or exchange data.

Outside the CGIAR system, other scientific organizations such as the Crop Scottish Crop Research Institute have adopted the MCPD to create their database (GERMINATE), a software which links phenotypic and genotypic data through passport data. It has been also adopted by the Generation Challenge Program for the creation of 'The Bioversity/FAO MultiCrop Passport Descriptor Ontology' which is an adaptation of the FAO/IPGRI passport standard.

## Coping with marker technologies information

With the rapid development of marker technologies and an increased molecular and biochemical characterization of plant genetic resources, the need arose to define common standards for documenting information about genetic markers. In order to address this issue, Bioversity published the 'Descriptors for Genetic Marker Technologies' to complement classical agro-botanical analysis (De Vicente *et al.* 2004). This descriptor list includes a minimum set of standards for documenting information about genetic markers and is targeted at researchers who use genetic marker technologies. This standard is meant to facilitate documentation and exchange of standardized genetic marker data. It also provides descriptions of content and coding schemes that will assist in computerized data exchange.

## Integrating farmers' knowledge and science

In an effort to integrate traditional knowledge and science, Bioversity has developed in 2009, a standard for sharing data describing farmers' knowledge about people and plants. This standard has been developed to create a *lingua franca* to capture and share information amongst farmers and scientists and to integrate biology and traditional knowledge.

It provides a standard format for the gathering, storage, retrieval and exchange of farmers' knowledge of plants. It aims to capture key characteristics, uses and values of cultivated and wild plants as described by farmers and other people in farming communities. Many of these descriptors are not included in conventional descriptor lists. Wild and weedy plants are also covered by this list since they often play a significant role in farming communities, being useful from a socio-economic and ecological standpoint.

This standard is a first attempt to combine a documentation system traditionally used in controlled environments (genebanks, breeding institutes) with an approach that involves people and their knowledge 'in the field'. We hope that this list, which is the result of many years of review of fieldwork by scientists and field practitioners, will become an important tool for integrating biology and traditional knowledge (Bioversity and The Christensen Fund, 2009).

## Maximizing information through a global portal

Bioversity and its partners are currently developing common information standards to describe the key characteristics of genetic resources that are important for crop improvement, so everyone can communicate effectively, through a project funded by the Global Crop Diversity Trust. These key standards constitute the backbone of the global portal of information on germplasm accessions which aims at making key information about accessions available for breeders and others in order to use the material stored in genebanks. This will increase the utilization of biodiversity, which is the key to agricultural development in a time of climate change.

The goal of the project is to provide access to information by scientists to the material they need and addresses the impediments faced by users who seek hard to find data about germplasm that can provide resistance to biological and abiotic stresses that reduce yields.

The project has three components: the first component will mobilize scientists to agree on initial key sets of characterization and evaluation traits of most interest to users. These standards will be incorporated into the second component, the GRIN-Global genebank datamanagement system being developed by USDA through another project funded by the Trust. This system will be deployed to national programmes and other genebanks in developing countries. Finally, the third component of the project involves the development of a global accession-level information portal for accessing and managing accession data in support of conservation and use of crops for food and agriculture, by linking up national, regional and international genebank databases (see Figure 1).

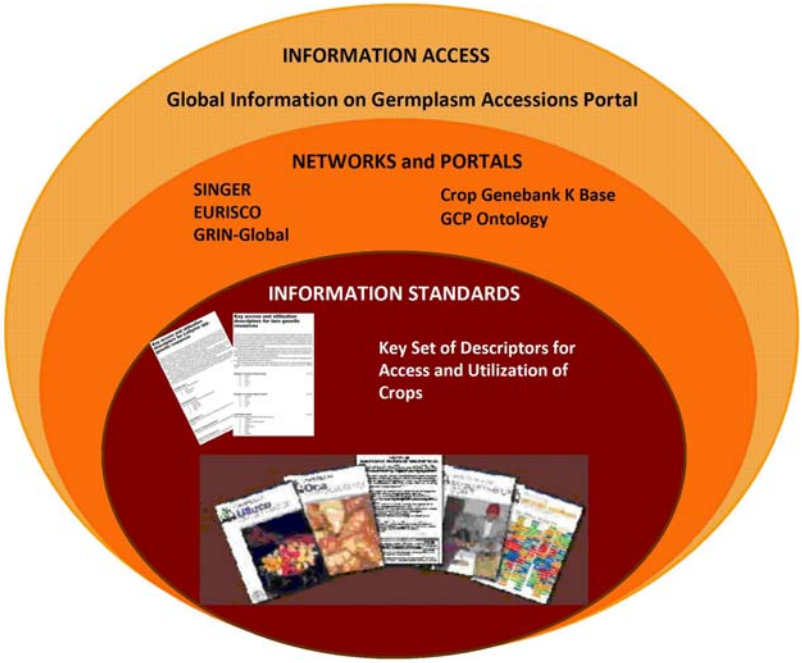


**Figure 1. Contribution of standards to developing networks and providing access to PGR utilization**

## Conclusion

Through the production of standards in collaboration with partners, Bioversity aims to stimulate the characterization and evaluation of plant genetic resources collections by providing uniform and unambiguous methodologies for the description and exchange of information on germplasm. Thus, the adoption of descriptors and derived standards should be integral to genetic resources activities, assuring adequate germplasm conservation and its efficient utilization in crop improvement programmes.

Crop descriptors and derived standards are essential for the scientific documentation of plant genetic resources and are an instrumental tool that permits the international community to exchange information in a common language. This in turn helps to establish databases and to develop crop networks because data exchange is easy, and nurture collaboration globally.

Furthermore, these networks can be assembled into a global portal whereby access to information and use of germplasm are further facilitated, which assures a full implementation of the Convention on Biological Diversity and supports the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

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