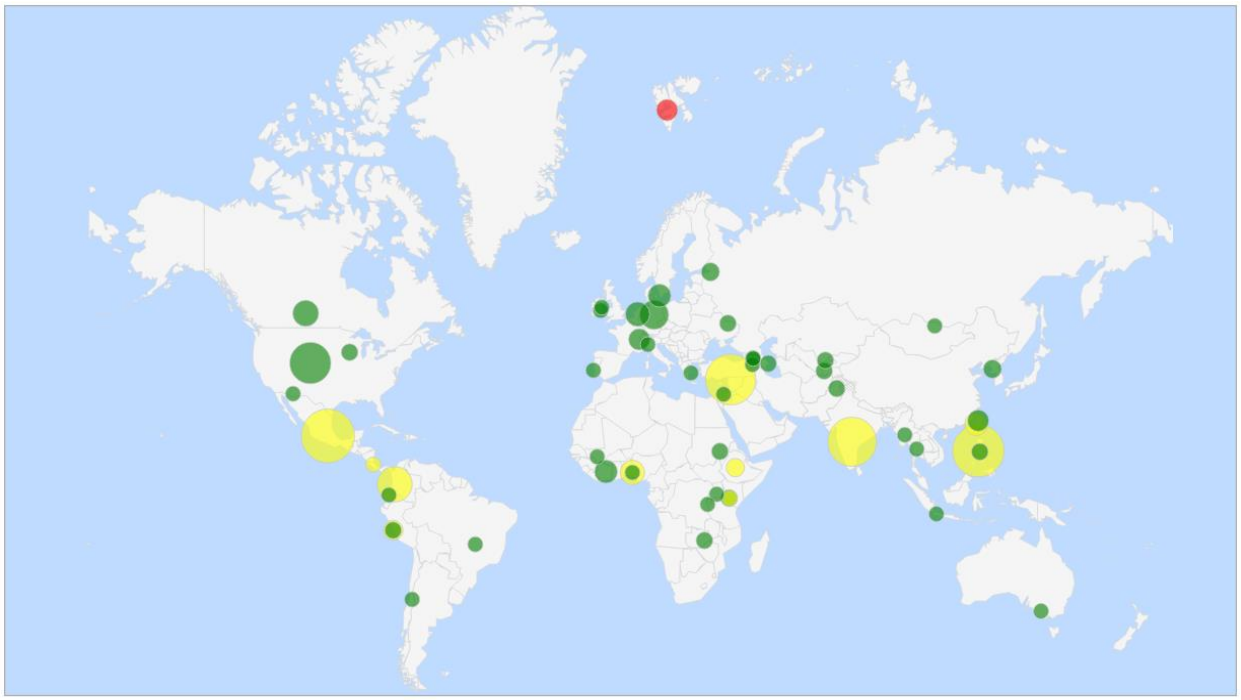
Svalbard
Global Seed Vault

Annual Progress Report 2013



Contents

2013 at a glance

- 29,155 new safety duplicates from 12 depositors were stored in the SGSV 2013. This increased holdings by about 4% and the total holding by the end of the year was 801,752 samples.
- By the end of the year chamber two is filled to 77% of its current capacity.
- 6 institutions from Australia (2), Japan, Thailand (2) and Uzbekistan signed the Standard Deposit Agreement in 2013.
- The International Advisory Council for the SGSV met at Svalbard in February 2013.
- The Standard Deposit Agreement was updated and the new version replaced the previous version in January 2013.
- NordGen presented SGSV at science and policy conferences, in scientific journals as well as in the popular media.

Foreword

The Svalbard Global Seed Vault (SGSV) is a safety-net for the global collection of plant genetic resources. NordGen is responsible for the management and operation of the safety duplication process and storage in the SGSV. The terms of reference for NordGen's responsibilities are laid out in an agreement with the Norwegian Ministry of Agriculture and Food (LMD) and the Global Cop Diversity Trust (the Crop Trust). The year 2013 was the sixth year of regular operation of the SGSV. The success of the SGSV has continued this year both measured in terms of participation from the global genebank community and in terms of public interest and awareness about the purpose of SGSV.

By the end of 2013, the SGSV held safety duplicates for 56 genebanks from around the world. Housing more than 800 thousand samples from a broad inter- and intra-specific range of crop diversity the SGSV is today a true global hot-spot for PGRFA. Sitting on top of the world it has become the major site for safety duplication of the emerging global *ex-situ* conservation system.

The SGSV is a flagship project for NordGen. We take great pride in the role we play in this project together with LMD and the Crop Trust. I would like to express my gratitude to LMD and the Trust for the continued good cooperation and support in 2013. I would also like to thank Statsbygg for the excellent working relationship we have on site at Svalbard and through the periodic meetings with all partners.

Arni Bragason

Director NordGen

Introduction

This annual progress report for the Svalbard Global Seed Vault (SGSV) is prepared by NordGen to give an overview of the operation of the Vault in 2013.

The SGSV was established with the ''*objective to provide a safety net for the international conservation system of plant genetic resources, and to contribute to the securing of the maximum amount of plant genetic diversity of importance to humanity for the long term in accordance with the latest scientific knowledge and most appropriate techniques*''[1]. After six years of operation the SGSV has become the major safety back-up site for PGRFA worldwide and by the end of 2013 the collection at Svalbard stood at 801,752 safety duplicates from 56 institutes.

The operation of the SGSV is a collaborative endeavour at several levels. At the management level NordGen collaborates closely with the Norwegian Ministry of Agriculture and Food and the Global Crop Diversity Trust. At the facility operation level NordGen cooperates with Statsbygg in Longyearbyen who is responsible for the maintenance and the daily surveillance and monitoring of the facility at Svalbard. At the seed logistics level we cooperate with the institutions sending safety duplicates as well as with a chain of logistics- and security- partners during shipment and transport to the SGSV. The partnerships at all levels have worked very well in 2013 and the SGSV has functioned according to its mission in all important respects also this year.

In 2013, 29,155 safety duplicates were deposited by 12 depositors. Three genebanks deposited for the first time in 2013 and the 9 others were existing depositors sending additional material. The international publicity about the SGSV project continued to increase in 2013. NordGen organized 42 visits and responded to 131 inquiries from media and others from 29 countries in 2013.

Operation of the Seed Vault consists of two aspects: (1) Physical maintenance of the facility, overseen by Statsbygg and (2) Seed management and operation, overseen by NordGen. NordGen's responsibilities for the management of seed deposits are stated in the three part agreement providing for the long term funding, management and operation of the Svalbard Global Seed Vault.

[1] Norwegian Ministry of Agriculture and Food, Global Crop Diversity Trust, NordGen (2007) Agreement between the Royal Norwegian Ministry of Agriculture and Food, The Global Crop Diversity Trust and the NordGen providing for the funding, management and operation of the Svalbard Global Seed Vault.

Facility management

SGSV is the property of Statsbygg (the Norwegian directorate for public constructions). The property management and daily monitoring of the SGSV is Statsbygg's responsibility. The Norwegian Ministry of Agriculture (LMD) is the national authority liable for the SGSV and the property management duties of Statsbygg are stated in the lease-agreement between LMD and Statsbygg. Statsbygg reports on the daily operation and the outcomes of work on the physical facility to LMD in user-meetings.

The Seed vault is a one-of-a-kind facility and the first years of physical operation met with some challenges: The most notable problem was the damage of the entrance section, the "Svalbard tunnel" (summer 2008 and recurring during summer 2009) caused by settling of rock and dirt (due to the fact that the permafrost above was not re-established prior to spring and thawing). The damage has now been repaired in such a way that the tunnel structure at the entrance is stronger and more secure. During 2010 -2013, the new tunnel structure was monitored by independent external consultants from Multiconsult on a regular basis, finding little or no movement in the structure. Achieving the desired temperature of -18°C in chamber 2 (where the seeds are stored) took longer to achieve than expected. The target temperature was reached by the end of 2010 and has been stable since 2011. Statsbygg in November 2012 reported a satisfactory situation with regard to 1) the temperature in chamber 2 and all others parts of the facility; 2) the tunnel movement; 3) the back-up power-supply. The remaining problem is the recurrent water intrusion which has to be pumped out during the summer months. It is important to note that these problems have not jeopardized the security of the seeds.

The situation in 2013 remains satisfactory with regard to temperature in chamber 2, tunnel stability and back-up power supply. Realizing that it is unlikely that the permafrost will resettle to seal-off the entrance tunnel as initially assumed in the construction project, Statsbygg has indicated that it will present options for permanent solutions to the water intrusion problem in 2014. There was no water intrusion during the winter 2012-2013 and the winter 2013-2014. The intrusion during the summer months 2013 was well controlled by the current water pumps and back-up power supply.
The security report from "Forsvarsbygg Futura" has been followed-up through installation of security equipment by Statsbygg (safety line in tunnel, personal safety alarm system, automatic fire extinguishing system).

Seed management and operation

NordGen is responsible for managing and operating all aspects of the safety deposit process. This responsibility spans from liaising with collection holders interested in depositing seed samples to operation of the databases and organization of the storage process at Svalbard. The SGSV is a high profile project with a special status within NordGen's organization (Figure 1).

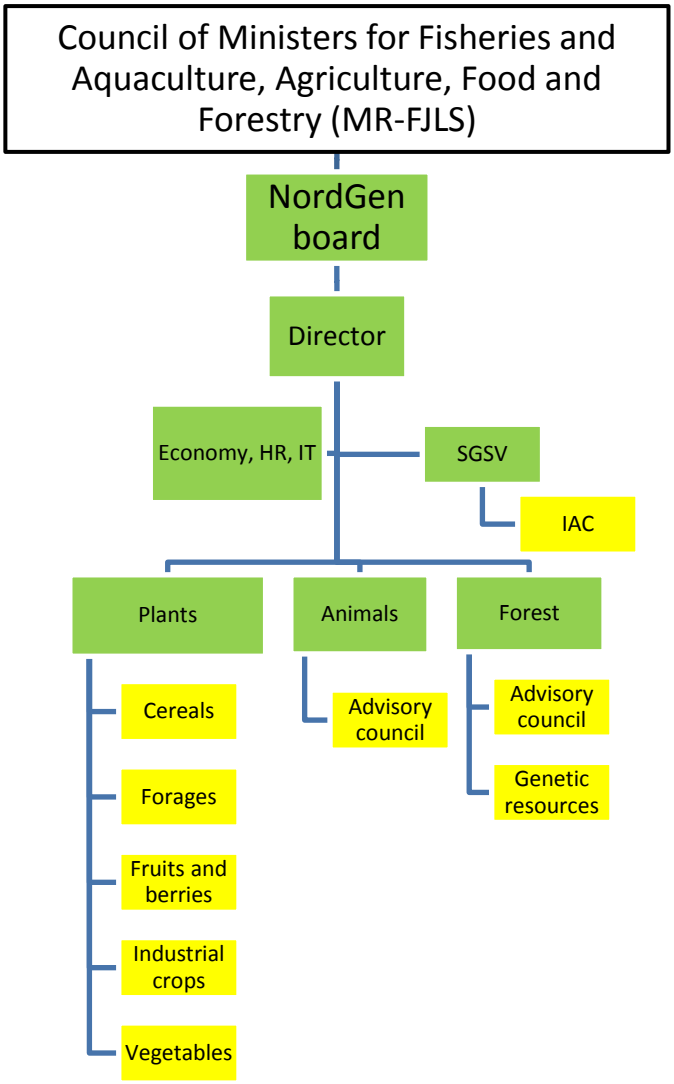


Figure 1. Organogram for NordGen with SGSV.

The overall framework for the tasks carried out by NordGen is organized into four platforms, illustrated in Figure 2. The coordinator for the management and operation of the Seed Vault provides overall leadership and internal coordination of entering into deposit agreements, planning and preparing for seed shipments, and handling of the deposit openings on the site. The scientific expert works with public requests for information and visits to the site. All NordGen activities are done in cooperation with the partners, including in particular LMD and the Trust.

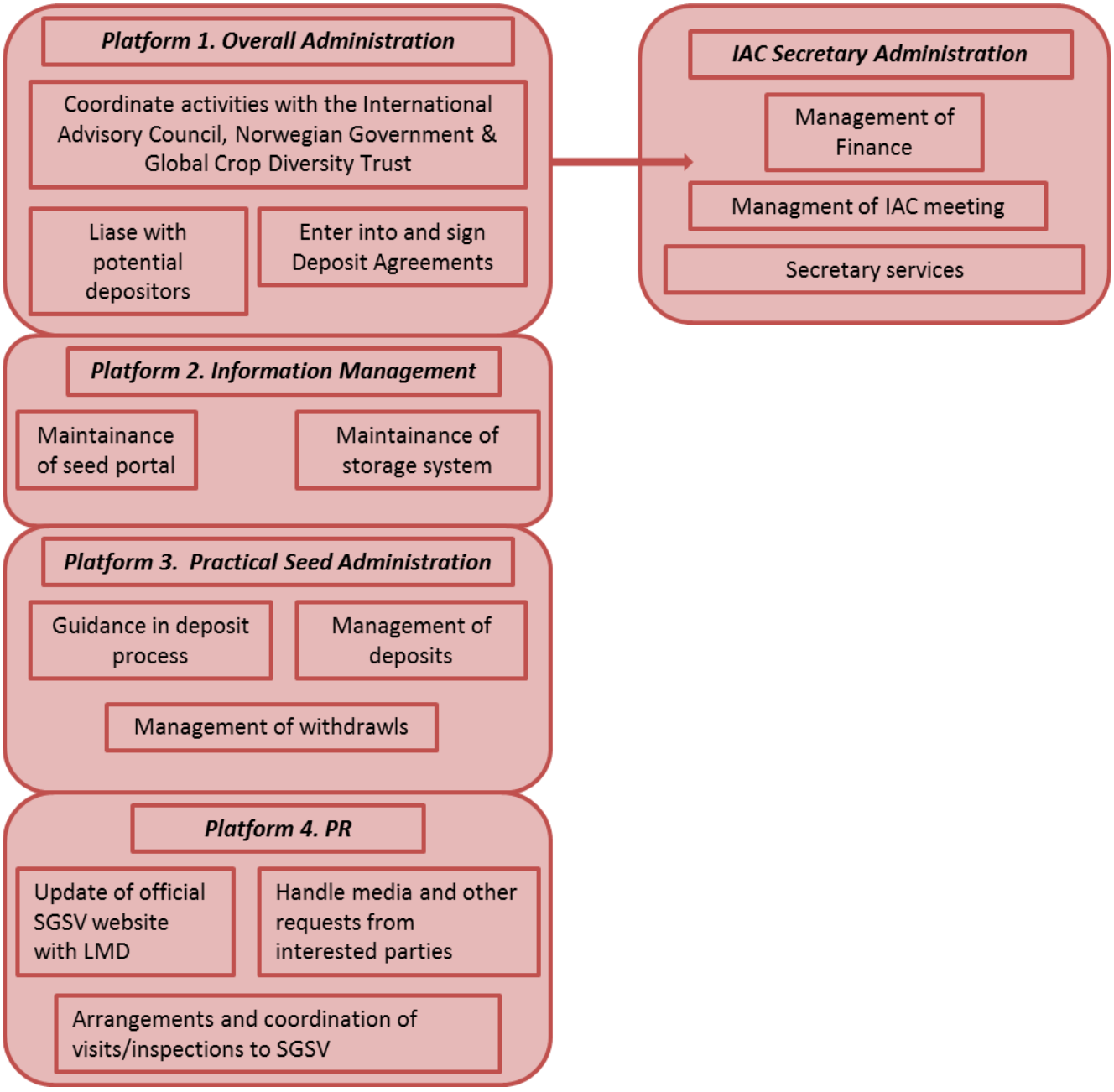


Figure 2. NordGen's organisation of the management and operation of SGSV.

Platform 1: Overall Administration & IAC Secretary Administration

The overall administration includes coordination and liaising with all relevant stakeholders to SGSV including, but not restricted to, LMD, the Crop Trust, Statsbygg, the governor of Svalbard, and depositors. This platform also includes the provision of secretariat services for the International Advisory Council (IAC) in accordance with the Three Party Agreement.

The financial administration covers annual financial statements to be presented to the Crop Trust and LMD, bookkeeping's of records and original vouchers in accordance with Nordic Council of Ministries practice. Open book inspection service available for the Crop Trust and the LMD. NordGen reports on its work throughout the year in meetings between the partners and more formally in its annual progress report for SGSV. NordGen prepares an annual budget for each financial year (to be approved by the Crop Trust and LMD), submitted by April 1 of the year prior to the onset of the budget period.

The secretary administration tasks for IAC lies within (1) budgetary administration (2) planning, arrangements and follow up of IAC meetings and (3) general secretary services for IAC members.

SDA signing and deposit coordination

By the end of 2013 NordGen had signed the Standard Deposit Agreement (SDA) with 61 institutions (annex 1) and 56 genebanks had deposited 801,752 safety duplicates (Annex 2). Six SDAs were signed in 2013; two Australian genebanks, one Japanese, two Thai genebanks and one in Uzbekistan. One depositor (National Plant Germplasm System, USA) has still not been able to sign the SDA due to legal hurdles. This depositor is informed that from the Norwegian side their current safety duplicates are considered as deposited under the terms and conditions in the SDA, but new deposits will only be accepted provided that a SDA is signed. Twelve of the depositors are International Agricultural Research Institutes (IARCs), 35 are national genebanks, 2 are regional genebanks, 6 are university genebanks and one is a NGO genebank. Figure 3 shows the proportion and numbers of safety duplicates deposited by different types of genebanks. The largest share of the current holdings in the SGSV is deposited by IARCs represented by several institutes belonging to the Consultative Group of International Agricultural Research Centres (CGIAR), the Asian Vegetable Research Centre (AVRDC) and the Tropical Agricultural Research and Higher Education Centre (CATIE), all hold collections of PGRFA in trust for the UN Food and Agriculture Organisation (FAO).

The number of new safety duplicates and the number of new depositors is somewhat lower than in previous years. This is due to the slowdown in deposits from the International Agricultural Research Centres whose collections now to a large extent are safety duplicated, and that the Crop Trust's Global System project (regeneration of globally threatened collections) now is concluded. The year 2013 was therefore to a larger extent than earlier dedicated to active invitation of othergenebanks to make use of the SGSV. NordGen's project coordinator participated in the fifth meeting of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in Muscat, Oman, September 2013. This provided an opportunity to communicate with current and potential future depositors about administrative, legal and practical aspects of the project. Several new dialogues and processes to recruit new depositors were started in 2013.

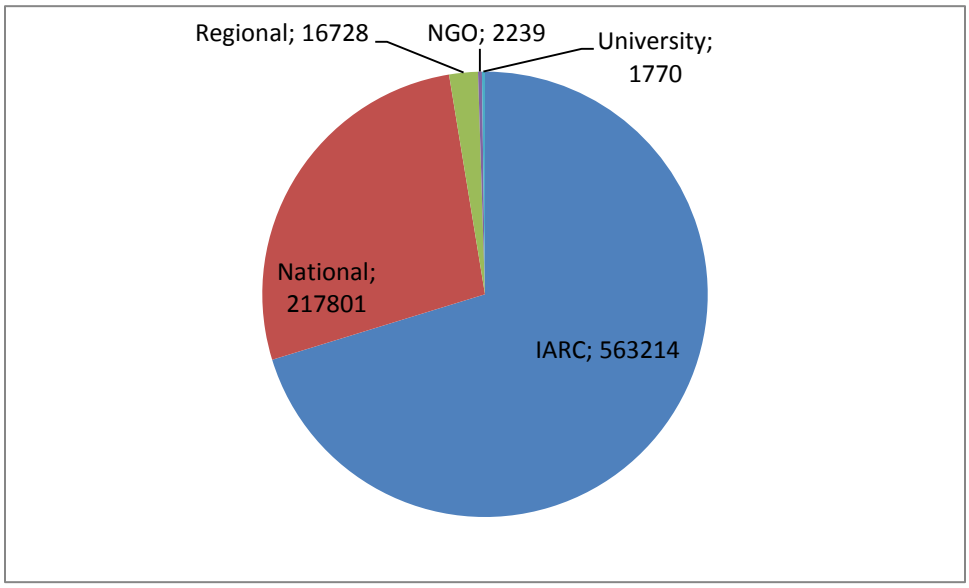


Figure 3. The proportion and numbers of safety duplicates deposited by different types of genebanks.

Platform 2: Information management

This platform serves the development, technical service to depositors, and maintenance of the databases. NordGen maintains two databases for the SGSV; one box level storage system database and one safety duplicate level database with descriptors of all the material stored.

Depositors are required to provide electronic inventories of the material they wish to deposit prior to shipment to Svalbard. The purpose of receiving the data prior to shipment is to allow NordGen to check if the data is of satisfactory quality, as well as to check for obvious duplications of material already stored in the vault. Depositors report a minimum set of descriptors necessary for unique identification of the samples. Information for depositors is provided on the "guidelines for depositors page" of www.nordgen.org/sgsv. The database is updated directly following every seed deposit event. The data is publicly available and searchable on the Information Sharing page of www.nordgen.org/sgsv (Fig. 4).

The data portal is an important tool in NordGen's interaction with partners, especially the Crop Trust and the depositors. The data portal is also a standard reference for journalists searching for the latest statistics and biological and geographic descriptors of the material stored in SGSV. There are links to this portal both from NordGen's homepage and the official webpage of the Seed Vault maintained by LMD (http://www.regjeringen.no/en/dep/lmd/campain/svalbard-global-seed-vault.html), as well as the website of the Trust (http://www.croptrust.org).

The SGSV is part of the emerging global system for *ex-situ* conservation of PGRFA. An important element in that system is the global accession level database Genesys – Gateway to genetic resources database

(http://www.genesys-pgr.org/). The provider institute code, accession number and genus in the SGSV data base is matched with data in Genesys and the database now reports whether the accession is backed-up at Svalbard or not.

The databases of SGSV are maintained on separate servers at NordGen headquarters in Sweden. All data are backed-up daily to three different locations: A dedicated backup server, tapes stored in a fire safe archive room, and finally a remote server located in another town.

Figure 4. The "Seed Portal" is the public interface of the SGSV.

Platform 3: Practical Seed Administration

Overall management of transport logistics for seeds deposited is managed by NordGen. The practical seed administration further covers assistance regarding security, customs, phytosanitary certificates and other relevant clearances. NordGen communicates closely with depositors on all practical aspects of making shipments. The depositors are instructed to make the shipment with a regular courier such as DHL, TNT etc. from their genebank to Oslo. In the many cases where the shipment cost is covered by the Global Crop Diversity Trust, NordGen and Trust staff works in close collaboration to ensure proper packaging, etc. To avoid problems with the bottleneck between the mainland and Svalbard, NordGen organizes transport from Oslo to Longyearbyen together with a private logistics company. NordGen renegotiates and enters into contracts for the Oslo-Longyearbyen logistics on an annual basis and in 2013 we worked with the company Jetpak.

Logistics at Svalbard is coordinated by NordGen and handled in close collaboration with the local logistics company, Pole Position. Screening and security at arrival in Svalbard is handled in collaboration with the airport management at Longyearbyen airport and the security company, Securitas. Statsbygg provides support with logistics and technical backstopping during deposit openings at Svalbard. Overall security during transport between the airport and the Seed Vault is provided by the police department at the Governor's office. NordGen receives, registers and stores seed boxes inside the Seed Vault. The routines for the management of SDAs, organization of deposit logistics, data handling and practical on-situ logistics and security is streamlined and formalized in Working Instructions under NordGen's Quality Management System.

NordGen has organized between three and six openings of the SGSV for storage of new safety duplicates per year since the opening in 2008. Depositors are asked to organize shipments for arrival in Oslo during seven days windows. In 2013 NordGen organized four deposit openings (Table 1).

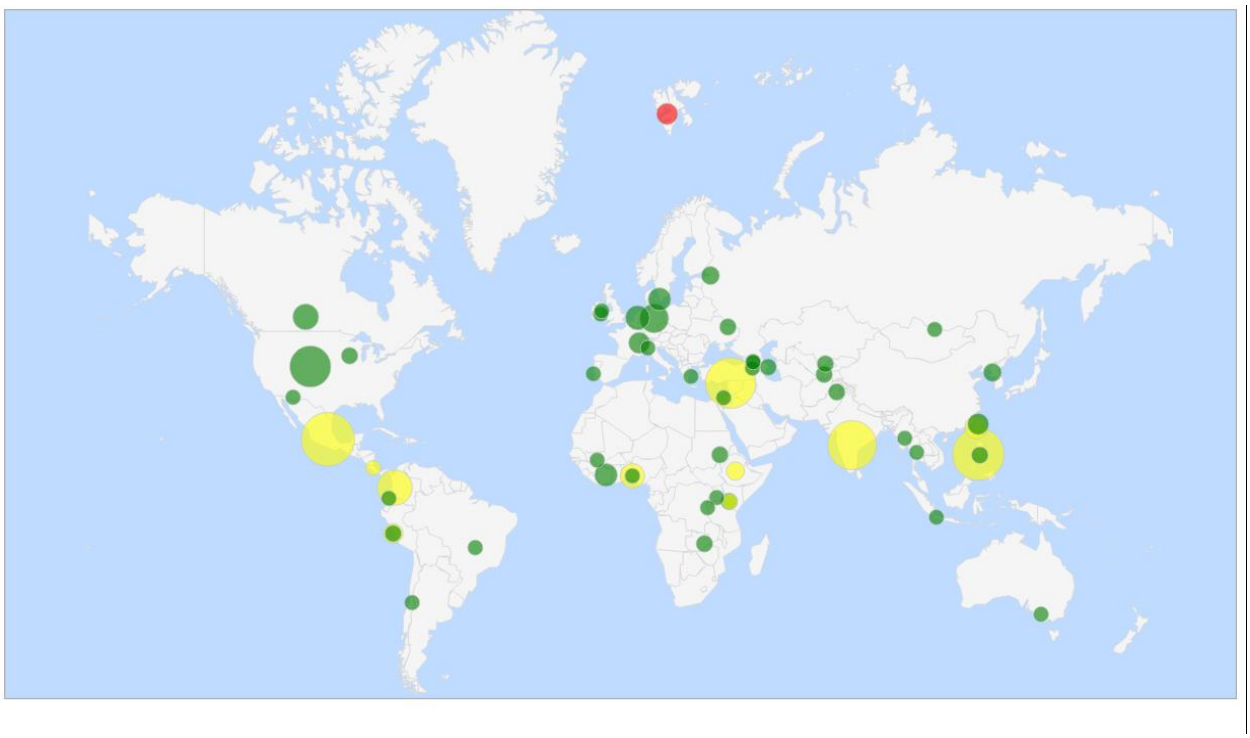


Figure 5. Genebanks with safety deposits in the Svalbard Global Seed Vault. The radius of the circles is relative to the number of samples deposited, and the circle size reflects the size of the deposits according to 25 size classes. Yellow circles are International Agricultural Research Centres and green circles are regional, national or subnational genebanks. The radius of the red SGSV circle is not relative to the holdings.

Table 1. Deposit openings in 2013

Deposit openings	Institute code	Institute acronym	Taxa	Accessions
February	CAN004	PGRC	185	4883
	NLD037	CGN	74	430
	SWE054	NORDGEN	51	868
	USA974	SSE	37	366
May	THA214	CN FCRC	3	150
	UZB006	UzRIPI	191	2038
October	COL003	CIAT	189	2000
	DEU146	IPK	1177	6573
	IND002	ICRISAT	10	6200
	THA012	NRSSL	1	81
November	NGA057	IITA	1	2337
	SYR002	ICARDA	16	3229
Total 2013			1935	29155

By the end of 2013 the collection at Svalbard stood at 801,752 safety duplicates from 56 institutes (annex 2). The statistics from the data base (Figure 6) shows that wheat and rice are still the crops best represented in terms of number of samples in the Seed Vault. Based on the data on holdings by the end of 2012 NordGen prepared an analysis of the current status of seed deposits in relation to the global *ex-situ* collections of PGRFA. The objective was to assess the existing global *ex-situ* genepool with a view to identify gaps in the current safety back-up collection in the Seed Vault. The outcome of this assessment was presented to the IAC in their meeting in February 2013.

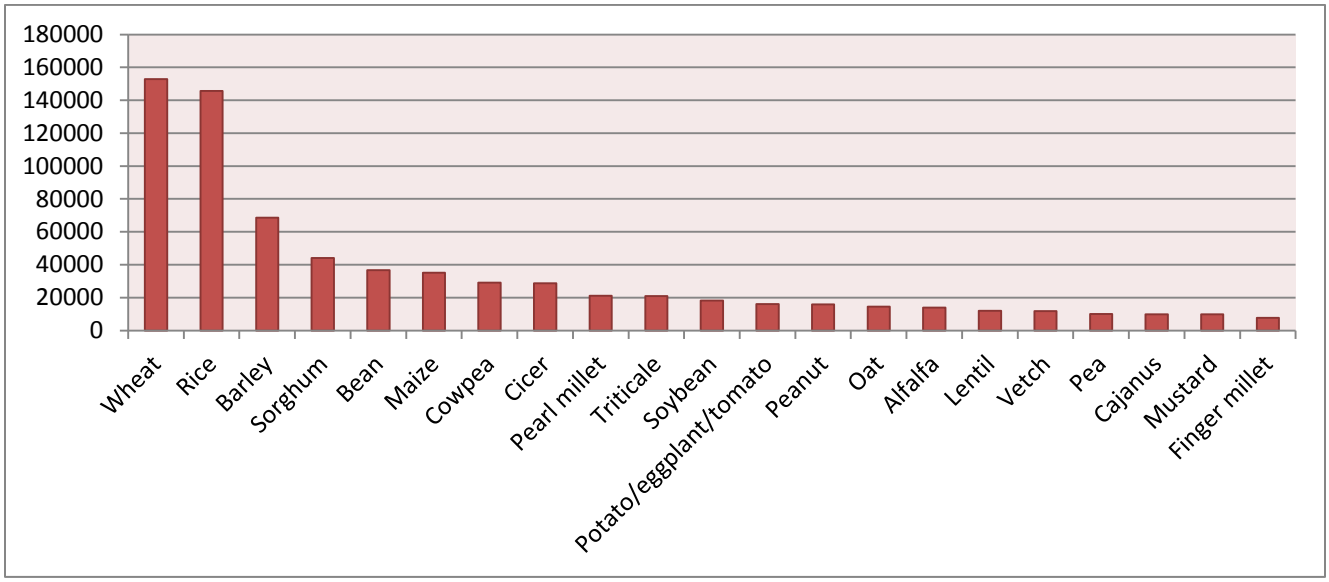


Figure 6. Statistics of holdings for crops represented by more than 5000 safety duplicates. Reported by vernacular names of most important crop in the genus.

Platform 4: Public Relations

In this section of the progress report we report on NordGen's public relations work. In addition to NordGen, both LMD and the Trust do active PR-work in connection with the Seed Vault.

Nordgen's work with public outreach and information about the SGSV is done through several arenas: we respond to questions of all kind of aspects about the operation from the public and the media; we present the SGSV to different scientific and general audiences through public presentations; we give interviews to the press and write about the SGSV in the various publications; we conduct visits to the SGSV for prioritized groups and media.

The five year anniversary was celebrated with an event at Svalbard hosted by the Norwegian Ministry of Agriculture. A book about the SGSV (http://www.komforlag.no/produkt/seeds-for-the-world-svalbard-global-seed-vault) was published on this occasion and a documentary film was released for public screening (http://vimeo.com/62688049). The initiative behind both of these major outreach efforts came from LMD and NordGen contributed as resource persons. In connection with the five year anniversary NordGen published a paper about the five year status in the project in the Open Access journal PLOS One http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0064146 and spread the word on this publication through social media as well as more specialized education channels such as through the Norwegian Biotechnology advisory panel publication http://www.bion.no/2013/06/bevaring-av-genetiske-ressurser-pa-svalbard/. We also wrote op-eds for the Nordic media on this occasion (http://www.sum.uio.no/forskning/aktuelt/i-media/2013/ola-frohvelvet-er-fem-ar.pdf).

The PGRFA science and policy community is a highly important constituency for the SGSV and NordGen prioritizes communication with this type of audiences. In 2013 we had an increased focus on presenting SGSV in papers at science and policy conferences and other fora. 15 lectures and interviews were given to different audiences. The Vault was presented in lectures during international conferences in China, Thailand, Sweden and Japan. A large exhibition with focus on the SGSV was arranged in Bangkok, August 2013 and the Vault was also presented by a stand exhibition at the International Biotech Innovation Forum& Exhibition in Shenzhen, China (September 2013). The interest for interviews and particular questions regarding plant genetic resources (PGR) in general and SGSV in particular increases. There is a large interest for lectures around PGR and SGSV. As far as it is feasible NordGen gives an introductory lecture about the conceptual ideas behind conservation and utilization of plant genetic resources at the University Centre in Longyearbyen prior to visiting SGSV.

Visits to the SGSV

In general our strategy is to bring SGSV to people, rather than bringing people to SGSV. However, the request for visits is considerable and we do organize a few visits for important visitors every year. In March 2013 the Vault was again open for a selected number of visitors after almost one year of closure due to a decision by the local fire authority in Longyearbyen. NordGen does not have permanent staff based in Longyearbyen, thus all visits to the SGSV must be scheduled ahead of time to coincide with planned deposit openings and a few special visit openings per year. The aim is to have the Vault

accessible for visits 4-6 times per year at those occasions when NordGen staff or representatives for the Trust or LMD are present on Svalbard.

In 2013, we received 131 inquiries from media and others from 29 countries. Most requests came from Scandinavian countries (57), Western Europe (17) and North America (17), but also from Africa, Asia and Latin America. 100 inquiries dealt with the possibility to visit SGSV – for various reasons. The majority, 75 requests, came from different media with TV channels (23), magazines (20) and newspapers (18). Other requests came from artists, researchers, students and policy makers, as well as some who wished to visit the Vault for commercial purposes (which is not permitted). Altogether, 42 visits were arranged and among notable visitors in 2013 were a delegation lead by H R H Princess Maha Chakri Sirindhorn of Thailand (March 2013) (Figure 8), a delegation with the Swedish Minister of Rural development Eskil Erlandsson (May 2013) and a group of advisors to American senators (August 2013).

Figure 7. Her Royal Highness Princess Maha Chakri Sirindhorn of Thailand makes the first deposit of seeds from the country in March 2013 after the severe flooding which affected the Thai gene bank in 2011.

Financial result and other activities

Financial result

The financial result for 2013 is stated in the budget and spending report in annex 5. The result in 2013 was negative with a 227.634 SEK deficit. The budget lines with negative results are personnel costs (on all platforms, except IT) and the lines for organization of the IAC meeting and for long-term storage experiment research and planning. The personnel cost was higher than budgeted in 2013 due to more work on overall management, seed deposit coordination and handling and public relations than foreseen when the budget was made in 2011. NordGen spent more funds on the long-term experiment than budgeted for 2013 because NordGen increased activity on this budget line considerably in 2013 after several years of spending only a small proportion of the resources allocated in the budgets (2010-2012). The budget was balanced with funds from the working capital fund which at the end of 2013 amounted to 875,440 SEK.

Meeting of the international Advisory Council

The IAC met in Longyearbyen in February 2013 in conjunction with the 5th anniversary celebrations of the Seed Vault. The agenda for the meeting included an introduction to the purpose, history, management plan/philosophy, link with other international PGRFA activities and reports on the status of seed deposits, SDAs, status of the facility, public awareness, review of the new SDA text and discussions about future strategy for deposits. The discussions and outcomes of the meeting are reported in the minutes attached as annex 3.

Three new members had been appointed and attended the IAC meeting for the first time: One new member was appointed by the Director General of the Food and Agriculture Organization of the United Nations: Ms. Linda Collette, Secretary of the Commission for Genetic Resources. The Norwegian Government appointed two members to represent the large depositors: Mr. Ruaraidh Sackville Hamilton, Genebank Manager at the International Rice Research Institute (IRRI), and Mr. Bert Visser, Director of Centre for Genetic Resources (CGN), the Netherlands.

Revision of Standard Deposit Agreement

Based on advice from the International Advisory Council, the LMD started to revise article 7 of the Standard Deposit Agreement in early 2012 in close dialogue with NordGen and the chair of the IAC and a new SDA was adopted in early 2013 and presented for IAC for review. The new SDA text has been used in 2013 and is published on the depositor guidelines website.

Long-term storage experiment

In 2013 NordGen took several initiatives to reinvigorate plans for a long-term storage experiment. Such experiments were first proposed by NordGen in the IAC meeting in 2009 and met with a positive response: “The IAC discussed the current “100 year experiment” on seed storage overseen by NordGen. There is a new proposal from NordGen to assess effects of long-term storage on a broad range of species for PGRFA. The IAC supports this initiative, because it will provide important scientific information about storage under permafrost conditions and contribute to due diligence in the management of the Seed Vault. The IAC hopes that NordGen will be able to develop this new research

initiative further."[2] Due to different reasons, including organizational challenges in NordGen, limited staff-time availability within the SGSV team and the challenges with achieving the required stable temperature in chamber 2, limited activities have been carried out in previous years. In 2013 we conducted a review of the original 100 year experiment in mine 3 and designed two separate experiments and research plans; one long-term viability monitoring plan that can be carried out under the current SDA provisions and one long-term seed preservation project involving a global partnership with among others, the Kew Botanical Garden's Millennium Seed Bank. The result of the 100 year experiment review and the two project plans are attached as annex 4.

Storage Capacity Assessment

In order to know when it is necessary to start to cool down a new chamber in the SGSV, NordGen reports annually on the storage capacity in chamber 2 which so far is the only chamber in use. The total storage capacity with the current shelving is 2880 boxes. The current holding in the Seed vault is 2225 boxes. Chamber 2 is therefore 77% full with the current shelving. It is possible to mount 288 more slots by re-installing the sections that were removed in 2009 (8x36 slots). See figure 9 and 10 for a graphical illustration.

Many of the large depositors, most notably the CGIAR genebanks, have already deposited the bulk of their material and will in the coming year only ship smaller consignments with freshly regenerated material. Deposit Agreements are signed with some potentially large depositors such as EMBRAPA in Brazil and NBPGR in India, but it is still too early to say if they will ship large amounts.
NordGen considers 200 boxes a high estimate for the number of boxes to expect annually in the coming years (in 2013 we received only 82 new deposit boxes) and we predict that the <1000 slots that will be available with increased capacity is sufficient for at least the five year period: 2013-2017. In conclusion, NordGen considers it unlikely that a new hall will be necessary before 2017.

The risk factors with this estimate remains: 1) We do not know how much current and future depositors want to deposit in the next years; 2) We do not know how future deposits will be packaged. NordGen have experienced that the smaller depositors are sending boxes with less samples per box, thus requiring more storage space per seed sample. NordGen will inform the Ministry and Statsbygg about significant new developments likely to impact the estimate presented here.

[2] Minutes of the IAC meeting 2009.

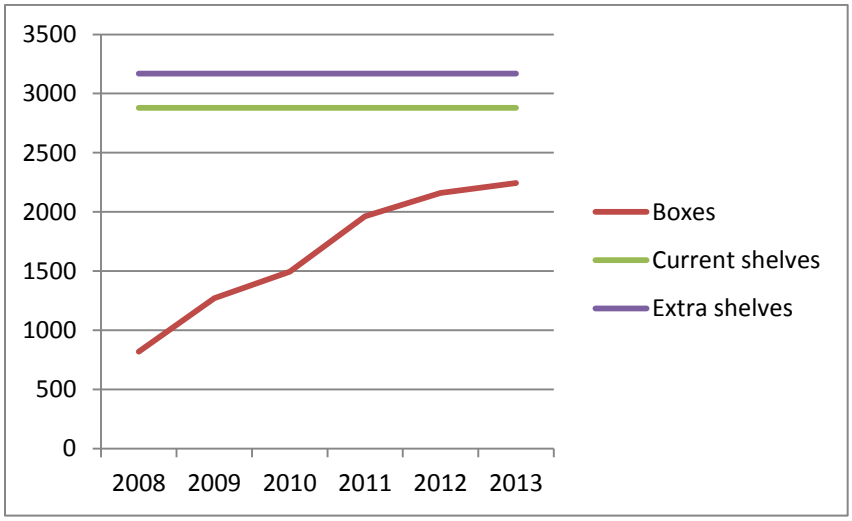


Figure 9. Total number of boxes vs. storage capacity in Vault chamber 2

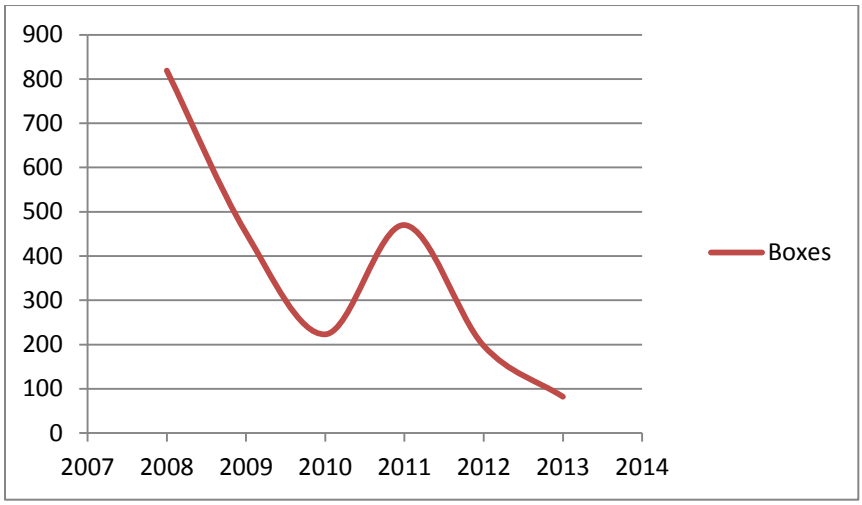


Figure 10. Number of boxes arriving per year 2008-2013

Annex 1. Standard Depositor Agreements in chronologic order

NordGen - Sweden
WARDA - Republic of Benin
CIAT - Republic of Colombia
CIMMYT - United Mexican States
CIP - La Molina, Republic of Peru
ICARDA - Syrian Arab Republic
ICRISAT - Republic of India
IITA - Federal Republic of Nigeria
ILRI - Federal Democratic Republic of Ethiopia
IRRI, Manila - Republic of the Philippines
ICRAF, Nairobi - Republic of Kenya
AVRDC - Taiwan
CGN - Netherlands
Goldman, Seed Savers - United States of America
NARC - Islamic Republic of Pakistan
IPK - Federal Republic of Germany
KARI - Republic of Kenya
ITCC/RDA - Republic of Korea
Institute of Agriculture - Republic of Macedonia
Embrapa - Federative Republic of Brazil
Vavilov Institute - Russian Federation
Agroscope Changins - Swiss Confederation
Departement of Agriculture, Fisheries and Food - Republic of Ireland
Teagasc, Crop Research Centre, Carlow - Republic of Ireland
The National Bureau of Plant Genetic Resources - Republic of India
National Centre for Plant Genetic Resources - Ukraine
Taiwan Agriculture Research Institute - Taiwan
Canadian Genetic Resource Program, Saskatoon - Canada
I Lomouri Research Institute of Farming - Georgia
Pyongyang Crop Genetic Resources Institute - Democratic People's Republic of Korea
Ugandan Plant Genetic Resources Centre - Republic of Uganda
Univeridad Nacional Agraria, La Molina - Republic of Peru
Institute for Cereal Crops Improvement, Tel Aviv University - State of Israel
Arizona Board of Regents Univerisity of Arizona - United States of America
Centro Agronomico Tropical CATIE - Republic of Costa Rica
PGR Unit Agricultural Research Corporation - Sudan
SPGRC Plant Genteic Resource Centre - Republic of Zambia
ICABIOGRAD - Republic of Indonesia
Australian Temperate Field Crops Collection - Commonwealth of Australia
NAGREF, National Agricultural Research Foundation - Hellenic Republic
Biotechnology, Plant Genetic Resources - Republic of the Union of Myanmar
INIAP - Republic of Ecuador
PGRC BARI - People's Republic of Bangladesh
Lombardy Seedbank - Republic of Italy
NACGRAB National Centre for Genetic Resources and Biotechnology - Federal Republic of Nigeria
National Republican Center of Genetic Resources - Republic of Tajikistan
Plant Science Agricultural Research Institute –Mongolia
Genetic Resources Institute (AGRI) of the Azerbaijan National Academy of Sciences –Azerbaijan
Unidad de Recursos Genéticos -INIA La Platina – Chile

Instituto Nacional de Recursos Biológicos – Portugal
Agricultural Research Institute of Burundi (ISABU) – Burundi
Institut de Recherche Agronomique de Guinée (IRAG) – Republic of Guinea
Institute of rural economy – Mali
Georgia State Agrarian University –Georgia
National Plant Genetic Resources Laboratory – Philippines
Armenian State Agrarian University, Laboratory of Plant Gene Pool and Breeding – Armenia
National Rice Seed Storage Laboratory for Genetic Resources – Thailand*
Chai Nat Field Crops Research Center – Thailand*
Uzbek Research Institute of Plant Industry – Uzbekistan*
Australian Grains Genebank*[1]
South Australian Research and Development Institute (SARDI)*
National University Corporation Okayama University*

* Signed standard depositor agreement during 2013. [1]New SDA signed to replace previous due to institutional restructuring.

Annex 2. Deposits by the end of 2013 (56)

Despoistor Insitute	Country	Acronym	WIEWS code	SDA	Accession Dec 2013
Armenian State Agrarian University, Laboratory of plant gene pool and breeding	Armenia	LPGPB	ARM035	X	175
Australian Grains Genebank	Australia	AGG	AUS165	X	343
Genetic Resources Institute of the Azerbaijan National Academy of Sciences	Azerbaijan	AGRI	AZE015	X	1522
Agricultural Research Institute of Burundi	Burundi	ISABU	BDI003	X	365
The Brazilian Agricultural Research Corporation	Brazil	EMBRAPA	BRA008	X	805
Plant Gene Resources of Canada	Canada	PGRC	CAN004	X	25868
Station Federale de Recherches en Production Vegetale de Changins	Switzerland	RAC	CHE001	X	9665
Unidad de Recursos Geneticos - INIA La Platina	Chile	INIA	CHL002	X	43
Africa Rice Center	International, Benin	WARDA	CIV039	X	12439
Centro Internacional de Agricultura Tropical	International, Columbia	CIAT	COL003	X	47898
Centro Agronomico Tropical de Investigacion y Ensenanza	International, Costa Rica	CATIE	CRI001	X	723
Leibniz Institute of Plant Genetics and Crop Plant Research	Germany	IPK	DEU146	X	36534
Instituto Nacional Autonomo de Investigaciones Agropecuarias	Ecuador	INIAP	ECU076	X	168
International Livestock Research Institute	International, Ethiopia	ILRI	ETH013	X	5335
I. Lamouri Research Institute of Farming	Georgia	TAVTAVI	GEO001	X	305
Agricultural University of Georgia	Georgia	AUG	GEO028	X	120
National Agricultural Research Foundation Greece	Greece	NAGREF	GRC035	X	25

Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Biotechnology	Indonesia	ICABIOGRAD	IDN179	X	1050
International Crop Research Institute for the Semi-Arid Tropics	International, India	ICRISAT	IND002	X	104000
Oak Park Research Centre	Ireland	AFT	IRL001	X	577
Department of Agriculture, Food and Rural Development	Ireland	DAFF	IRL029	X	100
Institute of Creal Crop Improvement, Tel Aviv University	Israel	ICCI	ISR003	X	900
Lombardy Seed Bank, Botanical Garden, University of Pavia	Italy	LSB	ITA411	X	2
National Genebank of Kenya	Kenya	NGBK	KEN015	X	1314
World Agroforestry Centre	International, Kenya	ICRAF	KEN023	X	777
National Agrobiodiversity Center	South Korea	NAC	KOR043	X	13185
Centro Internacional de Mejoramiento de MaÃz y Trigo	International, Mexico	CIMMYT	MEX002	X	123057
Institut d'Economie Rurale	Mali	IER	MLI002	X	158
Biotechnology, Plant Genetic Resources and Plant Protection Division	Myanmar	MPGRPPD	MMR003	X	718
Plant Science Agricultural Research and Training Institute	Mongolia	PSARTI	MNG030	X	160
Nigeria National Centre for Genetic Resources and Biotechnology	Nigeria	NACGRAB	NGA010	X	800
International Institute of Tropical Agriculture	International, Nigeria	IITA	NGA057	X	18813
Centre for Genetic Resources	Netherlands	CGN	NLD037	X	18642
Plant Genetic Resources Institute, National Agricultural Research Centre	Pakistan	PGRI-NARC	PAK001	X	2874
Centro Internacional de la Papa	International, Peru	CIP	PER001	X	6825
Universidad Nacional Agraria La Molina	Peru	UNALM	PER002	X	1296
International Rice Research Institute	International, Philippines	IRRI	PHL001	X	116668

National Plant Genetic Resources Laboratory	Philippines	NPGRL	PHL129	X	2254
Pyongyang AAS	North Korea	AAS	PRK013	X	5700
Instituto Nacional de Recursos BiolÃ³gicos	Portugal	INRB	PRT005	X	12
N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	Russia	VIR	RUS001	X	5278
Agricultural Research Corporation, Wad Medani	Sudan	ARC	SDN034	X	1195
Nordic Genetic Resource Center	Regional, Sweden	NORDGEN	SWE054	X	15265
International Centre for Agricultural Research in Dry Areas	International, Syria	ICARDA	SYR002	X	113910
National Rice Seed Storage Laboratory for Genetic Resources	Thailand	NRSSL	THA012	X	81
Chai Nat Field Crops Research Center	Thailand	CN FCRC	THA214	X	150
Republican National Genetic Resource Center	Tajikistan	NRCGR	TJK027	X	1646
The World Vegetable Center	International, Taiwan	AVRDC	TWN001	X	12769
Taiwan Agricultural Research Institute	Taiwan	TARI	TWN006	X	10503
National Agricultural Research Organization	Uganda	NARO	UGA031	X	777
Institute of Plant Production n.a. V.Y. Yurjev of UAAS	Ukraine	UAAS	UKR001	X	2782
Desert Legume Program	USA	DELEP	USA971	X	134
Seed Savers Exchange	USA	SSE	USA974	X	2239
National Plant Germplasm System	USA	NPGS	USA996	0	69307
Uzbek Research Institute of Plant Industry	Uzbekistan	UzRIPI	UZB006	X	2038
SADC Plant Genetic Resources Centre	Regional, Zambia	SPGRC	ZMB030	X	1463
Total					**801752**

Annex 3. Minutes of the IAC meeting 2013

International Advisory Council
Svalbard Global Seed Vault
Longyearbyen, Svalbard 26 February 2013

In Attendance:

Cary Fowler	Chair, Global Crop Diversity Trust, Germany
Ruaraidh Sackville Hamilton	International Rice Research Institute (IRRI), The Philippines
Bert Visser	Centre for Genetic Resources (CGN), The Netherlands
Javad Mozafari	International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Iran
Emile Frison,	Bioversity International, Italy
Linda Collette	Commission on Genetic Resources for Food and Agriculture (CGRFA), Food and Agriculture Organization of the UN (FAO), Italy
Zachary Muthamia	Kenya National Genebank, Kenya
Ruth Haug	Norwegian University of Life Sciences (UMB), Norway
Wilhelmina Pelegrina	Greenpeace, The Philippines
Árni Bragason	Nordic Genetic Resource Centre (NordGen), The Nordic Countries

Guests and observers/resource persons:

	Minister, Norwegian Ministry of Agriculture and Food (NMAF)
Trygve Slagsvold Vedum	
Anne Marie Aanerud	Political Adviser, NMAF, Norway
Pål Vidar Sollie	NMAF, Norway
Marianne Smith	NMAF, Norway
Grethe Helene Evjen	NMAF, Norway
Bente Næverdal	Statsbygg, Norway
Åslaug Haga	Global Crop Diversity Trust, Germany
Brian Lainoff	Global Crop Diversity Trust, Germany
Ola Westengen	NordGen, The Nordic Countries
Roland von Bothmer	NordGen, The Nordic Countries
Simon Jeppson, NordGen	NordGen, The Nordic Countries
Mads Rambol Wolf	Nordic Council of Ministries, The Nordic Countries

Members not able to attend:

Guri Tveito	Head of Department for Environmental Protection, The Governor, Svalbard, Norway

Agenda Item 1
Introduction
Cary Fowler, Chair

The Chair, Cary Fowler, opened the meeting and welcomed Council Members, guests and observers.

The Chair noted that media were attending an IAC meeting for the first time. In prior consultation with the Norwegian Government, it was decided to suggest to the Council that the media be allowed for the first two agenda items, but the Council would ask the media to excuse themselves from the room for the Council's deliberations on items likely to touch on matters relating to security. The Council agreed with this approach. The media reacted positively to this decision and were thanked for their understanding.

Speaking for the Ministry of Agriculture and Food, Grethe Evjen stated that the Ministry has been working on the standard depositor agreement (SDA). She mentioned that the budget for Svalbard Global Seed Vault (SGSV) is about 5 million crowns, however this includes information systems, production of a film, a book, and other activities not strictly associated with SGSV's seed conservation. Update of the website has been put on hold. Grethe thanked everyone for participating in this fourth meeting of the IAC.

The IAC agreed to reversing agenda items 3 and 4.

The Chair provided a brief history SGSV. He noted that the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) allowed for the creation of a rational global system obviating the need for each country to conserve everything. This, in turn, made it feasible to establish a global safety backup of every unique accession. There was historical precedence for storing seeds in Svalbard; Nordic countries had been doing so since 1984 in the shaft of a local coal mine. Following a feasibility study undertaken by an international committee, the Government of Norway agreed to construct the SGSV. It paid all the financial costs. NordGen is responsible for day-to-day operation of SGSV. The Global Crop Diversity Trust provides financing together with the Ministry, and the Trust and NordGen work together on seed shipments and technical matters. SGSV operates in the context of the International Treaty and the FAO Global Plan of Action. FAO has expressed the preference to safety duplicate unique accessions in more than one country, and has specifically recognized and commended SGSV. It is important that the IAC keep in mind SGSV's management plan: Simple, straight foreword, inexpensive, sustainable, functional, and practical. There are no full time staff members on site. When a depositor deposits seeds to SGSV, there is no transfer of property rights. Deposits are owned by the depositor. Deposit boxes are not opened. A formal Deposit Agreement between the depositor and NordGen on behalf of Norway describes the conditions under which the deposits are held and the rights and obligations of the Parties. There is no cost to the depositor for the conservation services provided by SGSV. SGSV is operated on the basis of a three party agreement between Norway, the Trust and NordGen. There is a close relationship with the Statsbygg and the Governor's Office in Svalbard.

The Chair stated that the roles of the IAC are as follows:

1. Monitor operations of SGSV.

2. Give technical and policy advice to the Government.

3. Provide transparency to the rest of the world; function as the eyes and ears of the international community.

4. Be active ambassadors for SGSV.

The Chair reminded the IAC that the IAC is an *advisory* body, not a decision-making or management body. He noted that the IAC had heretofore operated in an informal way and expressed the hope that this positive and constructive practice could be maintained. The meeting should provide for a full, but focused and practical discussion of all issues.

The Chair noted that the main discussion points would be captured in the Minutes and that following each agenda item he would summarize the conclusions reached, which would then form the basis for the Minutes and any advice to be given to the Government.

Agenda 2
Status of Seed Deposits
Introduced by Ola Westengen, NordGen

SGSV contains nearly 775 000 deposits. 52 of 53 depositors have signed the Standard Deposit Agreement (SDA), and NordGen will hopefully conclude the Agreement with the last depositor soon.

The SGSV contains deposits that were originally sourced from virtually every country in the world. Some 95% of UN countries are represented in SGSV today as well as a number of countries that no longer formally exist. The majority of depositors are non-OECD member country institutions. However, the largest number of samples are from International Agricultural Research Center (IARC) collections under Article 15 of the International Treaty. The main mechanism for recruitment of depositors has been through the Global Crop Diversity Trust's work with IARCs and national programs to regenerate threatened genebank accessions. Care has been taken to discourage the deposit of samples already protected in SGSV.

Information transparency is extremely important for SGSV. SGSV's "seed portal" plays a vital role in this transparency. It is a public website dedicated to providing information of what is currently in SGSV. Genesys is also animportant global accession level online database in which SGSV data is currently shared.

NordGen organizes the deposits in SGSV. Nordgen – as well as the Trust – work with depositors to make sure that they provide good relevant data about the samples to be deposited, and that those samples are prepared and packaged correctly, and shipped expeditiously to Oslo. From there NordGen typically accumulates boxes from various depositors and arranges to transfer them together to Longyearbyen. In Longyearbyen, boxes are screened at the airport, trucked to SGSV, logged in, and finally placed in a predetermined location on one of the shelves in SGSV.

The initial wave of deposits has now slowed, and one might consider that SGSV is in a "filling in the gaps" stage. A little more than 2/3rds of the storage capacity of Vault Room 2 has been used. NordGen does not anticipate that this room will be completely filled in the next couple of years.

Ruth Haug said she is very impressed by the work. She asked if there was a goal for the number of samples in SGSV? The Chair responded that there was no numerical goal, but suggested that we are numerically beyond where he thought SGSV would be now.

Emile Frison noted that the number of countries from the South that have deposited was encouraging. He always understood that the majority of samples necessarily would be from the large depositors. But, he was impressed by the number of countries participating and noted the importance of the Trust's regeneration project.

Zachary Muthamia suggested the IAC encourage individual countries to deposit more; in the future the IAC should focus on how this gap can be narrowed.

The Chair observed that in assessing the degree of participation by countries to date, it is too early to question whether any sizeable number of countries have failed to "buy-in". Five years ago SGSV was a new and unfamiliar concept to everyone. Those involved with SGSV have limited capacity to go to the world's 1700 gene banks to describe this concept and facilitate deposits. In this context, the number of samples deposited and the number of depositing institutions is truly impressive.

Summarizing, the Chair congratulated NordGen on the management of the facility. The IAC is impressed by the progress made in a relatively short period of time, while noting the need to fill the remaining gaps. In addition to providing protection for the world's largest assemblage of crop diversity, SGSV is the biggest ambassador for plant genetic resources and has played an historic role in alerting the public and policy makers to the importance of conserving this diversity.

Agenda Item 3
Future Strategy for Deposits
Introduced by Ola Westengen, NordGen

In 2011, the IAC requested Nordgen to undertake a study of SGSV's deposits – and gaps - to serve as a background for formulating a strategy for soliciting future deposits. The benchmark of the assessment was the FAO WIEWS database, which provides a rough estimate of distinct accessions. Another benchmark was the Genesys database. Nordgen also looked at the number of accessions covered by the International Treaty and the largest collections.

Ola Westengen presented the study. SGSV now houses approximately 45% of the accessions identified in WIEWS as unique. Cereals in SGSV represent more than 50% of the world's distinct accessions of those crops. However, he noted that the percentage of the world's distinct accessions deposited in SGSV

is not the same as the percentage of the diversity protected there. Furthermore, each of the major databases used in the study has its shortcomings in terms of the use made of it in this study.

Genera that are not in Annex 1 of the International Treaty are much less represented in SGSV than Treaty-related materials. India and China appear in the top 10 list for collections not duplicated in SGSV for 68 crops. It is clear that crop genera with a CGIAR mandate are much more represented. Redundant duplication in SGSV is thought to be slight. Some collection holders may want to maintain their core collection in SGSV and should be allowed to do so in the view of NordGen even if this entails a modest duplication of samples already stored in SGSV.

Topics of discussion:
1. What is the role of SGSV in promoting the GPA priorities?
2. How do we address the taxonomic gaps?
3. How do we address the institutional gaps?
4. How do we deal with the issue of duplication within SGSV?

The Chair suggested that the priorities of the International Treaty, as well as the FAO GPA exist and form the context in which SGSV operates. He suggested that the Council discuss the technical analysis of the report, determine whether there was a common understanding of the role of SGSV, and then address the question of a future strategy for attracting seed deposits.

Bert Visser remarked that cereals and legumes dominate collections and this is even more so the case in SGSV. Only 7% of the gene bank holdings are vegetables. Genesys data, therefore, have only a limited value; WIEWS make be the more useful database in assessing distinct accessions.

Ruaraidh Sackville Hamilton suggested that when considering distinctiveness and gaps, we should consider the Crop Wild Relative gap analysis work of the Trust, CGIAR Centers and other partners.

Javad Mozafari argued that duplications are very high with large collections. If SGSV takes these large collections, he argued that there is an increased chance of duplication within SGSV. He theorized that the smaller collections are more unique. The big crops are less endangered than smaller less duplicated crops. He argued that a higher priority be given to such crops. He suggested the analysis can be improved by examining gaps of geographical distribution in the field and also the minor crops being in greater need of duplication. These points were discussed at some length, with several members challenging the points made about large collections and duplications.

Ola Westengen stated that the report did not make any value judgments on what should be in gene banks. Also examining the geographic distribution of in-situ crops would be very difficult.

Ruaraidh Sackville Hamilton argued that the Trust has already done the work on regeneration project and suggested we include this data.

Emile stated that that effort about putting information into the databases allows for a detailed screening of what is original and what is not. Accession level data will be a good background. Wilhelmina

Pellegrina suggested a communications strategy be implemented. Zachary suggested that we develop strategy to capture the indicators of diversity rather than numbers and identifying uniqueness.

The Chair pointed out that while the Trust has good funding, it cannot possibly commit to funding for everything, everywhere. The Trust assumes that genebanks contain substantial amounts of unintended duplication that WIEWS does not indicate and cannot quantify. When the Trust contacted crop experts, crop by crop, and asked what needed to be added to existing "international collections" to compete the *ex-situ* conserved genepools of Annex I crops, the experts typically responded that 8-10 additional collections held that diversity out of 1700 genebanks. This formed the basis for the Trust's regeneration project. The Trust went to expert-identified gene banks holding unique material and offered to help them regenerate their unique accessions. This process, in practice, revealed a drastic overestimation of the unique material actually held in these genebanks. Much of the material was not unique. And, many samples were dead. The Chair suggested that this experience indicates that the estimated number of distinct accessions is exaggerated. He also underscored Ola's comment that accessions numbers do not equal diversity.

Javad agrees with the Chair's point that WIEWS has shortcomings in this context, but reiterated that we need to focus in finding the unique accessions.

The Chair moved discussions towards Emile's point of making sure the IAC is on the same page in regards to SGSVs purpose and mission. He suggested that some people would encourage SGSV to hold the entire world collection no matter how many duplicates are included. He warned that this cannot be done, practically or financially, nor does it need to be done scientifically, and thus we must make decisions about how to prioritize what is placed in SGSV.

Zachary pointed out that there are key countries that have not deposited. Our objective and focus must point to individual countries and accessions that are not represented in SGSV.

Bert suggested that the duplication issue (requiring a second level of duplication prior to placement of a sample in Svalbard) is a deterrent.

The Chair noted that the International Treaty provides the possibility for not having over duplication amongst collections. The "facilitated access/benefit sharing" provisions of the Treaty should mean that countries do not have to safety duplicate everything they have, which could result in SGSV containing numerous copies of the same accession deposited by different institutions. The mission of storing unique germplasm is the direction we have taken. SGSV could not be an active genebank, because that would be highly expensive. Is this how we want to continue to approach the mission of SGSV, he inquired?

Emile argued that the purpose of SGSV is not to provide access to material, but to provide a safety backup. The question is not how to retrieve material from SGSV, but where else is the sample duplicated.

The Chair suggested that the Council look at next steps: filling not just the "institutional gaps," but the "genetic gaps." Filling in the institutional gaps without reference to the underlying genetics would open

the door to over duplication and additional costs. He asked whether the Crop Strategies of the Trust could be a starting point for prioritizing future efforts to fill in the gaps in the materials held by SGSV. Bert suggested that this might be a good idea and very useful and could be compared to what is in SGSV already. It is very feasible and desirable to use the Trust crop strategies. Roland, Zachary, and Javad all stated that they are supporters of the idea of using the Trust strategies.

The Chair summarized that the IAC is in agreement in regards to the mission of SGSV. Existing databases and the crop strategies that we can be used to help identify gaps. We need, however, to find a way to identify the gaps as a genetic resources community, not just as a Seed Vault.

Emile noted that a successful Seed Vault strategy would largely depend on Treaty implementation at the country level. And, Bert noted that this depends on trust building. Continued communication about SGSV can be very helpful. Ruaraidh stated that it is great that the IAC has focused on the environmental/scientific rather than political issues, but that we will eventually need to address the political problems because they seem to be the greatest impediment.

Grethe updated the members that there have been many attempts to contact China and India, but they have not yet resulted in deposits. It may be more productive to look to other countries for deposits in the short term.

Ruth agreed with Grethe, adding that there is a need to better understand why certain countries have not deposited. Again, communication is key. She suggested that we work on the "good stories," such as the story of safety duplication by ICARDA in Syria to encourage other countries and organizations around the world.

A number of Members reiterated the importance of public awareness and communication with potential depositors as well as with Civil Society. Use of social media and regional and international meetings was noted.

The Chair observed: If we are focused on the gaps in the collections and we want to fill the gaps in a responsible way that won't create a lot of over duplication, we should use information that NordGen's agenda item paper has given and the Trust's Crop Strategies. The Trust used those strategies and went to every single country identified therein with the chance to regenerate and safety duplicate to Svalbard. Most of what is here now is because of the Trust's project. He noted in this interim summary that a few countries were unwilling to agree to those simple terms and the Council feels it important to find out why that is the case. Is it a political issue? Frankly, he observed, some countries don't want to send material out of the country even though the Treaty to which they are Party provides for this. This is not a technical problem, but a political problem. It is a problem for the Treaty and FAO. How do we change the culture and implement the Treaty? Can we use the mechanism of the Treaty – the Governing Body to explain what is going on in SGSV and what is not going on in SGSV? The role of the IAC and the partners is to make sure SGSV is working and functioning, as well as being transparent.

The Chair summarized the discussion. The IAC recognizes the necessity for SGSV to be efficient in order to be effective and sustainable. We need to avoid over duplication, which the Treaty frees us to do. This,

however, does not mean we need to be policing possible duplications in SGSV strictly. There is a scientific problem of identifying unique material. The Council acknowledges that there are political issues for SGSV that arise from or reflect unresolved disputes within the International Treaty. Indeed, we might consider SGSV as an indicator of Treaty support and implementation. Countries that are on board with the Treaty should have no problem with black box duplication in SGSV.

If we solve all of these problems we would still have a finance problem – who will pay for future deposits from developing countries? The Trust made a first effort and some countries didn't participate. Funding for that particular project has now expired.

Bert commented that in attracting new deposits, regional events might be a better option (than side events at the Treaty). Further involvement of civil society was suggested. Could senior officials at FAO, including the DG, help in approaching specific governments?

Javad noted that regional PGR meetings could be a good event for the future. Bert suggested having a 2-3 minute YouTube video walking through SGSV.

This concluded Agenda Item 3.

Agenda Item 4
Public Awareness
Introduced by Roland von Bothmer, NordGen

SGSV continues to attract huge media attention. The number of requests for information and visits has constantly increased since 2009. Requests go to the Ministry, NordGen, and the Trust. The Nordic countries, Europe, and North America dominated requests. Three-quarters of requests have been for visits. Others want information, interviews and lectures. Many requests, however, cannot be granted due either to practical issues (not being able to find a date that is feasible), or because of our policy prohibits visits for simply touristic reasons.

Media attention has been overwhelming positive. This independent reporting on SGSV has also had the effect of clearing up misunderstandings and reducing the incidence of “conspiracy theories,” even if some are remarkably creative and entertaining!

It is Nordgen’s view that visits by policy makers should be increased to heighten interest and commitment to conservation of crop diversity. Grethe discussed the importance of including political leaders and policy makers in talks concerning SGSV. It is very demanding to have a meeting in Svalbard, but it does create awareness of SGSV and crop diversity.

In the past year, many visits have been cancelled/rejected, however, because of building regulations that exist in regard to fire, and whether visitors could be adequately protected in such a case, as remote as it might be. We hope to come to a solution. Other obstacles include the fact that there is no

permanent NordGen staff based in Longyearbyen. Better information could be made available in Svalbard for those occasions when Nordgen staff cannot be present.

SGSV plays two important roles: Public awareness about crop diversity and its conservation and as an actual safety backup of our crop diversity.

Emile noted that it is important that we not convey the impression that SGSV is the only initiative needed to conserve crop diversity. However, even when media visiting SGSV are informed of other issues and efforts, there is no guarantee that these will be mentioned in the final product.

The Chair noted that SGSV is the only such conservation facility that is known to the general public. It has appeared on a postage stamp, in cartoons and comics, not to mention countless TV shows and films. Such attention was long the dream of scientists in the early days of crop diversity conservation. How do we use this tremendous resource effectively and responsibly? This is the question moving forward.

The Chair summarized by saying that the Council is pleased with the public attention garnered by SGSV and it re-emphasizes the importance of both roles SGSV plays: its practical conservation role, and its role as the best instrument the field has ever had to promote public awareness of and support for crop diversity conservation.

Agenda Item 5
Status of the Physical Facility (with reference to the inspection by the IAC earlier the same day)
Introduced by Bente Næverdal, Statsbygg

Bente reported on the inspection of SGSV and noted the issues that the IAC should discuss.

The Chair thanked Bente for giving her report. He noted that he has known no one who has visited SGSV who has feared for their personal safety or for the safety of the seeds. He observed that the fire department has not yet been inside SGSV to examine any issues concerning fire but has thus far relied on regulations formulated for other, very different types of structures, in making their decision to limit visitation.

The Council briefly discussed the ruling from the fire authorities that had prevented visits.

The Chair summarized that it is very unfortunate that this situation has occurred. It has compromised public awareness opportunities for SGSV. The Council urges the government to find a solution for this critical matter. The Council also commends Bente for her support and work on finding a solution.

Bente continued with her report to the Council. She noted that the temperature is now completely stable and at the appropriate level.

The initial part of the tunnel that leads into the permafrost region is lined with the Svalbard metal tube and measurements are being taken of the movement in the tunnel; only a few millimeters of movement have occurred. This is not unusual in this situation.

The power supply for SGSV is backed up by a generator; this generator was used recently for a short period when there was a fire at the energy plant in Longyearbyen. Power interruptions are not desirable, but this one served to demonstrate the effectiveness of the backup generator. There was no effect – no measurable rise in temperature at all – in SGSV as a result of this outage.

SGSV's computer system sends reports to a computer in Statsbygg and to the cell phones of Statsbygg personnel. There are immediate alarms for any situation associated with the pumps, the generator, and the entrance door.

Statsbygg has been monitoring water incursion into the tunnel. In the winter this is a non-issue because everything is frozen. During the construction, the thought was that the permafrost would return around the tunnel, seal it, and prevent water from entering. We now see that the water intrusion is increasing when the winter snow melts. The pumps work fine in removing the water (they are located at two levels, with the lower one catching water not collected by the first), and there are additional backup pumps on site. This, however, is not a perfect situation. We have waited and seen that the permafrost will not return anytime soon. Statsbygg is contacting experts and considering options. Statsbygg and the Ministry are committed to finding a solution. The climate in the north is getting milder and the water issue will not go away without our action.

The Chair stated that the Advisory Council had noted the issue in the previous meeting and called for the situation to be monitored. He added that the temperatures in SGSV where the seeds are located are at the proper level and are stable. He invited the Council to comment or ask questions.

Zachary inquired about the costs of pumping out the water from the tunnel and Bente responded that Statsbygg would examine costing figures. She added that Statsbygg hopes to find a solution for preventing water incursion or removing it expeditiously that does not require any electronics or machinery.

Pål Vidar Sollie observed that there have been many small technical issues over the five years and most have them have been solved. He stated that the water issue is critical. User meetings occur 2-3 times a year. It is important that solutions be discussed at the April user meeting.

Emile asked how long it would take for the next seed storage room to cool down in the event that the currently used room is filled. Bente noted that this is a question that must be addressed. She suggested that Statsbygg should be alerted 6-8 months and possibly a year before the next room is required.

Emile asked what the cost of electricity is for SGSV. Bente and Grete confirmed that the electricity costs less than 20,000 USD per year. The Chair noted that this is substantially less expensive than most large individual genebanks around the world.

Bert asked how far down the tunnel water incursion is occurring. Bente said that it occurs around halfway down the main tunnel. The Chair explained that while the tunnel slopes down from the entrance, it slopes up again towards the end as it approaches Vault Room 2 where seeds are stored. Were water ever to reach the area where seeds are stored – which it has never done – it would quickly freeze and offer a barrier to entry of water into SGSV room.

The Chair summarized this discussion and reiterated the conclusions made at the last meeting. There are critical issues with the water, and a permanent solution is required. The Council notes the efforts made by Statsbygg with the pumps. A solution that is not mechanical would be the best solution. The Council is encouraged by Pål Vidar's comments. It is noted that finding a solution and setting a timetable is necessary. A permanent solution is integral for an effective, efficient, and sustainable Seed Vault.

Agenda Item 6
Standard Deposit Agreement Article 7 Changes
Introduced by Marianne Smith, NMAF

The Chair provided historical background. The IAC advised the government to modify the Standard Deposit Agreement (SDA) – specifically Article 7 - to clarify the Agreement in response to politically motivated and erroneous allegations concerning the intent and effect of the SDA. The IAC felt that clearer wording would make the Agreement more transparent and less likely to be misinterpreted. Early in 2012, the Norwegian government decided that a review and editing of the entire standard deposit agreement should occur.

Marianne Smith reported on the changes to the Standard Deposit Agreement.

The revised draft SDA principally deals with two topics.

1) Article 4.1.2. The changes show the material will not be transferred to anyone except the original depositor.

2) Article 5 conveys that the property rights remain with the depositor and are not transferred to Norway.

The revisions do not, in the opinion of the Government and the Chair, change the substance of the original SDA, they simply make it very clear.

Bert asked whether the Government seeks one agreement per depositor or one per deposit? The Chair responded that it is just one agreement per depositor.

Emile asked what was the alternative to Article 3.1.C. The alternative, according to Marianne, was to take it out completely.

The Chair suggested that while there might be some redundancy or inconsistency, we must focus on the changes that have been made. He also pointed out that this is a voluntary agreement in the sense that

no one is required to use SGSV. Deposits are made voluntarily. NordGen has been given discretion to handle SDA agreements with depositors.

The Chair noted that the job of the IAC is to oversee this agreement but cautioned against recommending changes at every meeting, as this could undermine trust and stability. Emile expressed agreement and suggested the Council, and Government focus on the advice of the previous IAC meeting suggesting a rewording of a certain section. Emile, Linda, Zachary, and Bert recommended the adoption of the changes.

The Chair summarized the views of the IAC. The IAC welcomes the rewording of the agreement as provided by the Norwegian government. The IAC agreed that the Chair would provide editing of the draft agreement to the Ministry for the purpose of improving clarity and grammar in line with and to promote the intentions and substance of the draft. The IAC shall monitor this standard deposit agreement and address any remaining issues at the next meeting. We shall see how this agreement functions in practice. The IAC urges and encourages discussion and conversation with any party or concerned organization on the agreement so that any issues or misunderstandings may be resolved.

Closing.

Pal Vidar commented on the success of the first five years of SGSV. He commented on the validity and benefit of the advice received by the Government from the Council. He noted that transparency is extremely important and encouraged continued meetings in Svalbard. He commented on the fact that because it has been five years, those members who have been on the Council for the entirety must either be reappointed or a new member must be appointed.

The Chair stated that the IAC had had a full agenda, with the most detailed discussions on the status of the deposits and the physical structure of SGSV to date. He noted we have celebrated the five year anniversary. There are more than 750,000 accessions that are now safe in large part because of SGSV. The Chair suggested that the international community owes much to the Norwegian government for this achievement. He further emphasized the necessity for IAC members to be ambassadors for SGSV.

The Chair suggested that the Council put the time and place of the next meeting on hold until new members are chosen. He noted that updates will be more frequent, specifically on the reports of Statsbygg and pending issues and that views and advice might be sought of Council members between formal meetings.

Annex 4. Long-term experiment documents

100 year experiment in mine 3

NordGen

December 9, 2013

Contents

1 Introduction

We have looked through the archives thoroughly and so far found the project outline and the results from experiment A (see appendix). The raw data on replicate level is still missing and the statistics are based on the assumption that the germination test was carried out on 400 seeds according to plan. The standard error is based on binom logit with a confidence interval=0.95.

A sample box was retrieved from mine 3 during 2012 according to plan and those results are archived properly and the results from experiment B is also kept for future research (presented in Experiment B results).

1.1 Project plan

This is the documentation available from NordGen's archive

1.1.1 Background

Long-term storage of orthodox seeds is recommended at temperatures of approx. - 20 deg C after drying to water content about 3 - 5 percent. In these conditions the physiological processes in the seeds are slow. In these storage conditions the activity of the micro-organisms is also reduced.

1.1.2 Purpose

In NGB's security storage for duplicates on Svalbard the temperature is - 5 deg C. This will be used for studies with the following object in view:

A Investigation of the evolution of viability in seed samples representing different plant species.

B Investigation of evolution of the seed infected with different pathogens and its influence on the viability during storage.

The experiment is divided into two parts:

1 The experiment will last for more than 100 years, investigations of the viability, extent of infection and so on, being made every five years. This experiment will inform us of storability of different species during long-term preservation.

2 The experiment will last for 20 years, investigations being made every 2 ½ years. This will make it possible to compare storage in permafrost with the conventional one. We hope that it will be possible for us to get an opinion of whether storage in permafrost can be a less expensive alternative for long-term preservation of seeds.

For scientists in 100 years 10 x 1000 seeds of each seed sample being disposed for further long-term preparation of the experiment. All analyses will be carried out at Statens Frökontroll in Aas in Norway.

1.1.3 Method for experiment A

The viability of the seed samples of following species will be studied during the experiment:

Taxa	Common name
Hordeum vulgare	barley
Triticum aestivum	wheat
Secale cereale	rye
Lolium perenne	English rye-grass
Phleum pratense	timothy
Poa pratensis	meadow-grass
Trifolium pratense	common purple trefoil
Pisum sativum	pea
Beta vulgaris	beet
Brassica napus	autumn-rape
Allium cepa	onion
Lactuca sativa	lettuce
Cucumis sativus	cucumber
Daucus carota	carrot
Brassica oleracea var. *botrytis*	cauliflower

Two modern cultivars of each species cultivated in the Scandinavian countries are included in the experiment. The background of the seed sample like origin, quality is known. Each seed sample consists of 1000 seeds divided into 2 ampoules each containing 500 seeds.

The seed sample are dried to water content between 3 - 6 percent before conservation in glass ampoules, which are being freezed during approx. 12 hours before sealing. After that ampoules which are going to be analysed at the same time are being placed in a wooden case and transported to Svalbard by air. The drying is made at a temperature of + 25 deg C and a comparative humidity of approx. 10 percent.

The number of investigation opportunities is 25 all together. In experiment 1 the investigations are taken place every five years during a period of 100 years. In experiment 2 analyses are made every 2 ½ years during a period of 20 years.

The results from the two experiments will be stated in that way that the values obtained in experiment 1 during the fist 20 years will also be used at the collation of experiment 2.

On each investigation opportunity the following analyses will be carried out:

1 Analysis of viability, carried out on 400 seeds according to ISTA methods.

2 Whether genetic changes have taken place during storage, will possibly be investigated by method suited for this.

3 Water content of approx. 100 seeds will be investigated during the first years according to ISTA methods.

1.1.4 Method for experiment B

During the experiment the evolution of seed carrying diseases and their influence on the viability during storage in permafrost will be studied.

The species and pathogens included in the experiment are as follows:

Taxa	Viability(%)	Infestation(%)	Pathogen
Triticum aestivum Runar	89	36	*Septoria nodorum*
		13	*Fusarium* spp.
Triticum aestivum	*	12	*Ustilago tritici*
Secale cereale	*	*	*Fusarium*
Hordeum vulgare Bamse	94	22	*Drechslera* spp.
		25	*Fusarium*
Festuca pratensis Salten	93	55	*Drechslera dictyoides*
Phleum pratense Forus	95	70	*Drecslera phlei*
Pisum sativum	*	*	*Aschochyta pisi*
Allium cepa Laskala	94	14	*Botrytis allii*
		1	*Fusarium* sp.
Daucus carota Forto Nantes	73	11	*Alternaria radicina*
		8	*Alternaria dauci*
Beta vulgaris	*	*	*Phoma betae*
Brassica napus	*	*	*Phoma ungarn*
		*	*Alternaria brassi-cola*
Lactuca sativa	*	*	Sallatmosaikvirus

Naturally infected sample of each species are stored in glass ampoules after being dried in a similar way as described in A. The extent of the infection as well as the viability of the sample are examined before storage.

Each seed sample consists of 1000 seeds divided into two ampoules of 500 seeds each. The number of analysis opportunities will be 25 in all, compare with A above.

In first part these will take place every five years during a period of 100 years (1) and the second part every 2 ½ years during a period of 20 years (2). The results from 1 will also be used at the collation of 2.

On each opportunity the following analyses will be carried out when samples are taken.

1 Extent of infection of respective pathogen will be carried out on 500 seeds according to prescribed method approved by ISTA.

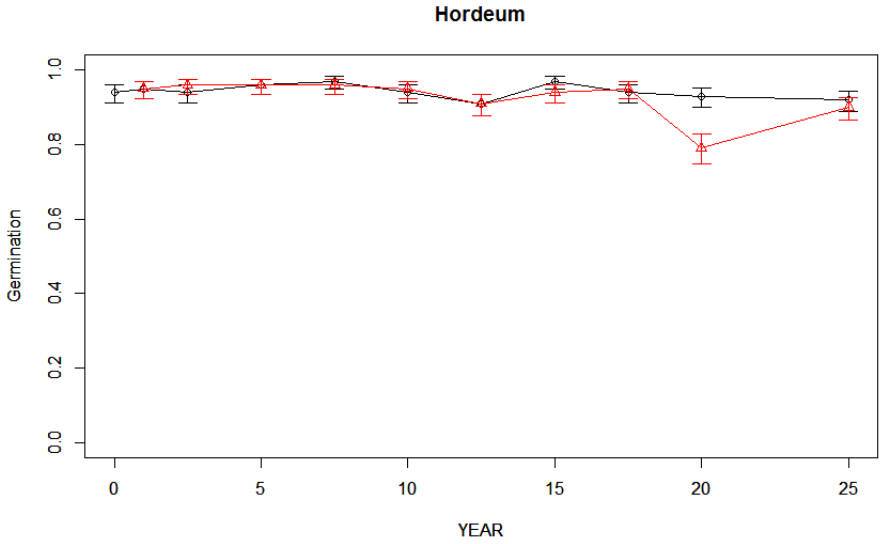
2 Viability of the seed sample using 400 seeds according to ISTA methods.

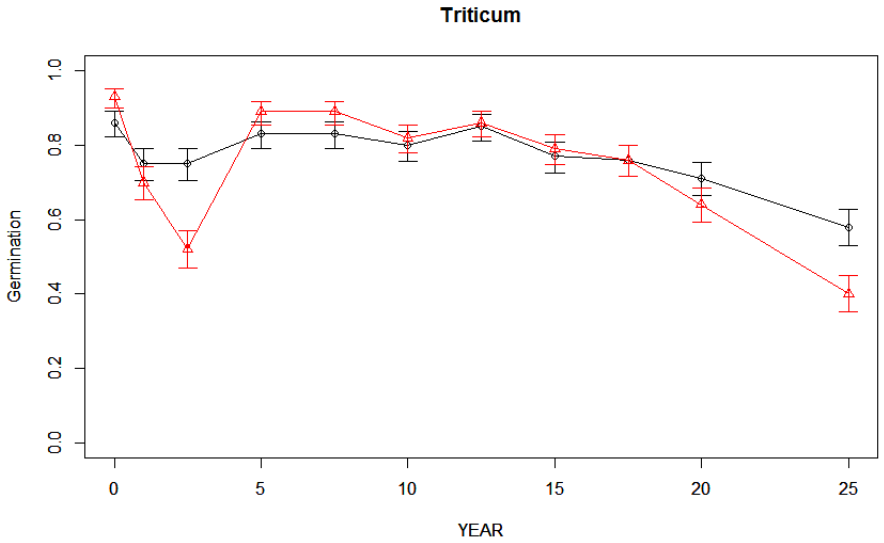
2 Results

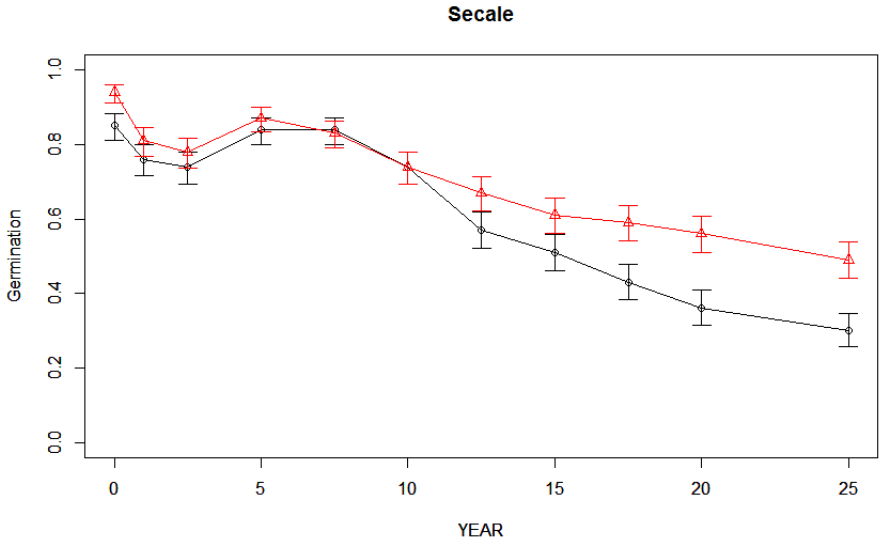
2.1 Experiment A

2.1.1 Cerals

Each line in the following graphs are representing an accession, the error bars are representing 0.95 confidence interval.






Secale
Germination
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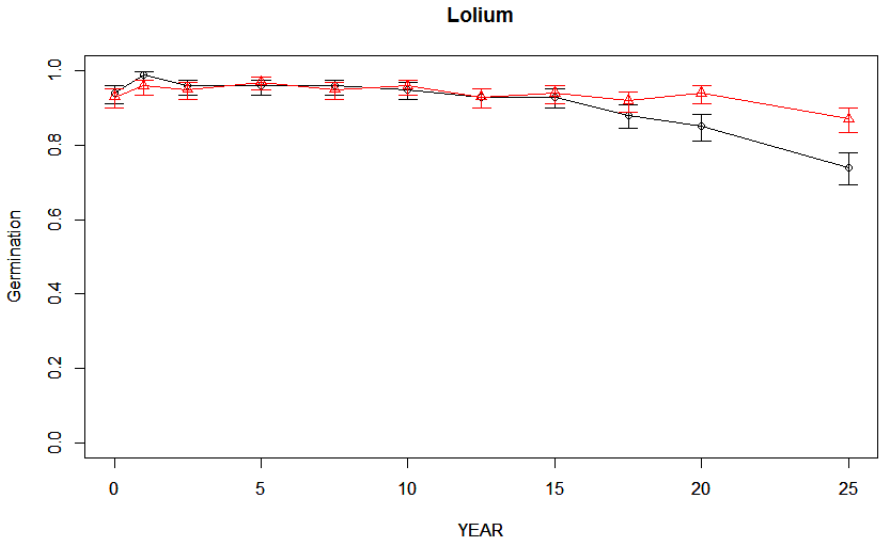
YEAR

2.1.2 Forages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Germination
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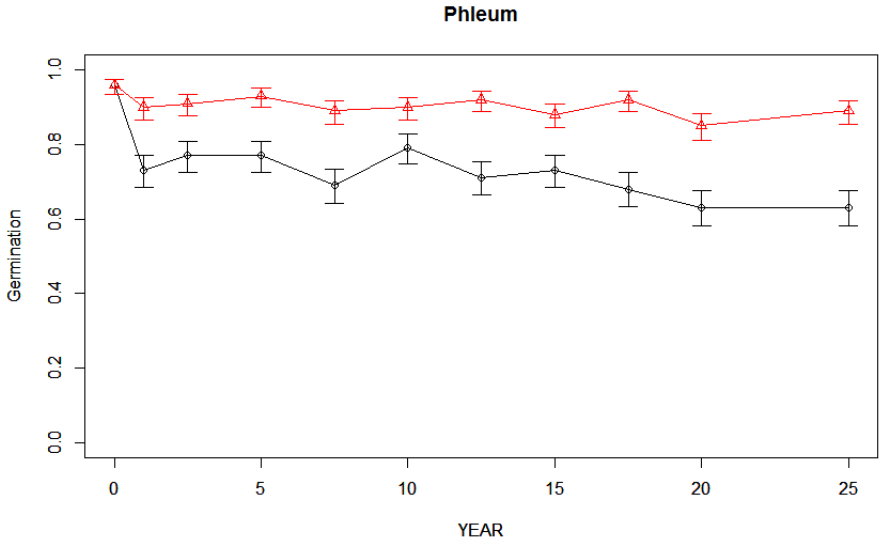
YEAR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Germination
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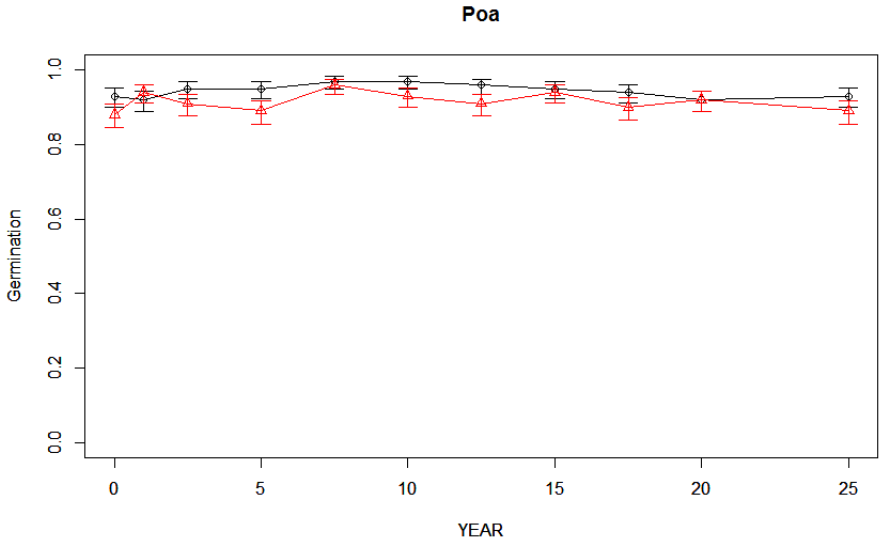
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Germination
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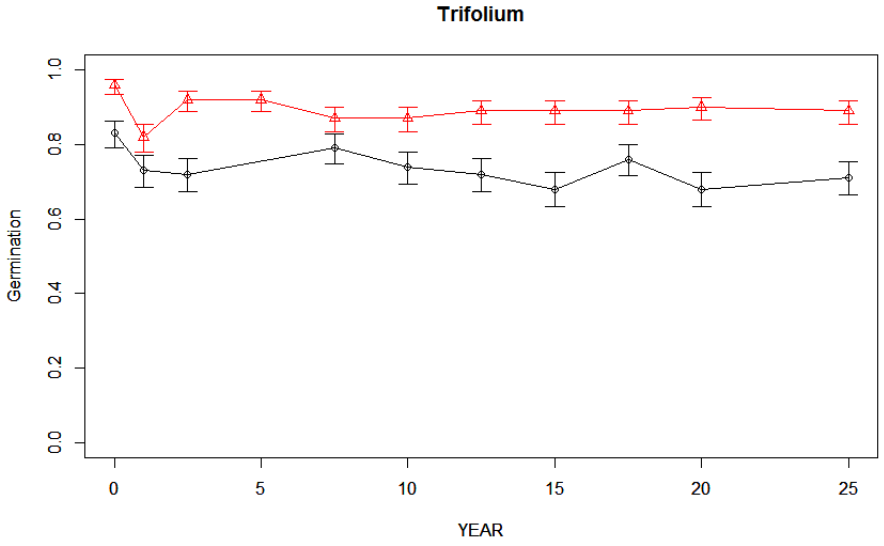
Trifolium
Germination
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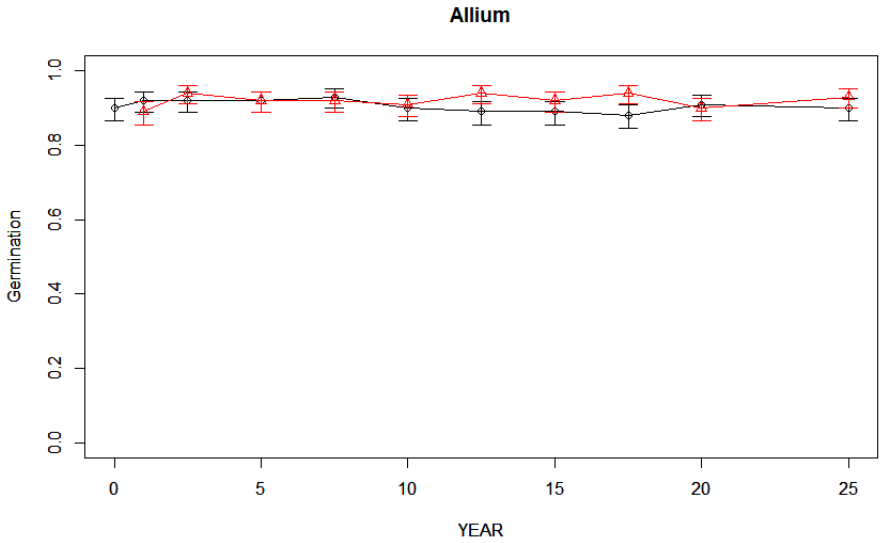
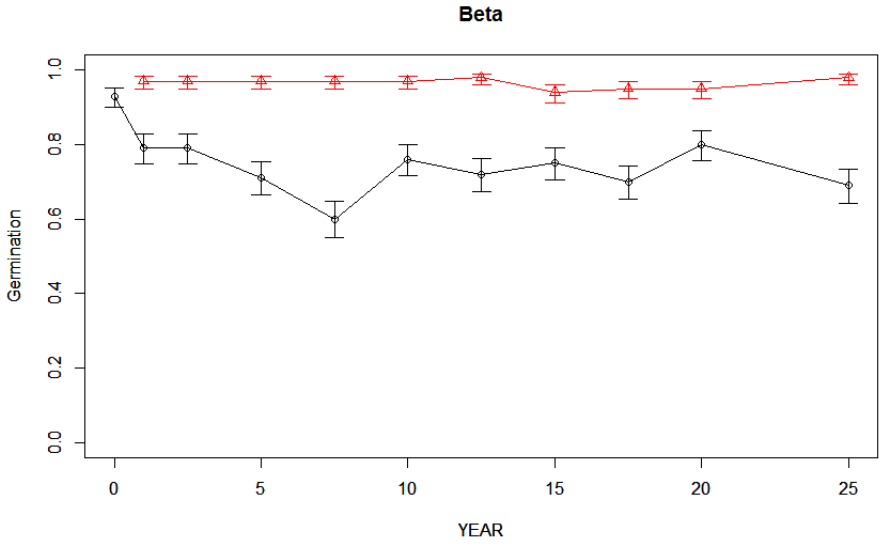
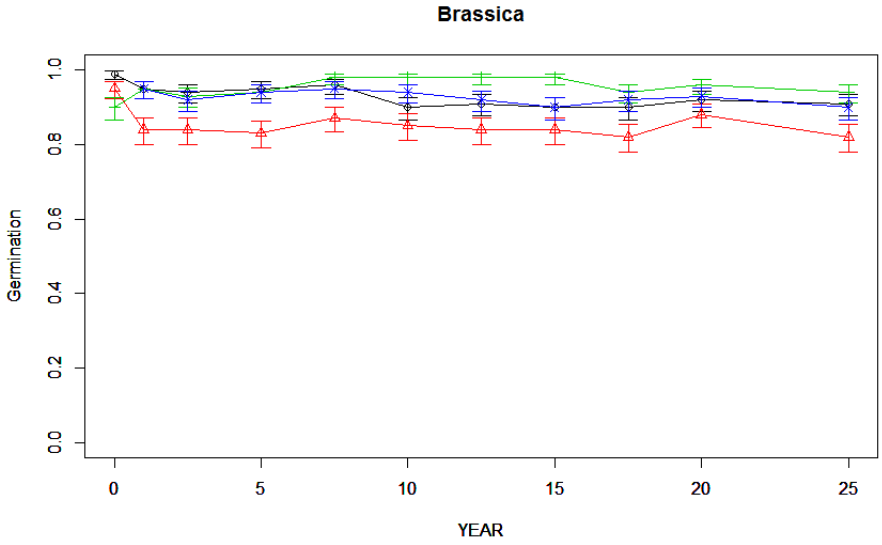
2.1.3 Vegetables



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Germination
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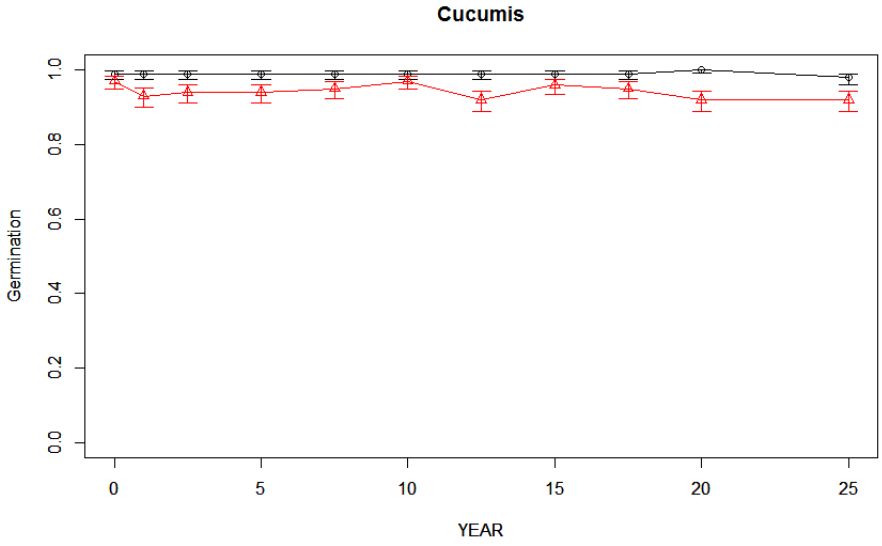
Cucumis
Germination
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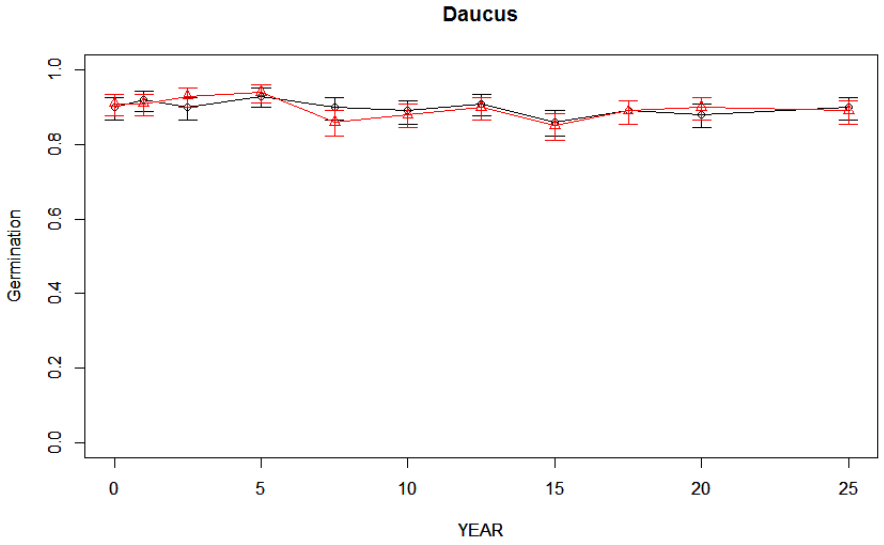
YEAR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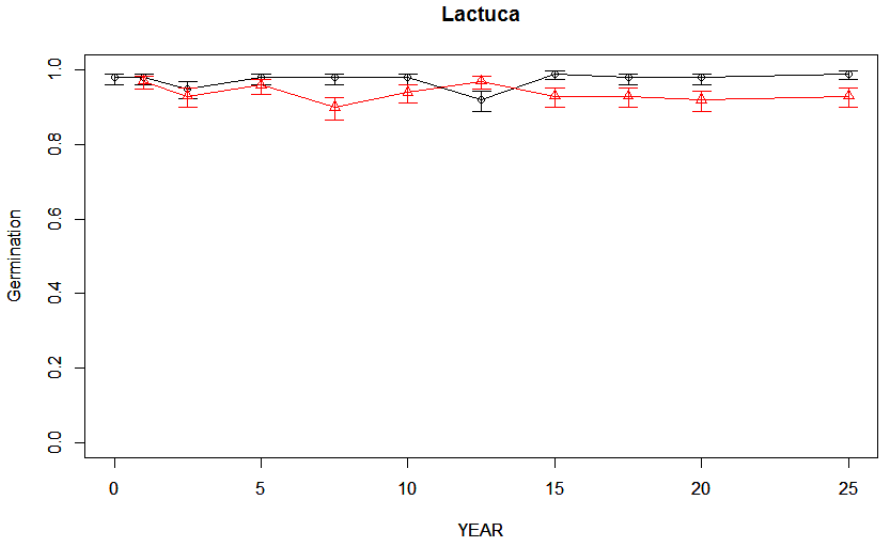
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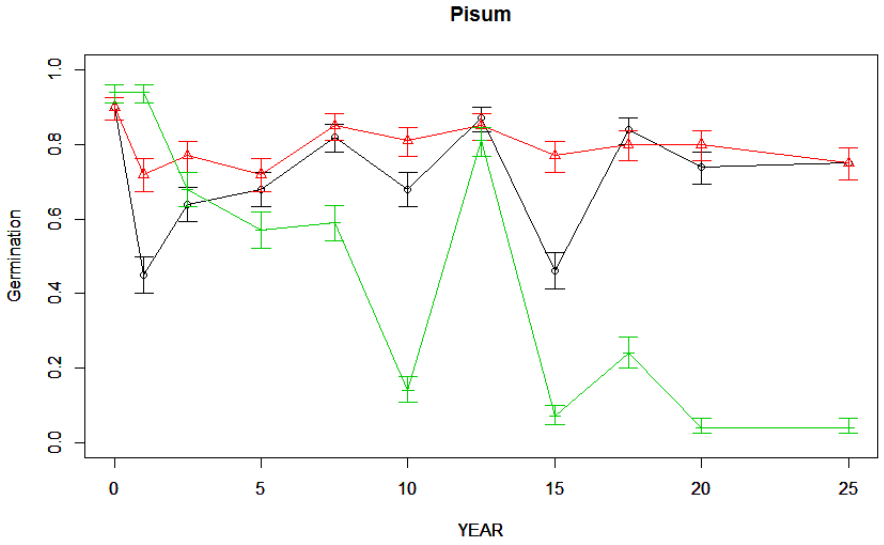
Pisum
Germination
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2.2 Experiment B

Summary of experiment B

Taxa	Cv	Germination			Pathogen	
		N	A	D	Pathogen	Infected (%)
Triticum aestivum	Runar	82	11	7	*Septoria nodorum*	7
					Fusarium spp.	6
	Line 79	83	10	7	*Ustilago nuda*	4.9
Hordeum vulgare	Bamse	85	4	11	*Drechslera* spp.	30
					Fusarium spp.	18
Festuca pratensis	Salten	69	5	26	*Drechslera dictyoides*	37
Phleum pratense	Forus	91	2	7	*Drechslera phlei*	63
Lactuca sativa	Attractie	75	4	21	salatmosaikvirus	1.7
Allium cepa	Laksala	88	5	7	*Botrytis allii*	2
					Fusarium spp.	1
Daucus carrota	Forto Nantes	71	3	26	*Alternatria radicina*	4
					Alternaria dauci	6
Beta vulgaris	Hilma	79	2	19	*Phoma betae*	44
Brassica oleracea	Trönder Lunde	76	17	7	*Alternaria brassiciola*	82

Pathogen	Viability
Sclerotinia sclerotiorum	8 of 20

3 Discussion

In most cases there is only a minor/no decline in viability during the last 25 year. The viability of wheat and rye seems to decline while barley is more or less unaffected. Within vegetables the peas are behaving erratic, while the remaining taxa seems to be rather stable as are the forage species.

Even though the early data may be lost it would be wise to continue the experiment for as long as possible, as the new data may be studied more thoroughly. Mine number 3 is currently abandoned and not maintained and not regarded as safe to enter any more so it might be difficult to continue the experiment for this reason. The cost for an eventual continuation is so far rather low (less than 10 000 NOK/year).

It would have been interesting as a comparative study where the difference between permafrost and -18°C is studied and could as such be used as a worst case scenario study for SGSV. The selection of taxa and genotypes are however Nordic and may not be applicable on an international safety duplicate collection.

The large fluctuations between different germination tests within a genotype e.g. *Pisum* may be explained by several causes:

- Different protocol used (ISTA update their protocols frequently).
- Interpretation of abnormal, hard and dead. It is not possible to conclude further as the raw data is currently lost.
- Temporal fluctuations due to change of equipment. Many of the accessions have an early decrease from which it recovers again.

It is obvious that the various seed-borne plant pathogens survive 25 years of permafrost as do sclerotia. how well they manage is impossible to say without prior data.

Appendix

	Germination results										
Plant species	Initial	1987	1989	1991	1994	1996	1999	2002	2004	2007	2012
Hordeum vulgare cv. Inga Abed	*	95	96	96	96	95	91	94	95	79	90
Hordeum vulgare cv.Tunga	94	95	94	96	97	94	91	97	94	93	92
Triticum aestivum cv. Vakka	86	75	75	83	83	80	85	77	76	71	58
Triticum aestivum cv. Solid	93	70	52	89	89	82	86	79	76	64	40
Secale cereale cv. Pektus	85	76	74	84	84	74	57	51	43	36	30
Secale cereale cv. Vioma	94	81	78	87	83	74	67	61	59	56	49
Lolium perene cv. Pippin	94	99	96	96	96	95	93	93	88	85	74
Lolium perene cv. Riikka	93	96	95	97	95	96	93	94	92	94	87
Phleum pratense cv. Tammisto	96	73	77	77	69	79	71	73	68	63	63
Phleum pratense cv. Bodin	96	90	91	93	89	90	92	88	92	85	89
Poa pratensis cv. Annika	93	92	95	95	97	97	96	95	94	92	93
Poa pratensis cv. Hankkijan Kyösti	88	94	91	89	96	93	91	94	90	92	89
Trifolium pratense cv. Jokioinen	83	73	72	*	79	74	72	68	76	68	71
Trifolium pratense cv. Molstad	96	82	92	92	87	87	89	89	89	90	89
Pisum sativum cv. Weitor	90	45	64	68	82	68	87	46	84	74	75
Pisum sativum cv. Hankkijan	90	72	77	72	85	81	85	77	80	80	75
Pisum sativum cv. Weitor prov 1	94	94	68	57	59	14	81	7	24	4	4
Beta vulgaris cv. 70500	93	79	79	71	60	76	72	75	70	80	69
Beta vulgaris cv. Hilleshög 81458	*	97	97	97	97	97	98	94	95	95	98
Brassica napus cv. Jupiter	99	95	94	95	96	90	91	90	90	92	91
Brassica napus cv. Linrama	95	84	84	83	87	85	84	84	82	88	82
Allium cepa cv. Hammond	90	92	92	92	93	90	89	89	88	91	90
Allium cepa cv. Owa	*	89	94	92	92	91	94	92	94	90	93
Lactuca sativa cv. Hilero	98	98	95	98	98	98	92	99	98	98	99
Lactuca sativa cv.Attraktion	*	97	93	96	90	94	97	93	93	92	93
Cucumis sativus cv.Gigant	99	99	99	99	99	99	99	99	99	100	98
Cucumis sativus cv. Rhinsk Druv	97	93	94	94	95	97	92	96	95	92	92
Daucus carota cv. Nantes Fancy	90	92	90	93	90	89	91	86	89	88	90
Daucus carota cv.Regulus	91	91	93	94	86	88	90	85	89	90	89
Brassica oleracea v. botrytis cv. Savit	90	95	93	94	98	98	98	98	94	96	94
Brassica oleracea v. botrytis cv. Pari	*	95	92	94	95	94	92	90	92	93	90

Long term viability monitoring

NordGen

December 5, 2013

The Svalbard Global Seed Vault (SGSV) has been operational for almost six years and currently contains more than 800,000 safety duplicates of genebank accessions from 56 genebanks around the world. The SGSV is a safety net for the global ex-situ conservation system. The new FAO Genebank Standards [1] states that all original genebank accessions should be safety duplicated in a geographically distant area, under the same or better conditions than those in the original genebank and notes that SGSV provides this service.

The Standard Depositor Agreement (SDA) [2] gives the depositors the opportunity to deposit boxes with germination test samples. NordGen is here proposing a joint long-term viability monitoring experiment whithin the framework of the SDA.

We invite your genebank to deposit test material with the purpose of long-term germination monitoring up to 100 years or more. Contributors can suggest genebank accessions or other seed lots as test material to a set included in the experiment. We aim at assembling a sample set representative for the current SGSV holdings [3], with test material from a wide range of taxa and with different initial viability.

The prerequisites for test material to be included in this experiment are:

- **Amount** Sufficient number of subsamples containing 200-400 seeds each multiplied with the number of monitoring events needed to cover 100 years or more.
- **Germination** Initial germination test conducted on 200-400 seeds
- **Moisture** Initial moisture content and/or water activity measurement

The test material will be stored under identical conditions as the safety duplicate collection, and will be stored under the terms stated in the SDA.

NordGen will administer a project database and handle the logistics of returning subsamples to the contributors at monitoring events. The germination tests shall be conducted by the contributing genebank. Data from germination tests shall be available for all partners from the database. NordGen propose an open access approach also with regard to publishing of the results in academic papers etc., but such use of course relies on the consent of the data providers. The data providers will be included in all publication processes and be invited as authors on papers etc.

If you wish to deposit test-boxes for other types of experiments in addition to the basic germination test material (e.g. morphological or genetic studies, cell ageing/cell death or other changes that might occur over time during long term storage) you are welcome to do so. Data on other aspects than viability can also be stored in the project database, but use will remain fully at the depositors' discretion.

We hope many of you are interested in participating in this experiment. Please contact Simon Jeppson (simon.jeppson@nordgen.org) and Ola Westengen (ola.westengen@nordgen.org) for more information and details.

List of Definitions

Safety duplicate Safety duplicate of accessions kept under strict black box arrangements regulated by the standard depositor agreement.

Subsample A subsample of the test material intended for one monitoring event.

Test material Seed lot from contributor included in the joint experiment.

References

[1] FAO. *Genebank Standards for Plant Genetic Resources for Food and Agriculture*. 2013.

[2] The Royal Norwegian Ministry of Agriculture & Food. Standard depositor agreement, 2013.

[3] Ola T Westengen, Simon Jeppson, and Luigi Guarino. Global ex-situ crop diversity conservation and the svalbard global seed vault: Assessing the current status. *PloS one*, 8(5):e64146, 2013.

Seed preservation under long-term *ex-situ* safety duplication

Proposal for a collaborative long-term experiment

Introduction

The Svalbard Global Seed Vault (SGSV) has been operational for nearly six years and by the end of 2013 the holdings stands at about 800 000 safety duplicates. The safety duplicates are deposited by 55 genebanks and represent accessions of major agricultural and horticultural crops and their wild relatives. The SGSV was established with the "*objective to provide a safety net for the international conservation system of plant genetic resources, and to contribute to the securing of the maximum amount of plant genetic diversity of importance to humanity for the long term in accordance with the latest scientific knowledge and most appropriate techniques*".

The Seed Vault is managed in partnership by the Government of Norway, the Nordic Genetic Resource Center (NordGen) and the Global Crop Diversity Trust (the Trust). The Norwegian Ministry of Agriculture and Food is the legally responsible authority of the Seed Vault, and its operation is overseen by an International Advisory Council consisting of international technical and policy experts representing, among others, the FAO, national genebanks, civil society organizations, the CGIAR and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

The safety duplicates preserved in the Svalbard Global Seed Vault represents accessions stored in the world's genebanks, including the collections held in-trust for the world community by the International Agricultural Research Centres (IARCs) under Article 15 of the ITPGRFA. According to the SGSV Standard Deposit Agreement accessions with safety duplicates in the SGSV shall also be safety duplicated in another suitable gene bank. Thus, the safety duplicates in the SGSV shall represent a second level safety net for the original accession.

The Svalbard Global Seed Vault is an important element in the global *ex-situ* conservation system under the auspices of the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) and the ITPGRFA. The new FAO Genebank standards for orthodox seeds (2013) explicitly states that SGSV provides the recommended safety duplication conditions. The role of SGSV as safety back-up site in the infrastructure of the global conservation system makes it uniquely positioned as the site for a global collaborative experiment on seed viability under long-term storage conditions.

The long-term storage project

Objective: To study seed viability under standard gene bank conditions for safety duplication over a long time span; particularly the conditions for long term safety duplication offered by the Svalbard Global Seed Vault.

Since the inauguration in 2008 depositors have been given the opportunity to deposit test boxes for experiments beside the safety duplicate deposits. Only a few institutes have made

use of this opportunity so far. NordGen is here proposing a joint long-term viability experiment where current depositors and others are welcome to join.

Few long term studies of seed longevity in genebanks have been undertaken (Nagel & Börner 2010; Nagel *et al.* 2011). Most studies have been undertaken with "artificial ageing" of seeds where the seed longevity has been extrapolated (Rehman *et al.* 2012).

The basic part of the proposed project should be comparatively simple and with low costs, but requiring the cooperation of several partners over a long time.

We suggest that institutes deposit test material with the aim of monitoring germination (and ev other parameters) during at least 100 years. Contributors interested have the possibility to nominate genebank accessions or other seed lots as test material to a set included in the experiment. It would be desirable to create a set that reflects the current composition of the SGSV holdings, including test material from a wide range of taxa and with different initial viability.

Project outline: a number of crop species with different characteristics are selected for the project. The chosen accessions are multiplied according to standard procedures for handling of gene bank material. A number of parameters are recorded for the material (water content and others, to be decided). The material is packed in standard foil bags, divided into three (or more depending on number of collaborators) batches: one is stored in the original gene bank, one at The Millennium Gene Bank in Wakehurst, UK and one in the Global Seed Vault at Svalbard. The storing conditions should be identical according the usual gene bank standard in the three locations. At regular intervals, e g every 5^{th} or 10^{th} year the viability of the seeds are tested (other parameters can be added, if desirable).

Material

The material chosen should optimally represent different crops, such as:

- temperate and tropical crops
- agricultural and horticultural crops
- different plant groups (e g Poaceae, Fabaceae, Solanaceae and Brassicaceae)
- Different seed structures (large vs small seeds, tough seed coats etc)
- Crop Wild Relatives (CWRs) of the crop taxa included above

Some of the major food crops of the world should be included in the project. The species should be well represented in gene banks of the world and are mandate crops for International Centres of the CGIAR system.

The suggested crops to be included are (in parenthesis the percentage represented in SGSV):

Crop Group	**Genus**	**Total no in WIEWS**	**CGIAR Inst**
Cereal	*Triticum*	855 000 (17%)	CIMMYT
Cereal	*Oryza*	774 000 (19%)	IRRI/CIAT
Cereal	*Hordeum*	486 000 (14%)	IPK
Cereal	*Zea*	324 000 (10%)	CIMMYT
Cereal	*Sorghum*	236 000 (17%)	ICRISAT

Cereal	*Pennisetum*	65 000 (31%)	ICRISAT
Food legume	*Phaseolus*	263 000 (13%)	CIAT
Food legume	*Arachis*	128 000 (11%)	ICRISAT
Food legume	*Cajanus*	41 000 (25%)	ICRISAT
Feed crop	*Trifolium*	75 000 (6 %)	NordGen
Feed crop	*Phleum*	10 000 (6 %)	NordGen
Roots/tuber	*Solanum*	148 000 (11%)	CIP
Vegetable	*Capsicum*	74 000 (3%)	World Veg Centre

Proposal for collaborating genebanks and institutes

The proposed long term project should optimally include major holdings of crop genetic resources of the world. The CG-centres and The World Vegetable Center, AVDRC, represent the largest holdings of major food crops of he world and they comprise a large knowledge of conservation and utilization of these crops. It is vital for the project that these centres are willing to participate. In the first phase we propose that the German genebank, IPK, Gatersleben participates. The institute has a large experience and knowledge concerning research and conservation in many crops, particularly in barley. Other national or regional genebanks may be involved in the project if they so wish.

The Millennium Seed Bank, Wakehurst, UK and The Global Seed Vault, Svalbard, Norway are both organisations involved in long term conservation *ex situ* of plant material. The Svalbard Global Seed Vault represents the largest holding of crop genetic resources in the world but no research and development facilities are available here. The Millenniun Seed Bank is a world leading research organization concerning seed preservation and holds the largest collection of wild biodiversity. A closer collaboration between the two in matters of conservation and research in particular fields would have several policy advantages for the whole area of biodiversity conservation in plants. In a cooperation The Millennium Seed Bank will gain experience in the area of crop plants and getting access the whole network of gene banks in the world. The Global Seed Vault/NordGen will gain from the great expertise on seed preservation and from the extremely good working facilities at Wakehurst.

The proposed projects on investigations of seed longevity aim to initiate further cooperation between all collaborating partners.

Collaborating institutions

The Nordic Genetic Resource Center, *NordGen*

NordGen is a Nordic organization dedicated to safeguarding and sustainable use of plants, farm animals and forests. It was established in 2008 and is mainly financed by the Nordic Council of Ministers. NordGen's primary task is to contribute to securing the broad diversity of genetic resources linked to food and agriculture.

Nordgen works to secure genetic diversity for agriculture and forestry in the Nordic

countries. The genebank at NordGen holds ca 30 000 accessions of a variety of crops and their wild relatives of importance for the Nordic area.

The Global Seed Vault belongs to the Norwegian Government and NordGen (Nordic Genetic Resources Centre) is responsible for seed management in the Vault.

The Millenium Seed Bank

The Millennium Seed Bank in Wakehurst, UK is a branch of Kew Royal Botanic Gardens. Today, 60,000 to 100,000 species of plants are faced with the threat of extinction. Kew's Millennium Seed Bank Partnership aims to save plants world wide with a focus on plants most at risk and most useful for the future. The Millenium Seed back is one of the leading institutes with experience and knowledge of seed physiology and seed conservation.

CG-centres

The International Maize and Wheat Improvement Center, CIMMYT

CIMMYT is the world's premier center for research, development, and training in maize and wheat and in farming systems for those two essential food crops. From its headquarters in Mexico and offices throughout the developing world, the center works for sustainably increasing the productivity of maize and wheat cropping systems.

With more than 175,000 accessions, CIMMYT maintains the world's largest maize and wheat seed bank.

Mandate species: maize (*Zea mays*), wheat (*Triticum aestivum* and other species)

International Rice Research Institute, IRRI

IRRI develops new rice varieties and rice crop management techniques that help rice farmers to improve the yield and quality of their rice in an environmentally sustainable way. Headquaters is situated in Los Baños in The Philippines.

The International Rice Genebank, maintained by IRRI, holds more than 117,000 accessions of rice - the biggest collection of rice genetic diversity in the world.

The International Crops Research Institute for the Semi-Arid Tropics, ICRISAT

ICRISAT conducts agricultural research for development in Asia and sub-Saharan Africa. ICRISAT is headquartered in Hyderabad, Andhra Pradesh, India, with two regional hubs and four country offices in sub-Saharan Africa.

Mandate crops are chickpea (*Cicer arietium*), pigeon pea (*Cajanus cajan*), groundnut (*Arachis hypogaea*), pearl millet (*Pennisetum glaucum*), sorghum (*Sorghum bicolor*) and six species of small millets. The ICRISAT Genebank serves as a world repository for the collection of germplasm of the mandate crops. With over 120,000 germplasm accessions assembled from 144 countries, it is one of the largest international genebanks.

The majority of the collection is seed producing and essentially orthodox in nature.

International Center for Tropical Agriculture, CIAT

CIAT has its headquarters near Cali, Colombia, with regional offices in Nairobi, Kenya, and Hanoi, Vietnam. CIAT has global responsibility for improvement of the staple crops cassava and common bean, together with tropical forages for livestock.

CIAT's Genetic Resources Program hosts the world's largest genetic holdings of beans (over 35,000 accessions), cassava (over 6,000), and tropical forages (over 21,000), from over 141 countries.

The International Potato Center, CIP

CIP was founded in 1971 as a root and tuber research-for-development institution. CIP has headquarters in Lima, Peru and offices in 30 developing countries across Asia, Africa, and Latin America.

Mandate crops are potato (*Solanum tuberosum*), sweet potato (*Ipomea batatas*), Andean roots and tubers (several species).

The genebank holds over 80% of the world's native potato and sweetpotato cultivars and over 80% of the known species of wild potato. It also maintains more than 1,500 accessions of native Andean root and tuber crops.

Other centers

The World Vegetable Center, AVRDC

AVDRC is an independent non-governmental, international agricultural research institute working with increased production and consumption of nutritious and health-promoting vegetables. It was founded in 1971 and the headquarters campus lies in Taiwan.

Mandate crops: several species

The AVRDC Genebank maintains the world's largest public vegetable germplasm collection with more than 59,507 accessions from 156 countries, including about 12,000 accessions of indigenous vegetables.

National Genebank

The Leibniz Institute of Plant Genetics and Crop Plant Research, IPK

IPK is a research institution situated in Gatersleben in central Germany. IPK is working on the problems of modern biology in fundamental and applied research by focussing on cultivated plants.

The IPK genebank is one of the largest facilities holding ca 151 000 accessions of 3 212 species (776 genera) of crops and their wild relatives.

Project set up

The seeds to be included in the project must be of high quality and treated under optimal conditions. As much information as possible should be gathered at the start of the project:

- germinability
- protocol for germination test
- characterization data (UPOV or other descriptor list)

preferably also

- genomic data
- data on diversity at accession level

Each accession will be stored at three locations:

- The Svalbard Global Seed Vault with NordGen as responsible for management and operation
- Millenium Seed Bank
- Original Gene bank

Over the span of the project germinability (and perhaps other criteria) should be tested independently at MSB and the original gene bank in order to get information on the quality and standard for germination tests and other variables. For this purpose three identical batches should be available for testing at each occasion (5 or 10 years interval). To be able to make further studies (for example of mutation rate, DNA degradation etc), one additional batch should be prepared for the whole project. Each batch should contain 500 seeds.

***To be discussed and decided for the project*:**

- More than one accession/crop species
- Recording of initial data
- Should other partners (genebanks or CG-centres be involved)
- How to coordinate the project

References

Nagel, M. & A. Börner. 2010. The longevity of crop seeds stored under ambient conditions. Seed Science Res. 10: 1-12.

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Rehman Arif, M.A., M. Nagel, K. Neumann, B. Kobiljski, U. Lohwasser & A. Börner. 2012. Genetic studies of seed longevity in hexaploid wheat using segregation and association mapping approaches. Euphytica 186: 1-13.

Appendix

Other gene bank projects eventually to be added:

In connection with the "basic experiment" several other, more scientifically directed projects could be initiated, requiring fewer collaborators but a higher input of funding. The objectives for these projects are to scientifically investigate the reliability of gene bank conservation of crop plants under different or varying conditions. These projects are shorter in time, requires a more substantial funding but with fewer project collaborators.

1. ***Worst case scenario for conservation: inferior quality of original material***
   Objective: to study what happens over time with initially low seed germinability
   Project: suboptimal conditions in the seeds are artificially induced (e g with high moisture content), one batch with optimal seed quality is used as standard. Rather few species are used, e g rice, barley and rapeseed

2. ***Suboptimal conditions during storage***
   Objective: to study seed viability under different regimes
   Project: rather few species are used. A number of different, suboptimal conditions are set for storage are set up (temperature, type of storage bags etc)

3. ***Genetic changes during conservation, crop species***
   Objective: to follow the genetic identity for a particular accession over time
   Project: two crop species are chosen one self-pollinator (e. g. barley) and one cross-pollinator (e. g. rapeseed) are selected, preferably landraces. The material is multiplied and subdivided; one batch goes to long-term storage, one batch goes for multiplication/rejuvenation at certain intervals (5 years or arbitrarily done every year). The multiplied batch is divided: one goes to long-term storage and the other goes for multiplication at the decided next interval. At the end of the project a genetic diversity study is performed on all material with suitable technique at a time. A further elaboration of the project would be to have the chosen accessions to be handled with "on farm management" each year.

4. ***Genetic changes during conservation, wild species***
   A similar project as number 2, but including wild species, then with a living population preserved *in situ* (nature reserve)

Annex 5 Budget and Spendings 2013

Activity	*Cost Category*	*Items*	*Cost basis*		*Budget 2013*	*Actual spending*
			SEK	*Qty*	*SEK*	*SEK*
709512: Coordinator	Personnel [a]	Coordinator	94 000	6	564 000	642 159
	Travel [b]	To Svalbard and other destinations	15 000	6	90 000	67 039
	Communication / supplies	Phone, computer,printer, mailing etc.	30 000	1	30 000	25 956
Sub-total					**684 000**	**735 154**
709513: Platform 1 - Overall Administration	Personnel	Director and Finance Director	160 000	1	160 000	232 221
	Communication / supplies	Phone, printer, mailing etc.	20 000	1	20 000	18 084
	Travel [c]	To Svalbard and other destinations		4	30 000	9 773
Sub-total					**210 000**	**260 078**
709514: Platform 2 - Information Management	Personnel [a]	IT-manager	94 000	2	188 000	176 597
	Travel [b]	To Svalbard	15 000	1	15 000	
	IT System	Computer				8 885
	IT System	Server, web	54 000	1	54 000	54 000
Sub-total					**257 000**	**239 482**
709515: Platform 3 - Practical Seed Administration	Personnel [a]	Seed Technician	94 000	1	94 000	109 434
	Travel [b]	To Svalbard	15 000	3	45 000	35 342
		Vehicle hire, local supplies	60 000	1	60 000	34 187
Sub-total					**199 000**	**178 963**
709516: Platform 4 - PR	Personnel [a]	Scientific information expert	135 000	3,6	486 000	543 668
	Personnel [a]	Other staff	94 000	0,25	23 500	
	Travel [b]	To Svalbard and other destinations	15 000	6	90 000	119 676
	Materials for media	External filming, editing and multiplication	30 000	1	30 000	24 586
	Communication / supplies	Phone, printer, mailing etc.	10 000	1	10 000	17 496
Sub-total					**639 500**	**705 426**
709517: International Advisory Council	Personnel	Director	160 000	0,5	80 000	94 429
	Personnel [a]	Other staff	94 000	0,3	28 200	
	Travel [b]	Meeting at Svalbard	15 000	12	180 000	173 590
	Communication/Supplies	Communication (phone, printer, mailing etc.)	5 000	1	5 000	
	Expenditure	Meeting costs	30 000	1	30 000	81 692
Sub-total					**323 200**	**349 711**
709519: Pilot Project - Longterm storage		Testing, Testing Materials, Procedures	100 000	1	100 000	171 520
Sub-total					**100 000**	**171 520**
Total costs 2013 SEK					**2 412 700**	**2 640 334**
Result 2013 SEK						**(227 634)**
TOTAL SEK					**2 412 700**	**2 640 334**
TOTAL US$ [d]					**$386 651**	**$423 130**
WORKINGCAPITAL FUND SEK per 2013-12-31 [e]						**875 440**
WORKINGCAPITAL FUND US$ per 2013-12-31 [d][e]						**$140 295**

[a] NordGen Personnel costed at avg SEK 94,000/month and scientific information expert SEK 135,000/month.

[b] Travel costed at SEK 15,000/trip

[c] Travel costed at 2*SEK 10,000/trip to Svalbard and 2*SEK 5,000/trip to Oslo

[d] Based on exchange rate at April 2014: 1 US Dollar = 6,24 SEK

(e) Workingcapital Fund - adjusted per 2013-12-31 with the budget deficit (227 634 SEK) and the deficit due to downward movement in the exchange rate between the US $ and SEK (18 072 SEK).

Income 2013 comes from - $138.010 Global Crop Diversity Trust, SEK 1.403.900 LMD, SEK 80.000 NordGen.