



Report on the Second Workshop on *Musa* Germplasm: Identification Towards Optimising Use

Organised by the Global *Musa* Genetic Resources Network (MusaNet)
Bioversity International in collaboration with the National Research Centre
for Banana (NRCB) of ICAR Trichy, India

Saturday 6 December to Friday 12 December 2014



RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas



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1. Background

The Global *Musa* Genetic Resources Network, MusaNet, held a workshop to address the most urgent needs of *Musa* collection curators for an unequivocal standardized description of the germplasm and its associated management of information. This includes ensuring the correct identification of the materials conserved and making this information available to all users. This second MusaNet workshop built on the experience from the workshop organised in December 2013 that took place in the field collection of CIRAD in Guadeloupe. There, materials were available for the 12 partners of the Taxonomic Reference Collection Project (TRCP) to agree on the minimum descriptors, share their experience and find solutions for common difficulties in *Musa* collection management and, most importantly, in accession characterisation. Furthermore, some of the TRCP partners are now in the second cycle and characterising the plants with the full list of descriptors. This will generate more data on the different sites and provide useful information for the workshop discussions.

The MusaNet Expert Committee recommended that the second workshop be held in Asia where most of the *Musa* diversity exists, and that the main part of the programme should focus on the 12 partners of the TRCP. It was also proposed that it be held at one of the TRCP partners where the collection is managed in optimal condition, where a suitable range of diversity is maintained and where the development of the plants are at the right stage of growth for training. The Expert Committee thus

proposed the collection at National Research Centre for Banana (NRCB) of the Indian Council of Agricultural Research (ICAR) to host this follow-up workshop.

2. Workshop Goal and Objectives

The **Goal** of the workshop was:

- To optimise the use of *Musa* germplasm through best description and management practices.

The **Objectives** of the workshop were to:

1. Review the current practical and common description methodology with the TRCP partners and resource people.
2. Have a common understanding and agree on the revision of the minimum descriptors to be used in the field, i.e. interpreted and recorded in the same way by all curators.
3. Share knowledge and experience to promote best practices for the field management and documentation of *Musa* germplasm collections.
4. Discuss and propose solutions for optimum *Musa* germplasm data management.
5. Make recommendations for the next phase of the TRCP and the planning of regional and national training workshops.

3. Follow-up to the Workshop

The proposed follow-up to this MusaNet workshop is the following:

1. Revision of the illustrated minimum descriptors list.
2. Next steps of the *Musa* TRCP in 2015 and beyond.
3. Organisation of regional workshops coordinated by the respective Regional *Musa* Research Networks, including CARBAP workshop scheduled for April 2015.

More specific follow-up actions are listed in Section 13 of this report.

4. Summary of the Workshop Programme

The workshop was divided into the following sessions (see Annex 1 for full programme):

Official inauguration and opening session

1. Session 1: Introduction to the workshop and where we are
2. Session 2: Description of the accessions in the field collection
 - Round 1 – 16 descriptors
 - Round 2 – 11 descriptors
 - Round 3 – 9 descriptors
3. Session 3: Field management issues
4. Session 4: Documentation and sharing of information
5. Session 5: Global and regional context
6. Session 6: Next steps and agreed workplan
7. Session 7: Conclusion and workshop evaluation

This report by Bioversity serves as an official record of the workshop, including the minutes of discussions and [links](#) to all presentations on the MusaNet website (in pdf format). All the presentations are found on the MusaNet website (www.MusaNet.org) under the tab 'Meetings'.

5. Official inauguration and opening session

The workshop was officially opened in an inauguration ceremony on 6th December 2014 led by M.S. Saraswathi with welcome messages by M.M. Mustaffa (director of NRCB), N.K. Krishnakumar (deputy director general at ICAR), Uma Subbaraya (NRCB), and Nicolas Roux (Bioversity).

Nicolas Roux made a presentation on the TRCP, summarizing the original objectives, what has been done thus far, and the next steps of the project. [Full presentation here](#)



The MusaNet workshop delegates at the opening ceremony. The list of all participants is found in Annex 2.

6. Session 1 - Introduction to the workshop and where we are – 6 December

Objectives:

- Clear understanding of the purpose of the meeting, expected outputs and participation.
- Agreement on the proposed programme and process.
- Understanding of key constraints and proposed solutions.
- Common understanding where the *Musa* Genetic Resources community wants to be in 20 years vis à vis taxonomy and documentation.
- Clear status of where we are with the TRCP, why and how it was developed and where we want to be after the workshop.
- Assessment of progress made at each of the partners' sites.
- Agreement on the next steps of the TRCP.

The 11 TRCP partners at the workshop (EMBRAPA was not able to attend) each made short presentations on the current status of the project at their collections:

1. [IRAZ \(Burundi\)](#) - Ferdinand Ngezahayo
2. [CARBAP \(Cameroon\)](#) - Lucien Ibobondji Kapuku
3. [CORBANA \(Costa Rica\)](#) - Jorge Sandoval (*presented by Julie Sardos*)
4. [NRCB \(India\)](#) - Uma Subburaya
5. [ITFRI \(Indonesia\)](#) - Agus Sutanto
6. [IITA \(Nigeria\)](#) - Delphine Amah
7. [BPI \(Philippines\)](#) – Jonalyn Pabuaya
8. [SDR \(Tahiti\)](#) – Maurice Wong
9. [NARO \(Uganda\)](#) – Sedrach Muhangi
10. [USDA/ARS \(USA\)](#) – Brian Irish
11. [FAVRI \(Vietnam\)](#) – Phong Ngo Xuan

Each presentation was unique; however some of the shared concerns among the collections were:

- 1) the amount of work necessary while the activity is not funded.
- 2) the difficult logistics necessary for the characterization, such as synchronization of the activities, given the different needs and cycles of the plants.
- 3) the challenges of transferring the data to Bioversity, especially the photos.
- 4) issues specific to the collections, not specific to the TRCP but impacting it, such as irrigation, rodents and elephant attacks, and pests and diseases.

The individual progress of each collection towards the TRCP (at the time of the workshop) is shown in the table below:

Table 1. Status of the TRCP project (December 2014). Numbers are total accessions for each task/collection.

	NRCB	BPI	CAR BAP	FAVRI	IRAZ	USDA	CORB ANA	NARO	ITFRI	EMB RAPA	IITA NGA	SDR - MAP
Shipped	32	34	34	34	34	34	28	31	31	31	29	28
Growing	22	21	34	24	32	30	27	30	21	20	28	27
Min. Desc data sets	17	25	33	24	31	30	23	29	19			
Photos	16	25	27	24	31	30	23	30	17			
Full Desc. Datasets	17	25	0	24	0	30	12	0	4			

Presentations were then made by the additional curators (non-TRCP) participating in the workshop:

1. [DAFF \(Queensland, Australia\)](#) – Jeff Daniells
Jeff discussed the history and purpose of the South Johnstone collection and some of the work that is done there (e.g. yellow Sigatoka screening). He gave an overview of procedures concerning quarantine, virus indexing and tissue culture techniques and highlighted important recent publications.
2. [CIRAD \(Guadeloupe\)](#) – Kodjo Tomekpe
Kodjo gave a summary of the CIRAD collection in Guadeloupe, which has 417 field accessions and 300 *in vitro* accessions. He discussed the purposes of the collection and its contribution of

data to MGIS and to the publication of the Musalogue. Future participation with the TRCP could materialise pending negotiations with the quarantine service.

3. [MARDI \(Malaysia\)](#) – Maimun Tahir

Maimun presented an overview of important activities at MARDI, including tissue culture maintenance, field collection management and characterization.

4. [NARI \(Papua New Guinea\)](#) – Janet Paofa

Janet provided a brief history and highlights of the collection at NARI, which has 217 accessions in field. She discussed the challenges of maintaining the collection (e.g. drought and flooding) and her perceptions and suggestions towards the TRCP.

Following the curators' presentations, Julie Sardos (Bioversity) gave an overview of the TRCP exercise, its objectives, activities and partners. [Full presentation here.](#)

Julie discussed the what, why and how of the TRCP and summarized the work done from Guadeloupe until now. Significantly, the TRCP was established this year in IITA and SDR. Julie updated the table showing the status of the project (see Table 1 above) and requested a list from each partner of which accessions are still growing in their collection.

7. Session 2 - Description of the accessions in the field collection – 7, 8 and 9 December

This session was spread over three days, consisting of mornings in the field collection characterising four different accessions and afternoons discussing the descriptors that were measured each morning.

Annexes 3 and 4 contain details on the descriptors, accessions and groups organized for the field sessions.

Objectives:

- Description of accessions to share experiences on the interpretation of descriptors and to review some of them and agree on the most appropriate definitions.
- Practical training and knowledge exchange on the descriptors of the accessions based on the agreed descriptors.
- Solving the problem of different descriptions for the same cultivars of the TRCP.
- Firm agreement understood by everybody on the minimum descriptors.

Scoring of descriptors in the field (mornings):

1. Each curator scored the descriptors (16 descriptors, 11 descriptors and 9 descriptors for the respective 3 rounds) rotating among the 4 accessions (see accession names below).
2. The results on the first accession were given to Max, who (with Julie and Rachel) entered the scores.
3. The groups moved to the next accession and the curators scored the second accession for the descriptors and immediately gave the results to Max.
4. This continued until all 4 accessions were scored.
5. Once the field scoring is completed for each of the 4 accessions by each of the 4 groups, the next step was to discuss the results in the meeting room.

Accession 1 – Silk - AAB

Accession 2 – Mysore - AAB

Accession 3 – Red banana – AAA

Discussion in the meeting room (afternoons):

1. For each descriptor, the results for the 4 accessions were displayed on the video-projected screen. These results are online and linked here for [Day 2](#), [Day 3](#) and [Day 4](#).
2. Lavernee's photos for the same descriptor were displayed next to the graph for visual reference.
3. With alternating lead of Jean-Pierre and Jeff, the group looked at the visual results and assessed the different scores for each descriptor.
4. The group discussed the reasons for the discrepancies (if any) and then moved to the next accession to repeat the process for all 4 accessions.
5. The group concluded if the description/explanation of the descriptor needs to be modified/revised and how this might happen. Jean-Pierre and Jeff helped make a final decision and Rachel took notes for the revision (summarised in **Annex 5**).
6. The process was repeated until the all descriptors were discussed.
7. The group discussed the key field management issues that arose during the characterisation of the accessions.

Discussion on the revision of the minimum descriptors

There was an overwhelming consensus to have more clarity on descriptors so that they can be understood by everyone in the same way. There are many things to be corrected on the minimum descriptors and certainly there will be more in the full list of descriptors. This could not be comprehensively covered at this workshop but it was proposed to form a small working group to improve the minimum set of descriptors based on comments made during this workshop. After revision, the descriptors should be tested by small group of curators to confirm if they capture the diversity of a collection (e.g. plantains for the upcoming CARBAP workshop in April 2015) and then feedback results to the TRCP group.

Important questions for the working group to ask for each descriptor:

1. What to score
2. Where to score
3. When to score
4. How to do it

It would be useful to have a timeline with best time to score each descriptor (noting different stages of growth).

General discussion on colour chart:

- Should all colour options be added to the list of options so we can have better data? This is not only for the TRCP but for descriptors in general (ideal state). There are 3 options – 1) extend list of all 16 colours (but would this spread the answers?) 2) reduce colour chart to have less values 3) keep the values as they are.
- For easier scoring, the colour chart needs to be trimmed up to the edge of the colours blocks or put a hole in each colour block. Or change to a paint palette style chart.
- Colour vs pigmentation – explain the difference and more appropriate term for some descriptors.
- Replace 'basic' colour with 'main' colour.

A working group will be formed to review the comments on the colour chart and discuss options to help discriminate different varieties including those beyond the TRCP.

The descriptors need fine tuning for terminology. The translation from French to English resulted in some terms that are not botanically appropriate or misunderstood (eg 'ventral/dorsal' should be replaced with 'lower/upper'). This needs to be carefully examined by the working group. Spanish and French versions need to be examined separately and revised after the finalization of the English version. A working group should be formed for each language.

Videos should be made to explain how to score many descriptors. Lavernee could make videos in the near future according to what taxonomists decide is needed. In addition, there is a clear need for good photographs which would clarify many problems with the interpretation of descriptors as photographs are powerful for getting information across in all languages. Sometimes, diagrams are better than photos.

Road testing the new descriptors on curators would come after the working groups have done as much work as possible. Descriptors should be tested in collections that are diverse enough to cover the whole range of choices provided. All feedback must be very honest.

Curators are expecting to be told the 'correct' choice from experts, but it is up to curators to acquire the right answer in their own collection by getting to know the plants. But the what, where and how is important to clarify and that is the job of those who will revise descriptors.

It would be useful to have some descriptors scored by quantitative parameters (e.g. 2.2 expressed by ratio "circumference at mid height/height of pseudostem). Taking a measurement or range of values would be better. One comment was that quantitative data also depends on environment and won't be the same value in different collections (however that is one of the objectives of the TRCP – to determine the actual influence of environment). Perhaps add a reference variety for this one (and others) - eg balbisiana is wide. Or add pseudostem ratio – height to girth.

Finally, it would be good to have an online forum, and all email addresses put on the MusaNet website to discuss issues concerning characterization.

All comments from the discussions on the descriptors are summarized in a table in **Annex 5**.

8. Session 3 - Field Management Issues – 11 December

Ines Van de houwe (Bioversity-ITC) and John Thomas (Univ of Queensland) presented an overview of the field management guidelines, challenges and constraints and future efforts to update them. [Full presentation here.](#)

The presentation was a follow-up on the discussion of field management held in Guadeloupe in 2013. Comments on the guidelines were also drawn from TRCP partners during their presentations. Topics discussed were:

- Planting plan
- Planting material
- Climatic/environmental hazards

- Crop management practices
- Pest and disease management
- Monitoring
- Regeneration
- No back up of the collection
- Data recording and management
- Financial constraints
- Lack of manpower
- Logistics
- Vandalism

[The Regeneration Guidelines](#) were specially developed for regenerating field collections in order to improve the quality and viability of collections for conservation. They were reviewed in Guadeloupe and it was clear that they need to be updated or a new set of technical guidelines be developed for field management. There are elements missing such as tissue culture establishment. [FAO guidelines for genebank management](#) also exist but they are very generic. Feedback is sought from TRCP curators on what would be the ideal situation.

Comments from group discussion

- Plants that are not synchronized and don't acclimatize at same rate can lead to problems in the field with competition etc. Widely spacing rows could partially solve the issue of light competition.
- Guard rows –they are recommended for field collections in general and for any evaluation or characterization trial as they minimize edge effects. However, for simply maintaining a genebank they are not necessary as they increase plot size and expense. An alternative is to use strong disease-resistant cultivars along the edges.
- Guidelines need to be specific on what form the introduction takes: *in vitro*, seed or sucker.
- It was suggested to have plots arranged by genome and subgroup. Plants should also be arranged based on height.
- There is a need to develop topics such as safety duplication and its options. Clonal repository – accessions should be maintained in an insect-free screen house. Especially where *in vitro* backup is not available.

Jeff Daniells then led an informal follow-up session on considerations and tips for field management

1. Objectives of work – you need have a clear idea of what to do. This applies to the TRCP but also general collection conservation management, which may have different objectives. There is also a need to have funds to do the work. Funds and objectives must be well matched. It is recommended to start with a 'trial pre-schedule' (2-5 pages), which typically consists of: title, objectives, treatments, all the management requirement (eg pest and disease, irrigation, programme, fertilizer regime). It also needs to outline what is to be measured, why, and how. It should include proposed plan/diagram. The pre-trial schedule helps define the what, why and importantly, it provides a record. It should be a draft and be circulated for input to experts, supervisors, and others with relevant knowledge. Use the networks of curators for review – people are often very happy to help.
2. Keep a record - once the pre-trial schedule is put into place, note what changes are made, providing a valuable record what was done. In the TRCP, there is a need to have good notes of

what happened in each location, supplemented with photos. This provides data of what has been done at each site.

3. A Pacific curators training workshop was held at South Johnstone, Australia in 2008 ([report found here](#)). There were useful sessions on field bank management and characterization, photos, etc. The FAO document (link above) has general guidelines on genebank management which touch on key issues. It is not a recipe but a guide on how to think about a project. It is important to get a process in place to move forward and to get input from other people and resources.

9. Session 4 - Documentation and Information Sharing

Basic Guidelines for Taking Photos by Lavernee Gueco (BPI)

Lavernee discussed the following practical tips for taking photos, particularly for characterization and documentation purposes. [Full presentation here](#). In summary, Lavernee covered the following topics:

- Know your camera
- Check/clean camera lens
- Take high resolution photos
- Prepare the subject to be photograph
- Best time/place for shooting
- Get as close as possible to the subject
- Press shutter button halfway
- Review the photos in the LCD
- Take lots of photos at different angles
- Identify the best light source
- Shaking hands – blurred images (tripod)
- Add a ruler/scale on your images
- Add a color chart on your images
- Photos taken at specific growth stages
- More photos - more familiar with camera
- Always carry an extra battery and memory card
- Try experimenting on different settings
- Take lots of photos – select later
- Discrepancies – camera lcd vs computer monitor vs LCD projector
- Post editing software

Recommended software for free downloading from the internet: Faststone (editing), Easy thumbnails (re-sizing) and Picture Shark (for adding labels).

The new MGIS interface by Max Ruas (Bioversity)

[Full presentation here](#)

Max introduced the new MGIS and discussed its functions/applications. The new MGIS interface was put online in January 2015. It is now possible for collections to add their own molecular studies (eg TRCP SNP tree).

There is an urgent need for more partners to upload their data. The data uploading template is the same at this time. Only collections that have signed the Data Sharing Agreement (DSA) **and** have uploaded their data will be visible on the new MGIS (via logos). The DSA however **does not** oblige a collection to share material.

Max also discussed the mobile device application currently under development which was tested with curators during the workshop (see Section 11 for more details on mobile device). The application will be available mid-2015 (android only).

Comments on the new MGIS

- Cross referencing will be easier with new MGIS. All shared information needs to be acknowledged. It is important to show logos of all institutes that contributed on home page. This was done in January 2015.
- It will soon be possible to search for synonyms.
- Search by character should be developed. This would be useful for breeders looking for evaluation data (e.g. drought tolerance).
- There are many useful traits contained in MGIS. Bioversity will ask breeders if there are any other traits that they are looking for that could be added.
- Photos cannot be downloaded for copyright reasons. However, MGIS can facilitate the connection to a collection so that request can be made to the person that took the photo.

Max Ruas led a discussion on use of the mobile device

The mobile device for field characterization was piloted during this workshop. Over the week, Max took time with each curator to show them the basic functioning of the device and to get feedback. The software will be further developed in early 2015 (for CARBAP regional workshop).

Comments on the mobile device:

- Multi-plant data: what to do with the descriptors that are difficult to average? For example if there are 3 plants with 3 different colours? This requires further discussion.
- Would it be possible to add a colour chart to the mobile device?
- There is a need to include agronomic evaluation descriptors in the list of descriptors scored with the mobile application.
- The application needs an official name.

10. Session 5 - Global and regional context

Discussion and feedback on the Global Strategy

Brigitte Laliberté (Bioversity) presented an overview of the development of the *Global Strategy for the Conservation and Use of Musa Genetic Resources*. Since the Guadeloupe workshop, the Strategy has been re-structured with the help of Edmond de Langhe. It should be finalized early 2015 and published in May/June 2015. Brigitte presented the background of the strategy and the new proposed structure with a diagram depicting the different parts (see below).

[Full presentation here](#)

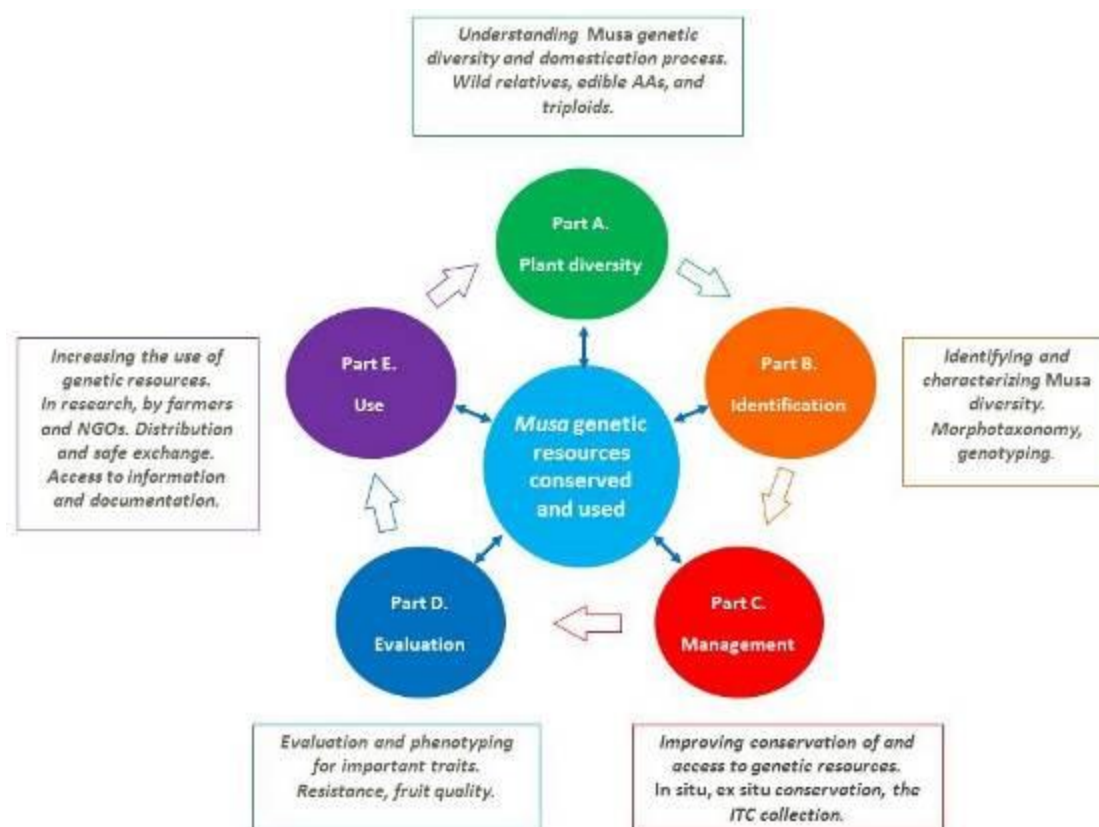


Figure 1. Diagram showing the structure of the *Global Strategy for the Conservation and Use of Musa Genetic Resources* that is currently under development.

Comments from group discussion on the Strategy

- Need to increase access to Genetic Resources (GR) for Crop Improvement (CI).
- Dealing with natural GR – need to increase use access and documentation and legal aspects as well (e.g. Treaty).
- Breeders are a major user of GR but breeding is not our business. It was questioned should pre-breeding concept be the bridge between GR and breeding? Characterization has breeding aspects included and there is not a clear barrier between the two. Role of pre-breeding and breeding should be clarified.
- The use of GR for breeders is key. Documentation of useful traits can fall under Part E. We can evaluate for two things 1) for breeding 2) for use of existing cultivars.
- Need greater participation of breeders in our group – what characters are they looking for eg dwarfism. Is what we are producing meeting the needs of our users?
- Breeding and evaluation should overlap – Genome Wide Association Studies (GWAS) based on phenotyping is related to breeding.
- Breeders are looking for new varieties – fruit quality and country specific traits. All parts can be considered by breeders.
- Need to incorporate breeding and GR work. Eg Rony Swennen (IITA) is developing a scheme on breeding and working with GR experts.
- Evaluation should include climate analogues that are being produced for most crops plants. Any studies in *Musa*? The Strategy needs to cover the regions.

- Part E Use – How to measure use? Survey is baseline looking to increase diversity in the market. Not an inventory of what is used. Assumption is making more GR available will increase use. Survey asked questions on distribution and accessibility.
- Concept of use and seeing an endpoint (market diversity). Conservation is promoted by use. We need to position ourselves for future threats in global food supply. Anything that promotes use helps conserve the resource that can be useful in the future. To do this we must have access to GR.
- As for the Strategy review – there is not enough time to work through the whole document but will be useful for a few people to dedicate some time to review small parts. Then others interested in consultation will see the mostly finalized document in Feb-April 2015. Publication to be May/June 2015.
- For discussion – is there any consideration on training of new generation of taxonomic specialists? Important topic and could fit into Part A.

11. Session 6 - Next steps and agreed workplan

The Next Steps of the TRCP by Nicolas Roux

[Full presentation here](#)

Overview on the origin and objectives of the TRCP:

1. To provide a reference for comprehensive molecular and morphological characterization (with photos) through which all collections may communicate
2. To enable GXE studies
3. To train at national and subnational levels

What have we done? Guadeloupe and Trichy have allowed us to work on the interpretation variable. However we still have the field management and environment variables to work on. After Trichy, partners should revisit their collection and apply what they have learned; this may modify their data. If they no longer have these accessions, it should be possible to find the same accession. If given the choice, always select ITC material.

The TRCP should have a teaching role, using the diversity as a teaching tool. For the moment all we have is Simmonds 1959 as a reference. The description data obtained from the first cycle with the minimum set of descriptors for all 12 collections, supported by the results of the characterizations performed during both workshops (Guadeloupe and Trichy) will also be statistically analyzed with the goal of writing a paper. Eventually, a catalogue of the TRCP accessions will be published with all data received and photographs.

The TRCP also facilitates communication among the curators. Bioversity will develop a forum to exchange photos and information on the project.

After Trichy, we should be able to draw conclusions on first results. We need to decide whether to replace OT accessions and/or select more accessions. We also need to find a solution to the AAB plantain problem (not available because of BSV).

Regional workshops will transmit work that has been done by TRCP partners to others, including CARBAP in April 2015 focusing on plantains. There will not be fine-tuning on descriptors at CARBAP but trying to achieve a better understanding and exchange of information. CARBAP workshop will also be a

start to using the mobile device for data collection in the field. Other possibilities could be NARO for EAHB, SDR for pacific plantains and fe'i bananas. The needs in the Pacific are broader – there is a TRCP connection but also wider interests. What about SE Asia and Latin America?

Discussion on next steps of the TRCP:

- Create a TRC mailing list including the partners to share information.
- Get information on which accessions each partner still have and which are missing so that they can be replaced from the ITC.
- Get a list from each partner on what is still alive and how many accessions are common and TTT.
- Ensure that standardized (as much as possible) cultural practices/field management (plot plans, irrigation schedules, etc) are applied by all partners.
- Collect information on climate parameters as stated in the TRCP guidelines. Only 1 or 2 partners have provided this so far.
- Data should be sent to Bioversity (Julie) as soon as possible and she will be in contact with each partner. If needed, Julie can send a USB key by DHL receipt so that partners can provide data and photos. For excel files of data they can be sent directly by email (preferably full data sets).
- The TRC guidelines should be clarified in terms of formats, quantities and dates by which to send data.
- Curators were asked to help with the photos on revision of min descriptors – Lavernee, Maurice, Kodjo, Durai and Brian have volunteered and Rachel will contact them end of Jan 2015 to give update on revisions.
- Decision on substitution of OTs (list below) – it was decided that there will be no substitutions at this point as it would be too difficult and we need to work on what we have. The TRC will not be identical for all people (due to OTs) but will have the same representatives from the subgroups.
- After the descriptors are finalized, partners should be re-characterize their TRC with the better understanding of some descriptors.
- Publication with statistically valid results (at least 8 collections of the 13) could take up to five years, but the results need to be published earlier. Results may not have high scientific value as there are too many different parameters to be valid. However, there are 8-9 sets of first cycle data and three additional datasets (EMBRAPA, IITA, SDR) that should be available this year. Once all the datasets are gathered, they will be statistically analyzed and, coupled with the use of the outputs of the two workshops, could be used to publish something solid.

12. Session 7 – Conclusion and workshop evaluation

In conclusion, the MusaNet-Trichy workshop achieved the following key outcomes:

- Further identification of the important constraints and practices in establishing, maintaining and managing the TRCP collection
- Better understanding of how to score many *Musa* morphological descriptors
- Agreement on the revision of the minimum illustrated descriptors (to be revised early 2015)
- Understanding of the features of the new MGIS interface
- Testing of and feedback on the mobile device (hand-held tablet) for collecting data in the field (software to be available in mid-2015)
- Exchange of knowledge on best practice field management and documentation
- Proposals on the next steps of the TRCP
- Discussion and feedback on the revised *Global Strategy for the Conservation and Use of Musa Genetic Resources* (to be published mid-2015).

The anonymous evaluations completed at the end of the workshop showed that the vast majority of participants thought the sessions were very relevant to the workshop objectives and that the time spent on each session was appropriate. Logistical arrangements were also well received and overall the participants felt that it was an excellent and productive workshop.

13. Summary of follow-up actions

The particular activities below were proposed for action following the workshop, with the responsible person in **bold type**:

1. Next steps of the *Musa* TRCP

- **Julie** to send out a form for partners to specify:
 1. deadline on when she will be using the first cycle data for analysis.
 2. which accessions are still alive
 3. which are missing in their collection
 4. cultural practices/field management (plot plans, irrigation schedules, etc)
 5. climate parameters as stated in the guidelines.
 6. whether to replace the OT accessions and/or select more accessions and inform the partners.
- **TRC Partners** to send the data as soon as possible.
- **Julie and partners** to publish the TRCP first cycle results obtained from all collections in 2015.
- **Biodiversity and the virologist Task Force led by John** to investigate a solution to the BSV problem (plantain accessions not available) after formal recommendations of the BSV workshop at the Promusa Symposium in 2014, coordinated by John Thomas.
- **Julie/Max** will develop an online forum (or email list?) with the TRC partners to exchange photos and information on the project.

2. Revision of the illustrated minimum descriptors list

- **Rachel**, relying on the expertise of **Jean-Pierre and Edmond de Langhe**, will be revising the illustrated minimum set of descriptors (31 descriptors) based on the discussions held at the

- Trichy workshop (and as documented in Annex 5). A draft revision of the descriptors will be circulated in early 2015 to the participants for testing/feedback.
- **Rachel** to ask curators to help with the photos on revision of min descriptors – Lavernee, Maurice, Kodjo, Durai and Brian have volunteered and Rachel will contact them end of Jan 2015 to give update on revisions.
 - After descriptors are finalized, **TRCP partners should re-characterize their TRCP** with the better understanding of some descriptors.
3. Organisation of regional workshops that will transmit TRCP work to others
 - **Nicolas/Bioversity and CARBAP** to organise a regional workshop to be held in Cameroon in April 2015, which will focus on characterisation and documentation of regional varieties (i.e. plantains). The mobile device for data collection in the field will be developed and tested.
 - **Bioversity** to identify other possible regional workshops, such as East Africa, Pacific, SE Asia or Latin America.
 4. Field Management Guidelines for Germplasm Collections
The existing Regeneration Guidelines need to be updated or a new set of technical guidelines be developed for field management. This will be coordinated by **Ines and John** along with the original authors **Kodjo** and Emmanuel Fondi.
 5. The development of MGIS and mobile device application
 - **Max/Bioversity** to release improved version of MGIS every three months based on comments from users.
 - **Max/Bioversity** to test the mobile device application during the CARBAP workshop in April 2015.
 - **Max/Bioversity** to release mobile device application (android version) and associated MGIS application in mid-2015.
 - To get feedback from breeders, **Max** will contact other MusaNet thematic groups (eg Evaluation thematic group) to test the new MGIS.
 6. Global Strategy for Musa Conservation and Use
A draft of the revised strategy will be circulated for consultation in March by **Brigitte** and **Rachel**. Publication is scheduled for end of June 2015.

14. Acknowledgements

The MusaNet workshop in Trichy was made possible thanks to the financial contributions from Bioversity International and the CGIAR Research Programme on Roots, Tubers and banana (RTB) and to the support from the NRCB of ICAR Trichy, Tamilnadu, India. MusaNet is grateful to the many individuals and their respective organisations for supporting the overall goal of the workshop. Special appreciation goes to the staff at Bioversity, namely Silvia Araujo de Lima for coordinating all logistics and participation and Karen Lehrer for the travel arrangements. Great appreciation goes to NRCB namely Dr M.M.Mustaffa and Dr Uma Subbaraya and their team for their excellent organisation and collaboration. MusaNet would also like to thank the members of the Programme Committee for their input into the development of the workshop coordinated and facilitated by Brigitte Laliberté. This report was compiled by Rachel Chase (Bioversity).

Annex 1. Programme of MusaNet Trichy workshop

DAY 1 SATURDAY 6 DECEMBER 2014	
09:30-10:30	OFFICIAL INAUGURATION and OPENING SESSION Venue: Hotel Femina <ul style="list-style-type: none"> • NRCB Director - <i>10 minutes</i> • NRCB Deputy Director General - <i>10 minutes</i> • NRCB Scientist - <i>10 minutes</i> • Bioversity International and MusaNet - <i>10 minutes</i> • Introduction of all participants – <i>15 minutes</i> • From Guadeloupe to now – Introduction to the Taxonomic Reference Collection Project , its objectives, activities and partners – <i>Julie Sardos – 5 minutes</i> • Workshop objectives and proposed process (programme) – <i>Brigitte Laliberté – 5 minutes</i>
10:30-11:00	Coffee/tea break at Hotel Femina
11:00-11:45	Bus transportation to the NRCB Office meeting room
12:00-13:00	SESSION 1: INTRODCUTION TO THE WORKSHOP AND WHERE WE ARE Venue: NRCB Office meeting room Objectives of the session: <ul style="list-style-type: none"> • <i>Clear understanding of the purpose of the meeting, expected outputs and participation.</i> • <i>Agreement on the proposed programme and process.</i> • <i>Understanding of key constraints and proposed solutions.</i> • <i>Common understanding where the Musa Genetic Resources community wants to be in 20 years vis a vis taxonomy and documentation.</i> • <i>Clear status of where we are with the Taxonomic Reference Collection Project, why and how it was developed and where we want to be after the workshop.</i> • <i>Assessment of progress made at each of the partners' sites.</i> • <i>Agreement on the next steps of the Taxonomic Reference Collection Project</i> <p>GENERAL DISCUSSION AND AGREEMENT ON THE PROGRAMME – <i>15 minutes</i></p> <p>Presentations from the TRCP partners on current status:</p> <ul style="list-style-type: none"> 12. Brazil – EMBRAPA - <i>5 minutes</i> 13. Burundi – IRAZ - Ferdinand Ngezahayo – <i>5 minutes</i> 14. Cameroon – CARBAP - Lucien Ibobondji Kapuku – <i>5 minutes</i> 15. Costa Rica – CORBANA - Jorge Sandoval – <i>5 minutes</i> <p>Group discussion – 10 minutes</p>
13:00-14:30	Lunch catered by Ramyas Hotel at NRCB Office meeting room
14:30-15:30	SESSION 1: INTRODCUTION TO THE WORKSHOP – <i>continued</i>

	<p>Venue: NRCB Office meeting room</p> <p>Objectives of the session:</p> <p>16. India – NRCB - Uma Subburaya – 5 minutes 17. Indonesia – ITFRI - Agus Sutanto – 5 minutes 18. Nigeria – IITA - Delphine Amah – 5 minutes 19. Philippines – BPI – Jonalyn Pabuaya – 5 minutes</p> <p>Group discussion – 10 minutes</p>
15:30-16:00	Coffee/tea break at NRCB Office meeting room
16:00-17:00	<p>20. Tahiti – SDR – Maurice Wong – 5 minutes 21. Uganda – NARO – Sedrach Muhangi – 5 minutes 22. USA – USDA/ARS – Brian Irish – 5 minutes 23. Vietnam – FAVRI – Phong Ngo Xuan – 5 minutes</p> <p>Group discussion – 10 minutes</p> <p>Additional collections participating in the workshop:</p> <p>5. Australia – Jeff Daniells – 5 minutes 6. Guadeloupe/France – CIRAD – Kodjo Tomekpe – 5 minutes 7. Malaysia – MARDI – Maimun Tahir – 5 minutes 8. Papua New Guinea – NARI – Janet Paofa – 5 minutes</p> <p>Group discussion – 10 minutes</p>
17:00-18:00	<ul style="list-style-type: none"> • Summary of Status of the Taxonomic Reference Collection Project - <i>Julie Sardos</i> – 5 minutes • Proposed next steps of the Taxonomic Reference Collection Project – <i>Nicolas Roux</i> – 10 minutes <p>Group discussion – 15 minutes</p>
18:00-18:45	Bus transportation back to Hotel Femina
19:30	Social dinner at the Hotel Ramyas (near Hotel Femina)

DAY 2 SUNDAY 7 DECEMBER 2014	
07:30-08:15	Bus transportation from Hotel Femina to NRCB Farm meeting room
08:30-13:00	<p>SESSION 2: DESCRIPTION OF THE ACCESSIONS IN THE FIELD COLLECTION – 1st round</p> <p>Venue: NRCB Farm Meeting Room:</p> <p>Description of the field exercise for the next 3 days – <i>Brigitte Laliberté</i> – 10 minutes</p> <ul style="list-style-type: none"> • Description of the process, the materials • Questions of clarification and agreement <p>FIRST ROUND OF FIELD EXERCISE – in the NRCB field collection</p> <p>Objectives of the session:</p> <ul style="list-style-type: none"> • <i>Description of accessions to share experience on the interpretation of descriptors and to review some of them and agree on most appropriate definitions.</i> • <i>Practical training and knowledge exchange on the descriptors of the accessions based on the agreed descriptors.</i> • <i>Solving the problem of different descriptions for the same cultivars of the Taxonomic Reference Collection.</i> • <i>Firm agreement understood by everybody on the minimum descriptors.</i> <p>SCORING OF DESCRIPTORS IN THE FIELD – coordinated by Jean-Pierre Horry:</p> <ol style="list-style-type: none"> Each curator scores the first of the 4 accessions for the <u>16 descriptors of the FIRST round</u> The results on the first accession are given to Max who will start entering the scores. The groups move to the next accession and curator scores the second accession for the 16 descriptors and gives the results to Max. The groups move to the next accession and curator scores the third accession for the 16 descriptors and gives the results to Max. The groups move to the next accession and curator scores the fourth accession for the 16 descriptors and gives the results to Max. Once the field scoring is completed for each of the 4 accessions and by each of the 4 groups, the next step is to discuss the results in the meeting room. <p>Note: If the field exercise is interrupted by the rain, meeting room discussion can take place after 2 of the 4 accessions have been documented.</p>
08:30-09:30	<p>Group A - Accession 1 - Red banana – AAA</p> <p>Group B - Accession 2 – Ney Poovan - AB</p> <p>Group C - Accession 3 – Jwari Bale – AAB</p> <p>Group D - Accession 4 – Namwa Khom – ABB</p>
09:30-10:30	<p>Group A - Accession 2 – Ney Poovan - AB</p> <p>Group B - Accession 3 – Jwari Bale - AAB</p> <p>Group C - Accession 4 – Namwa Khom - ABB</p> <p>Group D - Accession 1 - Red banana – AAA</p>
10:30-11:00	Coffee/tea break at the NRCB Farm meeting room

11:00-12:00	Group A - Accession 3 – Jwari Bale – AAB Group B - Accession 4 – Namwa Khom - ABB Group C - Accession 1 - Red banana – AAA Group D - Accession 2 – Ney Poovan - AB
12:00-13:00	Group A - Accession 4 – Namwa Khom - ABB + PHOTOS Group B - Accession 1 - Red banana - AAA + PHOTOS Group C - Accession 2 – Ney Poovan - AB + PHOTOS Group D - Accession 3 – Jwari Bale - AAB + PHOTOS
13:00-14:30	<i>Lunch catered by Ramyas Hotel at NRCB Office meeting room</i>
14:30-15:30	Discussion in the NRCB Office Meeting room of the results with the proposed process: <ol style="list-style-type: none"> 1. For each descriptor, the 4 graphs of the results for the 4 accessions is displayed on the video-projected screen 2. Laverne's photos for the same descriptor will be displayed next to the graph for visual reference 3. The group looks at the visual results and assess how different the scores are 4. For each accession, those who scored differently will be invited to explain why they chose a different score 5. The group will discuss the reasons and debate and move to the next accession and repeat the process for the 4 accessions 6. The group will conclude if the description/explanation of the descriptor needs to be modified/revised accordingly. Jean-Pierre will decide and Rachel will take note for the revision. 7. The next descriptor will be discussed and the process is repeated until the 16th descriptor on the first day of the field exercise 8. Discuss the key field management issues arising during the characterisation of the particular accessions.
15:30-16:00	<i>Coffee/tea break at the NRCB Office meeting room</i>
16:00-17:00	Discussion in the meeting room of the results – <i>continued</i>
17:00-19:30	<i>Proposed visit of the temple in Tanjore – Estimated drive 90 minutes – arriving around 18:30 and visit for about one hour</i>
19:30-21:00	Dinner in Tanjore
21:00-22:00	Bus transportation back to the hotel

DAY 3	MONDAY 8 DECEMBER 2014
07:30-08:15	Bus transportation from Hotel Femina to NRCB Farm meeting room
08:30-09:30	<p>SESSION 2: DESCRIPTION OF THE ACCESSIONS IN THE FIELD COLLECTION – 2nd round</p> <p><i>SECOND ROUND OF FIELD EXERCISE – in the NRCB field collection</i></p> <p>SCORING OF DESCRIPTORS IN THE FIELD – coordinated by Jean-Pierre Horry:</p> <ol style="list-style-type: none"> Each curator scores the first of the 4 accessions for the <u>11 descriptors of the SECOND round</u> The results on the first accession are given to Max who will start entering the scores. The groups move to the next accession and curator scores the second accession for the 11 descriptors and gives the results to Max. The groups move to the next accession and curator scores the third accession for the 11 descriptors and gives the results to Max. The groups move to the next accession and curator scores the fourth accession for the 11 descriptors and gives the results to Max. Once the field scoring is completed for each of the 4 accessions and by each of the 4 groups, the next step is to discuss the results in the meeting room. <p>Group A - Accession 1 - Red banana – AAA Group B - Accession 2 – Ney Poovan - AB Group C - Accession 3 – Jwari Bale – AAB Group D - Accession 4 – Namwa Khom – ABB</p>
09:30-10:30	<p>Group A - Accession 2 – Ney Poovan - AB Group B - Accession 3 – Jwari Bale - AAB Group C - Accession 4 – Namwa Khom - ABB Group D - Accession 1 - Red banana – AAA</p>
10:30-11:00	<i>Coffee/tea break at the NRCB Farm meeting room</i>
11:00-12:00	<p>Group A - Accession 3 – Jwari Bale – AAB Group B - Accession 4 – Namwa Khom - ABB Group C - Accession 1 - Red banana – AAA Group D - Accession 2 – Ney Poovan - AB</p>
12:00-13:00	<p>Group A - Accession 4 – Namwa Khom - ABB + PHOTOS Group B - Accession 1 - Red banana - AAA + PHOTOS Group C - Accession 2 – Ney Poovan - AB + PHOTOS Group D - Accession 3 – Jwari Bale - AAB + PHOTOS</p>
13:00-14:30	<i>Lunch catered by Ramyas Hotel at NRCB Office meeting room</i>
14:30-15:30	Discussion in the NRCB Office Meeting room of the results – <i>see first round process</i>
15:30-16:00	<i>Coffee/tea break at the NRCB Office meeting room</i>
16:00-17:00	Discussion in the meeting room of the results – <i>continued</i>
17:00-17:45	Bus transportation back to the Femina hotel and free evening

DAY 4	TUESDAY 9 DECEMBER 2014
07:30-08:15	Bus transportation from Hotel Femina to NRCB Farm meeting room
08:30-09:30	<p>SESSION 2: DESCRIPTION OF THE ACCESSIONS IN THE FIELD COLLECTION – 3rd round</p> <p><i>THIRD ROUND OF FIELD EXERCISE – in the NRCB field collection</i></p> <p>SCORING OF DESCRIPTORS IN THE FIELD – coordinated by Jean-Pierre Horry:</p> <ol style="list-style-type: none"> 1. Each curator scores the first of the 4 accessions for the <u>9 descriptors of the THIRD round</u> 2. The results on the first accession are given to Max who will start entering the scores. 3. The groups move to the next accession and curator scores the second accession for the 9 descriptors and gives the results to Max. 4. The groups move to the next accession and curator scores the third accession for the 9 descriptors and gives the results to Max. 5. The groups move to the next accession and curator scores the fourth accession for the 9 descriptors and gives the results to Max. 6. Once the field scoring is completed for each of the 4 accessions and by each of the 4 groups, the next step is to discuss the results in the meeting room. <p>Group A - Accession 1 - Red banana – AAA Group B - Accession 2 – Ney Poovan - AB Group C - Accession 3 – Jwari Bale – AAB Group D - Accession 4 – Namwa Khom – ABB</p>
09:30-10:30	<p>Group A - Accession 2 – Ney Poovan - AB Group B - Accession 3 – Jwari Bale - AAB Group C - Accession 4 – Namwa Khom - ABB Group D - Accession 1 - Red banana – AAA</p>
10:30-11:00	<i>Coffee/tea break at the NRCB Farm meeting room</i>
11:00-12:00	<p>Group A - Accession 3 – Jwari Bale – AAB Group B - Accession 4 – Namwa Khom - ABB Group C - Accession 1 - Red banana – AAA Group D - Accession 2 – Ney Poovan - AB</p>
12:00-13:00	<p>Group A - Accession 4 – Namwa Khom - ABB + PHOTOS Group B - Accession 1 - Red banana - AAA + PHOTOS Group C - Accession 2 – Ney Poovan - AB + PHOTOS Group D - Accession 3 – Jwari Bale - AAB + PHOTOS</p>
13:00-14:30	<i>Lunch catered by Ramyas Hotel at NRCB Office meeting room</i>
14:30-15:30	Discussion in the NRCB Office Meeting room of the results – <i>see second round process</i>
15:30-16:00	<i>Coffee/tea break at the NRCB Office meeting room</i>
16:00-17:00	Discussion in the meeting room of the results – <i>continued</i>
17:00-17:45	Bus transportation back to the Femina hotel and free evening

DAY 5 WEDNESDAY 10 DECEMBER 2014	
All day – time TBC	EXCURSION AND TOURISM DAY <ul style="list-style-type: none"> • Visit of Madurai with banana plantations, temple and shopping activities • About 2 hours drive from Hotel Femina • Lunch organised in Madurai • Return to the hotel – <i>time to be confirmed</i>
DAY 6 THURSDAY 11 DECEMBER 2014	
08:00-08:45	Bus transportation from Hotel Femina to NRCB Farm meeting room
09:00-10:30	SESSION 3: FIELD MANAGEMENT ISSUES
10:30-11:00	<i>Coffee/tea break at the NRCB Farm meeting room</i>
11:00-12:30	SESSION 4: DOCUMENTATION AND SHARING OF INFORMATION <ul style="list-style-type: none"> • Documentation and sharing of information – feedback from the field exercise and transfer of data into a database management system including photos and field data.
12:30-14:00	<i>Lunch catered by Ramyas Hotel at NRCB Office meeting room</i>
14:00-15:30	SESSION 4: DOCUMENTATION AND SHARING OF INFORMATION - <i>continued</i>
15:30-16:00	<i>Coffee/tea break at the NRCB Office meeting room</i>
16:00-17:00	SESSION 4: DOCUMENTATION AND SHARING OF INFORMATION - <i>continued</i>
17:00-17:45	Bus transportation back to the Femina hotel
	Free evening

DAY 7 FRIDAY 12 DECEMBER 2014	
08:00-08:45	Bus transportation from Hotel Femina to NRCB Farm meeting room
09:00-10:30	SESSION 5: GLOBAL AND REGIONAL CONTEXT <ul style="list-style-type: none"> • Update on the Global Strategy (focused on Taxonomy and Documentation) – <i>Brigitte Laliberté</i> • Global and regional context: looking at the priorities and actions of the Global Strategy for the Conservation and Use of <i>Musa</i> Genetic Diversity
10:30-11:00	<i>Coffee/tea break at the NRCB Farm meeting room</i>
11:00-12:30	SESSION 5: GLOBAL AND REGIONAL CONTEXT - <i>continued</i>
12:30-14:00	<i>Lunch catered by Ramyas Hotel at NRCB Office meeting room</i>
16:00-17:00	SESSION 6: NEXT STEPS AND AGREED WORKPLAN <ul style="list-style-type: none"> • Agreement on the main achievements and results of the workshop. • Clear recommendations for the TRCP • Suggestions for Regional and National workshops • Agreement on workplan – who, what, how, by when between the partners.
15:30-16:00	<i>Coffee/tea break at the NRCB Office meeting room</i>
16:00-17:00	SESSION 7: CONCLUSION AND WORKSHOP EVALUATION <p>What has been achieved and conclusion of the workshops including evaluation of what worked and what could be improved.</p> <ul style="list-style-type: none"> • Evaluation of what worked well and what could be improved. • Official closing of the meeting
17:00-17:45	Bus transportation back to the Femina hotel
	Free evening
DAY 8 SATURDAY 13 DECEMBER 2014	
	Departure of all travelling participants

Annex 2. List of participants at MusaNet Trichy workshop

No	Last name	First name	Institute	Country	Email
1.	Daniells	Jeff	Queensland DAFF	Australia	Jeff.Daniells@daff.qld.gov.au
2.	Thomas	John	Univ. of Queensland	Australia	John.Thomas@daff.qld.gov.au
3.	Van den houwe	Ines	Bioversity-ITC	Belgium	Ines.VanDenHouwe@biw.kuleuven.be
4.	Ngezahayo	Ferdinand	IRAZ	Burundi	ngezafred@yahoo.fr
5.	Lucien	Ibobondji Kapuku	CARBAP	Cameroun	ibobondji@gmail.com
6.	Sandoval	Jorge	CORBANA	Costa Rica	jsandoval@corbana.co.cr
7.	Chase	Rachel	Bioversity	France	r.chase@cgiar.org
8.	Horry	Jean-Pierre	CIRAD	France	jean-pierre.horry@cirad.fr
9.	Roux	Nicolas	Bioversity	France	n.roux@cgiar.org
10.	Ruas	Max	Bioversity	France	m.ruas@cgiar.org
11.	Sardos	Julie	Bioversity	France	j.sardos@cgiar.org
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15.	Durai	Palan	ICAR-NRCB, Trichy	India	nkpdurai@gmail.com
16.	Mahanthi	Kishor Kumar	ICAR-NRCB, Trichy	India	mkkhorti@gmail.com
17.	Menon	Rema	Kerala Ag. Univ, Kannara	India	rmenon.brs@gmail.com
18.	Saraswathi	Marimuthu Somasundaram	ICAR-NRCB, Trichy	India	saraswathimse@gmail.com
19.	Subbaraya	Uma	ICAR-NRCB, Trichy	India	umabinit@yahoo.co.in
20.	Sutanto	Agus	ITFRI	Indonesia	bagusutanto_02@yahoo.com
21.	Laliberté	Brigitte	Bioversity	Italy	Brig.lalib@gmail.com
22.	Tahir	Maimun	MARDI	Malaysia	mun@mardi.gov.my
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29.	Muhangi	Sedrach	NARO	Uganda	muhangised@yahoo.co.uk
30.	Irish	Brian	USDA-ARS	USA	Brian.Irish@ars.usda.gov
31.	Ngo Xuan	Phong	FAVRI	Vietnam	phongvqr@yahoo.com
32.	Mustaffa	Dr MM	ICAR-NRCB, Trichy	India	nrcbdirector@gmail.com directornrcb@gmail.com
33.	Kumar	N.K. Krishna	ICAR	India	ddghort@icar.org.in ddghort@gmail.com

Annex 3. Minimum set of descriptors for bananas to be studied on the 3 days of the field exercise –
developed by Jean-Pierre Horry and Edmond de Langhe

Note: yellow descriptors are those not part of the minimum list

	Descriptor	Standing plant	Leaf needs to be cut	Male bud needs to be cut	Bunch needs to be cut	Day of observation (option 1)
1	6.2.1 Pseudostem height (m)	X				1
2	6.2.5 Predominant underlying colour of the pseudostem	X				1
3	6.2.7 Sap colour	X				1
4	6.2.8 Wax on leaf sheaths	X				1
5	6.3.1 Blotches at the petiole base	X				1
6	6.3.2 Blotches colour (petiole base)	X				1
7	6.3.3 Petiole canal of the third leaf		X			1
8	6.3.4 Petiole margins	X				1
9	6.3.6 Petiole margin colour	X				1
10	6.3.7 Edge of petiole margin (rim)	X				1
11	6.3.21 Colour of midrib ventral surface	X				1
12	6.3.22 Colour of outer surface of cigar leaf	X				1
13	6.4.6 Bunch position	X				1
14	6.4.7 Bunch shape	X				1
15	6.4.12 Rachis position	X				1
16	6.4.13 Male rachis appearance	X				1
17	6.4.15 Male bud shape			X		2
18	6.4.16 Male bud size at harvest			X		2
19	6.5.1 Bract base shape			X		2
20	6.5.2 Bract apex shape – flatten bracts to determine shape			X		2
21	6.5.3 Bract imbrication			X		2
22	6.5.4 Colour of the bract external face			X		2
23	6.5.5 Colour of the bract internal face			X		2
24	6.5.12 Bract behaviour before falling	X				2
25	6.6.2 Compound tepal basic colour			X		2
26	6.6.4 Lobe colour (tip of the tepal) of compound tepal			X		2
27	6.6.13 Anther colour			X		2
28	6.4.4 Peduncle colour				X	3
29	7.10 Number of hands on the whole bunch				X	3
30	6.7.2 Number of fruits on the mid-hand of the bunch				X	3
31	6.7.3 Fruit length				X	3
32	6.7.4 Fruit shape				X	3
33	6.7.6 Fruit apex				X	3
34	6.7.7 Remains of flower relicts at fruit apex				X	3
35	6.7.8 Fruit pedicel length				X	3
36	6.7.11 Fusion of pedicels				X	3

Annex 4. Descriptors worked on each day and groups during the 3 field sessions

DAY 2 – Sunday 7 December - 16 descriptors

- Pseudostem height (m)
- 6.2.5 Predominant underlying colour of the pseudostem
- 6.2.7 Sap colour
- 6.2.8 Wax on leaf sheaths
- 6.3.1 Blotches at the petiole base
- 6.3.2 Blotches colour (petiole base)
- 6.3.3 Petiole canal of the third leaf
- 6.3.4 Petiole margins
- 6.3.6 Petiole margin colour
- 6.3.7 Edge of petiole margin (rim)
- 6.3.21 Colour of midrib ventral surface
- 6.3.22 Colour of outer surface of cigar leaf
- 6.4.6 Bunch position
- 6.4.7 Bunch shape
- 6.4.12 Rachis position

PHOTOS:

- Bunch
- Neck

Time	Accession 1 - Red banana - AAA	Accession 2 – Ney Poovan - AB	Accession 3 – Jwari Bale - AAB	Accession 4 – Namwa Khom - ABB
08:30-09:30	Group A	Group B	Group C	Group D
09:30-10:30	Group D	Group A	Group B	Group C
10:30-11:00	Coffee break	Coffee break	Coffee break	Coffee break
11:00-12:00	Group C	Group D	Group A	Group B
12:00-13:00	Group B + PHOTOS	Group C+ PHOTOS	Group D+ PHOTOS	Group A+ PHOTOS

DAY 3 – Monday 8 December - 11 descriptors

- 6.4.15 Male bud shape
- 6.4.16 Male bud size at harvest
- 6.5.1 Bract base shape
- 6.5.2 Bract apex shape – flatten bracts to determine shape
- 6.5.3 Bract imbrication
- 6.5.4 Colour of the bract external face
- 6.5.5 Colour of the bract internal face
- 6.5.12 Bract behaviour before falling
- 6.6.2 Compound tepal basic colour
- 6.6.4 Lobe colour (tip of the tepal) of compound tepal
- 6.6.13 Anther colour

PHOTOS:

- Male bud shape
- Male flower

Time	Accession 1 - Red banana - AAA	Accession 2 – Ney Poovan - AB	Accession 3 – Jwari Bale - AAB	Accession 4 – Namwa Khom - ABB
08:30-09:30	Group A	Group B	Group C	Group D
09:30-10:30	Group D	Group A	Group B	Group C
10:30-11:00	<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>
11:00-12:00	Group C	Group D	Group A	Group B
12:00-13:00	Group B + PHOTOS	Group C+ PHOTOS	Group D+ PHOTOS	Group A+ PHOTOS

DAY 4 – Tuesday 9 December - 9 descriptors

- 6.4.4 Peduncle colour
- 7.10 Number of hands on the whole bunch
- 6.7.2 Number of fruits on the mid-hand of the bunch
- 6.7.3 Fruit length
- 6.7.4 Fruit shape
- 6.7.6 Fruit apex
- 6.7.7 Remains of flower relicts at fruit apex
- 6.7.8 Fruit pedicel length
- 6.7.11 Fusion of pedicels

PHOTOS:

- Fruit shape
- Fusion of the pedicel

Time	Accession 1 - Red banana - AAA	Accession 2 – Ney Poovan - AB	Accession 3 – Jwari Bale - AAB	Accession 4 – Namwa Khom - ABB
08:30-09:30	Group A	Group B	Group C	Group D
09:30-10:30	Group D	Group A	Group B	Group C
10:30-11:00	<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>	<i>Coffee break</i>
11:00-12:00	Group C	Group D	Group A	Group B
12:00-13:00	Group B + PHOTOS	Group C+ PHOTOS	Group D+ PHOTOS	Group A+ PHOTOS

Annex 5. Table of proposed revisions to the descriptors noted during the discussions

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
6.2.1	Pseudostem height	If plant is bent, measure from the base of the plant to the peduncle, not between ground and peduncle.				Would be better to have exact value for statistical reasons (for TRCP only)? Follow up discussion with JS and NR. In the case of multiple plants per accession – take the mean height?
6.2.5	Predominant underlying colour of pseudostem	Already says outermost sheath – perhaps emphasize this? How far up the pseudostem should the measurement be taken?	Should be pseudostem colour – not blotches.		Need to add all 16 colours to chart	
6.2.7	Sap colour					JPH doubts the relevance of the milky vs watery only significance is between white and red – is this character stable enough? Remove?
6.2.8	Wax on leaf sheaths		Define leaf sheath	Would photos help? Need diagram showing where to score, on which leaf sheath		
				Add diagram in descriptor book pg 24 showing petiole/midrib/leaf		
6.3.1	Blotches at petiole base		Quantify - add percentage of blotching for each modality	Photos should be the same scale and show where to score (arrow).		Re-order the modalities to go from without to extensive
6.3.2	Blotches				Absence of colour chart a	Looking up to 3m so describing colour

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
	colour				real problem. JPH suggests reducing choices as they are too similar.	difficult.
6.3.3	Petiole canal of the third leaf					Change to Petiole margin of the 3 rd leaf <ol style="list-style-type: none"> 1. Margins spreading 2. Margins erect 3. Margins curved inward 4. Margins overlapping
						Add from descriptor book, for descriptors 6.3.4 to 6.3.8 observations on the margins and petiole wings should be made where the petiole and pseudostem meet.
6.3.4	Petiole margins	Mark area to score. Score at harvest. Use pen to see if clasping or not.	Define clasping	Photos 2,3, and 5 need to be replaced.		This measures 2 characters so should be 2 separate descriptors. Winged or not winged, clasping or not clasping.
6.3.6	Petiole margin colour	Observe where the petiole joins the pseudostem. Margin is where you can break the wings of the petiole. General colour is below the rim.	Exact area to score needs to be shown. A line on the edge where the margin starts and finishes.		All 16 colours? Less discrepancy on this one.	
6.3.7	Edge of petiole margin	Add arrow on area to score. Flowering is good stage to record (harvest is too late). Or look at younger plant.			It is actually the <u>contrast</u> not the colour that we are scoring.	Remove 'specifiy colour on answer sheet' – not necessary. But perhaps add 'age of leaf'?

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
6.3.21	Colour of midrib surface	Cut the leaf. Replace ventral with 'lower'. Take the score at the halfway pt of the leaf (middle).	Which stage of growth?		All 16 colours?	
6.3.22	Colour of outer surface of cigar leaf	If no cigar leaf, wait a couple of days.	Perhaps pigmentation is better word than colour.		Add some more green shades?	
6.4.6	Bunch position					Straightforward only variation in red banana. Not much of a problem with this one.
6.4.7	Bunch shape	Add examples of each? e.g. cultivar		Photos are not helpful enough – maybe a schematic drawing would be better. Spiral photo contradicts the text.		There should be example for plantains. A bunch can be cylindrical with curve in axis – need to resolve this.
6.4.12	Rachis position		Best stage is at harvest.			Another category needed for Fe'l banana. What about silk?
6.4.13	Rachis appearance					No problems.
6.4.15	Male bud shape		Stage of growth – says 60 days but would be better to link with event eg harvest.	Should there be 2 examples – slightly confusing. Arrows for shoulders.		Could shape and shoulders be separated? Degenerative buds would be 'other'
6.4.16	Male bud size at harvest	Use caliper if possible or remove bract and flatten it.				Should be 'male bud length'
6.5.1	Bract base shape	More explanation needed. 3 – not large shoulder but high	Define shoulder.	Diagram needs arrow.		Major discrepancy. Maybe a ratio would

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
		shoulder				help?
6.5.2	Bract apex shape			Diagrams rather than photos – focus on shape. 2 and 3 very similar. Photos need improvement – flat with arrow pointed at apex.		3 categories instead – pointed, intermediate, obtuse. Obtuse with split is rare.
6.5.3	Bract imbrication		Add imbrication and convolute in glossary.	Photos need same background.		
6.5.4	Colour of bract external face				Same discussion as in round 1 – reduce or add all colours to list. Colours should listed more in order of gradation.	
6.5.5	Colour of bract internal face				Colour options different from 6.5.4. based on obvious diversity. Add all 16 colours?	Descriptors are only for Eumusa. Not for Fe'i. but can be used for development for unique descriptors. Hard to score if we don't know the full range of possibilities. One role of TRCP?
6.5.12	Bract behavior before					Need to study this one to see how robust this one is – eg pisang awak

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
	falling					(same subgroup as N Khom) had different answer than N Khom. Should be placed earlier within sequence of descriptors.
6.6.2	Compound tepal basic colour	Should be observed in middle part of back side.	Basic is not good word. But 'main' colour.		Add red-purple to pink/pink-purple. Put all colours as categories? Should we put eg cream/ivory? General note: Add clarification on what is colour and what is pigmentation.	
6.6.4	Lobe colour of compound tepal				Need to have bright yellow on the list.	
6.6.13	Anther colour	To score at harvest	Explanation from book was not put into the min list – 'observed on the face opposite to the dehiscence split of the anther'		Missing colour – bright yellow needed. Grey also? But if only for one descriptor is it worth it?	Need better description and showing which side of the anther – side where the pollen sac is (check term). Pollen sac colour for title?

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
6.4.4	Peduncle colour	Descriptor explanation is confusing. Must score at harvest		Part of the peduncle to score needs to be shown. Add drawing.	Lack of medium green on the list led to 'other'	
7.1	Number of hands on the bunch	Should be just an exact value. Best time to count is just after flowering	Count only fully developed fruit. Needs to be defined.	Drawing of what is a hand and what is finger.		
6.7.2	Number of fruits on the mid-hand of the bunch			Mid hand needs to be defined and shown on Diagram.		Odd versus even number of hands. In case of even take the upper hand. Varieties do have gradation up or down the bunch e.g Cavendish
						<i>Comment For the following descriptors, observations should be made on the inner fruit in the middle of the hand should come after 6.7.2. but should be 'upper' fruit rather than 'inner'.</i>
6.7.3	Fruit length	Explain that should be measured at maturity. Internal arc.				Helpful to have actual value recorded as well
6.7.4	Fruit shape			Photos to be improved – standardized, same stage of		

Desc No	Desc name	Explanation	Definition of terms	Photos/diagrams	Colour chart	Additional notes
				development.		
6.7.6	Fruit apex	Record at stage of maturity		Better photos showing apex clearly. Or should we stick with the diagram from the book?		Add category to reflect plantain tip. Put back lengthily pointed – not the same a slightly bottle necked.
6.7.7	Remains of flower relicts	More explanation about which fruit should be observed.	Term - Floral or flower?	Photos to be improved. Or diagram from book.		Variation in bunches. Instructions say mid-hand inner fruit.
6.7.8	Fruit pedicel length	Add sentence: Measure from the scar on the stalk until the beginning of the fruit.				Suggestions - Can use twine to measure or make a print on paper.
6.7.11	Fusion of pedicels	Indicate whether to look from the top or bottom. Text should be (before they join the <u>rachis</u> not crown)	Quantify: Partially – 50% of the length of the pedicel	Photos need to all be from the bottom. And clearly indicated what is pedicel and what is crown. Cut through the rachis and take photo from the Also to indicate whether to look from the top or bottom.		What is the range of fusion? Inner fruit of mid hand – does not apply to this

Annex 6. List of the 34 accessions of the *Musa* Taxonomic Reference Collection

	ITC code	Accession name	Species Group	Subspecies - Subgroup/Cluster (AA)
1	ITC0766	Paliama	<i>acuminata</i>	<i>banksii</i>
2	ITC1177	Zebrina	<i>acuminata</i>	<i>zebrina</i>
3	ITC0249	Calcutta 4	<i>acuminata</i>	<i>burmannicoides</i>
4	ITC0247	Honduras	<i>balbisiana</i>	type 1
5	ITC1120	Tani	<i>balbisiana</i>	IND BAL 101
6	ITC1121	Pisang Lilin	AA	Pisang Lilin
7	ITC0653	Pisang Mas	AA	Sucrier
8	ITC0312	Pisang Jari Buaya	AA	Pisang Jari Buaya
9	ITC1187	Tomolo	AA	Cooking AA of PNG
10	ITC0654	Petite Naine	AAA	Cavendish
11	ITC1122	Gros-Michel	AAA	Gros Michel
12	ITC0575	Red Dacca	AAA	Red
13	ITC0662	Khai Thong Ruang	AAA	Ibota
14	ITC0277	Leite	AAA	Rio
15	ITC0081	Igitsiri (Intuntu)	AAA	Mutika/Lujugira (beer)
16	ITC0084	Mbwazirume	AAA	Mutika/Lujugira (cooking)
17	ITC1287	Pisang Berangan	AAA	Philippine Lacatan/Sgr. 555
18	ITC0245	Safet Velchi	ABcv	Ney Poovan
19	ITC0450	Pisang Palembang	AAB	Pisang Kelat
20	ITC0769	Figue Pomme Géante	AAB	Silk
21	ITC0587	Pisang Rajah	AAB	Pisang Raja
22	ITC0649	Foconah	AAB	Pome / Prata
23	ITC1441	Pisang Ceylan	AAB	Mysore
24	ITC1169	Mai'a popo'ulu moa	AAB	Maia Maoli/Popoulu
25	ITC0825	Uzakan	AAB	Iholena
26	ITC0519	Obubit Ntanga green mutant	AAB	Plantain- French sombre
27	ITC1325	Orishele	AAB	Plantain-False Horn
28	ITC0121	Ihitisim	AAB	Plantain-Horn
29	ITC0767	Dole	ABB	Bluggoe
30	ITC1483	Monthan	ABB	Monthan
31	ITC0361	Blue Java	ABB	Ney Mannan
32	ITC0123	Simili Radjah	ABB	Peyan
33	ITC0472	Pelipita	ABB	Pelipita
34	ITC0659	Namwa Khom	ABB	Pisang Awak

Off-type accessions that are no longer part of the TRCP

ITC0121- Ihitism

ITC0247 - Honduras

ITC0519 - Obubit Ntanga green mutant

ITC1325 - Orishele

ITC1169 - Mai'a popo'ulu moa