AGENT Project – Genebank Review

Genebank Reviewed: Millennium Seed Bank, Ardingly, UK

Date: July 6-7, 2022

Participants MSB: John Dickie, Sharon Balding, Rachael Davies, Keith Manger, Tiziana Ulian, Efisio Mattana, Michael Way, Alice Hudson

Reviewers: Theo van Hintum (CGN, The Netherlands) and Lise Lykke Steffensen (NordGen, Sweden)

Background

To improve the quality of European genebanks a new system of peer review is being tested. In this system a genebank is being reviewed by two other genebanks, each of which will also be reviewed reciprocally by the other two. The review concerns the organisation and operations of the genebank, and results in a report with recommendations for improvement. It could be part of a blueprint for a genebank monitoring system, as adopted by the European Genebank Integrated System (AEGIS). The test of the reviewing system involves the participants of the EU-funded AGENT project.

Curators of 11 genebanks will visit each other's facilities and 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 involved the Russian partner institute VIR, however due to political reasons their participation in AGENT had to be terminated. NordGen, the Nordic Genetic Resources Center including the Plant Genebank of the Nordic countries volunteered to take this place in the third cycle. NordGen was reviewed the week before the Millennium Seed Bank was visited. This report reports on this second review in the third cycle, the review of the Millennium Seed Bank.

While, in view of the collections of crop wild relatives in the MSB, RBG Kew is a member of the AGENT consortium, including the Millennium Seed Bank (MSB) in the genebank peer review process was not an obvious decision since this seed bank is not fully comparable to the other genebanks in the project. The MSB focusses on collecting wild species from all over the world, both as long-term insurance against species' extinction and, whenever possible, as a current resource for researchers and other *bona fide* users. Furthermore, the material in the MSB collection is not regenerated when the viability drops, or the seed stock becomes depleted; and access to users depends on the terms of bilateral agreements under the Convention on Biodiversity with source countries. But, despite these differences it was expected to be an opportunity to learn from each other, improve quality based on experiences and knowledge from the other community.

Visit/Organization

The second visit in the third cycle was organized by John Dickie and staff at the Millennium Seed Bank. They provided a draft of an Operation Manual, that will be completed after the review, but already provided a basis of the review, as it describes the organization and procedures of the seed bank. Flights were arranged by the reviewers and all the rest was organised and paid for by the hosts; the seed bank staff arranged transport from and to the airport, the lodging at the guest house of the Millennium Seed Bank, as well food and other needs to facilitate an optimal review work.

Based on an agenda for the two-day review, all operational aspects of the seed bank including the facilities could be reviewed and discussed. The reviewers met and discussed with the staff, touching all topics on the agenda and the Operational Manual. The reviewers visited the drying room, the germination testing lab, the storage facilities, and the technical equipment of the building including equipment for cooling and drying. They conducted interviews with staff at the MSB to understand and get information on the organisation, management, funding, quality management systems, germplasm acquisition and accessioning, security and information activities. Further, time was spent to understand the activities at MSB on the germplasm management, on germination testing, storage conditions, regeneration, seed processing and availability. The MSB also presented research activities and project activities with partners. At the end of the second day, the reviewers followed up on remaining issues and then discussed and presented a first draft of their impressions of the seed bank with the staff members.

Outcome of the Review

As during the previous genebank peer reviews, the first and most important outcome of the review was the exchange of views on approaches and insights regarding the conservation and use of Plant Genetic Resources for Food and Agriculture (although at the MSB it obviously concerned wild plants including but certainly not limited to crop wild relatives).

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

<u>Management/Funding</u>

The MSB was established at the beginning of the new millennium; and went through an intensive ten-year period of building up the facilities, hiring staff and establishing the collection. Procedures were created and agreements with seed donors were made to allow for this rapid expansion. This resulted in a fantastic facility at a beautiful location, a large network of partners all over the world, a group of enthusiastic and capable staff members, and a seed collection at present of about one hundred thousand accessions of wild plants, representing more than forty thousand species. The achievements of this first building up phase should be acknowledged.

After the first ten years, funded, among others by the UK National Lottery, the source of the funding changed and the organisation of the seed bank entered a new phase of operation. This required changes at the strategic, organisational and operational level, which required changes of the original set-up and procedures as they were formulated in the period of rapid growth. However, the main focus remained on accumulating collections of new species until 2019. The reviewers had the

impression that the change management process from a rapidly expanding organisation, with highly motivated staff, to a new set-up still needs some attention to be able to reach its full potential. The new management structure, no longer more or less independent, but part of five Science departments of the Royal Botanic Garden Kew (RBGK), combined with the original procedures, developed in the period of rapid expansion, created an imbalance that does not optimally exploit the potential of the organisation. The reviewers felt that the MSB has added value as a unit, that was not used sufficiently, but at the same time did not use the benefit of being part of the RBGK, possibly because it did not function as a unit.

Recommendation 1

To revisit the organisation structure for optimising the advantages of being part RBGK, but at the same time strengthening the MSB's own identity, internal coordination and collaboration between the MSB units.

An important publicly funded institution such as the MSB needs to act at a high and guaranteed quality level; and be transparent regarding its operations. The MSB has an extensive list of written procedures, most originating in the first ten years of its existence. These documents provide an excellent base for proper quality management, provided they are properly managed and used. A good quality management system, possibly but not necessarily a standardised system such as ISO 9001, assures quality and assures all staff members know what they do and why they do it.

Recommendation 2

To develop the quality management system of the Seed Bank further; and give more attention to roles and responsibilities within the Seed Bank, define standard operating procedures and the management thereof and provides an auditing system.

Based on the short review visit the reviewers had the impression that, despite being and open site, the security aspects of managing the MSB were very well taken care of. There was only one, possibly small, concern in that regard, concerning movement between zones within the building.

Recommendation 3

Revisit the security routines regarding access to the premises of guests and vehicles.

Collection Management

The research at MSB on viability testing is state of the art and MSB gives access for users around the globe to its germination protocols for wild species. This should be acknowledged and understood as a core part of the MSB operations. However, the creation and initial expansion of the MSB required procedures that might not now be the most appropriate in the current maturity of the MSB. Furthermore, there are limits to continuous expansion, especially seeing the current backlogs regarding viability tests. MSB has built up a backlog of around 40,000 germination/viability tests, which continues to grow. With the current set-up, and prioritization of resources within the MSB, it is very unlikely that this problem will be solved. Immediate actions are needed to avoid a further build-up. The MSB should consider dividing germination/viability tests into 1) what is needed for the long-term conservation/operation and 2) what is needed as part of research activities.

The reviewers thought it essential to rethink the MSB's operation in terms of protocols for the various types of material in the collection, answering question such as 'is it necessary to retest every accession every ten years?'. It seemed possible to tune the conservation procedures to the types of material. Some types could be stored only, others will need to be monitored. Some types of material should be closely monitored, for other material a random testing of material might be sufficient. In all decisions the reason for storing the material should be taken into account; for example, if it is unlikely the material can be recollected, it might be decided not to monitor viability at all, except if the material is requested, etc. Having just one simple protocol for all material results in a waste of capacity, much needed for other activities. After tuning the protocols, the backlogs should become for example, much smaller since many of the now required tests will no longer be necessary, and capacity for clearing the reduced backlog is likely become available. In discussion, members of the MSB team were in agreement with the general principle of exploring possible triage approaches, to focus staff resources; though such approaches are unlikely to be appropriate for single collections of Endangered or Extinct in the Wild species. Also, the reviewers had the impression that there were options for improving the workflows and operations.

Recommendation 4

Define the 'steady state' of the MSB given the long term expected funding level and revisit the various types of material and associated required protocols, searching for possibilities for optimization of workflows and operations; including exploring the development of a triage approach to collections of high conservation value.

Recommendation 5

Take immediate action and initiate a project to solve the build-up of back-logs of viability tests.

The MSB is not equipped to regenerate material that falls below the viability- or seed amount thresholds; although, in certain instances the projected Wakehurst Research Nursery will have capacity; and, given sufficient funding, there may be an opportunity MSB Partner organisations to carry out regeneration in-country. Rather, it would seek to organise recollecting of the material from its original sources, depending upon funding and species. The reviewers doubted if that is a long-term valid strategy. In many cases material has disappeared due to various reasons including climate change; or is no longer accessible due to political changes. Furthermore, using the capacity required for recollecting might be better used in sampling other gene pools or regions.

Recommendation 6

To develop and adopt a policy regarding re-collection of accessions that fall below required viability or seed quantity; and use the planned research Nursery at Wakehurst place for limited regeneration/multiplication of high priority collections.

Generally, the material at the MSB is duplicated in the country of origin. An exception appeared to be the material collected in the UK; this material is only partly duplicated at other locations in the UK (in Scotland; and some in Wales, depending on project). The two main reasons for lack of duplication are: low seed numbers, and consequent reluctance to divide already very small accessions; and backlogs of duplication built up since the COVID pandemic. The following recommendation has therefore some priority.

Recommendation 7

To complete safety duplication of any unique material originating in the UK, and where overseas collections are not duplicated in country. (Note that in most cases the collections held at the MSB are the safety duplicates for collections held in the source countries.)

Collection Material Distribution

The material in the collection is generally acquired under an 'Access and Benefit Sharing Agreement' (ABSA) or 'Memorandum of Collaboration' (MOC), and occasionally under the Kew Donation Agreement. The reviewers had the impression that this final document was drafted before the Nagoya Protocol came into force.

Recommendation 8

To revisit the current Material Acquisition Agreements (including: Access and Benefit Sharing Agreements; Memoranda of Collaboration; and the updated Kew Donation Agreement, currently under review) covering seed material, ensuring that they comply with all aspects of relevant international agreements and agreements with donor countries.

It was also observed that the information provided with the seed material in case of distributions was limited to the most basic taxonomic identification and germination testing protocols. Users generally appreciate more information and wherever this is available and can be shared, it should be provided.

Recommendation 9

To consider providing as much information as possible about each accession to the recipients, either as hard copy with the seeds or via a clear link to that (digital) information.

Use

An organization like the MSB has to show its value to the world, and in the case of the MSB this should be relatively easy. It can do this via communication with the public, but in the end it is the practical utility, the use of the material, that proves its value (as well as the long-term insurance against species' extinction). Currently the MSB 'allows use of the material', however the search interface to the collection is hard to find, limited information is made available, requests have to be made via email and the material transfer agreement is very restrictive (limited to non-commercial use). Only a very small part of the collection is available under the FAO standard material transfer agreement (the SMTA) that does allow commercial use. The reviewers found that the use of the material could be promoted by improving the interface and facilitating access, by looking at ways to widen the potential use and extend the user community, by creating sets of material for specific purposes and actively promoting their use, etc. Talking to (potential) users, asking them about their expectations, needs and frustrations can help in finding possibilities for improvements.

In addition to distribution of samples, it should be pointed out that a significant part of the MSB concept is the direct promotion of the use of seeds collected from wild species in restoration and sustainable use, e.g. in Mexico; and projects describing these were presented during the review.

Recommendation 10

To look actively for ways to promote and facilitate the use of the material in the collection and implement these. For example, opportunities could be sought within the newly-funded (after the review visit) *Seed Portal project, to optimize external access to the collections and data and information associated with them.*

Recommendation 11

To seek to limit the complexity of the conditions for distribution of material within the Partnership Agreements; in new agreements and, where possible, in existing agreements, to increase access to the material.

Documentation

The documentation of genebanks, apparently including the MSB, often appears to be a challenge. The current documentation system in use in the MSB, the ICMS, was not developed to manage a seed collection, but rather natural history collections and laboratory-based collections; and the adaptations made to make it suitable for the MSB have not been completed. The change from the old system clearly might have come too early as many of the vital operations in managing the seed bank are seriously hindered by the lack of functionality in the ICMS. Furthermore, most of the staff are hardly able to operate the new system.

Recommendation 12

Given the recognized challenges of incorporating MSB data and functionality into Kew's new Integrated Collection Management System, ongoing priority efforts in both system development and staff training should be continued, to remove any potential for longer term negative impact on MSB operational efficiency.

Final conclusion

The Millennium Seed Bank has a unique position in the world with a great reputation, fantastic facilities and a good network of partners. After the first period of growth, the MSB now has to re-think its position, role and *modus operandi* to stay relevant in a changing political and scientific environment. The potential to make these changes within the Millennium Seed is very high, as the basis certainly is there.

Final remarks

The reviewers were grateful for the preparation, kind reception, positive atmosphere and transparency presented by the hosts. Discussions were open and fruitful. This was very much appreciated.

November 20th, 2023

The reviewers: Lise Lykke Steffensen and Theo van Hintum