AGENT Project – Genebank Review

Genebank Reviewed: Centre for Genetic Resources (CGN), Wageningen, The Netherlands

Date: September 21-22, 2023

Participants CGN: Dione Bouchaut (Germination); Martin Brink (Policy); Lana de Bruijn (Collections/Heritage Seeds); Wouter Groenink (Collections); Theo van Hintum (Management/Research and Peer Review Host); Roel Hoekstra (Collections/Documentation); Rik Lievers (Collections); Hariette Nijnens (Secretariat); Laura Reiniers (Collections); Jorik Smits (Seed Management/Collections); Rob van Treuren (Collections/Research); Erik Wijnker (Research).

Reviewers: Lise Lykke Steffensen (NordGen, Sweden); John Dickie (Millennium Seed Bank, UK); with Sharon Balding (MSB, UK) as an active observer.

Background

With the aim of reviewing and guiding the improvement of the operations of European gene banks, a new system of peer review is being tested within the AGENT project. It consists of reciprocal peer reviews of genebanks in groups of three, with each being reviewed by the other two. Each review focuses on the organisation and operations of the genebank; and leads to a report with recommendations for improvement. The process has potential to be part of a blueprint for a genebank monitoring system, as adopted by the European Genebank Integrated System (AEGIS); and the involvement the participants of the EU-funded AGENT project constitutes a test of the reviewing system.

The system involves curators of eleven genebanks visiting each other's facilities, to evaluate the efficiency of operations, based on jointly prepared protocols. Reports will offer recommendations for improvement and will be used to approach suitable funding agencies for targeted capacity building.

Two successful cycles of reviews, involving six genebanks were held in 2022. In the first cycle the genebanks of CRI (Czech Republic), NPPC (Slovakia) and IPK (Germany) were involved, in the second INIA (Spain), IPGR (Bulgaria) and WR (The Netherlands). The third cycle, held in 2023, would have included the Russian partner institute VIR, however due to political reasons their participation in AGENT had to be terminated. NordGen, the Nordic Genetic Resources Centre including the Plant Genebank of the Nordic countries volunteered to take this place in the third cycle. Following peer review visits to NordGen and the Millennium Seed Bank during Summer 2023, this report is of the final review, of CGN in September 2023.

The Netherlands Centre for Genetic Resources (CGN) is hosted by Wageningen University and Research. It fulfils the Dutch government's obligations in genetic resources conservation; and, as well as the Plant Genetic Resources Cluster, on which the peer review was focused, consists also of separate clusters dealing with both animal and forest genetic resources. The PGR cluster is about 85% funded by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV), with LNV having

oversight of any additional funding secured by CGN, to ensure independence from its stakeholders. CGN has adopted and implement a quality management system, compliant with NEN-NE ISO 9001:2015, to assure the quality of its operations. CGN-PGR concentrates on crops that are important to Dutch agriculture and the breeding industry and strives to avoid duplicating the efforts of other genebanks. In line with Dutch government policy, so far as is legally possible, all plant genetic resources held by CGN is made available for the widest possible use under the terms of the SMTA of the International Treaty on Plant Genetic Resources for Food and Agriculture.

Visit/Organization

The third visit in the third review cycle was organized by Theo van Hintum and staff at the CGN-PGR. They provided the reviewers with a comprehensive Operational Manual in advance of their visit. Flights and rail travel were arranged by the reviewers; and the remaining elements of the visit were organised and paid for by the hosts at CGN: the seed bank staff arranged transport from and to the airport and railway station, accommodation at WICC Wageningen, as well food and all other requirements for an efficient and affective review.

The agenda for the two-day visit was based on the framework provided by the operational manual; and it allowed a full review and discussion of all operational aspects of the seed bank, including the facilities; and, importantly, detailed and open discussion with all the relevant staff members who were available. Following an introduction that covered organisation, management and funding, on the first day the review covered: germplasm acquisition, accessioning and security; seed handling; germination testing; and wider germplasm management. Detailed discussions of CGN's procedures continued on the second day with an intensive look at information systems and sharing; rounded off by a return to outstanding issues and specific items from the manual, before the reviewers presented their preliminary recommendations and report.

Outcome of the Review

As with the preceding genebank peer reviews in this cycle, the primary and most important outcome, for both reviewers and reviewed, was the open exchange of views on approaches and insights regarding the conservation and use of Plant Genetic Resources for Food and Agriculture.

In addition to this general outcome, many observations were made, some of which could be translated into recommendations. These are presented below.

General remarks

CGN was founded in 1985, as a crop genetic resources centre, conserving mostly *ex situ* (seed) collections from Wageningen and managed within Wageningen University and Research. In 1999 it was merged with farm animal activities, which focused on *in situ* conservation, with some (semen) material; followed in 2002 by the addition of a role in forest genetic resources, supporting native trees and shrubs. Since 2004 it has operated under 5-year agreements with Ministry as 'statutory task'. It is comparatively well-funded by the Minstry LNV and stable, with additional funding from external sources like EU research programmes, commercial companies and the Crop Trust *et al*.

CGN-PGR is a separate business unit within Wageningen Plant Research, with transparent responsibility and authority for its activities: managing a genebank with seed collections, with a focus on vegetables and oriented to users supporting on–farm and *in situ* activities in NL; policy development and advice, being the National Focal Point on Access and Benefit Sharing; methodological research, including seed storage behaviour, species niche modelling and the interface between genomics and genebank management.

CGN-PGR has a dedicated and professional staff, comprising 15 persons (12.61 Full Time Equivalents), with a further curator (1x FTE) currently under recruitment. Workloads are high, but not currently a cause for concern. The average age of permanent staff has been relatively high, but is decreasing rapidly; and active succession planning is progressing well

Overall, the reviewers were presented with a well-functioning genebank, having a strong focus on its users and very close collaboration with the industry. The staff are very dedicated, flexible and knowledgeable about their roles and professions.

The announced increased funding is very positive, with the consequent possibilities to expand the activities of the genebanks. The building of a new dedicated facility will give opportunities for anticipated future demands for the genebank and should improve the integration of the different functions of the whole genebank.

Recommendation 1

To support the integration of the different functions of the genebank, it is strongly recommended to have all the staff and functions situated within the new building.

Recommendation 2

Given the scale and scope of the proposed new facility, it is most strongly recommended that a dedicated project manager be appointed, to coordinate and oversee the whole project.

Organisation, Management and Funding

The CGN-PGR has a comprehensive Quality Management System, designed in-house and compliant with ISO9001 and forms an important structure for working instructions and procedures and support the the management of the genebank and its collections. The QMS is comprehensive and well structured; though its use could be yet further improved.

Recommendation 3

Consider sharing any non-conformities with all relevant staff, both when a non-confirmity is observed and registered, and when it has been handled; to allow the organisation to learn from them.

Recommendation 4

The list of non-conformities to be updated immediately and made available for all of the staff.

Recommendation 5

Consider involving persons from the staff in the internal audits to engage and take more ownership of the QMS.

The level of outsourcing by CGN-PGR of conservation activities like regeneration, threshing, seed cleaning, germination tests allow significant cost savings and thus freeing resource for a greater focus on utilization and valorisation of the seed collection. There are, nevertheless, downsides to outsourcing that should be considered in a medium to long term perspective; as CGN may not have sufficient control, knowledge and competencies in house on seed science; and may miss opportunities to apply ongoing developments in scientific based seed conservation arising from within the genebank community.

Germplasm Acquisition and Accessioning

As the CGN undertakes collection expeditions itself, it is important to ensure that all ABS provisions are fully compliant with CBD-Nagoya.

Recommendation 6

The current written procedures could be further optimized, by including a paragraph that gives clear criteria (decision tree?) for a 'go/no-go' for an expedition to take place.

Security

To the reviewers it appeared that access to the current seed storage facility would be relatively easy for unauthorised persons.

Recommendation 7

It is recommended that the security of the current seed storage is improved. Furthermore, it is recommended that the level of security in the proposed new genebank building be increased significantly, with a separate security level for the seed storage chamber/areas.

Almost all material is duplicated in a colleague genebank (99.7% of accessions); and a high proportion are triplicated in Svalbard 'Global Seed Vault' (85.4% of accessions). There are opportunities for further improvement.

Recommendation 8

CGN should review and update the policy and procedures for depositing safety duplicates. Specifically, consider carrying out an audit at one or more of the 'colleague' institutions that hold CGN 'black boxes'. At the same time, consider the sustainability of continuing to expect fellow genebanks to continue to maintain 'black boxes' that have become obsolete.

Collection & Germplasm Management

The collections currently cover 32 crops and consist of 23,301 accessions; originating from more than 100 countries. The focus is on vegetables and wild potatoes, with the proportion of vegetables relative to agricultural crops increasing considerably over the last 20-30 years. The total number of accessions has more or less plateaued over the last 15 years or so, with a slight reduction since 2010, following disposal of duplicates; the emphasis is on high quality, rather than high numbers.

The collections are managed by the Head Curator and individual Crop Curators, who bring their expert knowledge of each crop and its particular conservation needs. For decision support they rely on the CGN documentation system, GENIS, for all accession-based information; including its capacity to deliver 'Collection Management Reports' with comprehensive monitoring and management data.

Seed accessions are stored at -20°C and moisture content 6-8%, compliant with FAO Standards. Pre-packaged user samples were formerly kept at +4°C, but now at -20°C.

The facilities for seed storage meet the safety standards. Nevertheless, though adequate for their purpose, both the seed laboratory and its associated handling procedures do have significant possibilities for improvement. While all these opportunities could and should be taken in the development of the proposed new building, some of them are procedural and could be considered earlier and implemented in the current laboratory.

Recommendation 9

Prohibit consumption of food and drinks in the seed laboratory.

Recommendation 10

Ensure that there is disinfection between handling seed accessions.

Recommendation 11

Make most effective and efficient use of existing equipment in the seed lab; at the same time investigate and invest in newer and more effective seed lab equipment.

Recommendation 12

Ensure that the physical working conditions are optimal; as a minimum, provide extraction hoods, tables, correct lighting, microscopes etc.

Recommendation 13

The planned new facility should have separate rooms for wet operations, dry operations, germination, drying, seed cleaning and storage.

Viability testing is carried out on all material, by germination testing: initial, following regeneration; and periodic monitoring. Monitoring tests start after 25 years and thereafter every 20 years (barley and wheat) or 10 years (all other crops). The FAO Genebank Standards (2013) thresholds are applied. When viabilty has fallen close to the threshold, but above it, then monitoring period is reduced to 5 years; and when it is close to but below the threshold, regeneration is first regarded as 'not urgent'. Accessions are classified as: 'very good'; 'good'; 'needs regeneration soon'; or 'needs urgent regeneration'. Previously, germination testing was outsourced to ISTA-certified institutes. However, these were discovered to be subject to large errors, mostly due to the nature of the material. Germination testing is now performed in-house, maintaining the previously applied thresholds of 60% to crop wild relatives and 80% for all other species. At the same time tests were simplified wherever possible, with testing methods for each crop chosen by individual crop curators.

Recommendation 14

Seeds should be stored for no longer than six months from harvest to the start of seed operations.

Recommendation 15

Monitoring of accessions' moisture status by hygrometry should be resumed, to minimise the risk of early viability loss through undetected increase in seed moisture content.

Recommendation 16

To increase concentration on germination testing; specifically through staff capacity building, which is needed to improving knowledge and experience of different techniques and methods, aimed at increasing success in germination testing.

Recommendation 17

Review an consider raising the germination thresholds currently applied. The reviewers were surprised to see germination thresholds of 60%, given the amount of genetic variation that could already have been lost when viability had fallen so far.

Recommendation 18

Give strong consideration to restricting germination testing to the seed lab, rather than elsewhere, such as in glasshouses, to promote consistency.

The storage facility/freezer chamber is satisfactory; but there are opportunities for improvement and a state-of-the-art facility should be specified for the proposed new building.

Recommendation 19

Storage of accessions in drying room, other than for drying itself is not recommended and should be avoided.

Recommendation 20

An airlock could be installed to avoid changes in the storing conditions and better control the airflows, humidity, temperature and prevent contamination in the current drying room; and should be specified in the new facility, Regeneration is outsourced, mostly in collaboration with breeding/seed companies known to and trusted by CGN-PGR; as is characterisation and evaluation.

Recommendation 20

Be aware that CGN risks a loss of control of seed quality by being wholly reliant on third parties' expertise, diligence, and priorities. Review this practice, in the light of lost opportunity to increase and maintain important knowledge and skills within CGN-PGR.

Recommendation 21

Recommended that CGN-PGR produce protocols for the regeneration of CWR species, as well as the domesticated crops conserved in the seedbank.

Material Distribution and Use

The value of the collections is based on how much they are available and used; CGN is (one of) the major supplier(s) of vegetable genetic resources samples to the world. With very few exceptions, all accessions are available to all serious users under the SMTA of the ITPGRFA, via the web-interface; though hobby growers are discouraged; and farmers can only be served indirectly via breeders or NGOs, as producing and handling seeds in the quantities they require is too expensive. Requests for

over 50 accessions need special justification; though large screening programmes are supported, provided the information is shared with CGN (and thus its users).

Documentation and Information

As well as use of the collection the value of PGRs held by CGN-PGR is well recognised as a function of the quality of information associated with accessions and its availability to users. The data is held in the seedbank's comprehensive database, GENIS; and all information is made available online (www.wur.nl/cgn), with full search and sample ordering functionality.

Other Activities

As well as the core activities of collection development, management and use, it is worth briefly listing here some of the other, related activities undertaken by CGN-PGR, which mark it out as a mature crop genebank, playing a full role in genetic resources conservation and sustainable use at national, European and global levels. Activities like research, methodological and strategic, to improve efficiency of activities and services and to create a stronger knowledge base; niche modelling of CWR, next-generation sequencing, policy advice and development: internally, nationally and internationally and not least development of a metric overview and quality management framework for inspiration for other genebanks.

Final conclusion

During their visit and discussions the reviewers were exposed to a very well-functioning genebank, with a major focus on the utilization and user- orientation. Prime among the organisation's assets are the well qualified and highly motivated staff. If the relatively large number of recommendations for potential improvement contained in this report appear inconsistent with such a positive impression, it is because the reviewers judged the CGN-PGR against higher standards than they would do for most other genebanks.

Constant improvement is implicit in CGN-PGR's full adoption of a quality management system; and there are many prospects in the future developments of the genebank; and the team are encouraged to use this opportunity to build and use the new building; and include the possibilities of optimizing synergies, interaction and workflows within CGN Plants and CGN as a whole.

Final remarks

The reviewers very much appreciated the efforts put into pre-visit preparation and attention to their accommodation and subsistence needs; and the welcoming reception, positive atmosphere and transparency presented by the hosts. The discussions were open and fruitful; certainly for the reviewers, and, it is hoped also for the CGN staff.

December 18th, 2023, prepared by

The reviewers: Lise Lykke Steffensen and John Dickie (accompanied by Sharon Balding, observer)