

# CIP Genebank Review 2015

**Programme:** Genebanks CRP

**Genebank reviewed:** CIP

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**Place:** Lima, Peru

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RESEARCH  
PROGRAM FOR  
Managing and  
Sustaining Crop  
Collections



## CIP 2015 Genebank Review: recommendations and responses

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
<b>A</b>	<b>Funding and sustainability</b>		
1. CRP	Senior management at CIP with the genebank manager develop a strategic options paper on the future funding of the genebank that considers a range of scenarios regarding funding streams, including a mixed funding model that balances the 'costed collections' work supported by the Trust and complementary research that can be underpinned from other grant sources, including possibilities under the CRP.	We agree this is very valuable and since the review, the genebank has assessed potential cost savings in the next five year period and have prepared a plan outlining and specifying the assumptions, needs and actions required to achieve these savings. A summary of the results of this assessment was made at the Rome Genebank Platform writing workshop in early 2016. The results included a reduction in staff by 10 FTE and an annual cost reduction of ~\$150K by 2021. As mentioned this is dynamic and we believe such an assessment should be an ongoing activity done periodically. Regarding complementary research, this is also an ongoing activity with priorities identified and then funding sought. This was the case for identity verification and now the priority for complementary funding is to improve phytosanitary cleaning. In short, we do have a system for priority setting and strategic planning that works yet due to the dynamic nature of this planning we do not see the need for investing time in preparing an options paper at this time.	The Crop Trust supports the reviewers' recommendation and vision of a dynamic genebank funded from multiple sources. CIP's response has taken this suggestion further by identifying areas for rationalization. This is strongly supported also. It is worth highlighting the importance of encouraging and providing a supportive environment for developing this dynamism in the genebanks. In this context the funds alone from the future endowment and also even from the Genebank program (in whatever form it takes) are unlikely to be adequate to support the level of dynamism that is possible or desirable. CIP is taking strides in this respect.
2. CRP	A working group is established, comprised of CRP researchers and breeders and genebank managers, to regularly review (e.g. quarterly) opportunities for closer collaboration, including joint bids for funding.	This is greatly needed and is something that CIP has focused on developing. This started with the development of the CIP strategic plan to include the genebank and conservation of genetic resources as one of six strategic objectives and has continued to evolve with the inclusion of the head of the genebank in the CIP Science Leadership Team and a focal point for RTB. This continues to be a work-in-progress which is progressing. The Science Team meets bi-	The Crop Trust is highly supportive of both the recommendation and the response.

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
		weekly while the Strategic Objective/RTB team meets about four times a year. Examples of opportunities being sought since the review includes the genebank participating with breeding to write and obtain funding for a joint project through Horizon 20/20, an in situ/ex situ Climate change proposal just submitted and an ongoing discussion with BMGF for funding of a genebank initiative with GHU to improve phytosanitary cleaning and testing in sweetpotato. In summary, CIP has taken this recommendation to heart and is working hard to encourage and support collaborations.	
3. Research, development and resources	Genebank management review the capabilities and capacities for research work in the group as the main thrust of the true-to-type and cryopreservation work start to 'tail off,' particularly with the purpose of removing technical constraints to operational efficiency within the genebank programme.	We agree this is needed but also see the true-to-type and cryopreservation work continuing well throughout the next five year period and will not start to tail off soon. We do however understand the thought behind this recommendation and do continue to improve processes by removing technical constraints. The biggest urgency continues to be physical space constraints and aging equipment but progress is being made in the area on a yearly basis. Other advances since the review have been made in the implementation of barcoding throughout the processes of cryo and the herbariums. Additional improvements have been made in tracking and scheduling media preparation which includes inventory management and better control over what each project is consuming. Regarding the use and ongoing analysis of the fingerprinting data, the Response Action Proposal does have a component to do a more full analysis than is possible in the genebank.	The Crop Trust interpretation is that the reviewers are giving priority to the true-to-type analysis, although sweetpotato cryopreservation protocols were a clear priority in discussion. We do not see, therefore, any conflict between the reviewers' recommendation and CIP's response. The details and ideas for further areas of work are also highly appreciated. Thus the Crop Trust supports the CIP response.
4. Research, development and	Senior management work with 'Resource Mobilisation' to improve the 'cost recovery' model to render service	Full cost recovery is something all Centers are wrestling with. Although constantly improving it will never satisfy all users or needs. The genebank has	The reviewers' recommendation and CIP's response are both supported and appreciated.

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
resources	costs for the use of the laboratories more supportable (e.g. cumulative unit rather than individual charging, and discounts for genebank student projects) and encouraging of research work.	made several suggestions (daily or weekly lab use fees rather than monthly, questioning the basis of some fees, etc.) and the situation is evolving. There is still room for improvement but changes are being made and investments in upgrading equipment are ongoing. Management has taken note of the suggestions and will ensure they are included in future discussions and improvements.	
<b>B</b>	<b>Collections development and promotion</b>		
5. Collections acquisition	Materials are added to the genebank to counteract perceived threats to the accelerated loss of GR from climate change and other risks. Genebank staff should prepare a GR acquisition plan for the strategic filling of gaps in the collection.	An action plan for the collection of wild potato germplasm was prepared and has evolved into the basis of a TRUST funded project to INIA in which CIP will participate. This project will be initiated when a collection permit is issued from the Peruvian government. We are awaiting the issuance of this permit before requesting other collection permits as this will be the first collecting permit granted that will specifically allow material to be placed in the MLS in the past 20 years in Peru. Despite this limitation we do have an active program to exchange germplasm with communities and have received ~150 potato cultivars from indigenous over the past two years.	The Crop Trust supports the recommendation and CIP response for Peru where activities are underway at least. There is a need for a more comprehensive response but that may be possible within the Genebank Platform where a global level analysis is being planned. Thus, there will be a need for further monitoring of this recommendation.
6. Collections acquisition	The collaboration with INIA on conservation activities of shared interest is intensified and consolidated in an updated inter-institutional agreement.	As mentioned above we have made a conscious effort to engage with INIA due to this recommendation. We have a funded proposal for collecting wild potato with INIA which is based on our collection plan. Additionally, we have facilitated the purchasing of computer and barcoding equipment for INIA and continue to provide training and software support to keep their system operational. We housed the entire INIA tissue culture collection while their lab was being renovated. Finally, we are collaborating on a project for phytosanitary screening of the ARTC collection. All this since the external	The Crop Trust supports the recommendation and recognises CIP's significant efforts to address this issue. Clearly the relationship with INIA is being strengthened. The reviewers suggest that the formalized relationship with regard to interests and perhaps roles also needs to be strengthened. This could be explored.

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
		review. In short we have made great progress in our interactions with INIA since the review and expect that the ground work have been laid for this to continue. I think this is another area we are making progress.	
7. Information systems and data / information access	A system is introduced to ensure the rapid uploading of key trait data to the 'Corporate Database' from laptops and mobile devices, preferably supported by a written policy on the 'filing' of data centrally, protecting both projects from data loss and developing longer-term institutional 'memory.'	A draft flow diagram has been prepared and is in discussion. Our goal is that by the end of 2016, a written SOP for the uploading of field data into a centralized repository will be prepared. A longer-term issue will be the timely analysis of this data so that it can be associated with the accessions. However, the concern of the reviews that data could be lost with our present system is real and we have taken steps to help avoid this with a written SOP to be developed and incorporated into our QMS system by the end of the year.	The Crop Trust support the reviewers' recommendation. CIP has addressed this concern already by developing a written SOP. In monitoring the response to this recommendation, we would hope to see that this SOP has resulted in mechanisms being successfully put in place/implemented to avoid loss of data.
8. Information systems and data / information access	The Genebank webpage is maintained more systematically than at present and 'down-time' minimised to ensure requests for material can be made online and responded to as quickly as possible.	As part of our Response Action Plan (RAP) we have hired a web programmer (due to start July 1) and done a quick fix to allow public access to the collection information. We also have started using Genesys for ordering and this appears to be functioning well. As per the RAP, our goal is have a new user friendly interactive webface for the genebank by the end of 2016.	Crop Trust supports reviewers' recommendation and CIP's response.
<b>C</b>	<b>Phytosanitary and germplasm movement</b>		
9. Pest risk analysis	The genebank negotiates with the Peru NPPO (SENASA) more transparent and technically justified phytosanitary requirements than exist at present, so as to ensure the smoother exchange of germplasm into the genebank from worldwide sources. In particular, CIP should assist with the provision of Pest	We agree completely and as explained to the panel when this recommendation was presented, SENASA is a Peruvian government organization over which we have no authority. We have fostered an excellent working relationship with SENASA which we continue to grow. It is not a situation where CIP can march in and demand changes – this simply would not work. Rather, we work collaboratively with them to	Crop Trust appreciates the issue that the reviewers are bringing up here and that CIP is best placed to know how to move forward. A quarantine bottleneck of 24 months is seriously constraining and does not have a justifiable scientific basis. We would suggest that if this continues to be imposed on materials coming into CIP that action is taken to move the to a higher level –

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
	Risk Analysis (PRA) information on worldwide disease distribution and diagnostics so that the PRA is accurate in accordance with international standards and the post-entry quarantine (PEQ) period is appropriate and the period reduced.	improve the issues raised. We already do help with PRAs to the extent possible. An example of progress is that this year (2016) we have facilitated a PRA with Kenya which allows us to bring in material from Kenya with only a 3 month quarantine period. We are organizing a shipment of ~12 sweetpotato lines from Kenya to test this system and when successful, we will then coordinate the shipping of material from Uganda and use the Kenyan experience to request a reducing in the quarantine of Uganda material from 24 months to three months. Another example is a request for clearance to return safety back-up material from Colombia. This has been a negotiation and education – slow and steady which appears to work to move this forward. As repeatedly mentioned at the review we feel we have a good relationship with SENASA and continue to make great strides in accomplishing our needs.	whether institutionally or beyond.
10. ARTC phyto-cleaning	Plans for a genebank ARTC virus diagnosis/phytocleaning project are accelerated and implemented so that increased opportunities for germplasm exchange internationally can be safely achieved.	The identification of viruses from ulluco is one component of our Response Action Plan (RAP). A technician has been hired to work on the isolation and sequencing of a minimum of two viruses from ulluco and work is on schedule. In addition, the ARTC curator is the PI on a new project to characterize all viruses infecting the ARTC collection in four of the ARTC crops, oca, ulluco, mashua and yacon. This is a very ambitious project which should aid greatly in the diagnosis of viruses in these ARTCs. Although it is not anticipated that these projects will fully develop phytosanitary cleaning or screening methodology, they will provide the much needed foundation for this work to be developed in the future.	The Crop Trust supports the recommendation and recognises CIP's progress to address it.
11. Diagnostic authority	CIP explore the possibility of the Genebank Quarantine and Plant Health	We do not believe this to be a high priority for CIP and could be a bureaucratic distraction for the	Our understanding of the recommendation is that by being a certified SENASA quarantine agency, CIP will

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
	Unit being designated as an approved SENASA diagnostic authority, such that the indexing procedures they develop and adopt are acceptable for both germplasm import and export purposes without need for further intervention from SENASA.	genebank at the time. We believe in the strength of having a third party provide the certification certificates as it adds credibility to counterparts in other countries. Discussions do occasionally float around regarding the use of our quarantine facilities more broadly for other plants entering Peru and CIP charging a service fee for this but these discussions have not materialized into any action. We do remain receptive to the development of some arrangement for this in future if it can be done in a mutually beneficial way which does not create a burden on the genebank. I should note we do have a ten-year backlog on phytosanitary cleaning of sweetpotato and hence any other use of this space and staff could distract from this effort.	avoid the bottlenecks that are behind R#9 and not that CIP should offer its services to outside users. Some CGIAR Centers have this status (e.g. CIMMYT), which allows them to process materials without delays and unnecessary impediment. We can explore this more fully under the Genebank Platform.
<b>D</b>	<b><i>In vitro</i> and cryo</b>		
12. Sharing best practice	Learning accumulated from the implementation of large-scale cryo-banking be analysed and best practice on the strategic rationalisation of collections shared throughout the CG and wider, through the publication of a guideline and / or research-in-practice paper (e.g., Biodiversity and Conservation; Plant Genetic Resources – characterisation and utilisation).	As of the week of June 11, 2016 we do have a first of two papers on cryopreservation accepted for publication in CryoLetters. This paper does describe our efforts in the high throughput cryopreservation of diverse potato accessions. We will also host staff from IITA for a week for them to view our cryo team in action. This will allow them to kick the tires in everything from cryobank management to the use of barcodes and the continued refinement of the in vitro systems. We have also done capacity building for INIA in cryopreservation.	Crop Trust supports the recommendation and welcomes the progress made by CIP
13. Cryopreservation science	Senior staff time be committed to resolving the research bottleneck concerning the cryopreservation of sweet potato, and / or recently retired (Towill, Reed) or active cryobiologists are funded to work at the CIP Genebank on this challenge. Significant progress	We greatly appreciate this recommendation and feel it recognizes the expertise in senior staff. As a result of this recommendation, the head of the genebank (Dave Ellis) has a reoccurring appointment on his calendar to spend every Friday morning in the cryo lab however in the past year he has kept this appointment only twice. However, the appointment	Crop Trust supports the recommendation and the progress made by CIP. The ultimate point of the recommendation is to address the persistent bottleneck presented in the cryopreservation of sweet potato. It may be that other means are needed to achieve this and we welcome CIP's creative thinking on this.

	<b>Recommendation</b>	<b>Responses by CIP</b>	<b>Responses by Crop Trust</b>
	should be made in the next two years.	will remain as a reminder of this recommendation. Regarding the invitation of experts, an invitation has gone out to Leigh Towill although we have not year heard back from him. We did have Dr. Niino from Japan visit which was very beneficial. Included in our Response Action Plan (RAP) was funding for two visiting senior scientists and Dr. Towill would be the first. We have also reached out to Theo van Hintun to visit to help with the webdesign for the genebank. We agree significant progress should be made over the next two years and a process for operational sweetpotato cryopreservation is being piloted in 2016.	



# External Review of the CIP Genebank Commissioned by the Global Crop Diversity Trust

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June 2015



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## Abbreviations and acronyms

ARTC	Andean root and tuber crops
asl	above sea level
CCCAP	China Centre for Asia and the Pacific
CGIAR	Consultative Group on International Agricultural Research
CRP	CGIAR Research Program
FAO	Food and Agriculture Organisation (of UN)
GCDT	Global Crop Diversity Trust (the 'Trust')
GR	Genetic resources
IBPGR	International Board for Plant Genetic Resources (now Bioversity International)
INIA	Instituto Nacional de Innovación Agraria
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
ISO	International Standards Organisation
M&E	Monitoring and Evaluation
NPPO	National Plant Protection Organisation
PEQ	Post Entry Quarantine
PGRFA	Plant Genetic Resources for Food and Agriculture
PRA	Pest Risk Analysis
RP	Review Panel (as commissioned by the Trust)
SCP	Strategy and Corporate Plan
SENASA	Servicio Nacional de Sanidad Agraria, Ministerio de Agricultura u Riego
SMTA	Standard Material Transfer Agreement
SO	Strategic Objectives
SOP	Standard Operating Procedure
SP	Sweet potato

## Executive Summary

The Consultative Group on International Agricultural Research (CGIAR) includes 11 genebanks in its CGIAR Research Programme (CRP) for Managing and Sustaining Crop Collections. Responsibility for the genebank CRP resides with the Global Crop Diversity Trust (the Trust), which commissioned (see TOR, **Annex 1**) the Review Panel (RP), comprising Hugh W. Pritchard and Robert Ikin (**Annex 2**), to assess the efficiency and effectiveness of the genebank operation at the Centro Internacional De La Papa (CIP), Lima, Peru, for the conservation and use of the long-term *ex situ* collections. These 'costed' collections are the focus of an agreement between the Trust and CIP.

Prior to visiting the genebank at CIP the RP invited end-user feedback on the collections through an on-line survey, comprising 17 questions (**Annex 3, 4, 5**). In brief, >90% of 24 respondents commented that the facilities, genebank management and curation at the CIP genebank meet international standards. During the visit, the RP studied a large number of documents, often detailing procedures, e.g., on plant health (**Annex 6**). The RP also held discussions with researchers at CIP who were using the collections in their plant breeding programmes; held five phone or Skype conversations with other stakeholders and held face-to-face discussions with SENASA and INIA staff. In-so-doing, the RP developed a clear impression of the value of the collections at CIP and their use from a stakeholders' perspective.

Overall, the RP spent five working days at CIP (16-20 June 2015; **Annex 7**) meeting staff and specifically reviewing the:

- 1) operations and activities of the genebank;
- 2) roles, services and use of the genebank, and the linkages with users and partners both within and outside the CGIAR;
- 3) status of the seed, *in vitro* and field genebanks;
- 4) outcomes or impact specific to the provision of the long-term grant;
- 5) future plans for the strategic scientific development of the Genebank.

Through a series of tours, discussions, demonstrations and short lectures, the RP found the staff of CIP and the Genebank to be open, engaging and enthusiastically immersed in their work. The submission to the RP of two volumes of supporting information on the genebank activities, including SOPs, and strategic ambitions was welcome. Such an extensive engagement permitted the RP to make **13 actionable recommendations** regarding the strategic direction, functionality and effectiveness of the genebank science and operations.

Finally, the RP acknowledges the help and support of key personnel of the GCDT (Charlotte Lusty, Janet Muir, Matija Obreza and Cristian Moreno), prior to and during the visit to CIP.

## List of recommendations

Recommendation number and topic	The Review Panel recommends that	
<b>A</b>	<b>Funding and sustainability</b>	
<b>1</b>	<b>CRP</b>	Senior management at CIP with the genebank manager develop a strategic options paper on the future funding of the genebank that considers a range of scenarios regarding funding streams, including a mixed funding model that balances the 'costed collections' work supported by the Trust and complementary research that can be underpinned from other grant sources, including possibilities under the CRP.
<b>2</b>	<b>CRP</b>	A working group is established, comprised of CRP researchers and breeders and genebank managers, to regularly review (e.g. quarterly) opportunities for closer collaboration, including joint bids for funding.
<b>3</b>	<b>Research development and resources</b>	Genebank management review the capabilities and capacities for research work in the group as the main thrust of the true-to-type and cryopreservation work start to 'tail off,' particularly with the purpose of removing technical constraints to operational efficiency within the genebank programme.
<b>4</b>	<b>Research development and resources</b>	Senior management work with 'Resource Mobilisation' to improve the 'cost recovery' model to render service costs for the use of the laboratories more supportable (e.g. cumulative unit rather than individual charging, and discounts for genebank student projects) and encouraging of research work.
<b>B</b>	<b>Collections development and promotion</b>	
<b>5</b>	<b>Collections acquisition</b>	Materials are added to the genebank to counteract perceived threats to the accelerated loss of GR from climate change and other risks. Genebank staff should prepare a GR acquisition plan for the strategic filling of gaps in the collection.
<b>6</b>	<b>Collections acquisition</b>	The collaboration with INIA on conservation activities of shared interest is intensified and consolidated in an updated inter-institutional agreement.
<b>7</b>	<b>Information systems and data / information</b>	A system is introduced to ensure the rapid uploading of key trait data to the 'Corporate Database' from laptops and mobile devices, preferably supported by a written policy on the 'filing' of data centrally, protecting both projects from data loss and developing

	<b>access</b>	longer-term institutional 'memory.'
<b>8</b>	<b>Information systems and data / information access</b>	The Genebank webpage is maintained more systematically than at present and 'down-time' minimised to ensure requests for material can be made online and responded to as quickly as possible.
<b>C</b>	<b>Phytosanitary and germplasm movement</b>	
<b>9</b>	<b>Pest risk analysis</b>	The genebank negotiates with the Peru NPPO (SENASA) more transparent and technically justified phytosanitary requirements than exist at present, so as to ensure the smoother exchange of germplasm into the genebank from worldwide sources. In particular, CIP should assist with the provision of Pest Risk Analysis (PRA) information on worldwide disease distribution and diagnostics so that the PRA is accurate in accordance with international standards and the post-entry quarantine (PEQ) period is appropriate and the period reduced.
<b>10</b>	<b>ARTC phyto-cleaning</b>	Plans for a genebank ARTC virus diagnosis/phytocleaning project are accelerated and implemented so that increased opportunities for germplasm exchange internationally can be safely achieved.
<b>11</b>	<b>Diagnostic authority</b>	CIP explore the possibility of the Genebank Quarantine and Plant Health Unit being designated as an approved SENASA diagnostic authority, such that the indexing procedures they develop and adopt are acceptable for both germplasm import and export purposes without need for further intervention from SENASA.
<b>D</b>	<b><i>In vitro</i> and cryo</b>	
<b>12</b>	<b>Sharing best practice</b>	Learning accumulated from the implementation of large-scale cryo-banking be analysed and best practice on the strategic rationalisation of collections shared throughout the CG and wider, through the publication of a guideline and / or research-in-practice paper (e.g., Biodiversity and Conservation; Plant Genetic Resources – characterisation and utilisation).
<b>13</b>	<b>Cryopreservation science</b>	Senior staff time be committed to resolving the research bottleneck concerning the cryopreservation of sweet potato, and / or recently retired (Towill, Reed) or active cryobiologists are funded to work at the CIP Genebank on this challenge. Significant progress should be made in the next two years.

## Aims of this review

This review aims to assess the efficiency and effectiveness of the genebank science and operation as a whole, and the status of the genebank within the context of the global system for the conservation and use of the crops in question, i.e., sweet potato, potato and Andean roots and tubers.

The terms of reference of the review included the following elements (**Annex 1**):

- Assess the operations and activities of the genebank;
- Assess the roles, services and use of the genebank, and the linkages with users and partners both within and outside the CGIAR;
- Consider the status of the genebank or individual collections within it, in the context of a global system for long-term conservation and use of the crop(s) in question;
- Assess any outcomes or impact specific to the provision of the long-term grant;
- Provide actionable recommendations related to all of the above.

## Review methodology

A Review Panel (RP) consisted of two scientists with expertise in the fields of: international policy; plant health; plant biosecurity, gene bank management, seed storage, *in vitro*- and cryopreservation; research collaboration and research management; use of plant genetic resources for food and agriculture; and crop improvement (**Annex 2**). With active support from the Trust and the genebank, the RP, considered replies to a survey sent to end users (**Annex 3, 4, 5**) and studied a large number of documents, often detailing procedures, e.g., on plant health (**Annex 6**). A review visit to the genebank facilities was made from 16-20 June 2015 (**Annex 7**) to meet many of the genebank staff. Staff led tours of the facilities (due to the distance, field sites were not visited), provided handouts and made short presentations on all aspects of germplasm handling.

During the review visit the panel was accompanied by three staff members of the Trust: Charlotte Lusty, Janet Muir and Matija Obreza. Cristian Moreno provided support at the Trust.

On the final afternoon of the visit the preliminary conclusions were presented to senior management of CIP and then to the genebank staff, specifically to provide an opportunity for feedback.

The report was drafted, checked for factual accuracy and sent to the Trust, who checked for consistency and clarity. Thereafter, the Trust submitted the report to the genebank, CIP and solicited a response. These responses have been considered and are incorporated in this report.

## Background to CIP

(source: <http://cipotato.org/about-cip/>)

The International Potato Center, known by its Spanish acronym CIP, was founded in 1971 as a root and tuber research-for-development institution delivering sustainable solutions to the

pressing world problems of hunger, poverty, and the degradation of natural resources. CIP is truly a global center, with headquarters in Lima, Peru and offices in 20 developing countries across Asia, Africa, and Latin America. Working closely with partners, CIP seeks to achieve food security, increased well-being, and gender equity for poor people in the developing world. CIP furthers its mission through rigorous research, innovation in science and technology, and capacity strengthening regarding root and tuber farming and food systems.

CIP is part of the CGIAR Consortium, a global partnership that unites organizations engaged in research for a food secure future. CGIAR research is dedicated to reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring more sustainable management of natural resources. Donors include individual countries, major foundations, and international entities.

### **Strategic Corporate Plan**

(source: <http://cipotato.org/strategic-objectives/>)

#### ***Executive Summary***

There have been dramatic changes in both CIP's operating environment and the broader external environment. This is particularly true for donors, who increasingly—and understandably—value an emphasis on pragmatic science and research that deliver tangible development impacts. In response, CIP has developed a new Strategy and Corporate Plan (SCP) for the next 10 years. Some of the fundamental changes driving the SCP include the following: the emergence of a post-2015 development framework; evolving regional and national frameworks that empower countries to own and lead their own development; CGIAR reform, with an expanded focus that explicitly addresses food and nutritional security; and a richer and more diverse partnership landscape. To this dynamic set of forces is a heightened sense of urgency that it is imperative to catalyze a step-change in development impact within the next generation. This shift is driving the focus on Results-Based Management (RBM), the scaling-up of innovations, and a more sustained emphasis on gender issues.

#### ***Strategic objectives (SO)***

CIP focuses on six strategic objectives (SOs).

The **Research AND Development SOs** are:

- **SO 1: Resilient nutritious sweet potato**
- **SO 2: Agile potato for Asia**
- **SO 3: Potato seed for Africa**

The **Research FOR Development SOs** embody 21<sup>st</sup>-century upstream research on biotechnology and systems research. They are:

- **SO 4: Game-changing solutions**
- **SO 5: Resilient food systems**

**At the heart of CIP's mission is SO 6: Conserving Biodiversity for the Future.** This SO builds on the legacy of conserving genetic resources over the last 40 years to ensure that conservation and utilization is enhanced for the coming decades.

As part of the implementation plan for these SOs in the scope of the SCP (2014–2023), the formal presence of the CIP-China Center for Asia and the Pacific (CCCAP) will play a key role. CCCAP was established in 2010 to support efforts to improve food security and reduce poverty. In the next two to three years CCCAP will expand its program via a leading-edge Asia and Pacific R&D potato and sweet potato platform, with particular relevance to SOs 1, 2, and 4, as well as contributions to a number of CGIAR Research Programs (CRPs).

CIP's SOs are fully aligned with the CRPs, particularly with RTB, for which SOs 1, 2, and 3 are already active flagships. The genebank-related SO 6 is fully aligned with the Genebank CRP. Therefore, CIP's work in achieving its SOs will contribute to the Intermediate Development Outcomes (IDOs) prioritized by the CRPs and CGIAR. In turn, CIP's direct participation in the eight CRPs will support our efforts to achieve our SOs. In addition to the SOs, CIP's SCP outlines corporate objectives (COs). The COs address the operational challenges that will be required to implement the SOs successfully.

## Review of the CIP genebank

### Introduction

In 2012 a CGIAR Research Programme (CRP) for the management of the CG genebanks was approved with the objective to “conserve the diversity of plant genetic resources in CGIAR-held collections and to make this diversity available to breeders and researchers in a manner that meets high international scientific standards, is cost efficient, is secure, reliable and sustainable over the long-term and is supportive of and consistent with the ITPGRFA”. The Trust has accepted the role of managing the funding of CGIAR genebanks.

The **CIP genebank** houses in trust collections of potato, sweet potato and nine Andean root and tuber crops (ARTCs). The majority are maintained as clonal accessions *in vitro*, comprising what has been called the largest *in vitro* genebank in the world with >14,000 accessions.

The material must be certified and maintained long-term in ‘disease-free’ form. The maintenance of these tissues cultures is resource and technology intensive, with about 50% of the genebank budget committed to the management of the *in vitro* collection. In addition, the wild relatives of potato and sweet potato are maintained as seed, two of the ARTCs (ahipa and maca) are held exclusively as seed. Challenges associated with working with wild species regeneration include poor flowering, formation of meagre seed set, due in sweet potato to there being only four carpels (and thus seed) per flower. In addition, some sweet potato species require grafting onto *Ipomoea tiliacea* to stimulate flowering.

The genebank is organised into 11 management areas each headed by a supervisor:

- |                                  |  |                      |
|----------------------------------|--|----------------------|
| 1. Cultivated potato collection; | 4. Andean root and tuber crop (ARTC) collection; | 7. Safety back-up;   |
| 2. Wild potato collection;       | 5. <i>In vitro</i> ;                             | 8. Cryopreservation; |
| 3. Sweet potato collection;      | 6. Phytopathology cleaning / quarantine;         | 9. Herbarium;        |
|                                  |  | 10. Breeding lines;  |
|                                  |  | 11. Distribution.    |

As summarised above, the context for the genebank's activity is clear from the new CIP Strategy and Corporate Plan (Research, Innovation and Impact), as the genebank is the main focus of Strategic Objective 6 (under the Research For Development theme) 'Conserving Biodiversity for the Future' which seeks to ensure that conservation and utilization of GR is enhanced for the coming decades; improving nutrition and livelihoods for about 18 million households.

The question is whether the genebank is well placed to live up to this ambition. Based on a careful analysis of the background documentation provided, exploration of the facility and discussions with staff, the RP strong believes that the genebank is fit-for-purpose. Opportunities for further development will depend on the funding landscape and other factors, as highlighted in the recommendations.

## **(A) Genebank funding and sustainability**

### ***CRP***

The genebank is well respected at CIP and is being included in the research agendas. Funding through the genebank CRP has enabled the genebank to have a longer-term vision. However, funding for most of the research activities comes from the Roots Tuber and Banana-CRP. Consequently, the genebank remains a separate entity from the research agendas. The desirability of receiving conservation-related research funds from the RTB-CRP was raised. The RP do not know how likely this is, but notes that a new set of CRPs are currently being developed for 2017-2022.

Closer relations between the genebanks and the RTB CRP will generate many benefits, such as the better planning of field trials and accession-specific trait associations. The RP were informed of many areas of research interest, including the impacts of climate change across Peru, particularly at high altitude. At 3000 m a.s.l. there are now changes in precipitation, extra risks from disease vectors and an increased uncertainty of frost. Clearly, improved integration of research datasets and genebank accessions information would be beneficial, leading to better decision making on pre-breeding lines for banking; or which clones to clean; etc.

**Recommendation 1:** Senior management at CIP with the genebank manager develop a strategic options paper on the future funding of the genebank that considers a range of scenarios regarding funding streams, including a mixed funding model that balances the 'costed collections' work supported by the Trust and complementary research that can be underpinned from other grant sources, including possibilities under the CRP.

**Recommendation 2:** A working group is established, comprised of CRP researchers and breeders and genebank managers, to regularly review (e.g. quarterly) opportunities for closer collaboration, including joint bids for funding.

## ***Research development and resources***

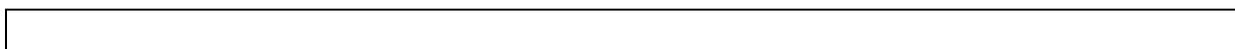
The RP recognise that the Genebank staff are experts in characterisation of potato and sweet potato, using internationally-accepted descriptors, and other descriptors based on many years of experience. And some staff demonstrated an interest and enthusiasm to contribute to evaluation studies. The carrying out of some applied research by Genebank staff will enable gaps in knowledge to be plugged, e.g. shortage of information on sweet potato landraces and wild species. Input in this area will, over time, also likely increase the use of Genebank accessions. In addition, the inclusion of some element of applied research in the job descriptions of Genebank staff with an interest in such work will, amongst other things, result in their gaining wider (transferable) skills (such as inquisitiveness, hypothesis testing) and increase their longer-term employment opportunities. Unit managers being able to (occasionally) attend meetings with staff of other genebanks, and opportunities for staff exchange / secondment, would also benefit programme delivery and staff development.

Through discussions with management, staff, 'Resource Mobilisation' and HR, the RP found evidence of recent progress in the working environment at the genebank over the last three years. Staff have the right skills, are performing tasks to a high standard, and succession planning (particularly related to well-established, 'specialist' curators whose depth of knowledge is impressive) is underway. The genebank also received strong backing from CIP management for the introduction of a Quality Management System with ISO accreditation (not limited to the genebank).

The current ISO compliant procedures were well in place, and given the pressure on the allocation of priority funding, the reviewers questioned whether it was necessary to continue with external annual audits of this kind, and wondered if the ISO requirement was dropped whether the current internal audit and review systems would continue to deliver the same quality standards. When this issue was raised with Unit managers there was no strong consensus. Most felt that the current working conditions would continue at the same quality level as the internal auditors were now well practiced in their tasks. On the other hand a few felt that the ISO certification did give some status to the genebank that they felt proud to be able to achieve. Some managers felt that the need to document the operational procedures was, sometimes, excessive and not time efficient. They felt that time could be spent doing research that could improve efficiency and the systems in place.

The QMS has also had a transformative effect on genebank staff, e.g. engendered a 'sense of pride', shown leadership among CGIAR Centers and provided a strong professional footing in the Quarantine Health Unit, as well. Such quality assurance systems have a yearly cost. Senior management at CIP with the genebank (and other) managers should review the cost-benefit of retaining ISO accreditation, especially if the funding landscape changes dramatically in the next two years.

In a related context, the levying of 'cost recovery' charges to genebank staff for access to the laboratory has created a disincentive for carrying out research work. A balance needs to be found such that genebank research and innovation are encouraged and supported.



**Recommendation 3:** Genebank management review the capabilities and capacities for research work in the group as the main thrust of the true-to-type and cryopreservation work start to 'tail off,' particularly with the purpose of removing technical constraints to operational efficiency within the genebank programme.

**Recommendation 4:** Senior management work with 'Resource Mobilisation' to improve the 'cost recovery' model to render service costs for the use of the laboratories more supportable (e.g. cumulative unit rather than individual charging, and discounts for genebank student projects) and encouraging of research work.

## **(B) Collections development and promotion**

### ***Collections acquisition***

Even though CIP's genebank is one of the largest *in vitro* genebanks and cryobanks in the world, there are still gaps in the collections. Acquisition (and distribution) needs to comply with the necessary international guidelines and requirements. It was clear to the RP that 'CIP Legal' is able to provide up-to-date information on international treaties (ITPGRFA) and conventions (CBD), and national legislation, dealing with both access and distribution. The RP recognises the opportunity for CIP to play a role in moving towards an uniform position on such policy matters within the CG, although (travel) funds will need to be made available for this to be realised; and this prospect should be raised with the Consortium Office.

At the genebank there is little (or no) active acquisition of germplasm at the moment. Yet, about 15-20 % of cultivated potato of the Andes has likely not been conserved. With increasing environmental threats, it seems appropriate to address this matter soon. Already there is clear evidence of excellent working relations between the genebank and Parque de la Papa, which has seen repatriation of many accessions (cleaned *in vitro*) of cultivated potato, with concomitant improvement in yield (and benefits) to local people. The RP believe that this is one of the best examples globally of the *in situ* – *ex situ* dynamic conservation. The current global interest in the work of Parque de la Papa is an exciting development that will presumably generate publicity too for the CIP Genebank.

During the visit of the RP to INIA, it became clear that INIA is also interested in the repatriation of material to local peoples and sites. Other overlapping interests with the CIP Genebank include cleaning of material *in vitro*, better database systems, improved cold storage (moving to -20°C from 4°C), acquisition of potato wild relatives and ARTCs (perhaps requiring rationalisation of the two collections). All such shared interests suggest opportunities for the development of closer working relationships between CIP and INIA.

**Recommendation 5:** Materials are added to the genebank to counteract perceived threats to the accelerated loss of GR from climate change and other risks. Genebank staff should prepare a GR acquisition plan for the strategic filling of gaps in the collection.

**Recommendation 6:** The collaboration with INIA on conservation activities of shared interest is intensified and consolidated in an updated inter-institutional agreement.

### ***Information systems and data / information access***

CIP has highly functional information systems that are regularly backed-up and secure. Also, there is a range of planned improvements in the IT area for 2015, including updates to LIMS (Laboratory Information Management System), adoption of GRIN Global to (possibly) supercede the existing accession database, and a new public site for the genebank collections.

Demands on data management in genebanks have changed with the introduction of new technology, although activities are still mainly divided into 'Collections Operation Management' and 'Accession Documentation' databases. The accession number and taxonomy provide a link between the two (i.e., a backbone).

Both are only as good as the information input, which is immediate in the case of pocket PC (workflow) and at varying speeds for field notes. Delays in uploading data simply reduces the availability of accessions, thereby decreasing accession value. Failure to upload data also leads to the perception (wrongly) that a piece of work generated no results.

**Recommendation 7:** A system is introduced to ensure the rapid uploading of key trait data to the 'Corporate Database' from laptops and mobile devices (etc.), preferably supported by a written policy on the 'filing' of data centrally, protecting projects from data loss and developing longer-term institutional 'memory.'

Improved efficiency in disseminating genebank-related information is critical to the successful utilisation of accessions. Such use potentially has a large economic impact. Already well-known is the use of C88 to develop resistance in potato to late blight caused by *Phytophthora infestans*. The RP was pleased to learn that there was currently an economic assessment being made of the CIP commodity material, using quantitative and qualitative information. The RP offered, with the Trust's permission, to share the user feedback as part of this review.

The RP was very impressed by the draft version of volume 1 of Catalogue of Sweet Potato (covering 689 accessions; with two more volumes [LAC, Asia] to follow).

The RP accepted that the uploading of information to central repositories will only have maximal impact if accession data is made public. Currently, requests for accession information are being responded to within two days. However, the RP note that during the review period the genebank page of the Germplasm Acquisition Site had the following message: The online 'germplasm ordering system' is currently undergoing maintenance and not accessible.

**Recommendation 8:** The Genebank webpage is maintained more systematically than at present and 'down-time' is minimised to ensure requests for material can be made online and responded to as quickly as possible.

### **(C) Phytosanitary and germplasm movement (Biosecurity)**

#### **International context**

With the conclusion of the World Trade Organisation (WTO) Sanitary and Phytosanitary Agreement (SPS) in the early 1990s, administration of the trade in plants and plant products for the first time moved towards a 'rules based' system. The SPS agreement mandated the International Plant Protection Convention (IPPC) as the international agreement with the responsibility of identifying, developing and approving standards: 'The International Standards for Phytosanitary Measures (ISPMs)'. The SPS agreement also identified key principles that need to be applied in the development and application of standards between countries. These key principles are equivalence, assessment of risk, transparency and harmonisation.

#### **Panel 1: Key principles that need to be applied in the development and application of Sanitary and Phytosanitary standards between countries**

- (1) Members shall accept the sanitary or phytosanitary measures of other Members as equivalent, even if these measures differ from their own or from those used by other Members trading in the same product.
- (2) Members shall ensure that their sanitary or phytosanitary measures are based on an assessment of the risk to (plant) health.
- (3) Members shall ensure that all sanitary and phytosanitary regulations which have been adopted are published promptly in such a manner as to enable interested Members to become acquainted with them.

(4) Members shall base their sanitary or phytosanitary measures on international standards, guidelines or recommendations, where they exist

The 1997 revised text of IPPC to enable the development of ISPMs and the recognition of a wider range of phytosanitary principles that recognised operational activities concerning the exchange of plant material. Peru is a signatory to the 1997 IPPC text.

The movement of germplasm from other countries into and out of the genebank requires authorisation by the National Plant Protection Service (NPPO) of Peru that resides within the Department of Agriculture as the Service Nacional de Sanidad Agraria (SENASA). Under the relevant legislation, import conditions are allocated after the conduct of a Pest Risk Analysis (PRA) by SENASA. Similarly, export Phytosanitary Certification is provided for material that is exported in conformity with conditions specified by the importing country NPPO. The plant health status of material within the genebank is determined following disease testing by the Phytosanitary and Post Entry Quarantine Section with diagnostic support from the Virology Unit. The goal is to produce pathogen-free plant material for conservation and global safe exchange and the repatriation of varieties to Andean farmer Communities so that phytosanitary risk is minimised.

The overall policy within the genebank is for all material to be tested for all known viruses that infect the crop. A list of viruses that are indexed is in Table 1. This testing is conducted without reference to the status of the material prior to export and any accession found to be infected with a virus is subjected to heat therapy to eliminate any pathogen. Currently 54% of in vitro potato accessions and 56% of in vitro sweet potato accessions are visually free of bacteria and fungal infections and are certified as free of known virus diseases.

### ***Import requirements***

In accordance with ISPMs the import conditions for the movement of *in vitro* material into Peru should be determined following a pathway PRA by SENASA. The quarantine pests of concern should be identified and the management condition should specify pest management options that would be necessary to eliminate the risk of the identified pests. As such import requirements would vary depending upon the source and potential pest and disease status of the material. In this context a quarantine pest is defined as 'a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled'.

Examination of current import requirements from Uganda specifies that imports of potato and sweet potato in vitro are required phytosanitary certification by the NPPO of the exporting country and in addition to undertake a PEQ period of 2 years before release from quarantine. This is despite the fact that in discussion with SENASA staff they have failed to identify any quarantine pest in the pathway from Uganda. During this period in PEQ visual examination of the material is undertaken by SENASA personnel. No indexing of the material during the PEQ period is permitted by CIP staff. The import permit does not specify any pests of quarantine concern and therefore it is not possible to determine why that PEQ

is required. Comments from stakeholders within the genebank and outside were critical of the prolonged PEQ period and felt that it delayed access to new varieties.

The FAO/IBPGR Technical Guidelines for the safe movement of germplasm for potatoes and sweet potatoes (Moyer, Jackson and Frison, 1989, and Jefferies, 1998) are not being followed since the purpose of the movement of germplasm *in vitro*, with acceptable prior virus certification, does not require a prolonged PEQ period. In practice tissue cultured plant material from sources tested for identified quarantine pests (viruses and bacteria) is released from PEQ after examination for contamination immediately after arrival at point of entry. This provides an alternative to the higher risk of importing whole tubers that require growth in PEQ and regular inspection and testing. Because it is not possible to identify visually any virus and virus like organisms in tissue cultured germplasm, the acceptable import requirements are for the plants from which the tissue cultures are derived to have been indexed for virus and declared as virus free.

The conditions for the import of seed were not considered at this time as the RP was informed that seed introductions have not been made in the last few years.

SENASA indicated that a revision of the post entry quarantine period for tissue cultures was being undertaken as they recognised that the conditions could not be technically justified. It is important the CIP technical staff be involved in this revision to encourage the development of requirements that more closely conform to international norms.

### ***Genebank health requirements.***

Distribution of potato and sweet potato genebank *in vitro* material nationally (to Peru) and internationally does not take place until accessions have been found to be free of all known pests and diseases. This procedure was developed as far back as 1978. With this status the potential barriers to exchange are substantially removed but it requires that all accessions be heat treated to remove virus infection and in the case of sweet potato treated for bacterial infection. This is an ongoing process within the genebank and within the collection accessions are assigned a Health Status identified as 'clean – disease free and available for distribution -HS2' or 'uncleaned – not available for distribution HS0'.

The management of the health status of genebank material and thermotherapy is provided by the Phytosanitary and post entry quarantine section of the genebank with service support from the CIP Health Quarantine Unit – which acts as a completely independent authority on the diagnostic process in conformity with the International Standard ISO/IEC 17025:2005. This arrangement ensures the independence and reliability of any diagnostic results and provides clients with the necessary assurances required to ensure export certification. The 'list of virus tests' are provided in Annex 6 with details of the 'process of indexing and thermotherapy' and the 'capacity to produce HS2 status material' as a timeline based on the current annual capability to virus index 420 potato and 550 sweet potato accessions.

Currently 54% of the 4490 potato accessions are considered as pathogen free (HS2), 56% of the 5293 sweet potato accessions are HS2 and all of the ARTCs are considered as HS0 because acceptable and reliable virus indexing procedures have not yet been developed. This is commendable, but as a consequence no transfer of ARTCs takes place and the

unintended outcome may be the movement of untested germplasm from other sources to meet demand.

There are a number of scientific papers that have reported on the virus content of ARTCs and procedures for their elimination, and these should be studied and links made to overseas experts who would advise on methodologies that are reliable and could be used to test ARTCs in the genebank (Fletcher and Fletcher (2010), Jones and Kenten (1978)).

### **Export biosecurity requirements**

Because of the high health status provided by the mandatory HS2 testing within the collection there are very few problems with the export of in vitro material to other countries.

On receiving a request to supply material from overseas the genebank determines if material is available and requests that an import permit from the importing NPPO specifying the phytosanitary requirements be obtained to conform with IPPC rules.

Import permits at one end of the spectrum may specify no phytosanitary requirements, whilst other NPPOs may identify specific plant quarantine pests as a result of a PRA, and which should be declared as absent from the material. Where no phytosanitary conditions are required by an importing NPPO, SENASA issues a standard Phytosanitary Certificate, which although in excess of specifications serves as an identifier for the source of the material as CIP in Peru.

For countries that require a phytosanitary certificate with an Additional Declaration indicating freedom from quarantine pests, CIP, through the Health Quarantine Unit, issues a 'Notification of Phytosanitary tests and ISO accreditation scope' that identifies the standard set of tests undertaken by the Virology Section and details of the specific organisms for which these have been performed. Since the range of tests undertaken aim to declare freedom from all pests at the HS2 level, this may be in excess of the particular country's requirement, but is considered the most efficient methodology. As the national certifying authority under the IPPC for trade/exchange of plant material SENASA may endorse the CIP 'Notification' and attaches it to the Phytosanitary Certificate to accompany the consignment, or may conduct its own tests.

### **Technical diagnostic support services**

Within CIP there is ongoing research into the development of new disease testing protocols, in particular for those not readily detectable by visual means such as viruses, viroids and mycoplasma like organisms. The operational performance in support of genebank activities are ISO certified, but in addition research is undertaken in the detection and identification/description of new organisms and the development of effective and efficient diagnostic tests that could be incorporated into all areas of CIP and may or may not be useful in assisting germplasm exchange. CIP holds and maintains as samples and infected plants in glasshouses 200+ virus isolates from potato, 30 isolates from sweet potato, 500 isolates of *Phytophthora infestans* and 400 isolates of *Ralstonia solanacearum* bacteria. This resource is vital for the effective operation of the diagnostic work of CIP and provides

support for the operational/exchange capability of the Genebank and its favourable health status

## Distribution unit

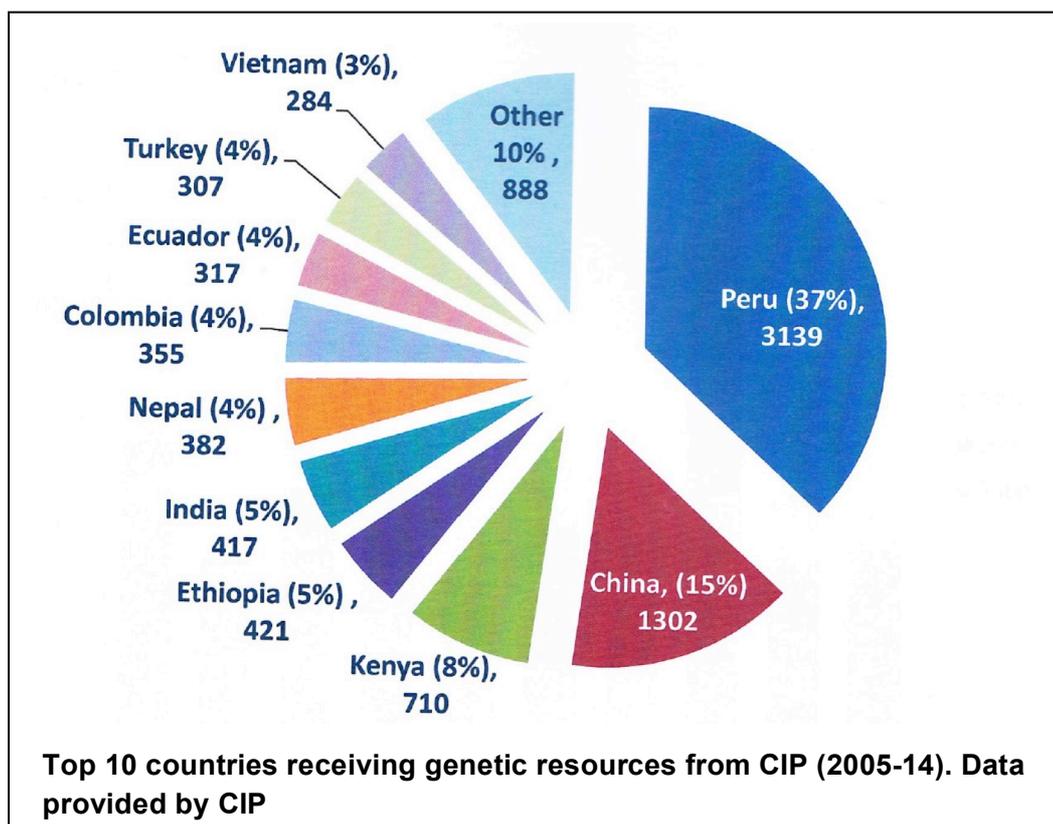
### Local

The local distribution of accessions within Peru presents no phytosanitary problems, 37% of all distribution is within Peru. Although no specific details of the schemes were available it is understood that a national potato certification scheme is in place and that material from the genebank serves as the starting point for such schemes providing the most healthy clones of commercial varieties that are further multiplied by private and public organisations aiming to improve production levels through the use of virus free planting material. Anecdotal evidence was presented indicating that the use of virus free material resulted in a 20% increase in yield at Parque de la Papa.

### International

In general the exchange of material to other countries is no major impediment to the international activities of the genebank. Data on top ten receiving countries is shown in the Figure below.

As a general rule the inclusion of the CIP 'Notification' document is an aid to satisfying the phytosanitary requirements of most countries who specify an additional declaration for organisms they consider quarantine pests, however SENASA reserves the right to re-test the material. Where importing countries identify other pests then if diagnostic methods are available and possible these have to be undertaken.



Although the acceptance and otherwise of import conditions are the responsibility of a dialogue between the importing country and the Peru NPPO (SENASA) the Distribution unit has involved itself in bilateral discussions that have resulted in the revision of import conditions that have enabled exchange to take place. Delays may occur in the negotiation of such protocols, but it is only rare for the genebank not to be able to meet overseas phytosanitary restrictions. Regrettably many NPPOs consider the outcomes of PRAs to be only available to counterpart NPPOs so the technical basis of the requirements are not directly available to CIP, and in some cases the technical basis for restrictions are never provided and a blanket certification of a wide range of pests is necessary.

**Recommendation 9:** The genebank negotiates with the Peru NPPO (SENASA) more transparent and technically justified phytosanitary requirements than exist at present, so as to ensure the smoother exchange of germplasm into the genebank from worldwide sources. In particular, CIP should assist with the provision of Pest Risk Analysis (PRA) information on worldwide disease distribution and diagnostics so that the PRA is accurate in accordance with international standards and the post-entry quarantine (PEQ) period is appropriate and the period reduced.

**Recommendation 10:** Plans for a genebank ARTC virus diagnosis/phytocleaning project are accelerated and implemented so that increased opportunities for germplasm exchange internationally can be safely achieved.

**Recommendation 11:** CIP should explore the possibility of the Genebank Quarantine and Plant Health Unit being designated as an approved SENASA diagnostic authority, such that the indexing procedures they develop and adopt are acceptable for both germplasm import and export purposes without need for further intervention from SENASA.

#### **(D) *In vitro* and cryopreservation**

The genebank conducts crucial studies on improving preservation success for the storage of two of the world's top 8 crops and nine locally important ARTC, applying both *in vitro* and cryopreservation techniques. The facility is well equipped, with adequate cold storage space (4°C and -20°C; recently 'refreshed'), two refurbished *in vitro* storage rooms (potato and sweet potato), back-up generators. The cryo-preparation / banking area is (intentionally) at full capacity.

The RP was pleased to see that the recommendations of the 2012 Health and Safety Audit of the cryo-banking operation had been implemented, including the use in the laboratory of capped dewars with handles, the appropriate use of safety glasses, etc.

The RP recognises that genebank staff are highly skilled and dedicated. They have embraced change – not just ISO but also introduction of pocketPC, 2-D barcoding / label printing, etc. – and bought into a push to reduce redundancy in the collections, by ensuring that the *in vitro* collection is ‘true-to-type’ and clean. They have committed to the scaling up of the cryo-banking work. This has included the recent re-setting of the regeneration standard for post-cryo success (which is now 30%), modifications made to key steps in the procedure (e.g. longer recovery phase in darkness, use of coconut water, attention to variability between vials), and the ambitious targets of cryopreserving 450 accessions of potato per annum. Plans have also been accepted at CIP for the genebank to install a liquid nitrogen production plant. If not yet in name, the Genebank is a Centre of Excellence for cryopreservation, conducting key research, such as the long-term (decades) stability assessment.

The RP believe that others can learn from these combined changes in practice.

**Recommendation 12:** Learning accumulated from the implementation of large-scale cryo-banking be analysed and best practice on the strategic rationalisation of collections shared throughout the CG and wider, through the publication of a guideline and / or research-in-practice paper (e.g., Biodiversity and Conservation; Plant Genetic Resources – characterisation and utilisation).

Whilst the cryopreservation of the potato collection is making rapid progress, the greater challenges associated with sweet potato (and even ARTCs, in time) suggests an urgent need for more detailed research investigation to improve methods and outcomes, e.g. to overcome the challenges of oxidative stress. This research can be delivered internally, through external input or a combination of both approaches.

**Recommendation 13:** Senior staff time be committed to resolving the research bottleneck concerning the cryopreservation of sweet potato, and / or recently retired (Towill, Reed) or active cryobiologists are funded to work at the CIP genebank on this challenge. Significant progress should be made in the next two years.

The RP note that because the laboratory activity expanded rapidly in 2013 to accommodate more cryobanking, DNA banking and seed lab work, supervisory staff moved into a temporary (3-5 years) shared office in 2014. The space available may not be ideal for the longer-term.

## **Annex 1: Terms of reference for the review**

### **Genetic Resources Centre review – Guidelines and Terms of Reference**

The Global Crop Diversity Trust commissions the five-yearly review of the CGIAR Center genebanks in its role as Project Manager of the CGIAR Research Programme (CRP) for Managing and Sustaining Crop Collections and also as donor of long-term grants. This review aims to assess the efficiency and effectiveness of the genebank operation as a whole, and the status of the genebank within the context of the global system for the conservation and use of the crops in question.

The objectives of the review are to:

- Assess the operations and activities of the genebank;
- Assess the roles, services and use of the genebank, and the linkages with users and partners both within and outside the CGIAR;
- Consider the status of the genebank or individual collections within it, in the context of a global system for long-term conservation and use of the crop(s) in question;
- Assess any outcomes or impact specific to the provision of the long-term grant;
- Review the general appropriateness of current expenditures for the routine operations of the genebank with reference to the Costing Study estimates;
- Provide actionable recommendations related to all of the above.

Additional specific areas of focus for the review will be identified in Phase 1 of the review.

In 2010, a comprehensive Costing Study was carried out of the genebank operations, which resulted in the publication of cost estimates for routine operations for each Center crop collection. These now form the basis of the funding allocations of the CRP and also of the Trust's endowment target. The current level of operation and operating costs may be an important consideration of the review if there are significant differences from the Costing Study. This will be clarified during the interactions with the Trust in Phase 1 of the review. The Trust will also undertake a financial audit, during the review, and will provide any relevant findings to the panel. The overall responsibility to resolve financial and budgeting issues will remain with the Trust.

The review will be facilitated by a Trust member of staff, who will provide background information, coordinate the development of the agenda and the execution of the review on site. The Trust facilitator will participate in all review sessions unless requested not to, and will assist the Chair in any aspects of the review and the completion of the final report. However, the Trust will not take part directly in the formulation of the review report and recommendations.

The review will be undertaken in three phases:

#### **Phase I: General background and literature review**

Reviewers will be provided with the following documents:

- Long-term grant agreement(s)
- Annual long-term grant reports
- Genebank Costing Study
- Genebank CRP proposal
- Genebank manuals, website and related materials
- Relevant past donor or internal reviews of the genebank as given by the Centre
- Any other materials given by the Centre as background for the review

All review panel members and the genebank manager will be involved in the development of the agenda for the site visit. This is an important process during which specific issues and questions are identified for review and relevant stakeholders and users within and outside the Centre are identified for consultation.

At least one interaction will take place in advance of the site visit between the panel members and Trust staff, either through a visit to the Trust HQ or by conference call.

### **Phase II: Site visit and review of the Centre's genebank**

The panel members will conduct a site visit of the genebank following the agreed agenda. Usually the site visit involves interactions between the panel members and Centre of CRP senior management and germplasm users, as well as the full genebank staff. There will be at least one visit to field stations and, if feasible, national partner institutes. The panel members should determine the scale of these interactions in the development of the agenda in Phase I.

Given that discussions during the review are usually intensive, panel members may wish to review together the findings at the end of each day. There may also be a need to make adjustments to the agenda in order to pursue certain issues in greater detail. The draft recommendations will be presented to the Centre staff and management on the last day of the site visit.

### **Phase III: Completing the report and presenting the recommendations**

The review panel will produce a report of no less than 5,000 words in which actionable recommendations are clearly stated and justified. The report should be submitted to the Trust for initial review to ensure that the recommendations are clear and actionable. A response will be solicited from the Centre by the Trust. Specific actions or workplans to respond to individual recommendations may be requested.

The Trust will, finally, provide its own response to the recommendations. In the event of a lack of endorsement by the Center or the Trust to a recommendation, further discussions may be necessary between the Trust, panel members and the Center staff. If necessary, the CGIAR Consortium Office or other bodies may be consulted.

The Trust Executive Board and the CGIAR Consortium Office will review the completed report. The report will also be made available on the Trust web site and circulated to the CGIAR genebank managers and presented at the Annual Genebanks Meeting.

### **Terms of reference for Review Panel members**

The specific responsibilities of the Review Panel Members are to:

- Review background documents and data
- Participate in developing the site visit agenda
- Conduct any background research, ground-truthing or informal consultation concerning the review crops or Center in preparation for the site visit
- Participate in discussions with Trust staff to form an understanding of past interactions and experiences between the Trust and the review Centre, and of future workplans for the Genebank CRP.
- If required, present the aims of the review to the Centre staff
- Participate and/or conduct interviews with participants of the review
- Contribute to the formulation of the review recommendations and the written report
- If required, present the findings and recommendations of the review in subsequent relevant meetings.

In addition, a chair will be appointed by the Trust and will be required to take overall responsibility for:

- Organizing and conducting review presentations and interviews (unless otherwise delegated)
- Leading the panel members in formulating the recommendations and writing the review report
- Ensuring that the feedback from the Trust or review institute is adequately incorporated into the review report
- Ensuring that the formulation of the recommendations is based on principles of scientific and political objectivity, and that the interests or opinions of any one interviewee or panel member do not override this need for objectivity
- Ensuring that the final report is of an acceptable standard to the Trust.

## **Annex 2: Biopics of the Review Panel members**

### **Hugh W. Pritchard (Panel Chairman)**

Hugh is Head of the Comparative Seed Biology research at the Royal Botanic Gardens, Kew. He has a PhD in plant cryobiology and 30 years' experience in genetic resources preservation, including as a member of the senior management team delivering the Millennium Seed Bank Project / Partnership. His research specialities include seed cryopreservation, germination modelling and stress biology. He has published >190 scientific papers (c. 50% in international peer-reviewed journals), including in the *Proceedings of the National Academy of Sciences* and *Trends in Plant Science*. His research work is multidisciplinary in approach and his research group has global connections, publishing with co-authors from >30 countries (from Brazil to China) in the last 10 years. He has led four Darwin Initiative (UK) projects (2003-17). He currently manages Kew's role on two EU Framework 7 projects on 'climate and seed quality' and 'native seed biology' and a NERC project on seeds of Amazonian plants.

In addition to being a publisher of the low temperature science journal *CryoLetters*, he has been chairman of the Society for Low Temperature Biology (2008-11) and a governor at Writtle Agricultural College (2008-12). He is chairman of the Seed Storage Committee of the International Seed Testing Association. He holds honorary professorships from the University of Sussex and the Chinese Academy of Sciences, is a fellow of the Royal Society of Biology and the Linnean Society; and is an elected member of the Academy of Sciences of South Africa. He was a Senior International Visiting Professor with the Chinese Academy of Sciences in 2011.

### **Dr Robert Ikin**

Bob has a PhD from the University of Manchester, UK, in plant virology and worked for many years in the Australian plant quarantine service, initially in diagnostics, then as a manager of research, risk analysis and multilateral relations. He also held posts in plant protection and plant pathology in the Pacific and Caribbean. He was the Senior Officer Plant Pathology and Plant Quarantine in FAO with responsibility for the development of international Phytosanitary standards as well as inputs into the global programme on integrated pest management and with IBPGR the development of germplasm exchange guidelines. He is now a self-employed consultant specializing in current procedures for the application of international standards in phytosanitary control at a national level, and issues relating to biosecurity and market access and the protection of biodiversity in vulnerable ecosystems. He has worked in the Pacific, South East Asia, Africa, the Caribbean and in many Small Island Developing States (SIDS) such as Galapagos, Seychelles, Falkland Islands and Sri Lanka. He has extensive experience in project design, evaluation and implementation for a number of international aid agencies with reference to alien invasive species management, pre-border, at the border and post-border emergency outbreaks. In addition to drafting technical components of biosecurity legislation, he delivers training in pest risk analysis to ensure technical resource staff draft import conditions to meet national biosecurity obligations under the WTO/SPS, IPPC and other agreements. He has produced many publications and policy documents on plant quarantine, biosecurity and trade and germplasm exchange.

### **Annex 3. List of end-users (stakeholders) invited to complete the on-line survey.**

The questions covered the following areas: Conserving and Making Available the CIP-held Collections; Germplasm Exchange and Phytosanitary Requirements; Furthering the Development of a Global System for PGRFA; and Additional Comments. There was an excellent level of feedback, with 25 respondents (i.e., > 40 % of those approached).

<b>Name of stakeholder</b>	<b>Affiliation, city, country</b>	<b>Area of collaboration with stakeholder</b>
Dr. Jorge Abad	USDA-APHIS, Beltsville, MD, USA	Lead Pathologist Plant Germplasm Quarantine Program - responsible for potato and sweetpotato
Dr. Greg Forbes	CIP, Kunming, China	Leader of Program for Agile Potato in Asia
Dr. Noel Chen	Novogene, Beijing, China	Genome sequencing of potato
Dr. Jill Gready	Australian National University, Canberra, AU	rbcL sequencing in potato
Dr. Norman Warthmann	Australian National University, Canberra, AU	Genome sequencing of potato
Dr. David Douches	Michigan State University, E. Lansing, USA	SNP markers in potato
Dr. Jiwan Palta	University of Wisconsin-Madison, USA	Long-time collaboration on Ca <sup>++</sup> and cold tolerance in potato
Dr. John Bamberg	USDA-ARS, Head of potato genebank	Collaboration on many different projects on potato germplasm
Alejandro Argumendo	NGO - ANDES, Cusco, Peru	Collaboration principally with Parque de la Papa
Dr. Ruairaidh Sackville Hamilton	IRRI - Philippines	Co-executive committee member for A15 genebank groups
Dr. Tom Payne	CIMMYT - Mexico	Co-executive committee member for A15 genebank groups
Dr. Fernando de la Torre Sanchez	Director Centro Nacional de Recursos Geneticos, Tepatitlan, Jalisco, Mexico	Genetic resources conservation
Dr. Bob Jarett	USDA-ARS, Griffin, GA, USA - Sweetpotato curator for US	Genetic resources conservation

<b>Name of stakeholder</b>	<b>Affiliation, city, country</b>	<b>Area of collaboration with stakeholder</b>
Deanne Brill	Business Manager, Plant Sciences Institute, Iowa State University, Ames, IA, USA	Borlaug Summer Internships at CIP genebank
Dr. Andrzej Killian	Diversity Arrays Technology, Canberra, AU	DarTSEQ markers
Dr. Jan Low	CIP, Kenya	Vit A enhancement of sweetpotato, genebanking of sweetpotato in Kenya
Dr. Ted Carey	CIP, Ghana	Sweetpotato breeder
Dr. Lava Kumar	IITA, Nigeria	Virologist - phytosanitary cleaning
Dr. Babara Gueye	IITA, Nigeria	In vitro genebank - phytosanitary cleaning
Dr. Jan Kreuze	CIP, Lima	Virologist - phytosanitary cleaning
Dr. Robert Scotland	Plant Sciences, University of Oxford, UK	Ipomoea taxonomist
Dr. Sanday Knapp	Life Sciences Department, Natural History Museum, London, UK	Solanaceae expert
Jim Gradoville	CIP, Beijing, China	Director of CIP-China, genebank design and construction
Dr. Graham Thiele	RTB, Lima, Peru	Director - RTB
Marty Reisinger	Consultant for USDA-ARS	Grin-Global
Wilmer Perez	CIP, Lima	Post-entry quarantine officer - Germplasm acquisition
Cinthya Zorrilla	Instituto Nacional de Innovación Agraria (INIA), Lima, Peru	National regulatory authority for access, storage and distribution of ARTCs
David Ponce	Universidad Nacional Daniel Alcides Carrión (UNDAC), Lima, Peru	Acquisition and taxonomy of Maca
David Campos	Universidad Nacional Agraria La Molina (UNALM), Lima, Peru	Analysis of secondary metabolites in ARTCs
Luis Cisneros-Zevallos	Texas A&M University, Texas, United States	Analysis of secondary metabolites in ARTCs
Andres Valladolid	Comisión Nacional contra la Biopiratería, Lima, Peru	Biopiracy related to ARTCs

<b>Name of stakeholder</b>	<b>Affiliation, city, country</b>	<b>Area of collaboration with stakeholder</b>
Manuel Ruiz	Sociedad Peruana de Derecho Ambiental (SPDA), Lima, Peru	Legal status of ARTCs (CBD, ITPGRFA, Reglamento 391, Nagoya, etc.)
Luis Lizárraga	Universidad Nacional San Antonio Abad del Cusco (UNSAAC), Cusco, Peru	Homologation of arracacha and yacon
Sara Sánchez	Universidad Nacional de Tucumán, Tucumán, Argentina	Yacon as a functional food for human health (clinical studies)
Luis Rodriguez-Saona	The Ohio State University, Ohio, United States	Antioxidant compounds in ARTCs
Erika Benson	Cryobiology, University of Derby, Scotland (UK)	Cryobank, Audited CIP's cryobank in 2012
Keith Harding	Conservation & Molecular Genetics, University of Derby, Scotland (UK)	Cryobank, Audited CIP's cryobank in 2012
Bart Panis	Cryobanking, Bioversity, Leuven (Belgium)	Cryobank, project collaboratio 2009-11
Joachim Keller	Cryobanking, IPK, Gatersleben (Germany)	Cryobank, project proposal in 2011
Dr. Robert Mwanda	CIP, Uganda	Sweetpotato breeder
Dr. Asrat Amele	CIP, Nairobi	Potato breeder
Alfonso Del Rio	University of Wisconsin-Madison, USA	Long-time collaboration on Ca <sup>++</sup> and cold tolerance in potato and Collaboration on many different projects on potato germplasm
Lino Mamani Huaraca	"Papa Arariwa", "Asociacion del Parque de la papa" leader, Peruvian community Farmer	Collaboration on many different projects on Repatriation and Potato Park's germplasm
Carlos Hidalgo Romero	San Jose de Aymara community leader, Peruvian community Farmer	Collaboration on potato germplasm production in San Jose de Aymara for Repatriation to other Peruvian communities
Elvis Romero Hidalgo	AGROPIA association leader in San Jose de Aymara community, Peruvian community Farmer	Exporters of native potato chips from high Andean communities to European countries
Jesus Alcazar	CIP, Lima	Entomology expert, collaboration in identifying pests of potato germplasm

<b>Name of stakeholder</b>	<b>Affiliation, city, country</b>	<b>Area of collaboration with stakeholder</b>
Dr. Daniel Debouck	Genetics Resources Area, CIAT - Colombia.	Lead Genetics Resources Area - cooperation for maintenance of safety copies of sweetpotato from CIP at CIP and safety copy of cassava from CIAT at CIP.
Kazumitsu Matsumoto, PhD em Agrobiologia	Empresa Brasileira de Pesquisa Agropecuária (Embrapa)	Researcher and curator of in vitro collection of plant - maintenance of safety copy of potato.
Francisco Ricardo Ferreira, Engenheiro Agrônomo, MSc. Dr.	Embrapa Recursos Genéticos e Biotecnologia (Cenargen)	Supervisor of exchange germplasm core- NIG- acquisition of black box of potato.
Ola T. Westengen	Svalbard Global Seed Vault	Coordinator of Operation and Management - Svalbard Black Box
Victor Otazu	Experimental Station Santa Ana - CIP Huancayo	Experimental Station Manager - Storage of national safety copy
Ing. Moises Pacheco Enciso	Servicio Nacional de Sanidad Agraria (SENASA) Lima Peru	Importing in vitro plants - Risk analysis
Ing. Johny Naccha	Servicio Nacional de Sanidad Agraria (SENASA) Lima Peru	Risk analysis- Vigilancia Fitosanitaria y Análisis de Riesgo y del área de Cuarentena
Ing. Cesar De la Cruz Lezcano	Servicio Nacional de Sanidad Agraria (SENASA) Lima Peru	Phytosanitary certificate with additional clause
Ademar Quiñonez	Servicio Nacional de Sanidad Agraria (SENASA) Lima Peru	Airport Lima Callao- Puesto de Control del Terminal Aéreo del Callao
Ing. Maximo Flores Torres	Servicio Nacional de Sanidad Agraria (SENASA) Lima Peru	Dirección Ejecutiva SENASA Lima - Callao
Dr. Alberto Dante Maurer Fossa	Instituto Nacional de Innovación Agraria (INIA)	Head of INIA
Dra. Rosa Angélica Sánchez Díaz	Instituto Nacional de Innovación Agraria (INIA)	Directora de la Dirección de Recursos Genéticos y Biotecnología
ABOG. Fabiola Muñoz Dodero	Servicio Nacional Forestal y de Fauna Silvestre (SERFOR)	Directora Ejecutiva

## Annex 4: Screenshot of the start of the on-line questionnaire

### CIP review

#### Your participation

Dear Genetic Resources Specialist

The Global Crop Diversity Trust has appointed a panel to review the work of the CIP genebank in Lima, Peru.

In addition to discussions with staff, the Review Panel would also like to understand what interaction there is between the genebank operations and end-users of the collections, including the transfer of knowledge, delivery of capacity building, etc. With this in mind, the Panel has devised a questionnaire, which I hope you can spare the time to complete.

Please could you provide brief answers to the most relevant questions that relate to your experience of interacting with the CIP genebank?

It would be most helpful if you could return your comments by Monday 01 June 2015.

Many thanks

Prof Hugh W. Pritchard  
Chair of Review Panel  
and on behalf of the Global Crop Diversity Trust  
Email: h.w.pritchard@btinternet.com

1. Name of respondent:

2. Institutional or company name:

3. Role (breeder, educationalist, etc.):

### CIP review

#### PART A:

##### Conserving and making available the CIP-held collections

4. In your experience, are the storage facilities, management and curation of the CIP-held collection at international standards (health, regeneration, etc.)?

- Yes  
 No

If no, which aspect(s) of the collection management need(s) improvements?

5. Have you safety duplicated any plant genetic resource collection(s) in the CIP genebank?

- Yes  
 No

## **Annex 5: Findings of the end-users survey**

### **Background.**

Prior to the visit of the Review Team to the CIP, Lima site, a survey of 17 questions was conducted, between 4-19 of June 2015, to users of the germplasm held at the CIP genebank. A questionnaire was submitted to a total of 55 users through the SurveyMonkey platform. A total of 17 questions were asked, including user name, affiliation and her/his role as user. Most questions had a field for open comments and no question was compulsory (see Appendix 1). In addition to the initial email invitation to answer the survey, users were reminded twice before the survey was closed. A total of 29 users (53% response rate) filled in the survey. During the period in Lima, five Skype meetings were held with genebank users across the world. Each lasted about 20 minutes. During these conversations all issues relating to the Genebank that were of concern to the stakeholder were explored.

### **Key responses.**

#### **Part A: Conserving and making available the CIP-held collections**

From the on-line survey 92% of respondents (out of 24 responses) were of the opinion that the facilities, genebank management and curation at the CIP genebank are conducted with international standards. One user did not support this statement, although this negative impression was based on colleagues' comments rather than those of the actual respondent. Two users mentioned the challenging issue of identity maintenance and verification, which are inherent to vegetative propagated crops. Also, problems with documentation were mentioned.

About 32% of respondents, (8 users) have safety-duplicated collections at the CIP genebank. This includes collections of cassava (CIAT), sweet potato (The genebank in Griffin, US), potato (Potato Park) and wild potato (US potato genebank) including "late blight differentials" (CIP-pathologist). From these users, about 25% stated that deposited material at CIP has been characterized or evaluated. "Materials have been characterized for a number of attributes over the years. Again, documentation is perhaps not quite where it should be. At least I am not totally certain of how to access this documentation" said Edward Carey (CIP-sweet potato breeder).

Issues concerning the availability and content of information was also raised by Unit managers who felt that the different technical languages used by the different groups within CIP (breeders, researchers and the genebank) had different objectives, were not harmonised and could cause confusion in a multilingual context.

#### **Part B: Germplasm exchange and phytosanitary requirements**

In the online survey the limitations and requirements on movement of germplasm from and to the CIP genebank due to plant health requirements, 7 users (32% of respondents) reported problems and mentioned the unnecessarily long post entry quarantine import

conditions specified by the [Peru national] plant quarantine authority that delayed access to imports. Respondents and staff of the genebank considered that the SENASA quarantine requirements were far too stringent and the reviewers also considered that they were not compliant with international norms.

Genebank staff recognised that there was a continuing need to improve virus detection methodologies so that timelines for health clearance could be reduced. Currently the virologist used combinations of molecular and biological methodologies based on their own research and those adopted from worldwide sources. Molecular techniques were more efficient but often had been developed for very specific virus strains. There was a need for the development of rapid but broad spectrum testing methods so that multiple testing for a single virus with many strains was no longer necessary.

The distribution of genebank material that had tested virus free pre-2006 that was subsequently found to be virus-infected was the catalyst for the adoption of more rigorous operating procedures.

Starting in 2008 the methodologies for the production of pathogen-tested free exchange material was begun with the systems being externally audited under ISO/IEC 17025:2005. There is ample evidence of the adoption of the ISO standards in the workplace with very visible reminders of standard operating procedures and the extremely detailed methods for the electronic labelling of material at all stages of the testing and curation process. Supervising managerial staff, who worked at the genebank prior to the adoption of ISO certification, clearly recognised that the standardised procedures had imposed a new level of reliability into the health status of the material as well as the identification and trueness to type of the clones/isolates within the collection. The use of hand-held electronic devices to record information, and to print out labels when required, had been a recent development that had reduced errors in manual transcribing text.

Now that the system has been in place for several years the processes are well entrenched the working environment is such that the internal evaluation of compliance by identified co-worker auditors appears a normal day to day operational activity. External audit for compliance with ISO/IEC 17025:2005 occurs annually and at a considerable cost.

### **Part C: Furthering the development of a global system for Plant Genetic Resources for Food and Agriculture**

When asked about receiving training or capacity building from the CIP genebank staff, 5 respondents (22%) answered positively. Some examples are: training on "characterization and evaluation, seed management, botanical seed multiplication and participatory plant breeding." (ANDES association). Also mentioned were the several visits to CIP genebank facilities mentioned by another user.

More than half of respondents (58%) have been partnering with CIP to create a more efficient and effective global conservation system. This included safety duplication (black box), phytosanitary issues such as virus cleaning, and disease detection, health status certification, "pushing and supporting greater SMTA discipline" and research for improving

efficiency of genebank management. Bioversity collaborated with CIP “to develop a more efficient cryopreservation protocol for potato that is now being used”. Alejandro Argumendo (Asociacion ANDES) said "CIP supports the work of the Potato Park as gene reserve. The 25% of respondents (6 users) have been involved in helping CIP extends its ITPGRFA collections to better cover genepools.

Conservation services provided by the CIP genebank have been mentioned by 6 users (27% of respondents). This involved seed and plant materials. Another service mentioned was the "evaluation of cultivars to stand climate threats" – Alejandro Argumendo (Asociacion ANDES).

Most users (87% of 15 respondents) have strong links with the CIP genebank and provided very positive feedback. Collaboration took place in terms of "sharing experiences, training, capacity building, and lately preparing publications together", research and joint publications, characterization and evaluation of material. Jim Gradoville (CIP-CCCAP) said "Dave Ellis has been extremely supportive during the time of CCCAP strategy development in the SCP, the design of labs in Yanqing and now leading a proposed project with BGI. We value highly his engagement and support". Edward Carey (CIP- sweet potato breeder): "The Head of genebank is extremely willing and eager to collaborate for improvement and effective utilization".

From 13 respondents, 46% recognized CIP’s efforts to promote the use of collections held at the genebank such as in “meetings, online and through GENESYS”. Jim Gradoville said “I’ve watched the recent video that Dave was featured in and I’ve read trip reports and other materials as they’ve been distributed around CIP”. Another 7 people were not aware of any promotion while other 16 interviewed persons didn’t respond. Among the latter group, two users mentioned their active promotion to farmers, universities, NGOs for using CIP-held collections.

At the Unit managers meeting comment was made that improvements to process may be possible if staff could be permitted to undertake research into their areas of expertise, but that this was not permitted under their terms of employment. The possibility of research and the source of funding was an issue and it was felt that if savings were made through efficiencies that this could be re-allocated to the development of potentially more effective activities.

#### **Part D: Other comments**

Several survey stakeholders commented on the positive experiences they had found in cooperating with CIP staff. In particular there was considerable respect for their technical competency and their commitment to cooperation both at formal and informal levels. Unit managers during our meeting recognised from their attendance at meetings where other genebank workers were present that experiences were common and that the exchange of experiences through staff secondment or other mechanisms would be very beneficial to other institutes. Opportunities should be sought for these types of exchanges/secondments.

Kazumitsu Matsumoto (Embrapa): "We would like to have stronger links with the CIP gene bank".

Alejandro Argumendo (Asociacion ANDES): "Mutual trust and work based on respect and reciprocity".

Babara Gueye (IITA): "Would be great if the Andean aroids kept at CIP could be accessible. Would like more response (no answer yet) on assistance request from IITA GRC sent for LIMS implementation. Great collaboration in cryopreservation and germplasm cleaning work!!!"

Alfonso Del Rio (US Potato Genebank/University of Wisconsin-Madison): "We have a great experience working with the CIP genebank. We have been very fortunate of interacting with high-class scientists at CIP. Product of this long collaboration we have a large number of research papers related to potato conservation. So interaction has been very positive and hope we can keep cooperating with CIP".

Wilmer Perez Barrera (CIP-Pathologist): "All materials hold in CIP gene bank need to be characterized by resistance to abiotics and biotics traits. Almost 25% of germoplasm is characterized by these traits".

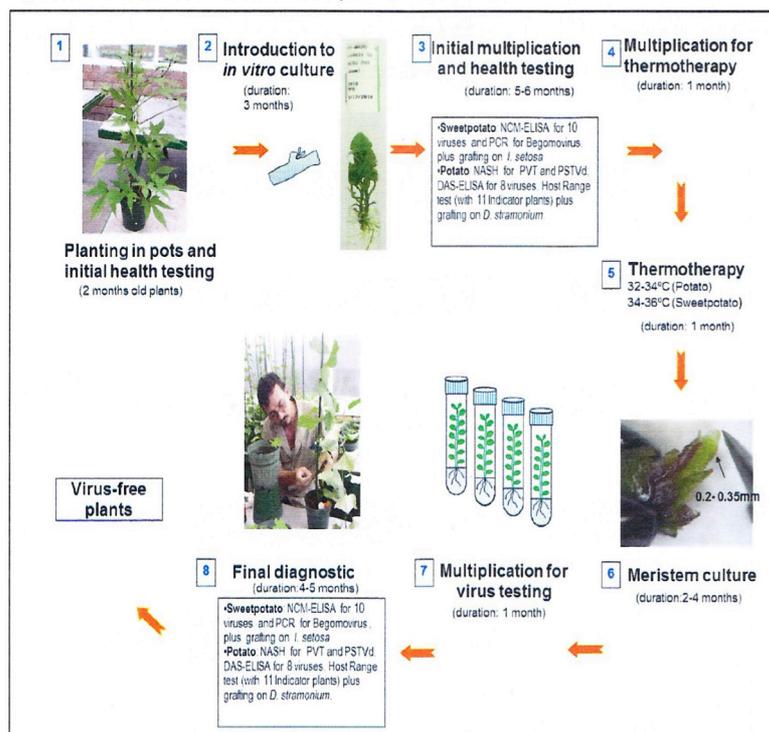
Jose Fernando de la Torre Sanchez (INIFAP): "As Mexico is also a Center of origin and domestication for potato, we feel that strong interaction with CIP is a must. We have plans to start formal interaction with CIP this year".

## Annex 6: Phytosanitary procedures and throughput

**List of virus tested for by serological and molecular methods. \*NASH - Nucleic Acid Hybridization detection; DAS-ELISA - double-antibody sandwich (DAS) method of the enzyme-linked immunosorbent assay; NCM-ELISA – immune-enzymatic test that uses nitrocellulose membranes.**

Crop	Virus		Detection method *
Potato	Potato virus T	PVT	NASH
	Potato spindle tuber viroid	PSTVd	NASH
	Potato virus X	PVX	DAS-ELISA
	Potato virus Y	PVY	DAS-ELISA
	Potato leaf roll virus	PLRV	DAS-ELISA
	Potato virus S	PVS	DAS-ELISA
	Andean potato mottle virus	APMV	DAS-ELISA
	Andean potato latent virus	APLV	DAS-ELISA
	Potato yellowing virus	PYV	DAS-ELISA
	Arracacha virus B- Oca strain	AVB-O	DAS-ELISA
Camote	Sweetpotato feathery mottle virus	SPFMV	NCM-ELISA
	Sweetpotato mild mottle virus	SPMMV	NCM-ELISA
	Sweetpotato collusive virus	SPCV	NCM-ELISA
	Sweetpotato chlorotic fleck virus	SPCFV	NCM-ELISA
	Sweetpotato C6 virus	C-6 virus	NCM-ELISA
	Sweetpotato mild speckling virus	SPMSV	NCM-ELISA
	Sweetpotato chlorotic stunt virus	SPCSV	NCM-ELISA
	Sweetpotato latent virus	SPLV	NCM-ELISA
	Cucumber mosaic virus	CMV	NCM-ELISA
	Sweetpotato virus G	SPVG	NCM-ELISA
	Begomovirus	Begomovirus	PCR

### Schematic of virus elimination process



### Pathogen-tested under current conditions of capacity



### Pathogen-tested under estimated conditions of capacity



### Current and enhanced (with additional resources) pathogen testing capacity

### Annex 7: Schedule of meetings for the Review Panel (16-20 June 2015)

Day	Time	Item	Names/positions of participants & presenters	Issues to be addressed
	8:30- 9:00	Meet with Dave and Noelle and look at the agenda	Dave Ellis, Noelle Barkley	Settling in and overview of the week
Tuesday June 16	9.00 - 9:30	Brief presentation by the Review Panel Chair and Q&A to all relevant staff including senior management.	Barbara Wells, Oscar Ortiz, Amalia Perochena, Merideth Bonierbale, Karla Lazarte, Michael Gerba, Guy Hareau, Roberto Quiroz, Dave Ellis, Graham Thiele, Karla Seminarion, Milagros Patino, Susana Zapata	Introduction to the review panel and to the objectives and approach of the review, including an introduction to the separate reviews conducted by Janet Muir and Matija Obreza.
	9:30 - 10:30	General introduction to the Center	Barbara Wells, Oscar Ortiz, Amalia Perochena, Merideth Bonierbale, Karla Lazarte, Michael Gerba, Guy Hareau, Roberto Quiroz, Dave Ellis, Graham Thiele, Karla Seminarion, Milagros Patino, Susana Zapata	Presentation of CIP's strategic program and approach. Description of how the genebank links into CIP's research programs and RTB and any constraints or challenges in this regard.
	10.30-11.00	Coffee with genebank supervisors	Dave Ellis, Noelle Barkley, Ana Panta, Nataly Franco, Rocio Silvestre, Ivan Manrique, Rainer Vollmer, Charo Falcon, Brenda Zea, Genoveva Rossel, Rene Gomez, Fanny Vargas, Alberto Salas	Informal introduction to heads of genebank programs
	11:00 - 12:00	Introduction to the genebank	Dave Ellis, Noelle Barkley	Overview of the genebank, including an outline of all research stations, their facilities and functions

Day	Time	Item	Names/positions of participants & presenters	Issues to be addressed
	12:00 - 13:30	Lunch		
	13:30 - 14:30	Tour of the In vitro genebank	Ellis, Barkley, Panta, Vollmer, Franco, Zea	Tour of the facilities following the general workflow and brief presentation from key staff of their roles and activities
	14:30 - 16:30	Overview of the cultivated potato collection	Ellis, Barkley, Gomez, Marisol Durante, Julian Soto	Overview of management of cultivated potato collections. Cultivated potato as a model of collection curation - themes, challenges, objectives
	18:00	Dinner		
Wednesday June 17	8:00 - 08:30	Stakeholder call (Europe, Asia & Africa)	Marc Ghislain (Biotech, Kenya)	Stakeholder
	8:30 - 9:30	ARTCs	Ellis, Barkley, Ivan Manrique	Overview of management of ARTC collections. Phytosanitary and legal status. Constraints and future plans. CIP's role and mandate with regard to these crops
	09.30-11.00	Wild potato collections from a curator standpoint & tour of seed bank	Ellis, Barkley, Alberto Salas, Violeta Quispe	Overview of management of wild potato collections. Tour of the seed storage and meet with key staff.
	11:00 - 12:30	Quarantine & phytosanitary	Ellis, Barkley, Brenda Zea	Overview quarantine facilities
	12:30-13:30	Lunch		
	13:30 - 14:00	Quarantine & phytosanitary	Ellis, Barkley, Brenda Zea	Finish up phytosanitary cleaning

Day	Time	Item	Names/positions of participants & presenters	Issues to be addressed
	14:00 - 15:00	Sweetpotato collections from a curator standpoint & tour of the greenhouses	Ellis, Barkley, Genoveva Rossel	Tour of the greenhouses
	15:00-15:30	Stakeholder call (Europe, Asia & Africa)	Ted Carey, CIP-Ghana, sweetpotato breeder	Stakeholder
	15.30-16.30	Sweetpotato collections from a curator standpoint & tour of the greenhouses	Ellis, Barkley, Genoveva Rossel	Overview of management of wild + cultivated sweetpotato collections.
	18:00	Dinner		
Thursday June 18	8:00-8:30	Stakeholder meeting	Call with Marilia Burle, Embrapa	Safety back-up
	8.30 - 10:00	Cryobank	Ellis, Barkley, Rainer Vollmer	Overview of management of the cryo program, current status and future direction
	10:00 - 11:00	Herbarium	Ellis, Barkley, Fanny Vargas	Overview of management of the herbarium. Role of the herbarium in the management of the live collections.
	11:00 - 12:00	Distribution	Ellis, Barkley, Charo Falcon	Overview of management of the distribution program
	12:00 - 13:00	Lunch		
	1:00 - 1:20	Interactions with partners & users (USA, LAC)	John Bamberg - USDA potato genebank	
	1:20 - 1:40	Interactions with partners & users (USA, LAC)	Alejandro Argumedo - ANDES (Peruvian NGO)	Active collaboration with Parque de la Papa - ABS, ITPGRFA
	14:00 - 15:00	Discussion sessions with breeders, researchers, genebank users	Awais Khan/Merideth Bonierdale/Wolfgang Grunenberg/Jan Kreuze	CIP breeders (AK, MB [potato], WG [weetpotato]), virology (JK)

Day	Time	Item	Names/positions of participants & presenters	Issues to be addressed
	15:00 - 15:20	Interactions with partners & users (USA, LAC)	Jorge Abad - USDA-APHIS	USA quarantine of roots and tuber crops
	15:30 - 16:00	Tour virus testing facilities	Giovanna Muller	CIP facilities
	16:00 - 17:00	Conservation of breeding lines	Ellis, Barkley, Rocio Silvestre	Overview of management of the breeding lines
	18:00	Dinner		
Friday June 19	8.00 - 8:30	Impact of ex situ conservation	Guy Hareau (Economist)	Ongoing impact study on CIP's ex situ genebank
	8:30 - 9:00	Meet with Selim Guvener	Selim Guvener (Intellectual Assests Manager)	Genebank compliance with ITPGRFA and Nagoya
	9:00 - 10:30	Data management issues	Ellis, Barkley, Edwin Rojas	Database manager & Matija presents feedback on data management review
	10:30 - 11:15	Meet with Operations	Eduardo Ferreyra, Karla Seminario, Brandy Wood	Interaction of genebank with HR, logistics, resource mobilization, etc
	11:15 - 12:00	ISO System	Ellis, Barkley, Charo Falcon	Implementation and impact of the QMS. Overview of risk measures and health & safety
	12:00 - 13:00	Lunch		
	13:00 - 16:00	Visit to INIA & SENASA	SENASA - Moses Pacheco (Director General de Sanidad Vegetal); INIA - Alberto Mauer (Jefe), Rosa Angélica Sánchez Díaz (Directora General Genetic Resources and Biotechnology), Cinthia Zorrilla Cisneros (Subdirectora de Recursos Genéticos)	Exactly who you will meet with is still not clear SENASA at CIP Visit INIA (plan on 15 min transfer - ask for <u>Dr. Cinthya Zorrilla Cisneros</u> Director de la Subdirección de Recursos Genéticos
	16:00-16:30	Meet with Carla Lazarte	Head of HR	

Day	Time	Item	Names/positions of participants & presenters	Issues to be addressed
	16:30 - 18:00	Overview of genebank & focus on key issues	Ana Panta, Nataly Franco, Rocio Silvestre, Ivan Manrique, Rainer Vollmer, Charo Falcon, Brenda Zea, Genoveva Rossel, Rene Gomez, Fanny Vargas, Alberto Salas, Edwin Rojas	Q&A as needed with genebank staff
	18:00	Dinner		
Saturday June 20	8:00 - 12:00	Review panel deliberation		Discuss/prepare report
	12:00 - 13:30	Lunch		
	13.30-14.30	Presentation of draft recommendations to senior management	Barbara Wells, Oscar Ortiz, Amalia Perochena, Karla Lazarte, Michael Gerba	
	14.30-15.30	Presentation of draft recommendations to genebank staff	Dave Ellis, Noelle Barkley, Ana Panta, Nataly Franco, Rocio Silvestre, Ivan Manrique, Rainer Vollmer, Charo Falcon, Brenda Zea, Genoveva Rossel, Rene Gomez, Fanny Vargas, Alberto Salas	