Chapter 28: Processing of germplasm, associated material and data

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Abstract

Together, the material and associated information assembled prior to the completion of a collecting mission represent the most important outcome of the mission. Furthermore, any accessions or reference materials are of little value unless accompanied by the associated information that facilitates their use. There have been few changes to the activities involved with the processing of germplasm, associated material and data acquired during plant collection missions since the original version of these guidelines was published. Changes primarily relate to technological advances and standardization of descriptors, which allow much of the information associated with the mission to be captured electronically, either during or after the actual mission. These include notebook computers, personal digital assistants (PDAs), smartphones, digital cameras and geographic positioning systems (GPS). The data-collection forms used in the past are no longer available but contemporary technology, along with data standards, allow these to be quickly developed and customized for specific genera and situations. Several international initiatives have occurred since 1995; these offer updated information that mainly relates to the data component. This chapter provides guidelines to assist in the processing of germplasm and reference samples along with associated data.

Introduction

While much of the work involving the processing of germplasm, associated material and data is determined during the planning phase of a collecting mission, actually completing these activities may require significant onsite decision making regarding procedures and processes to ensure that the material and its associated information are both as complete and accurate as possible. Since 1995, little has changed in the processing, drying, cleaning, treatment and phytosanitary inspection, sharing out, packaging and dispatch of collected samples. However, in the case of gathering and handling data, there have been some significant changes, mostly associated with the availability of new technologies and the standardization of descriptors to facilitate data gathering, management and storage during the collecting mission, so that their use in

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This chapter is a synthesis of new knowledge, procedures, best practices and references for collecting plant diversity since the publication of the 1995 volume *Collecting Plant Diversity: Technical Guidelines*, edited by Luigi Guarino, V. Ramanatha Rao and Robert Reid, and published by CAB International on behalf of the International Plant Genetic Resources Institute (IPGRI) (now Bioversity International), the Food and Agriculture Organization of the United Nations (FAO), the World Conservation Union (IUCN) and the United Nations Environment Programme (UNEP). The original text for Chapter 28: Processing of Germplasm, Associated Material and Data, authored by J. A. Toll, has been made available online courtesy of CABI. The 2011 update of the Technical Guidelines, edited by L. Guarino, V. Ramanatha Rao and E. Goldberg, has been made available courtesy of Bioversity International.

research and plant improvement can be facilitated. There are also more options for safety duplication today. International initiatives, such as the International Treaty on Plant Genetic Resources for Food and Agriculture and the Global Crop Diversity Trust, bring additional responsibilities and resources for collectors. And there are many online resources to assist in the planning and execution of collecting missions. These change constantly, but internet search engines enable the most current resources to be quickly located and assessed.

Current status

The International Plant Genetic Resources Institute (IPGRI) changed its operating name to Bioversity International in 2006. All reference to IPGRI in the original text should now read as 'Bioversity'.

Since 1995, there have been ongoing technological developments that provide opportunities to electronically capture most, if not all, of the data previously written onto data-collection forms. At that time, most information from collecting missions was captured as hardcopy/written text on standard forms, and photographic records were based on film technology. Today, digital photography has mostly replaced film-based photographs and also provides options for storing and sharing data more widely than what was possible with film-based photographs and slides. Additionally, new technologies can now make the capture, processing, storage and distribution of data much more accurate and efficient.

There are three technological advances relevant to this chapter:

- Portable computers, personal digital assistants (PDAs), smartphones and global positioning systems (GPS) all allow the accurate capture of pertinent data in the field.
- Digital photography makes the capturing, labelling and duplication of images much easier than what was possible in 1995. Image files, together with associated metadata, can be downloaded to computers as required.
- Environmental data associated with collection sites can be electronically harvested using geographic information system (GIS) technology.

The portable computer, now mostly represented by notebook/laptop and netbook designs, allows data to be captured *in situ* on electronic text-based forms (facsimiles of hardcopy forms) entered directly into a database. This allows 'data standards' to be enforced by enabling the operator to select input based only on the accepted standards for the specific data being recorded. For example, the options for 'biological status' in the FAO/IPGRI List of Multi-crop Passport Descriptors (MCPD) (FAO/IPGRI 2001) can be fixed in the database as the only permitted values for this data field. More recently, other options have become available for electronically capturing collecting-mission data onsite. These include the PDAs, GPS and smartphones. They employ a number of common operating systems, most of which have GPS and database applications to facilitate the ease of capturing information, processing and storing it, and ensuring quality.

A GPS device can determine the georeference of the collecting site simply and accurately (Kaplan and Hegarty 2006)). The use of a standard geographical datum, such as WGS84, is recommended and should be part of the georeference annotation. Many modern smartphones also have GPS functionality, providing an alternative option for capturing georeferences.

Digital photography, together with associated computer software for annotating, editing and enhancing digital images, allows significant additional information to be captured and reviewed *in situ* before accepting it for inclusion with the other information associated with each germplasm and/or reference sample.

While time is precious during actual collecting activities, it can be a simple process to capture additional data outside collecting hours. One example would be to harvest environmental information about each collecting site from continuous surface layers of such data stored on a personal computer. These data could include climatic data, such as that available from WorldClim (Hijmans et al. 2005) or other sources (De Pauw 2002). This type of information can be generated in advance by creating continuous surface digital maps for the region where the collecting mission is to take place, for environmental parameters from point data using the 'thin-plate smoothing spline' method (Hutchinson and Corbett 1995), as implemented in ANUSPLIN software (Hutchinson 2000). Then the value of each parameter can be extracted from the digital maps for each collecting site and associated with the germplasm sample. Adding value to germplasm in this way requires the use of GIS technology, such as Diva GIS (Hijmans et al. 2001).

The data can be dispatched as hardcopy (computer-generated, typed or handwritten) or on electronic media, or they can be transmitted electronically. A hard copy of the data should accompany sample shipments.

Although many organizations develop their own collecting forms according to their specific needs, this has led to difficulties in data exchange. To address this challenge, Bioversity International, in collaboration with crop experts, promotes the standardization of descriptors, and many crop descriptor lists include a crop-specific collecting form. A useful source of Bioversity descriptors and derived standards is available on the Bioversity website (www.bioversityinternational.org/?id=3737).

Germplasm should be duplicated in at least two other collections. While some base collections are still able to provide a duplication service, it is also recommended that duplication in 'significant international collections' (including the CGIAR international collections) be ensured. There is also the option to have material securely backed up in the Svalbard Global Seed Vault (www.croptrust.org/main/arcticseedvault.php?itemid=211).

The IPGRI software mentioned in the earlier version of this chapter, in the section on processing reference samples, no longer exists. Relevant information and descriptors for creating electronic tools for data collection are available from various sources, including Bioversity's website (www.bioversityinternational.org). Additional information and resources are available from a number of other sites, including the Kew Royal Botanic Gardens (www.kew.org) and the Australian National Botanic Gardens (www.anbg.gov.au). A data-collecting template for direct use or for developing a customized tool for data input will soon be available from Bioversity International.

Future challenges/needs/gaps

Data standards are crucial to the long-term utility of all information gathered during collecting missions. Without accepted standards, information about collecting sites is less easily shared, putting correct identification of germplasm accessions at risk. It is imperative that the MCPD List of passport descriptors (FAO/IPGRI 2001) be used in all collecting activities to facilitate the effective access to and use of collection-site data.

Interoperability and/or linkages between information systems should be a goal behind documenting collection-site data. Interoperability allows systems to work together (inter-operate), thereby sharing data, while links allow users to identify a source of information in one system and then move to the second system using tagged URLs in the first system. These and similar technologies allow many systems to contribute to a greater store of information.

Conclusion

While there have been no significant changes in handling seed and reference samples during the collecting mission, a number of advances in the form of new technologies and standardized descriptors are now widely used for information capture, quality enhancement, processing, storing, distribution and ensuring that the collected germplasm can be more easily utilized in research and breeding programmes.

Updates primarily involve the capturing of data electronically in standardized format, the use of electronic storage and distribution technologies, and the associated shift from using paper forms for data collection and distribution.

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Internet resources

Australian National Botanic Gardens: www.anbg.gov.au

Bioversity International: www.bioversityinternational.org

Bioversity International Collecting Missions Database: http://singer.cgiar.org/index.jsp?page=coll-sample-data

Bioversity International Descriptor Lists and Derived Standards: www.bioversityinternational.org/?id=3737

DIVA-GIS: www.diva-gis.org

FAO/IPGRI Multi-Crop Passport Descriptors (MCPD): www.bioversityinternational.org/nc/publications/publication/issue/faoipgri_multi_crop_passport_descriptors.html

Global Crop Diversity Trust: www.croptrust.com

International Treaty on Plant Genetic Resources for Food and Agriculture: www.planttreaty.org

Royal Botanic Gardens, Kew: www.kew.org

Svalbard Global Seed Vault: www.croptrust.org/main/arcticseedvault.php?itemid=211

WorldClim: www.worldclim.org