Popular Article

TRENDS IN AGRICULTURE SCIENCE

Vol.3 Issue 11 November 2024, Page: 2291-2295

G Svalbard Global Seed Vault – Locker for crop biodiversity

R. Muthuvijayaragavan[1*] and S. Vellaikumar[2]

[1]Department of Plant Breeding and Genetics, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India – 641 003

[2]Department of Plant Biotechnology, Centre for Molecular Biology and Biotechnology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

https://doi.org/10.5281/zenodo.14207852

Introduction

The **Svalbard Global Seed Vault** is a secure backup facility for the world's crop diversity and it contains frozen and dried agricultural seeds that in many ways constitute the foundation of global food security. The vault, opened in 2008, is a cold storage carved into a mountainside in the Arctic Archipelago of Svalbard. The Seed Vault provides long-term storage for duplicates of seeds from around the world, conserved in gene banks. This provides security of the world's food supply against the loss of seeds in gene banks due to mismanagement, accident, equipment failures, funding cuts, war, sabotage, disease and natural disasters. The Seed Vault is managed under terms spelled out in a tripartite agreement among the Norwegian government, the Crop Trust, and the Nordic Genetic Resource Centre (Nord Gen). The Norwegian government entirely funded the Seed Vault's approximately 45 million crore (US$8.8 million in 2008) construction cost. Norway and the Crop Trust pay for operational costs. Storing seeds in the vault is free to depositors (*Hopkin and Michael 2008)*.

Importance of Seed Banks

Seed banks provide easy access to genetic material and play a vital role in the conservation of agricultural seeds. Farmers and plant breeders all over the world depend on access to a wide diversity of seeds, because these can be used to breed new varieties that can cope with evolving diseases and pest attacks. The seeds stored in seed banks around the world may contain genetic material that can help meet future challenges such as crops that can grow under hotter, drier, or wetter conditions. The principle of the long-term storage of seeds is to dry them to a 5–8 percent moisture content and store them at 2108C to 2208C, which secures their longevity for up to a hundred years (Qvenild 2012).

Not all types of plants can be conserved in this way. Those that cannot be are (1) plants that do not form seeds (e.g., potato); (2) seeds that are recalcitrant, which means that they cannot survive such a dried and frozen state (such as avocado, mango, rubber, and cocoa); (3) species with slow

Published: 22 November 2024
ISSN: 2583-7850

seed production (such as many tree species); and (4) crops that reproduce vegetatively (e.g., banana). Such species are therefore conserved in field gene banks, which are large areas of land where the plants are grown and looked after.

Norway- chosen for a reason

- The permafrost in the ground offers natural freezing for the seeds
- The vault's remote location enhances the security of the facility
- The local infrastructure is excellent
- Norway, a global player in many multinational efforts, is a willing host
- The area is geologically stable.

Construction

Norway, Sweden, Finland, Denmark, and Iceland's prime ministers ceremonially laid "the first stone" on 19 June 2006. The seed bank is 130 m (430 ft) inside a sandstone mountain on Spitsbergen Island and employs robust security systems. The facility is managed by the Nordic Genetic Resource Center, though there are no permanent staff on-site. Spitsbergen was considered ideal because it lacked tectonic activity and had permafrost, which aids preservation. It being 130 m (430 ft) above sea level will keep the site dry even if the ice caps melt. Locally mined coal provides power for refrigeration units that further cool the seeds to the internationally recommended standard of −18 °C (−0.4 °F). If the equipment fails, at least several weeks will elapse before the facility rises to the surrounding sandstone bedrock's temperature of −3 °C (27 °F),[5] and is estimated to take two centuries to warm to 0 °C (32 °F).

A feasibility study prior to construction determined that the Seed Vault could preserve most major food crops' seeds for hundreds of years. Some, including those of important grains, could potentially remain viable for thousands of years (Fowler 2008).

Running the length of the facility's roof and down the front face to the entryway is an illuminated artwork named *Perpetual Repercussion* by Norwegian artist Dyveke Sanne that marks the location of the vault from a distance. In Norway, government-funded construction projects exceeding a certain cost must include artwork. KORO, the Norwegian State agency overseeing art in public spaces, engaged the artist to propose an artwork for the Seed Vault. The roof and vault entrance are filled with highly reflective stainless steel, mirrors, and prisms. The installation reflects polar light in the summer months, while in the winter, a network of 200 fibre-optic cables gives the piece a muted greenish-turquoise and white light.

Necessity

Plant breeders help consumers and farmers. They have to produce varieties that are productive and popular. This is a moving target. Pest and diseases evolve, the climate changes and so do consumer preferences, and the plant breeder has to incorporate the appropriate characteristics

Published: 22 November 2024
ISSN: 2583-7850

into the variety he or she breeds. Hence a farmer's field, over time, is a study of change. One has to run fast just to stay in the same place, just to beat back the pests and diseases and other constantly evolving challenges.

Seed vault Partners

- Nordic Gene Bank,
- Norwegian Ministry of Agriculture and Food
- Global Crop Diversity Trust.

Tripartite agreement

The Seed Vault is managed under terms spelled out in a tripartite agreement among the Norwegian Government, the Crop Trust, and the Nordic Genetic Resource Center (NordGen). The Kingdom of Norway owns the Seed Vault. The Crop Trust provides funding for ongoing operations and provides financial assistance to depositors in their preparation of shipments. NordGen operates the Seed Vault and maintains the public database of the deposits. An International Advisory Council provides guidance and advice. It includes representatives from the FAO, CGIAR, the International Treaty on Plant Genetic Resources and other institutions.

Access to seeds

Vault seed samples are copies of samples stored in the depositing gene banks. Researchers, plant breeders, and other groups wishing to access seed samples cannot do so through the Seed Vault; they must instead request samples from the depositing gene banks. The samples stored in the gene banks will, in most cases, be accessible in accordance with the terms and conditions of the International Treaty on Plant Genetic Resources for Food and Agriculture, approved by 148 countries or parties.

The Seed Vault functions like a safe deposit box in a bank. The bank owns the building and the depositor owns the contents of their box. The Government of Norway owns the facility and the depositing gene banks own the seeds they send. The deposit of samples in Svalbard does not constitute a legal transfer of genetic resources. In gene bank terminology this is called a "black box" arrangement. Each depositor signs a Deposit Agreement with NordGen, acting on behalf of Norway. The Agreement makes clear that Norway does not claim ownership over the deposited samples and that ownership remains with the depositor, who has the sole right of access to those materials in the seed vault. No one has access to anyone else's seeds from the seed vault. The database of samples and depositors is maintained by NordGen.

Seed storage

The seeds are stored in sealed three-ply foil packages and then placed into plastic tote containers on metal shelving racks. The storage rooms are kept at −18 °C (−0.4 °F). The low temperature and limited access to oxygen will ensure low metabolic activity and delay seed ageing.

Published: 22 November 2024
ISSN: 2583-7850

The permafrost surrounding the facility will help maintain the low temperature of the seeds if the electricity supply fails.

Initially the Seed Vault would have some minor water intrusion at its entrance during the annual spring permafrost thawing. Warmer temperatures and heavy rainfall in October 2016 caused significantly greater amounts of water to seep into the entrance, but the facility's design ensured that the water froze after several meters and the seeds were not endangered. Work completed in 2019 eliminated this water seepage. Attached to the seed boxes are sheets of nanofilm that hold information on such things as seed identity.

Capacity

Seeds are stored in airtight aluminium bags. The number of seeds in each bag varies depending on the size of the seed, but on average each bag contains approximately 500 seeds. The facility has a storage capacity of 4.5 million seed samples. The table below presents the cumulative total of samples (i.e. accessions) deposited by year (*www.nordgen.org)*.

Year	Species	Total samples
2008		320,549
2009		490,054
2010		601,155
2011		714,519
2012		772,597
2013		801,752
2014		839,801
2015	4,000	837,858
2016		880,837
2017		890,886
2018		983,524
2019		992,032
2020		1,074,533
2021		1,125,419
2022		1,170,569
2023		1,267,127

Depositors

As of June 2021, 87 depositors safeguard their crop samples in the Seed Vault. The below table lists the top international gene banks followed by the top regional and national gene bank in terms of the number of samples currently deposited in the Seed Vault (*www.nordgen.org)*.

Published: 22 November 2024
ISSN: 2583-7850

International gene banks	Number of accessions
International Maize and Wheat Improvement Center (CIMMYT)	173,779
International Rice Research Institute (IRRI)	126,447
International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)	117,713
International Center for Agricultural Research in the Dry Areas (ICARDA)	97,123
International Center for Tropical Agriculture (CIAT)	57,534
World Vegetable Center	29,147
International Institute of Tropical Agriculture (IITA)	23,333
National and regional gene banks	
National Plant Germplasm System (USA)	135,237
Leibniz Institute of Plant Genetics (Germany)	58,862
Plant Gene Resources of Canada (Canada)	32,609
Australian Pastures Gene bank (Australia)	28,493
Nordic Genetic Resource Center (Sweden)	26,820
National Agrobiodiversity Center (Republic of Korea)	23,185
Centre for Genetic Resources (Netherlands)	21,703

Conclusion

The conservation of crop diversity is of crucial importance to both commercial plant breeders and subsistence farmers. The plants that constitute the foundation for the food on our tables have acquired their special qualities through hundreds of years of careful selection and cultivation in farmers' fields. While agricultural production in most industrialized countries is based on a handful commercial species, the subsistence farmers of the Southern Hemisphere are growing a wide variety of species in order to meet their monetary and dietary needs.

Seed banks have played and will continue to play a central role in maintaining and developing crop diversity for the future, in addition to playing a key role in restoring agriculture after climate-related emergencies. Whatever the future may bring, the new Svalbard Global Seed Vault is a step in the right direction toward securing global crop diversity in an era of rapid climate change.

References

Fowler, Cary. 2008. The Svalbard Global Seed Vault: Securing the Future of Agriculture (PDF). Global Crop Diversity Trust.

Hopkin and Michael.2008. Biodiversity: Frozen futures. Nature. **452** (7186): 404-405.

Qvenild, Marte. 2012. Svalbard Global Seed Vault: Berkshire Publishing group Pp. 303-305.

Siebert and Charles 2011. Food Ark. National Geographic. **220** (1): 108–131.

www.nordgen.org.

Published: 22 November 2024
ISSN: 2583-7850