Chapter 13: Published information resources for plant germplasm collectors

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Abstract

Widespread access to the internet and the technological changes we have seen over the last 16 years, since the first edition of this collecting manual, have dramatically altered the way people access and use information. They have also changed the paradigm of scientific publishing and research. Tools and resources for accessing information on plant genetic resources have grown and evolved from being mainly traditional and paper-based to sophisticated web-based platforms that provide the researcher with many features. Other tools, such as the social media platforms that have recently emerged, allow researchers to connect and collaborate with their peers regardless where they are located in the world. This paper looks at selective trends and movements that have had an impact on the paradigm of scientific publishing and research in the last 16 years, and, within this context, highlight authoritative web-based information resources for those working in the area of plant genetic resources.

Introduction

Sixteen years has passed since the publication of the first edition of *Collecting Plant Genetic Diversity : Technical Guidelines*. In that time, widespread access to the internet, along with other technological changes, have dramatically altered the way people access and use information. They have also changed the paradigm of scientific publishing and research. Sixteen years ago, a researcher would have primarily consulted hardcopies of abstract journals or standalone databases that were available at a library for his/her research purposes. The completed research would then be disseminated mainly via the medium of publishing in a scientific journal (available only in hardcopy). The same researcher would then meet and collaborate with peers, face to face, at conferences.

This scenario of only 16 years ago is difficult to grasp, when today, searching for information on search engines such as Google has become second nature, as has our ability to access, disseminate and generate information. The internet, today, can allow that same researcher to make his/her work available to the world, anywhere, at any time, in many different formats. It can also allow the researcher the possibility of collaborating with peers on different electronic platforms without leaving his/her desk.

While accessing the internet has now become part of our daily lives, the unprecedented amounts of information a researcher is faced with can be daunting. Together, published and professional web content is estimated to generate about 5 gigabytes/day, whereas user-generated content is created at the rate of about

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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 Genetic 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 13: Bibliographic Databases for Plant Germplasm Collectors, authored by J .A. Dearing and L. Guarino, 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.

10 gigabytes/day and growing. (Agichtein et al. 2009). These figures make it eminently clear that filters are required in order to access high-quality, authoritative scientific information. There is also a need to explore the concept that scientific research is now being carried out, communicated and disseminated by social media tools that previously did not exist. The researcher today has the opportunity to access information from many different formats, not just the traditional bibliographic databases that were discussed in the 1995 edition of these technical guidelines.

The two main objectives of this chapter are (1) to look at selective trends and movements that have had an impact on the paradigm of scientific publishing and research in the last 16 years and (2) within this context, to highlight authoritative web-based information resources for those working in the area of plant genetic resources.

Current status

The focus of this chapter is on the main trends and phenomena that have emerged over the last 16 years: (1) using search engines more effectively, (2) open-access resources, (3) social-media tools, (4) bibliographic databases and (5) reference-management systems.

Web searching: how to improve search results

Nowadays most people use the internet for their research purposes, but how effectively? If we are to examine the daunting statistics given to us by Agichtein et al. (2009), we realise that learning how search engines respond to queries can make a significant difference in the results we encounter when searching the web. Learning a few quick shortcuts and tricks can assist the researcher in finding more relevant and targeted information. Most of the major search engines have tutorials and guides on how to improve search results and retrieve relevant information. Table 13.1 provides a good overview of the search engines that are most used and where to locate their on-line tutorials and cheat sheets.

Table 13.1: Web Searching: Improving Your Search Results

This table provides information on where to locate search tips, shortcuts and cheat sheets for the three major search engines currently in use. Learning to use these tips will improve the relevance of research results.

Search engine	Search tips, shortcuts and cheat sheets
Google Search	Basic search help Advanced search help Cheat sheets
Yahoo!	Using Yahoo! Search (covers simple, advanced searching, plus tips and preferences) Cheat sheets
Bing	Search tips and techniques Advanced search options Advanced search keywords

Note: Access date for this information was 30 June 2011.

Google is the most used search engine. As of December 2010, its market share was 90.57% (StatCounter 2011). Nancy Blachmann from GoogleGuide.com has developed a simple and clear overview of the responses Google will provide depending on how one formulates the query (figure 13.1).

These searching tips can also be used when searching across portals such as Google Scholar, which is one of the major free web search engines that indexes the full text of mainly scholarly literature across an array of disciplines. It allows the researcher to search across many sources (e.g., professional societies, universities, academic publishers) from just one place, and one can view papers and documents either in full text or with a limited preview, depending on the content provider and how much they want their content to be freely available. Google Scholar is one of the first places many researchers refer to when embarking on specific fact-finding.

SAMPLE QUERIES	IN RESPONSE GOOGLE GIVES YOU PAGES with ...
holiday travel	the words **holiday** and **travel**
Aruba **OR** *Bermuda*	the word **Aruba** or **Bermuda**
"I have a dream"	the exact phrase **I have a dream**
+I spy	the words **I** & **spy** (force Google not to ignore **I**)
salsa -dance	the word **salsa** but NOT the word **dance**
part-time	the words **part-time**, **part time**, or **parttime**
Google ~Guide	the words **Google** & both **guide** & its synonyms
DVD player $100..$150	DVD players between $100 and $150
hybrid cars **site:***npr.org*	**hybrid cars** from the website **npr.org**
kite aerial photos **site:***edu*	**kite aerial photos** from the **.edu** domain
SAMPLE QUERIES	**IN RESPONSE GOOGLE GIVES YOU ...**
define:*gato*	definitions of **gato** from the web in several languages
books *"Alice in Wonderland"*	book-related info; click Book results to search text
movie:*Capote*, **movie:***94010*	reviews, showtimes, & locations
music:*Simon Garfunkel*	music-related info & where you can buy the music
weather *San Jose CA*	weather condition and forecast
15 **% of (***12***+***34*******5***/***6***)**	results of calculations
3 Euros **in** *US$*, *95 lbs* **in** *kg*	conversion of *x units* into *y units*
cbou goog hpq msft	financials including stock price, given a ticker symbol

Source: www.googleguide.com. Original can be found at www.googleguide.com/cheatsheet.html.

Figure 13.1: Formulating queries for Google

In some cases, it might also be relevant to search specifically for news items on different PGR-related issues, rather than websites in general. Strategies for doing this are discussed on the Google Books portal.

"Open" information resources: scholarly literature

The movement in scholarly publishing, known as open access, became much more prominent in the 1990s with the advent of the internet. It is a topic that in recent years has become the subject of much discussion among the academic community, funding agencies, government officials and publishers. "By 'open access' …we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself" (Suber 2011).

Open-access scientific content is accessed in two primary ways: through open-access repositories (digital collections) where researchers archive or deposit their post-print, or via open-access journals and e-books. While open access was a term hardly heard of 16 years ago, a study carried out by Björk et al. (2010) revealed that 20% of peer-reviewed articles across all disciplines are now freely available over the web, and this figure will continue to grow as authors and their affiliated organizations begin to understand the benefits that open access can bring.

One such benefit is higher citations: open-access papers are more cited than papers that are behind a "payment wall" (Hajjem and Harnad 2005; Harnad and Brody 2004; Swan 2010). Higher citations important for many universities or research organizations that want to improve their research impact and prestige. Yet, at the same time, content that is open access is often misunderstood, and at times the quality of the science published as open access is seen as somewhat inferior; however, as Swan (n.d.) succinctly states, "Open access is not self-publishing, nor a way to bypass peer-review and formal publication, nor is it

a kind of second-class, cut-price publishing route. It is simply the means to make research results freely available online to the whole research community." In fact, many open-access scientific journals are widely read and have impressive impact factors; the journal *PLOS Biology* has an impact factor of 12.469 (Thomson Reuters 2011)

There are numerous "open" information resources and platforms that are available on the internet for researchers working in plant genetic resources, where it is possible to access full-text research papers. Content is immediate, online and freely available without the use restrictions commonly imposed by publishers. Another major benefit open access brings is that it has removed the cost barrier for accessing scientific information, particularly for researchers and libraries in developing countries who cannot afford the cost of journal subscriptions. Major open-access resources include journal portals, institutional repositories and e-books. Details about selected resources are outlined in Table 13.2.

Table 13.2: Open-Information Resources: Scholarly Literature

This table outlines the major open-access websites and resources where it is possible to access the full text of research papers, documents and books. The main types of resources found in this table include journal gateways, virtual libraries and repositories. In most cases, content from these websites can be reused, disseminated and copied without requesting permission from the creator.

Resource/Platform	Type	Facts and features
Directory of Open Access Journals (DOAJ) DOAJ lists high-quality, peer-reviewed scientific and scholarly journals that are freely available to all from the time of publication. *Access date: 28.07.2011*	Journal gateway	• hosted by Lund University Libraries, Sweden • aim is to increase the visibility and ease of use of open-access scientific and scholarly journals, thereby promoting their increased usage and impact • free, full-text, quality-controlled scientific and scholarly journals, covering all subjects and many languages • directory holds 6100 journals, of which 2591 are searchable at article level
HighWire Press HighWire Press partners with independent scholarly publishers, societies, associations and university presses to facilitate the digital dissemination of scholarly literature. *Access date: 19.05.2011*	Journal gateway	• hosted by Stanford University (USA) since 1995 • hosts the largest repository of free full-text life-science articles in the world (over 2 million papers available without subscription) • some papers available after an embargo period • innovations include e-book content • mobile applications for smart phones, iPads and e-readers are available
Public Library of Science (PLOS) PLOS is a nonprofit organization of scientists committed to making the world's scientific and medical literature a freely available public resource. *Access date: 28.07.2011*	Journal gateway	• founded in 2000, publishing began in 2003 • presently has 7 titles, 6 of which are dedicated to core research areas; one is for the swift publication of original research in all areas of science and medicine • journal titles are peer reviewed, citation tracked and have impact factors • research papers are available immediately after publication
BioMed Central (BMC) BMC is a science, technology and medicine (STM) open-access publisher. *Access date: 28.07.2011*	Journal gateway	• has a portfolio of 218 journals • includes general titles such as *BMC Biology* alongside specialist journals such as *BMC Bioinformatics* that focus on specific disciplines • journal titles are peer reviewed, citation tracked and have impact factors • all research articles published by BioMed Central may be freely accessed, re-used and redistributed • includes interesting thematic series (i.e., *Open Access Biodiversity Research*)

Table 13.2: Open-Information Resources: Scholarly Literature (continued)

Resource Platform	Type	Facts and Features
Open J-Gate Open J-Gate is a directory of open-access journals *Access date 28.07.2011*	Journal gateway	• launched in 2006 • hosted by Informatics Ltd. (India) • links to the full-text of articles from more than 18,000 journals • content is taken from both the scholarly and popular domains • content is both peer reviewed and not reviewed
Biodiversity Heritage Library (BHL) BHL is a consortium of 12 natural-history and botanical libraries that have embarked on a digitization project to make the legacy literature of biodiversity held in their collections freely available. *Access date: 28.07.2011*	Virtual library	• initiated in 2003 • works with the international taxonomic community, rights holders and other interested parties to ensure that biodiversity information is made available to a global audience through open-access principles • focuses on the digitization of biodiversity legacy literature • 31+ million pages had been digitized as of September 2010 and are accessible
CGBooks on Google Directory of CGIAR published research outputs. *Access date: 14.07.2011*	Virtual library	• *CGBooks* is a virtual platform for free, full-text access to over 2000 books published and copyrighted by the various CGIAR centres • allows for federated searching across all CGIAR research publications • launched in 2009, content is multidisciplinary and covers all areas of work of the CGIAR • links are also provided to individual centre publication sites
OAISTER A union catalogue of millions of records representing open-access digital resources. *Access date: 14.07.2011*	Virtual library	• initiated in 2002 • includes more than 25 million records representing digital resources from more than 1,100 contributors (as of June 2011) • contains multidisciplinary resources and formats such as theses, technical reports, research papers, audio files, video files, images and data sets
Bielefeld Academic Search Engine (BASE) BASE is a search engine especially for open-access academic web resources. *Access date: 30.06.2011*	Search engine	• operated by Bielefeld University Library (Germany) • multidisciplinary search engine to scholarly internet resources • 28,911,265 documents from 1,890 content sources

Social-media tools for researchers

On-line social-media platforms such as blogs, wikis and micro-blogging sites such as Twitter provide a quick, effective means of engaging with other researchers. They have rapidly changed the way science is communicated and disseminated in the last few years, allowing researchers to keep abreast of emerging trends and developments in their respective disciplines.

So what exactly are social media? They are "the use of web-based and mobile technologies to turn communication into interactive dialogue" (Wikipedia 2011a). Most social-media platforms encourage discussion, feedback and sharing of information. Tools such as Twitter, for example, allow a person participating in a conference to write short updates (called *tweets*) about what is being discussed in real time. The participant's followers can keep abreast of the conference's developments wherever they are located in the world, and they are able to respond and interact with the person providing the updates. This type of communication was unimaginable 16 years ago.

The uptake and use of these tools is increasing within the scientific and research community. Why are researchers increasingly using social-media tools? Gruzd and Staves (2011) and prior studies have highlighted three main benefits:

- Researchers need to communicate with their peers, and social media allow them to do this regardless where they are located, at a low cost.
- Social-media platforms provide researchers with the ability to create a community or network of like-minded scholars, which can facilitate and bring together people working on similar research.
- Social media provide the opportunity to expand on ideas or research from the direct interaction between researchers and their readers.

In addition to Twitter, some of the more popular social-media platforms include wikis and blogs (see table 13.3 for specific links and more details about social-media platforms and tools). The wiki GRIN-Global is a good example of how researchers from different institutions in different locations in the field of plant genetic resources are able to collaborate and work together using social-media tools. Other social-media tools include forums (ScienceForums.Net) and platforms where one can upload and share scientific videos (SciVee), presentations (SlideShare) and images (Flickr). Only time will tell if these existing social-media platforms will be enhanced or even superseded by new technologies; however, the concept and value of "sharing ideas" is an integral part of human nature; consequently, it is difficult to think that social-media platforms will not continue to be part of our working and social domains for many years to come.

Table 13.3: Social Media Tools and Platforms

This table highlights social media websites that encourage scholarly discussion, feedback and sharing of information.

Resource name	Coverage and features
Flickr *Access date: 26.07.2011*	• launched in 2004, one of the biggest websites for sharing and managing photos • images can be uploaded through the web, mobile devices, e-mail or other photo applications • images can be shared publically or kept private • provides a Creative Commons collection of photos where users can re-use images under certain conditions • access: offers both a free or professional account for users • mobile applications are available
Mixxt *Access date: 26.07.2011*	• allows users to create their own social networks or communities of practice without needing IT expertise (a network can be set up very quickly and easily in a few minutes) • functionalities include customizable layout, discussion forums, event management, wikis, as well as file and media sharing • users have full control over the access levels to their networks • access: offers both free and premium accounts
ResearchBlogging *Access date: 26.07.2011*	• allows readers to easily find blog posts about serious peer-reviewed research • scans registered blogs for posts and updates, indexes them and then displays them from its home page, making hundreds of blog posts available to readers from a single platform • the quality of the posts is monitored by member bloggers and editors • topics of interest include biology, ecology, conservation, genetics, bioinformatics and agriculture
SciVee *Access date: 26.07.2011*	• founded in 2007 as a community site to promote research work and collaboration • researchers can upload videos and other media elements that compliment their scientific publication(s) • one of the main content types of this website is the *pubcast,* a short video of the author speaking about his/her published paper while the text of the paper is displayed next to the video • often referred to as the "YouTube for Science • access: registration is free and allows members to interact via messaging, community forums and blog

Table 13.3: Social Media Tools and Platforms (continued)

Resource name	Coverage and features
ScienceBlogs *Access date: 26.07.2011*	• launched in January 2006, ScienceBlogs is a portal that hosts over 80 blogs from an array of scientific disciplines, including the life sciences and the environment
ScienceForums.net *Access date: 26.07.2011*	• on-line platform where science and scientific topics are discussed at all levels – from beginners to researchers • registration is required to post to the forum or to reply to others • one can subscribe to topics and forums to get automatic updates • moderators and administrators of the website ensure that etiquette is maintained and non-scientific content is removed
Slideshare/SlideBoom *Access date: 26.07.2011*	• online slide-hosting websites • researchers can upload and share their presentations, either privately or publicly • presentations can be embedded in blogs and websites • scientific content on Slideshare is much more extensive than SlideBoom • Slideshare also supports other format types such as documents, PDFs, videos and webinars • SlideBoom offers free PowerPoint presentation templates • SlideBoom allows for the upload of presentations without any loss of features, including embedded audio, video and transitions (Slideshare presently does not offer this) • access: both platforms provide either free or professional accounts
Twitter *Access date: 26.07.2011*	• allows people to share information and interact with one another via very short messages that cannot be more than 140 characters • provides the ability to follow individuals and organizations working in PGR and allows users to keep up with emerging trends and latest research news • registration required in order to follow people and to post messages (registration is free) • mobile applications are available for smartphones and iPads
Wikis *Access date: 26.07.2011*	• an on-line collaborative space where researchers can work together • provide editing features so research papers and documents can be developed • other features include calendars, shared document folders, user profiles and discussion areas • good examples of active wikis in the PGR domain are Grin Global and the Crop Genebank Knowledge Base

Bibliographical databases

Bibliographical databases are, and have always been, important tools for conducting research. With the advent of the internet, many of the bibliographic databases that were featured in the 1995 edition of the Technical Guidelines have remodelled themselves from standalone databases to web-based digital libraries. Often, these databases not only provide the full text to indexed and abstracted content, but also often provide the researcher with tools for analysis and are capable of carrying out federated searches across data silos. A federated search is an information-retrieval technology that allows the simultaneous search of multiple searchable resources. A user makes a single query request, which is distributed to the search engines participating in the federation. The federated search then aggregates the results that are received from the search engines for presentation to the user (Wikipedia 2011b).

These platforms are always in constant evolution and are consistently improving and extending content, search features and support tools. Table 13.4 provides a listing of the main bibliographic databases for agriculture and plant science, which will be useful to a researcher working in plant genetic resources.

Table 13.4: Agricultural Bibliographic Databases

This table highlights the main bibliographic databases that cover agriculture, PGR and the life sciences.

Resource name	Coverage and features
AGRICOLA *Access date: 07.07.2011*	• serves as the catalogue and index to the collections of the US National Agricultural Library (NAL) • encompasses all aspects of agriculture and allied disciplines; coverage is mostly US publications • organised into two bibliographic data sets: *NAL Online Public Access Catalog* (which contains citations to books, audiovisuals and serials) and *Article Citation Database* (which includes citations to journal articles, book chapters, reports and reprints) • the two data sets can be searched separately or together. • access: freely available to all
AGRIS *Access date: 07.07.2011*	• coordinated and maintained by FAO since 1970 • content provided by 150 participating institutions from 65 countries • content includes unique grey literature, such as unpublished scientific and technical reports, theses, conference papers and government publications • future plans: AGRIS will be able to retrieve and interpret a wealth of diverse information sources, including full-text documents, threads from discussion forums, blog entries and news articles • access: freely available to all
CAB Abstracts/Plant Genetic Resources Abstracts (PGRA) *Access date: 07.07.2011*	• one of the main research products of the CAB International publishing group • holds over 6.3 million records from 1973 onwards • derived from the CAB Abstracts database, PGRA provides the latest information on the genetic resources of all plant species of economic value, as well as focusing on their wild relatives • includes information from core scientific journals as well as grey literature (including conference proceedings, annual reports, general reports and theses) • access: both databases are subscription based
FAO Corporate Document Repository *Access date: 14.07.2011*	• contains FAO documents and publications that are available in electronic format, full text • documents include publications, articles and reports of meetings • content covers all areas of the organization's work • access: freely available to all
Google Scholar *Access date: 07.07.2011*	• a subset of the larger Google search index, coverage consists of scholarly full-text journal articles, technical reports and books covering all disciplines • more a search engine than a bibliographic database, it does have similar functions to other subscription-based platforms in that it provides citation information and links to full texts where possible • the "cited by X" feature is very useful in finding citations • access: freely available to all
ISI Web of Knowledge Web of Science, Biological Abstracts, Biosis Previews *Access date: 07.07.2011*	• one of the main research products of Thomson Reuters • coverage is vast: 23,000 journals, 23,000,000 patents, 110,000 proceedings, 9,000 websites and over 250 product categories • aggregates both tools and content (biological abstracts, Biosis Previews, Web of Science, journal citation reports and author identification tools) in one place • a unified subject classification creates a unified, complete search across the whole platform • mobile applications are available • access: subscription based

Table 13.4: Agricultural Bibliographic Databases (continued)

Mendeley Research Catalog *Access date 14.07.2011*	• released in 2008, it is the biggest crowd-sourced catalogue on the web • holds approximately 31 million papers and is multidisciplinary • content provided by the major scientific, technical and medical publishers, learned organizations, individuals and other web-based catalogues like Google Scholar and Google Book Search • part of the Mendeley desktop and web program for managing and sharing papers • mobile applications are available • access: freely available to all
MusaLit *Access date: 14.07.2011*	• maintained by Bioversity International • largest bibliographic database that focuses specifically on *Musa* spp. • contains 12,968 trilingual bibliographic references (English, French and Spanish) • provides a searchable PDF archive • access: freely available to all
Science Citation Index (SCI) *Access date: 14.07.2011*	• one of the research products of Thomson Reuters, • part of the Web of Science databases • provides access to bibliographic and citation information from over 3,700 of the world's leading journals • allows for focused searching across high-level, peer-reviewed journals • provides cited reference searching, so one can see how their own, or colleagues' papers are being cited • expanded version (Science Citation Index Expanded) also exists, covering 6,500 high-level journals • access: subscription based
SciVerse SciVerse Scopus SciVerse Science Direct *Access date: 07.07.2011*	• one of the main research products from Elsevier, originally named "Scopus", launched in November 2004 • includes 18,000 titles (of which 16,500 are peer-reviewed) from 5,000 international publishers • integrates the content from Scopus, Science Direct and other web content on one platform and provides federated searching across these research products • mobile applications available • access: subscription based
Scirus *Access date: 07.07.2011*	• owned by Elsevier, it is a free search engine that focuses primarily on scientific information • being science specific, it acts as a filter and removes all the "noise" that one usually gets from a normal Google search • content is obtained from domains such as universities, government departments, subject repositories, publisher websites, patent offices and scientific organizations • access: searching the database is free to all; content is either accessible full text or by subscription or a one-off payment
Tropag and Rural *Access date: 14.07.2011*	• produced by the Royal Tropical Institute (KIT) in the Netherlands • covers all aspects of agriculture and livestock in tropical and sub-tropical areas • coverage is from 1975 to the present • has over 150,000 records, with content taken from 5,000 journals • access: subscription based
World Wide Science.org *Access date: 07.07.2011*	• global science gateway, maintained by the US Department of Energy and launched in 2007 • content derived from national scientific databases and portals in 65 countries • allows for federated searching across national/international scientific databases • multilingual: allows users to search non-English databases in China, Russia, France and several Latin American countries and receive search results translated into one of nine languages • access: freely available to all

Reference-management tools

With the huge amount of information and data available over the internet, researchers often struggle with how to manage the information they gather from databases and websites, as well as blogs and forums. Web-based reference-management systems can be the answer to this dilemma.

Reference-management software assists researchers and authors in managing the many bibliographic references they may have accumulated over time. The software is usually a database that allows for the creation of bibliographies and also acts as a personal online library. It has been around for many years, and with the advent of the internet, reference-management applications, like bibliographic databases, have evolved tremendously. From being databases installed on a stand-alone personal computer, these web-based platforms now have many features and tools. Apart from the traditional feature of generating bibliographies, today's reference-management systems also possess social-networking elements, research catalogues, drag-and-drop features to reduce manual data inputting, and mobile applications for smart-phones and iPads. Some systems also allow users to save not only documents but also screenshots of web pages so that they have the ability to come back to the webpage at a later time. A growing number of reference-management systems are free over the web and can be of great benefit to researchers struggling to come to terms with the amount of information or data they have accumulated. Wikipedia (2011c) has a good article on reference management systems where it compares 29 systems (both free and proprietary). This information has been reproduced in part in table 13.5, which has a selection of the better known systems.

Table 13.5: Bibliographic Reference-Management Systems

Bibliographic reference-management systems are excellent tools for managing references and generating bibliographies and citations when writing research papers.

Software	Developer	Access	Notes	Operating systems	Released
CiteULike	Oversity Limited	free	• centrally hosted website • no download of software required	Windows – Mac – Linux – BSD – Unix	2004
Connotea	Nature Publishing Group	free	• centrally hosted website • no download of software required	Windows – Macintosh – Linux – BSD – Unix	2004
EndNote	Thomson Reuters	cost involved	has desktop and web account components	Windows – Macintosh	1998
Mendeley	Mendeley	free & premium	has desktop and web account components	Windows – Macintosh – Linux	2007
Reference Manager	Thomson Reuters	cost involved	• network version available • built-in web publishing tool	Windows	1984
Zotero	George Mason University	free	a Mozilla Firefox extension, so it can only be used with the Firefox browser	Windows – Macintosh – Linux – BSD – Unix	2006

Source: Wikipedia (2011c).

Future challenges/gaps/needs

In this chapter, we have looked at information tools and resources that can assist the researcher in the PGR domain. We have seen how a researcher can use many different platforms for resource discovery, and we have highlighted different formats/platforms that one can use to disseminate and generate content. All of these tools and resources will continue to evolve, change or be superseded by new technology, which ultimately means that researchers also need to keep abreast of how scientific information is generated and disseminated. Currently, a lot of focus has been given to mobile technology, where one can access information from smartphones or iPads and download applications that permit one to do an array of things, such as data analysis or creating tables. Tools such as these allow information to be generated and disseminated in a timely fashion; researchers do not need to wait until they are back at their desks. These

tools have changed, and will continue to change, the way science is carried out, and it is to the researcher's advantage to be aware of their availability and features.

As the scientific world moves more and more into the digital realm, one of the challenges researchers and their respective organizational libraries need to address is that a lot of scientific information is available only through subscription-based avenues. With the advent of digital information, a subscription often means that one is purchasing access to content but not the actual content, *per se*, as is the case with paper subscriptions, where one would put the journal on the shelf for as long as necessary. Company takeovers, for example, could affect access to digital information. Negotiations with publishers for perpetual access is necessary in order to retain access to content.

Another factor to contemplate is the gap in knowledge that exists between researchers from the South and those from the North. As Schisler (2011) states, "The digital divide is something we must not dismiss when considering the fact that anyone can now publish. The digital divide represents the socioeconomic difference among communities in their access to computers and the Internet. It is also about the required knowledge needed to use the hardware and software, the quality of these devices and connections, and the differences of literacy and technical skills between communities and countries…. When we think of the World Wide Web, as of today, it does not yet encompass the entire world. Many of the countries on the African continent, for example, have less than 5 Internet users per 100 inhabitants as opposed to the richer countries in the world that have over 50 Internet users per 100 inhabitants. We are seeing a small but decreasing gap in this divide, and this trend will continue." Not everyone has the access to information that is taken for granted in many developed countries, and while the knowledge gap may be decreasing, it is still very evident in many developing countries. While addressing the question of how to overcome the complex issue of the digital divide is not the author's intention, it is important to remind ourselves of the situation that is present today.

Conclusion

The last sixteen years has seen monumental changes in the way scholarly information is accessed, retrieved and re-used. As a result, the paradigm of scholarly publishing, communication and collaboration has changed dramatically since 1995 and it has provided the opportunity to bring the scientific community together in ways that before seemed impossible. This chapter has attempted to bring to the fore some of the most useful and pertinent resources for researchers working in the domain of plant genetic resources and to highlight some of the challenges, gaps and needs that could affect them or their respective organizations. The websites and research tools highlighted here will hopefully provide researchers with relevant and timely information, allow them to connect with their peers, and provide some respite from the "information overload" that one encounters when searching across the internet.

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