

SEED STORAGE

Internet Resources

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This following handout is an updated excerpt from the Hawaii Conservation Alliance's on-line seed storage manual. To see the full manual, go to:

<http://www.hawaiiconservation.org/conservationresources.asp>

The Seed Conservation Laboratory of the University of Hawai'i Center for Conservation Research and Training produced the manual in 2001. Although it needs updating, the manual is still a useful resource for small seed savers. The Laboratory also sends occasional e-mailings of seed conservation news of related to conservation of native Hawaiian plants.

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USEFUL SOURCES OF INFORMATION

PRINT RESOURCES

The Center for Plant Conservation published (1995) a spiral-bound booklet, **Guidelines for the Management of Orthodox Seeds** by Gregory D. Wieland. It is available, in English or Spanish, for \$14 + \$4.75 shipping from the Center for Plant Conservation, P. O. Box 299, St. Louis, MO 63166, tel. # (314) 577-9450, fax -9465. For order information, check the CPC web site at www.mobot.org/CPC.

Those with access to a large institutional library may find the following references useful:

General Seed Science Reference:

Copeland, L. O. and M. B. Miller. 2001. **Principles of Seed science and technology. Fourth edition.** Chapman & Hall, New York.

Germination:

Baskin, C. C. and J. M. Baskin. 1998. **Seeds: Ecology, biogeography, and evolution of dormancy and germination.** Academic Press, San Diego, CA. The current bible on ecological aspects of germination, with much information on wild plants.

Seed Processing and Testing:

Association of Official Seed Analysts (AOSA). **Rules for testing seeds.** AOSA Rules Committee, United States Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS), Beltsville, MD. Detailed procedures for seed processing and germination testing in the United States. The AOSA issues periodic revisions of this publication.

International Seed Testing Association (ISTA). **International rules for seed testing.** ISTA, Zurich, Switzerland. These are the international rules corresponding to the AOSA rules cited above. They appear as a special supplement to the journal *Seed Science and Technology*. The ISTA issues periodic revisions of this publication.

Seed Conservation, including Storage:

Guerrant, E. O., Jr., K. Havens, and M. Maunder. 2004. **Ex situ plant conservation.** Island Press, Washington. Besides chapters on germination and storage, this book also has chapters on collection and philosophical issues.

Smith, R. D., J. B. Dickie, S. H. Linington, H. W. Pritchard, and R. J. Probert. 2003. **Seed conservation: Turning science into practice.** Royal Botanic Gardens, Kew. This large and expensive book is currently the bible of seed conservation. It is available in both paper and CD formats. You can download individual chapters for free from:

<http://www.kew.org/msbp/scitech/publications/sctsip.htm>

WORLD-WIDE WEB RESOURCES

Berry Botanical Garden
<http://www.berrybot.org>

Berry Botanical Garden was a leader in using seed storage as a conservation tool for wild plants. Go to the “Conservation” page for general information about seed storage, photos of their seed bank, and a summary of their seed processing practices. The Garden ceased operation in mid-2010 but the conservation web page was still accessible in 2011.

Bioversity International
(formerly International Plant Genetics Resources Institute - IPGRI)
<http://www.bioversityinternational.org/>

Most publications are sent free to institutional libraries. Many can be down-loaded for free. Check the link to “Publications” and use the “Search the database” function.

A comprehensive manual for seed banking is available in English, Spanish and French:

Manual of Seed Handling in Genebanks. Handbook for Genebanks No. 8

Manual para el Manejo de Semillas den Bancos de Germoplasma. Manuales para Bancos de Germoplasma No. 8

Manuel de manipulation des semences dans les banques de gènes. Manuel pour les banques de gènes No. 8

There is a link to interactive self-training modules for all of these modules at :

http://www.bioversityinternational.org/training/training_materials.html

A thorough presentation of theoretical background and technical issues of seed storage can be downloaded for no charge:

A Protocol to Determine Seed Storage Behaviour. IPGRI Technical Bulletin No. 1.

The document on which this is based, **Seed Storage Behaviour: A Compendium. Handbook for Genebanks No. 4** is available to download for no charge at:

http://www2.bioversityinternational.org/Information_Sources/Species_Databases/Species_Compendium/HBforGenebanks4introductiontossb.pdf

Consultative Group on International Agricultural Research
<http://croptgenebank.sgrp.cgiar.org/>

CGIAR has a web site at which people working on crop conservation can interact and exchange information informally.

Danish National International Development Assistance (DANIDA) Forest Seed Centre
<http://www.dfsc.dk>

<http://en.sl.life.ku.dk/Publikationer/Udgivelser.aspx>

(Note: as of June 2011, this web page no longer exists. No new links to these publications have been established.)

Publications from the former Danida Forest Seed Centre (DFSC) are now distributed by the Copenhagen University Faculty of Life Sciences. Go to “All publications” on the redirected web page. There are links to several excellent free publications on all aspects of seed management, including many on tropical trees. Most are available in downloadable form. Others are available for free by postal mail.

The following downloadable pamphlet is useful to those working with seeds:

Technical Note 59. Glossary of Seed Biology and Technology.

DFSC also distributes a useful book:

Guide to Handling of Tropical and Subtropical Forest Seed is a comprehensive guide to management of seed collections. You can down it for no charge, one chapter at a time.

Deno, N. C. 1993-1998. **Seed germination theory and practice. Second edition. First supplement. Second supplement.** Published privately by Norman C. Deno, 139 Lenor Dr., State College, PA 16801. Contains much empirical information about germination, mainly of horticultural plants. Now out of print, but you can download the Second Edition and supplements for free as PDF files from <http://hdl.handle.net/10113/41278> (Second Edition), <http://hdl.handle.net/10113/41279> (First supplement), and <http://hdl.handle.net/10113/41277> (Second Supplement)

European Native Seed Conservation Network (ENSCONET)
<http://www.maich.gr:9000/About.htm>

ENSCONET has a free seed conservation manual that can be downloaded from their website in many languages. The original European Native Seed Conservation Network URL www.ensconet.eu apparently no longer exists. The manual is now posted at:

<http://www.maich.gr:9000/About.htm>

FloraBank
<http://www.florabank.org.au>

Maintained by a consortium of Australian plant conservation organizations, this web site includes a comprehensive on-line manual for use of seeds in native plant restoration and revegetation projects. The manual covers all aspects of seed handling from collection to processing, storage, germination, and outplanting.

Hawai`i Conservation Alliance

<http://hawaiiconservation.org/conservationresources.asp>

HCA has an on-line storage manual and a guideline for germination for seeds of native Hawaiian plants.

The Kohala Center

<http://kohalacenter.org/publicseedinitiative/presentations.html>

The web page for the Kohala Center's Hawai`i State Public Seed Initiative has presentations, links, and downloadable documents oriented around seed saving for gardeners and small farmers.

Native Seeds/SEARCH

<http://www.nativeseeds.org>

Native Seeds/SEARCH maintains a seed bank that concentrates on traditional crops of the American Southwest, and an associated culture memory bank to preserve the folk knowledge associated with those crops. Their web site has links to many other web sites involved in heirloom plant conservation.

Nordic Gene Bank

<http://www.nordgen.org/ngb/>

Nordic Gene Bank operates germplasm repositories jointly for the Scandinavian countries. To see the web page in English, click on the link in the left column to the English version. Their seed storage page has a link to the home page of the Arctic "doomsday seed vault" natural cold storage facility at Svalbard.

Principado de Asturias/La Caixa

http://www.conservacionvegetal.org/PDF/Conserv-exsitu_Bacchetta_et_al._eds.pdf

From this web site, you can download a 378 page manual for ex-situ plant conservation of wild plants:

Conservacion Ex Situ de Plantas Silvestres by Bacchetta et al (2008).

It is in Spanish; non-readers of Spanish can make use of the extensive bibliography and appendix of web sites.

Royal Botanical Garden-Kew

<http://www.kew.org/msbp/index.htm>

RBG-Kew's Millennium Seed Bank Project is the world's largest seed bank of wild seeds. Imbedded within MSBP's web page is an excellent overview of seed conservation. At <http://data.kew.org/sid/> there is a searchable seed storage database which also has some information on germination, dispersal, seed weight, and oil content.

The Millennium Seed Bank's **Field Manual for Seed Collectors** is available from this web site:

<http://www.kew.org/msbp/scitech/publications/fieldmanual.pdf>

From this web site, you can download other useful publications for free, including technical pamphlets about seed bank operation and the book **Seed Conservation**. See the note in the PRINT RESOURCES section above.

The Kew Difficult Seeds Project web site at:

<http://www.kew.org/science-research-data/kew-in-depth/difficult-seeds/index.htm>

contains valuable guidance for those who need to work with seeds whose germination and storage properties are poorly known.

Seeds of Success

<http://www.nps.gov/plants/sos>

SOS is a consortium of mainly federal organizations developing seed banks for landscape restoration. This web site includes detailed seed collection and transport instructions based on RBG-Kew's practices. (For information about RBG-Kew's seed bank, see the previous paragraph.) Appendix I includes detailed information about species in the Center for Plant Conservation network collection.

U. S. Department of Agriculture Forest Service Reforestation, Nurseries, and Genetic Resources
<http://www.rngr.net>

USDA RNGR publishes an excellent book with a thorough overview of the principles of seed conservation, followed by detailed instructions for several hundred species of tropical trees, including many grown in Hawai'i:

Vozzo, J. A., ed. 2002. **Tropical Tree Seed Manual**. US Department of Agriculture Forest Service. The **Manual** can be downloaded for free, one chapter at a time, from the USDA RNGR's web site at <http://www.rngr.net/Publications/ttsm>. If you prefer to download it as a single large PDF file, you can do so from:

<http://old.rngr.net/Publications/ttsm/tropical-tree-seed-manual-all.pdf/view>

At <http://www.rngr.net/Publications> you can also download the USDA **Woody Plant**

Seed Manual.

U. S. Department of Agriculture National Center for Genetic Resources Preservation (formerly National Seed Storage Laboratory)

<http://www.ars.usda.gov/Aboutus/docs.htm?docid=17892#PGRPP>

This NCGRP has the world's largest seed bank. There are links to the NCGRP collection and the GRIN Genetic Resources Information System data bases. From the home page, the links to "Plant Collections" leads to detailed information about seed processing and storage. web site is revised frequently.

University of Freiburg Seed Biology Group

<http://www.seedbiology.de>

This web site has detailed discussions of numerous areas of seed biology (though not of storage).