



## **2016 MusaNet Meeting Report**

Organised by  
Bioversity International

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## 1. Background

MusaNet held a global meeting at Bioversity International in Montpellier, France, on the 14<sup>th</sup> and 15<sup>th</sup> of October 2016. The meeting was an opportunity to 1) announce the publication of the updated Global Strategy for the Conservation and Use of *Musa* Genetic Resources, 2) to touch base on what has been achieved since the launching of MusaNet 5 years ago (March 2011) and 3) for members (including most members of the Expert Committee and representatives from the four regions and ProMusa) to discuss and agree on MusaNet priority activities for the next 5-10 years.

## 2. Summary of the Workshop Programme

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

- Welcome message and introduction of participants
- Presentation: Implementation of the 2016 Global *Musa* Strategy
- Presentations: Updates from the four regional networks and ProMusa
- Presentations: Updates from the five thematic groups
- Side meeting between the MusaNet Expert Committee and the ProMusa Steering Committee
- Plenary discussion from presentations and sharing the lessons learned in the past 5 years
- Thematic group discussions and reporting back to plenary
- Plenary discussion on various topics (MusaNet structure, meetings, communication, etc.)

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

## 3. Presentation of the 2016 Global *Musa* Strategy

To start the meeting, MusaNet coordinator Nicolas Roux made a presentation on the publication and implementation of the 2016 Global Strategy for the Conservation and Use of *Musa* Genetic Resources. His talk briefly covered the vision, mission, objectives and content of the Global Strategy, including the actions proposed for each section. He also presented the organization of MusaNet: the five thematic groups (Conservation, Diversity, Evaluation, Genomics and Information) which are in charge of implementing the priority actions set out in the Global Strategy.

Nicolas's full presentation (pdf) can be found [here](#).

## 4. Updates on the four Regional Networks and ProMusa

The second session allowed the representatives from the four regional banana networks and for ProMusa to address the following questions:

1. What has happened in your region since MusaNet was established 5 years ago?
2. What are the current needs in your region related to *Musa* GR?
3. How can these needs be addressed through MusaNet and the proposed actions laid out in the new Strategy?

### BAPNET (Banana Asia-Pacific Network)

Lavernee Gueco (UPLB, Philippines) discussed the recent activities and needs of BAPNET. There was the MusaNet meeting in Bogor, Indonesia in 2012 on the *Effective Use of Genetic Diversity for Addressing Emerging Challenges in Banana and Plantain Breeding*, and a workshop in Trichy, India, in 2014 on *Musa Germplasm: Identification Towards Optimizing Use*. There was a BAPNET meeting last month in China. The Bureau of Plant Industries (BPI) in the Philippines has also been involved in the characterization of the Taxonomic Reference Collection (TRC). Some collecting, characterization and documentation of *Musa* has also been undertaken by UPLB (Philippines). Philippines and China have been undertaking assessment of *Musa* GR for host reaction to Foc TR4. BAPNET has set up a Facebook page for better communication of its activities.

The major needs for the BAPNET region are activities to mitigate the threat of Foc TR4, including the introduction and evaluation of GCTCV varieties. Work also needs to be done on soil suppression of *Fusarium* by various methods. The needs of the region could be addressed by various means, such as further characterization of *Musa* genetic resources, full documentation of the available diversity (including uploading information to MGIS), evaluation for important traits, improved germplasm exchange through the ITC and testing the top varieties in the region in different locations.

Lavernee's full presentation (pdf) can be found [here](#).

### BARNESA (Banana Research Network for Eastern and Southern Africa)

Robooni Tumuhimbise from NARO, Uganda, represented BARNESA. The priorities in the region in the last several years have revolved around enhancing regional production, marketing and fruit nutritional quality for increased income and health in ESA, strengthening capacity building for research and development, enhancing germplasm conservation and exchange, integration and validation of plant and soil health enhancing strategies, information collection analysis and dissemination to stakeholders, analysis and harmonization of cross border policies and enhancing technology delivery to stakeholders. They have experienced many constraints due to disease (BXW, BBTv and Foc TR4 (in Mozambique)) and several regional projects have focused on disease management and prevention. NARO has participated in the Field Verification of ITC accessions and the TRC project. They also established, maintain and characterize *Musa* germplasm as a national collection.

The needs for the BARNESA region include supportive policies at national levels and regional levels for germplasm exchange and to guide resources mobilization, capacity building in characterization of germplasm, collection of more diverse *Musa* germplasm, adequate resources, financial support to maintain existing *Musa* collections, and building confidence in regional germplasm scientists in co-authorship of shared data/info.

Robooni's full presentation (pdf) can be found [here](#).

### Innovate Plantain

Gérard Ngoh Newilah from CARBAP is the MusaNet representative for Innovate Plantain. They had a platform meeting in November 2013 in Cote d'Ivoire, where many plans were made to advance regional

activities but there has been very little progress since then. Another meeting was held back to back with the MusaNet workshop at CARBAP in May of 2015, where they developed descriptors for plantains and tested MusaTab in the field. In this meeting they reviewed the activities and made recommendations; however no funds have been found to implement these recommendations. One activity was the creation and management of an electronic forum on bananas and plantains in WCA and creation of an electronic bulletin that is circulated by email. Three regional projects have been established: FSTP1, CORAF Plantain and FSTP2. CARBAP is working with Bioversity on the creation of a collection catalogue as well.

The current needs in WSA related to *Musa* genetic resources are to share clean planting material, prevent disease (BBTV, etc), continue plantain prospection and secure sustainable funds for conservation and management of the CARBAP reference collection. They feel the need more implication of Bioversity and partners in regional coordination. There is also a need to meet and discuss specific topics and set priorities. Post-harvest data collection is a subject that is underfunded and needs more focus.

Gérard's full presentation (pdf) can be found [here](#).

#### MusaLAC (Banana Research and Development Network for Latin America)

The update for MusaLAC was presented by Charles Staver and Sirena Montalvo of Bioversity. In the past 5 years, many LAC collections participated in the Global *Musa* Survey which resulted in information on the national collections. USDA in Puerto Rico collaborated on the Field Verification of ITC accessions, the TRC project and the IMTP trials. There has been a project in Peru on Iholena and Maoli characterization. The recent *Musa* Usage Survey, which aims to document the use of materials received from ITC, has revealed impact paths that are being followed up for several countries by Sirena based at USDA. It is intended to expand this survey to all 4 regions. Suggestions from LAC to MusaNet include strengthening links between region and MusaNet, building a more complete agenda and activities on genetic resources of bananas in the region, establishing a focal point with better access to communication tools and increasing documentation in Spanish.

As a further note, the MusaLAC representative for MusaNet, Marie-Soleil Turmel, recently left her post, so a MusaLAC representative for the EC will need to be found in the coming months.

Charles and Sirena's full presentation (pdf) can be found [here](#).

#### ProMusa

Anne Vezina of Bioversity presented an update on ProMusa entitled *Banana knowledge sharing on the ProMusa website*. She spoke about the cultivar pages on ProMusa with links to MGIS, the cultivar checklist that has nearly 7,000 entries, and the popular NARITA hybrids pages. The Musapedia banana knowledge compendium features news on project results and first reports with the occasional feature and opinion piece. The blog, which covers a variety of subjects, is often written by guests, such as for the MusaNet TRC workshop in 2013. Points of mutual interest between ProMusa and MusaNet include the classification of sections (2 according to Markku – but there are 4 in the Strategy) and subgroups, which are still not clear, and discussions on pests and diseases. One of the most popular pages on ProMusa is

on banana plant morphology (plant, seed and leaf). ProMusa recently became more mobile device friendly, as a third of visits to the site are from mobile phones. In general, visits are on the rise: from Jan-Sept 2016 there are already 40% more visits than during the same period last year and it could reach 150,000 visits by the end of the year.

Anne's full presentation (pdf) can be found [here](#).

#### Discussion on regional network presentations

Inge asked if there was an opportunity to expand the TR4 trials in the BAPNET region to the rest of the cultivars in all regions (e.g. EHAB and plantains). Lavernee confirmed that yes it is possible, but the problem is that the material often does not look the same as in its original environment. However efforts toward this should be made.

Pat commented that there is not enough attention to post-harvest characters in the descriptors. 50% of the banana crop can be lost post-harvest. It is a critical aspect that needs to be addressed and we need more genetics work on post-harvest characters.

## **5. Updates on the five Thematic Groups**

### Conservation Thematic Group

John Thomas, Chair, presented the update on the CTG.

The CTG has as its objectives to 1) strengthen the capacity of partners for the cost-effective long-term conservation and management of germplasm collections and to 2) facilitate safe access to useful *Musa* genetic resources in improvement programmes and by other users. The overall aim is for the entire *Musa* gene pool to be conserved in perpetuity by a network of well-managed and rationalized collections and the global system for the safe exchange of germplasm to be strengthened.

Over the past 5 years, activities included cryopreservation, gap filling, MGIS data (at ITC), a protocol for banana seed conservation developed (Bioversity/KULeuven), revised Technical guidelines for the safe movement of *Musa* germplasm.

In collaboration with other thematic groups, the CTG accomplished the global survey of *Musa* ex situ collections (2012-2015), capacity building for improved management of field collections (MusaNet workshops involving TRC partners) and the Global *Musa* Strategy.

A major milestone was the acceptance of a proposal to allow eBSV material to be distributed under certain conditions. The implementation of the strategy will increase the percentage of the ITC collection available for distribution from 60% to 90% by 2020.

One of the recommendations for future activities is to update the 2008 Regeneration Guidelines and develop a new set of technical guidelines for the full range of activities in field management, including wild species, different ecologies, and tissue culture establishment.

Other important CTG-led priorities include:

- Improved effective management of collections through development of more comprehensive field management and *in vitro* guidelines
- Population genetics in support of seed banking initiative
- Comprehensive assessment of the content of collections
- Increased awareness for need of high health status germplasm (disease fact sheets)
- Increased access and use of ITC collection (proactive distribution, identification of sub-sets expressing desirable traits for users)
- Promotion of global network with specific responsibilities for conservation of *Musa* genepool (gap filling, safety back-up including cryopreservation at ITC, multi-location core collection)
- Improved efficiency of virus indexing protocols
- Increased capacity for virus indexing in national and regional centres
- Increased capacity for producing clean materials for exchange
- Revision of CTG membership

John's full presentation (pdf) can be found [here](#).

#### Diversity Thematic Group

Julie Sardos, Co-chair, presented the update of the DTG.

In terms of activities in the first 5 years of MusaNet, there was the MusaNet DTG/Trust meeting in Bogor in 2012, which focused on the TRUST initiative on CWR. In the meeting, breeders and diversity experts discussed and prioritized areas for germplasm collection. This led shortly thereafter (2012/2013) to the Triangle collecting missions of Indonesia, where Agus, Jeff and others collected 30 diploids (including wild species), 7 triploids and putatively 1 tetraploid. Another major activity was the Taxonomy Reference Collection (TRC), containing 34 accessions representing the whole *Musa* diversity that were planted at 12 field collections. There were two workshops involving the TRC curators, in 2013 in Guadeloupe and 2014 in India. Several TRC catalogues are being developed; the first was published by USDA this year and another is under development at UPLB. In 2015 in Cameroon, the DTG led the first MusaNet regional workshop on characterization and documentation for the WCA region. Outputs were a revised minimum descriptor list for *Musa* and a new minimum descriptor list for Plantains, as well as a review of the status of the WCA collections. MusaTab and MGIS were also discussed and tested.

Upcoming actions for the DTG include:

- the collecting mission in Bougainville (Julie and Gabe will be leaving for this just after the meeting, on 16 October 2016)
- the ESA regional workshop on EAHBs in Uganda from 12-16 December 2016
- the release of *Musa.ID* identification software, which has been updated from its original version

Future priorities for the DTG include:

- Fully assess the diversity of *M. acuminata* and *M. balbisiana*
- Refine the taxonomy of triploid cultivars

- Revise the taxonomy of diploid cultivars
- Explore AB diversity
- Assess which of the descriptors are robust across environments
- Identify subgroup-specific descriptors
- Facilitate the identification of cultivars – wild types
- Optimize use of past work with SSR
- Molecularly differentiate cultivars within subgroups
- Develop and publish catalogues on current diversity held in collections

Julie's full presentation (pdf) can be found [here](#).

### Evaluation Thematic Group

Miguel Dita, Chair, presented the update for the ETG.

Since the inception of MusaNet, the ETG has had fewer projects than other groups but has been involved in various aspects of germplasm evaluation. The 2012 Bogor meeting identified the major production constraints, with Fusarium wilt, BBTV and Sigatoka being the top three, but others such as drought and cold tolerance having an important effect. The 2013 RTB priority setting survey revealed the priorities by region, with again disease being the most significant constraint.

The ETG relies on data generation and this is an area that needs improvement. A comprehensive survey of available information is a prerequisite to prioritizing traits of interest. Then, analysis of this data needs to be undertaken. Evaluation protocols for the main traits should be identified so that they can be revised or newly developed. A project of global importance should be identified to secure adequate funding, and projects within hot spots of poverty.

The priorities for the next 5-10 years are thus to define working groups and workgroup leaders, define traits and deadlines [work plan] and agree on the ETG strategy. Focus will be on the constraints of BLSD, YLSD, Freckle, Fusarium wilt and drought and cold tolerance.

Miguel's full presentation (pdf) can be found [here](#).

### Genomics Thematic Group

Jaroslav Doležal gave the update on behalf of and with input from the chair (Angelique) and co-chair (Rob) of the GTG.

As the GTG only came into being a year ago, past activities are mostly those carried out by the Global *Musa* Genetics Consortium (GMGC). The GMGC has provided a valuable forum for interactions of *Musa* researchers during the last decade. Its first major goal, the production of a reference sequence for banana genome, was achieved in 2012. The aim of the GMGC in the 2002 Strategy was 'to apply genomics to the sustainable improvement of *Musa*'. This aim is still valid and is applicable to the Genomic Thematic Group within MusaNet.

The reference genome has led to many activities in the past 5 years, such as the creation of the Banana Genome Hub, an improved reference sequence, a draft B genome sequence, whole genome re-



sequencing. The markers used for assessment of diversity, parental selection and linkage map saturation are SSRs, DArTs and others. GWAS has been carried out on a panel of 105 accessions and identified regions of linked to parthenocarpy and sterility. Transcriptomics is used for gene discovery, expression analysis and marker development, for traits such as disease stress and drought tolerance. GTG members share knowledge at the annual PAG conference, where they have a banana workshop and GTG evening meeting. Major outputs from GTG/GMGC have been published in scientific papers and made available through the Musa genome hub <http://banana-genome-hub.southgreen.fr/>

Future needs of the GTG include:

- Provide a platform of information and interaction for the *Musa* genomics community, for discussing, coordinating and prioritizing resource development
- Embrace the genomics of genebanks and aggregate omics data generated from germplasm material held in collections
- Improve and complete the *Musa* reference sequence
- Characterize *Musa* germplasm genetic diversity through re-sequencing
- Characterize chromosome segregation
- Identify chromosome regions or genes involved in important agricultural traits (pathogen and pest resistances, drought tolerance, fruit quality/ripening/post-harvest, parthenocarpy,...) and develop molecular markers for breeding
- Characterize gene expression globally, improve gene annotation and elucidate gene function
- Assess the role of transposable element insertion/deletion and epigenetics in somaclonal variation
- Share information and knowledge

Jaroslav's full presentation (pdf) can be found [here](#).

### Information Thematic Group

Mathieu Rouard, chair, presented an update on the ITG.

The ITG currently has 21 members from various institutes and a wide range of interests. The Global *Musa* Survey in 2012 asked questions related to the information management. It highlighted that almost half of collections are managing data with excel, some on paper and other with a mix of the spreadsheet, database and only 10% are using databases, so clearly there was a need for thematic group on Information. At the same time, collections are putting a lot of effort to document their material. Examples are the one recently released by USDA and the one from UPLB that will be released soon. In order to facilitate and formalize data exchange within MusaNet members, it was agreed to put in place a Data Sharing Agreement (DSA), a bilateral document between collections and Bioversity. As of today, 20 collections have signed the document and 12 collections have provided data. We also worked on the development of a mobile application for field characterization that has been tested at several workshops. We got a lot of feedback from MusaNet members and the name, MusaTab, was chosen by the ITG. Another big achievement has been the release of a brand new MGIS website. It was necessary to adopt technologies commonly in bioinformatics (open source) so the developments are now much easier and cost effective. A lot of attention was also given to the user-friendliness of the website

interface in addition to data curation for passport data and regular data enrichment with pictures. ITG has been very much involved in testing the prototypes and provided very useful feedback.

Some planned activities of the ITG are numerous, but a few important ones are:

- Dissemination of MusaTab (i.e. at the MusaNet Uganda workshop to take place at NARO Field collection in Mbarara, Uganda in December 2016)
- Increased number of documented collections on MGIS
- Strengthen interoperability between banana Information Systems (API (i.e. BrAPI), Genotyping module, Crop Ontology)
- Geographical organization of the *in situ* diversity in *Musa* – an idea introduced by Christophe Jenny (see discussion Section 7 below for more details).

Mathieu's full presentation (pdf) can be found [here](#).

#### Discussion on TG presentations

Miguel said that there is difficulty achieving agreements with breeders. There is a disconnection in the community. More IMTP trials are needed to generate new data. We also need to develop and publish more protocols.

Inge thinks that MusaNet should focus on activities where a network brings a significant advantage and that data generation is best done at the level of an institute or project. Working on protocol compilation and sharing is where the network becomes important.

Charles asked if the iNaturalist application could be used during the PNG collecting mission. Julie said this depends on internet connection, which may be poor.

Inge commented on how the Musapedia pages are more focused on cultivars, whereas catalogues and MGIS have more accession-level information. How can we compile this accession level info to feed into the cultivar pages? For example, how can we describe a subgroup Pisang Awak, taking the data from all the various collections? Max replied that we could link a ProMusa page to a representative accession or we could look at all the data and try to bring it all together to help the description of cultivar. Inge said that Angela Kepler did something similar in her book and that there is opportunity for collaboration on this. Christophe said that *Musa.ID* contains an aggregation of all data for a subgroup and there is an identity within subgroup level already. It will be available by end of the year and the next step is to validate it by users. It is important to use MusaTab as it helps feed data to *Musa.ID*. The more samples you have, the higher resolution of analysis. Nicolas said that often we can input genotype and phenotype data, for example during collecting missions.

Pat said it is obvious that GTG (from its origin as GMGC) is somewhat different than other groups in that scientific publications/papers have been prioritized as the measurable outputs (often to meet the funder's requirements). This is the GTG's first meeting integrated into MusaNet. GTG wants to see that information from genomics is used by other groups and has links to impact pathways and outcomes (not 'just' scientific publications). It is cross-cutting like the ITG. Nicolas said that tomorrow we will discuss just this topic. We don't want to go into silos; we need to work across TGs. We will first look at TG

actions but then move onto activities working with others. The Strategy summary booklet is for the *Musa* community to approach stakeholders and policy makers. MusaNet is all of us; we are all responsible in developing projects and raising funds to have them implemented.

## 6. MusaNet EC and ProMusa SC meeting

For the last session on Friday, the members of the MusaNet Expert Committee and the ProMusa Steering Committee came together for an hour-long discussion. Two main questions were posed: 1) how can MusaNet and ProMusa complement each other and 2) what specific activities can they work on together?

First, the roles of MusaNet and ProMusa were discussed as many people do not see a clear difference between them. MusaNet is network for Global *Musa* genetic resources with five Thematic Groups and representation from four regional networks and ProMusa. Its main mandate is to develop and implement the Global *Musa* Strategy. ProMusa is a knowledge sharing platform covering all aspects of *Musa*, with three working groups: crop production, crop protection and crop improvement, as well as regional representatives and a MusaNet representative.

ProMusa's primary goal is sharing and linking knowledge for a wide audience, to help people find information about *Musa* on the web. ProMusa is also closer to the banana value chain and production. MusaNet on the other hand involves specialists and aims to develop projects and secure funding. It is more genetic resources related, but has some overlap with ProMusa on evaluation and breeding (via the ETG). The MusaNet website is for its members - all publications put on the site are based on MusaLit for the community to access. ProMusa's website is for the public.

It was decided that these distinct differences need to be clearly spelt out on both websites. ProMusa may reconsider the structure of their working groups so that there is more of a general focus.

There are many actions for collaboration. Updating disease factsheets, making Musapedia pages for the tools used by DTG and ITG (*MusaTab*, *Musa.ID*), and on GTG, ITC and TRC, for example. Anyone can add to these pages and include links. In this way MusaNet can make its results/tools known to the community.

## 7. Saturday morning discussion

Christophe Jenny began the day with a presentation entitled *Using citizen science to improve our knowledge of the organization of in situ geographical diversity in Musa*.

The goals are:

- To bring elements to understand and decipher the history of the diffusion of *Musa*, for instance its diffusion in Africa from SE Asia.
- To obtain a precise picture of the natural geographical diversity of *Musa*
  - To foresee the evolution of cultivating areas in connection with expected climate changes
  - To identify collecting gaps, endangered diversity areas

- Match the Global *Musa* Strategy document:
  - Map the distribution of CWRs and landraces in primary and secondary centers of diversity (p. 93) - Section 8.3 *In situ and on-farm conservation* of the Global Strategy.

How will we do it?

- Constitution of a geo-located knowledge base of the *in situ* repartition of wild and cultivated bananas
- Focus on landraces growing in close to natural ecological context (in opposition to mass production with high and recent introduction of exogenous genotypes)
- Recruit local observers (easier than setting up expensive collecting missions) and work remotely
- Develop a mobile app & website, or
- Use existing one (with minor adjustments required): example is iNaturalist

In conclusion, Citizen Science is the easiest and most reliable way to enrich our knowledge of the natural *in situ* diversity in *Musa*. iNaturalist (<http://www.inaturalist.org/>) is one of the best tools already identified so far to record and share data. It is lighter than developing our own app and website from scratch however some supplementary developments still may be needed to make it fit our specific needs and goals. How and where sharing gathered data will be done still need to be studied and decided.

For this to work, we need to rely on a first circle of interested volunteers:

- Living in the areas of natural growth of *Musa*
- With taxonomical skills about *Musa*
- Willing to contribute to a worldwide wealth initiative about biodiversity knowledge and conservation
- Already organized in a scientific network? = MusaNet

These people could be the kernels of local initiatives dealing with specific questions, focus and expertise on local landraces etc. Further interactions will be required to move ahead with this initiative.

An iNaturalist project has already been created for banana and can be accessed [here](#).

Christophe's full presentation (pdf) can be found [here](#).

### Discussion

Jeff said that during collection missions there is so much land to cover that we cannot dismiss the importance of the enthusiasm of amateurs. How to get info out? There are market mavens obsessed about finding new products. Christophe stated that for the climate change project, we would need locations of subgroups and where they can grow. Mathieu liked the way iNaturalist deals with the copyright, in that you can decide what the licence will be for the photos. What about the archive nature of the data? For example the California Academy of Sciences – what happens if they don't support iNaturalist in the long term? Google is removing images from google earth. Christophe stressed that we

need to back up everything uploaded to the website. You can also export from the website. It can take 5 years to develop such a system and everyone agreed that it is good to use something pre-built. Nicolas asked what about ETG? Can we do the same for pest and disease? Christophe is not sure about that. If there are too many questions requiring photos, people will not do it. Matthew said it is also a biosecurity issue, e.g. posts about BLS disease in Australia could cause panic. Christophe reiterated that the main idea is to mobilize people around a project. Regarding copyright, Pat is against the 'non-commercial' part of the CC-by-NC licence and thinks CC-BY is more appropriate for the Global Strategy. Rachel will contact Nora in communications about this.

## 8. Lessons learned in the past 5 years

For this session, all participants were asked to write on a post-it note what they think went well in MusaNet over the last 5 years and what could be improved.

### What went well

#### Communication

- Monthly meetings
- The website
- Good website, easy to find information
- Regular exchanges in the expert committee
- Good communication within the expert committee

#### Collecting

- International collaboration for collecting missions
- The workshop and collecting missions went well

#### Structure/general

- Great progress in most of the thematic groups
- Thematic group substructure
- MusaNet is a good network
- The network is excellent in bringing people and information together
- MusaNet was able to put together people that are experts in their own fields

#### Outputs

- Impressive array of works presented yesterday and collaborators/relationships developed
- Regular workshops training with curators
- We have a Strategy based on member contribution which has been updated
- Improvement in sharing of morphological characterization methods
- Tangible outputs: B genome and germplasm distribution and Strategy
- Structure and output delivery by each thematic group
- Delivery of outputs by the different thematic groups

- Revival of *Musa* research community raising awareness of *Musa* research
- Progress on *Musa* genome

### What could be improved

#### Communication

- Information flow to MusaNet members particular in the first 3-4 years
- Thematic group communication and collaboration
- How to engage the *Musa* community – not forcing
- Cross talks among thematic groups
- Interaction between members of each thematic group
- Planning a half term meeting (every 2.5 years)
- Greater interaction and discussion within groups

#### Funding/projects

- Lack of a federative funded project
- Fund mobilization for more project implementation
- Not enough efforts to secure funding for group research activities
- There should be more non-Bioversity initiatives from the group members
- Gathering people around one/few big projects to get funding instead of going on our own
- More collaboration on joint funding applications

#### Collecting

- Collecting missions

#### Structure/general

- More concise strategies (for TGs)
- Improve connection with regional networks.
- Leadership of regional networks
- Refocus on the main issues

#### Outputs

- More accessions should be collected and evaluated in field conditions
- International testing standards
- In situ conservation of wild species
- Better classification of *Musa* (inside groups and sub-groups)
- Phenotyping information/biotic and abiotic stress
- Global improvement of variety evaluation
- Screening of wild relatives for traits of interest.

## Discussion

Julie stated that we need other means of funding besides via Bioversity. There are the Gates BBTV project and the FAO TR4 initiative. What is the MusaNet connection to that? Nicolas said that often when we put Bioversity International, the funds are coming from RTB or GBs CRP. (e.g. Global *Musa* Strategy). We need to look for funding in FAO, EU, etc. Jeff stated that Bioversity could look for other funding? There are other projects that cross over in what we are doing, there is a lot happening and we could be involved. Nicolas agreed and said that this is more of what we call bilateral projects. Jeff said we need some representation to FAO to have an effect on what we can bring to the table. Miguel remarked that as soon as TR4 landed in Africa, FAO decided to act. MusaNet and ProMusa can capitalize more on what we are doing, for example by connecting to the Chinese botanical garden – they have a paper with Miguel on evaluation, but it is not reported here. Nicolas said this was an initiative with CAAS that is still ongoing and it could be captured for MusaNet communication. Miguel said it is not always clear that MusaNet is not research organization but a network.

Inge asked when other organizations put projects into MusaNet, what are the criteria for a project to get the MusaNet label? For example, CIRAD is collaborating with University of QLD? MusaNet is a forum where it can be advertised but there is a lot happening outside of Bioversity. Miguel said that MusaLAC is organized by Bioversity, we need to report activities, but the important thing is that it is happening. RTB rules are to put acknowledgement to RTB in papers, but sometimes the acknowledgement is longer than the paper. Mathieu also finds this problematic. Maybe we should see it like the Sustainable Development Goals – in that you want to reach a certain goal, for example, by targeting one of the actions in the Strategy.

Francoise said that a strength of the GTG is that they meet each year in PAG so there is communication at the workshop and evening meeting. For ETG is there something every year, where you can have a banana workshop to reinforce the TG? How about DTG? We need to make our work more visible. Inge said there is the ISHS congress for ETG. Each time we have a ProMusa meeting we can link to MusaNet. Andrew remarked that there is the International Plant Pathology meeting in Boston in 2018 – could we have a banana workshop? What about for Breeding?

Is there a good link between regional networks and TGs? Miguel says no, in case of MusaLAC this needs to be improved. Charles asked is it a unique problem for MusaLAC? Do we have any statistics? Gerard said that in WCA, communication is through emails and they have not had an Innovate Plantain meeting for years. He makes a short summary of work and distributes to network. Jeff stated that we need more from regional representatives in the EC. They should report what is happening within the regions - we don't understand for example what is going on with TR4. Thierry said that in WCA there are 4 countries, Cameroon, Nigeria, DRC, and Cote d'Ivoire, who are active in the network while the other countries are not as active. In MusaLAC, it is mainly Brazil, Colombia, Costa Rica and Peru.

## **9. Thematic Group priority actions for the next 5-10 years**

For the Saturday afternoon session, each TG (except for ITG, which was divided among all groups) broke into small discussion groups, in which they addressed the following key points:

1. Screen and prioritize actions from the Strategy to agree on a TG work plan for the next 5-10 years.
2. Brainstorm potential projects and sources of funding for activities within the TG.
3. What would these projects require in terms of support from other TGs?
4. What projects could involve all TGs?



## TG discussions – as reported in Plenary

### Conservation Thematic Group

Max Ruas presented the table of priorities that were discussed for the CTG.

Objective	Proposed Actions	Top Priority
<b><i>In situ</i> conservation</b>		
Improve effective management of ex situ collections and enhancement of services	<ul style="list-style-type: none"> <li>• Create a platform for effective information exchange and sharing of methods, techniques and experiences between collection managers not specific to our group</li> <li>• Develop field management guidelines including specific information on groups such as wild species management and ecological regions</li> <li>• Develop a new set of technical guidelines for the full range of activities in lab management including tissue culture establishment</li> </ul>	<p>NO</p> <p>YES</p> <p>YES</p> <p>+ Work together with the DTG</p>
Identify and set up a global network of partners with specific responsibilities for conservation of the <i>Musa</i> gene pool	<ul style="list-style-type: none"> <li>• Strengthen the global network of partners with specific responsibilities for conservation of the <i>Musa</i> gene pool including the safety duplication.</li> <li>• Improve characterization (phenotyping and genotyping) of germplasm in all collections to allow curators to make decisions on rationalization of accessions.</li> <li>• Introduce missing diversity to ensure full coverage at national, regional and global level.</li> <li>• Set up more locations of international field planting or in vitro culture conservation, safer for germplasm duplication and effective for <i>Musa</i> distribution.</li> <li>• Rationalisation of national collections based on improved characterization</li> </ul>	<p>2, 3- strong linkage with other Group DTG and 3 outside from CTG to be shared with ETG</p> <p>2 &amp; 5 merged</p>

Objective	Proposed Actions	Top Priority
	(phenotyping and genotyping) of germplasm.	
Identify and set up a global core collection of <i>Musa</i> biodiversity in several designated sites for in perpetuity conservation	<ul style="list-style-type: none"> <li>• Establishment of a global reference field collection (TRC) integrating subsets that represent specific parts of the diversity held by different collections.</li> <li>• Establish partnership agreements with regional and national field collections for complementary responsibility sharing to preserve global core accessions</li> <li>• Global core accessions duplicated in vitro and in cryopreservation at the ITC.</li> <li>• Targeted collecting and duplication of unique accessions from national collections, increasing the coverage of the known <i>Musa</i> diversity in the ITC collection</li> </ul>	<p>Long Term objective</p> <p>How it could be integrated with ITC mission, need review for better formulation.</p> <p>3 - in top priority</p>
Increase access and targeted use of the ITC collection	<ul style="list-style-type: none"> <li>• Link between ITC and MGIS database to create feedback mechanism for information on the ITC collection germplasm exchange and use</li> <li>• Promote the use of the on-line ordering tool running on MGIS for the global ITC collection. There is a new MGIS website with more user friendly functions for ordering accessions.</li> <li>• Field verification, morpho-taxonomical characterization , flow cytometric ploidy determination and genotyping of the ITC collection to ensure the genetic integrity and improve the documentation status of conserved accessions</li> <li>• Identification of accession ‘subsets’ expressing certain desirable traits of interest for potential user groups</li> <li>• ITC to proactively distribute germplasm to collections with specific interests for specific regions, and indicate these as subsets in MGIS</li> </ul>	<p>1- we should invest on it (MRU make our users confident with us to share Info) surveys, follow up and perform analysis</p> <p>3 - on going to be evaluated</p> <p>4 - For ETG to work on the solution and ITG to provide technical solution</p>

Objective	Proposed Actions	Top Priority
Increase awareness of the need for high health status germplasm	<ul style="list-style-type: none"> <li>• Update the Technical Guidelines for the Safe Movement of <i>Musa</i> Germplasm to incorporate newly discovered viruses and the latest indexing methods.</li> <li>• Update disease Factsheets</li> </ul>	<p>Done</p> <p>Factsheet -&gt; Promusa</p>
Improve the efficiency of virus indexing protocols	<ul style="list-style-type: none"> <li>• Review current virus indexing protocols to highlight deficiencies and inefficiencies</li> </ul>	<p>Ongoing (in perpetuity)</p> <p>add sanitation protocol</p>
Seek a consensus on the risks of distribution of integrated, activable BSV in germplasm	<ul style="list-style-type: none"> <li>• Bioversity to develop a position on the movement of germplasm with integrated, activable BSV based on the relative risks and advantages to the recipient country, and the responsibility of the germplasm supplier</li> </ul>	<p>Done</p>
Secure the long-term conservation of the entire ITC collection	<ul style="list-style-type: none"> <li>• Cryopreserve the entire ITC collection</li> </ul>	<p>Repetition</p>
Expand long term conservation capabilities by seed banking	<ul style="list-style-type: none"> <li>• Explore the feasibility of seed conservation for preserving the wider wild diversity as complementary approach</li> <li>• Assess the diversity within/between populations, to make decisions on how many seeds to collect so that they can be conserved and distributed.</li> <li>• Develop a Global <i>Musa</i> Seed Bank to conserve and distribute seeds under the ITPGRFA</li> </ul>	<p>On going</p> <p>2- long term priority</p>

Objective	Proposed Actions		Top Priority
<i>In situ and on farm conservation</i>			
	In situ	On farm	
Map the distribution of CWRs and landraces in primary and secondary centers of diversity (potential sites - South East Asia (India) and the Pacific Islands)	<ul style="list-style-type: none"> <li>• Establish and map the distribution of all taxa at all scales</li> <li>• Determine the threatened status of each taxon and red listing of highly endangered CWRs</li> <li>• Collecting and sharing traditional knowledge and uses linked to all wild <i>Musa</i> species</li> </ul>	<ul style="list-style-type: none"> <li>• Build regional databases of <i>Musa</i> landraces (with characterisation and evaluation data, indigenous knowledge, digital photo databases, and geo-referenced locations)</li> <li>• Develop distribution maps of landraces for analysis of geographic patterns</li> <li>• Identify geographic specific traits, i.e. traits which are specific to given areas (and their environmental constraints)</li> <li>• Establish and map the distribution of <i>Musa</i> landraces and farmers varieties</li> <li>• Determine the conservation status of all landraces and red listing those highly endangered</li> </ul>	<p>Some already addressed</p> <p>Too ambitious for now</p> <p>Need a re evaluation</p>
Establish institutional frameworks for the conservation of CWR and <i>Musa</i> landraces	<ul style="list-style-type: none"> <li>• Develop national and International Agreements to allow for efficient and permanent safeguard of CWRs in protected areas</li> <li>• Strengthen linkages with National and</li> </ul>	<ul style="list-style-type: none"> <li>• Develop national and International Agreements to allow for efficient and permanent safeguard of landraces in primary and secondary centres.</li> <li>• Facilitate national, regional and international networks to enhance local capacity for</li> </ul>	

Objective	Proposed Actions		Top Priority
	International <i>Musa</i> Research conservation networks <ul style="list-style-type: none"> <li>• Develop a territorial monitoring tool for CWR diversity conservation</li> </ul>	biodiversity information gathering and analysis. <ul style="list-style-type: none"> <li>• Develop a territorial monitoring tool for landrace on farm diversity conservation</li> </ul>	
Promote farm conservation and utilization of landraces under changing climatic conditions		<ul style="list-style-type: none"> <li>• Identify and promote the cultural value of local landraces</li> <li>• Facilitate national and international agreements on the conservation and use of landraces</li> </ul>	
Collect and establish DNA/RNA bank for all major landraces		<ul style="list-style-type: none"> <li>• Carry out studies on genomics and associated trait characterization</li> <li>• Evaluate landraces against major stresses (drought, pest and diseases)</li> </ul>	

*Other Comments:*

What about policy? Look at the bottlenecks.

Projects: Health opportunity - doing some research for new protocols, for diagnostic tool (NGS based?) currently ongoing on yam and sweet potatoes to be extended to banana.

Research funds are available for phytosanitary aspects; prioritize in CTG to come up with a project for *Musa* (chemotherapy, NGS)

What about capacity building (opportunity with the Trust CGDT)?

DTG uses GTG tools to help the CTG.

How best to promote collections? Availability of traits evaluations results. Capacity building.

Establishment of trait-based collections (fruit quality, etc), markers, information.

Diversity Thematic Group

Gabe Sachter-Smith reported the discussion for the DTG.

Objectives	Proposed actions	Comments
Fully assess the diversity of <i>M. acuminata</i> and <i>M. balbisiana</i>	<ul style="list-style-type: none"> <li>Set up collecting missions to: Myanmar, Extreme North India, Indonesia New Guinea, East Africa, Near Oceania</li> <li>Study the diversity of wild gene pools with molecular markers</li> </ul>	<ul style="list-style-type: none"> <li>Collection mission to Bougainville in Oct 2016; Myanmar is on hold</li> <li>Agus: Collecting mission to Sumatra and Kalimantan is being planned</li> <li>Populations genetics study</li> <li>We need a broad screening for TR4 susceptibility, among cultivars and wild species, relatively little is known</li> <li>BBTV project is commencing and is including wild material</li> </ul>
Refine the taxonomy of triploid cultivars – <b>this can be combined with “Assess which of the descriptors are robust across environments” below</b>	<ul style="list-style-type: none"> <li>Identify subgroup discriminative descriptors through the multi-environment characterization of the TRC</li> <li>Identify subgroup-specific descriptors through the extensive characterization of targeted subgroups</li> </ul>	<ul style="list-style-type: none"> <li>Need to understand environmental influence on phenotype (TRC-ongoing)</li> <li>what are the factors that diversify cultivars within subgroups (hypothesis is that it is epigenetic in nature)</li> </ul>
Revise the taxonomy of diploid cultivars	<ul style="list-style-type: none"> <li>Characterize the accessions composing the molecular clusters and assess if they compose subgroups</li> <li>If so, agree on subgroups names</li> </ul>	<ul style="list-style-type: none"> <li>Morphological classification of edible diploids and compare to molecular data,</li> <li>Link to GTG and ITG for characterization and classification of edible diploids</li> </ul>
Explore AB diversity	<ul style="list-style-type: none"> <li>Perform a survey of the AB in <i>ex-situ</i> collections (with descriptors and photos)</li> <li>Molecular analyses of these AB</li> </ul>	

Objectives	Proposed actions	Comments
Assess which of the descriptors are robust across environments	<ul style="list-style-type: none"> <li>Multi-location characterization of the TRC</li> <li>Statistical analysis of the results obtained</li> </ul>	
Identify subgroup-specific descriptors	<ul style="list-style-type: none"> <li>Organize regional workshops dedicated to specific subgroup e.g. East Africa for EAHB</li> </ul>	
Facilitate the identification of cultivars – wild types	<ul style="list-style-type: none"> <li>Update <i>Musa</i>.ID</li> </ul>	<ul style="list-style-type: none"> <li>This is happening soon and will be tested at the EAHB workshop end of 2016</li> </ul>
Optimize use of past work with SSR	<ul style="list-style-type: none"> <li>Pursue the molecular characterization of <i>Musa</i> diversity with SSRs to enrich existing databases and reach a molecular picture of the whole <i>Musa</i> diversity</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing, paper in progress with ~600 ITC accessions</li> </ul>
Molecularly differentiate cultivars within subgroups	<ul style="list-style-type: none"> <li>Test new techniques available</li> <li>Investigate other approaches (e.g. epigenetic)</li> </ul>	<ul style="list-style-type: none"> <li>Epigenetics work is a priority</li> <li>Maoli-Popoulu and P. Awak subgroups also good candidates for epigenetic work, information gathered from one subgroup can apply to understanding other subgroups. Plantains are a good starting point</li> <li>Epigenetics work can be in collaboration with GTG</li> </ul>
Develop and publish catalogues on current diversity held in collections	<ul style="list-style-type: none"> <li>Publish catalogues of <i>Musa</i> diversity at CARBAP, USDA, the Philippines (UPBI) and as part of the TRC project.</li> </ul>	<ul style="list-style-type: none"> <li>Good progress with CARBAP, Lavernee is working on catalogue in Philippines</li> </ul>

Other Comments:

What project can we develop that would involve all TGs working together?

- 1) Edmond: Diploid project: all TGs can be involved, for example ETG can look at fruit quality. No need to collect more diploids, there is enough to work with already in ITC. We need a deeper look with GxS and morphological classification.
- 2) Jeff: TR4 has been an important issue which has been able to bring together a lot of different areas of research.

## Evaluation Thematic Group

Miguel Dita summarized the discussion in the ETG

Specific objectives	Actions	Comments
Comprehensively assess currently available evaluation data	<ul style="list-style-type: none"> <li>• Review of literature on evaluation of <i>Musa</i> genetic resources</li> <li>• Review of currently available phenotypic and genotypic evaluation data information in MGIS and other collection databases</li> <li>• Identify major gaps in knowledge in terms of traits and accessions</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
Standardize evaluation protocols	<ul style="list-style-type: none"> <li>• Review currently available phenotyping/genotyping methodologies for evaluation of priority traits</li> <li>• Identify gaps in evaluation methodologies; identify for which traits and/or types of evaluation good protocols are not available</li> <li>• Develop and agree on a set of standard “best-practice” protocols for priority traits, and enter standardized traits/methods in Trait Ontology</li> <li>• Agree on a set of standard check genotypes for all trials</li> <li>• Identify a set of well characterized (climate, soil conditions, etc) reference trial sites</li> </ul>	<ul style="list-style-type: none"> <li>• Focus on agronomic protocols first</li> <li>• More high-throughput phenotyping</li> <li>• More focus on Pre-breeding</li> <li>• Less phenotyping of hybrids</li> <li>• Phenotyping platform/consortium               <ul style="list-style-type: none"> <li>– Drought at KULeuven</li> <li>– Sigatoka at CIRAD</li> </ul> </li> </ul>
Set up framework for data compilation and analysis	<ul style="list-style-type: none"> <li>• Compile existing evaluation data in <i>The Global Agricultural Trial Repository of CCAFS</i> (AgTrials) (<a href="http://www.agtrials.org">www.agtrials.org</a>)</li> <li>• Ensure link between AgTrials and MGIS</li> <li>• Ensure link between AgTrials and Trait Ontology</li> <li>• Engage in global analyses for germplasm performance and GxE interactions</li> </ul>	<ul style="list-style-type: none"> <li>• All IMTP results in Agtrials already</li> </ul>
Share information and knowledge	<ul style="list-style-type: none"> <li>• Make available and pro-actively share information and knowledge with the broader <i>Musa</i> research</li> </ul>	<ul style="list-style-type: none"> <li>• Need more training and evaluation protocol workshops</li> </ul>



Specific objectives	Actions	Comments
	<p>community and other users/stakeholders, in collaboration with MusaNet’s Information Thematic Group and the global network ProMusa (<a href="http://www.promusa.org">www.promusa.org</a>)</p> <ul style="list-style-type: none"> <li>• Make available a database search tool for information on different varieties that are being screened, such as agronomic, climatic and quality characteristics, in order to help priority setting in the regions.</li> </ul>	

*Other comments:*

Projects: Banana 20/20 – wait for November?

RTB Phase II

FP1: Pre-breeding in collections

FP2: Hybrid/cultivar screening

GWAS – in greenhouse and field, involving collections. Establish a reference accession for each character– and share with GTG.

Kodjo: Can there be more pre-breeding work in MusaNet?

Matthew: IMTP guidelines are not used, but not necessarily obsolete.

## Genomics Thematic Group

Pat Heslop-Harrison presented the discussion of the GTG.

Objectives	Proposed actions	Groups involved	Overlaps with other TGs
Develop genomic and genetic tools and knowledge to support characterization of genetic diversity, its conservation and use in breeding Discuss, advise, coordinate and prioritize genomic resources	<ul style="list-style-type: none"> <li>• Develop and exploit DNA-based markers</li> <li>• Obtain and analyse DNA sequence data</li> <li>• Obtain and sequence RNA sequence data</li> </ul>	<ul style="list-style-type: none"> <li>• All</li> </ul>	<ul style="list-style-type: none"> <li>• Interacting with all other Thematic Groups</li> </ul>
Provide a platform of information and interaction for the <i>Musa</i> genomics community, for discussing, coordinating and prioritizing resource development	<ul style="list-style-type: none"> <li>• Maintain an integrated bioinformatics platform/banana Genome Hub (<a href="http://banana-genome-hub.southgreen.fr/">http://banana-genome-hub.southgreen.fr/</a>), regularly updated with new datasets</li> <li>• Maintain a web site with information regarding <i>Musa</i> genomic resources, databases, and teams involved</li> </ul>	<ul style="list-style-type: none"> <li>• Bioversity</li> <li>• CIRAD</li> </ul>	<ul style="list-style-type: none"> <li>• ITG</li> </ul>
Embrace the genomics of genebanks and aggregate omics data generated from germplasm material held in collections	<ul style="list-style-type: none"> <li>• Genotyping including resequencing of diverse banana materials including ITC and other genebank material.</li> <li>• Interoperability fostered between MGIS, Banana Genome Hub and breeding resources such as Musabase</li> <li>• SNP and In/del DNA polymorphism in particular to deliver markers for diversity studies and breeding</li> </ul>	<ul style="list-style-type: none"> <li>• Bioversity</li> <li>• CIRAD</li> <li>• Cornell-BTI</li> <li>• ULeicester</li> <li>• China</li> <li>• UNBrazil</li> </ul>	<ul style="list-style-type: none"> <li>• ITG</li> </ul>
Improve and complete the <i>Musa</i> reference sequences	<ul style="list-style-type: none"> <li>• Improvement of the <i>Musa acuminata</i> DH-Pahang reference genome sequence</li> <li>• Produce reference sequences for other species and subspecies</li> <li>• Characterize the pan and core <i>Musa</i> genome</li> <li>• Develop a nomenclature to distinguish genes according to their (sub)species (or even accession) origin</li> </ul>	<ul style="list-style-type: none"> <li>• Bioversity</li> <li>• CIRAD</li> <li>• IEB</li> <li>• KUL</li> <li>• ULeicester</li> </ul>	

Objectives	Proposed actions	Groups involved	Overlaps with other TGs
Characterize genome sequences and genome organization. <i>Musa</i> germplasm genetic diversity through resequencing	<ul style="list-style-type: none"> <li>• Elucidate the inter(sub)specific mosaic genome structure</li> <li>• Large chromosome structural variation: inversion, translocation, duplication, deletion</li> <li>• Structural variation link to copy number variation (CNV)</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Bioversity</li> <li>• CIRAD</li> <li>• UNB</li> <li>• IEB</li> <li>• ULeicester</li> </ul>	<ul style="list-style-type: none"> <li>• DTG</li> </ul>
Characterize chromosome segregation	<ul style="list-style-type: none"> <li>• Characterize chromosome segregation in polyploid context</li> <li>• Characterize chromosome segregation in 2n gamete transmission context</li> <li>• Characterize chromosome segregation in inter(sub)specific context in relation to large chromosomal structural variation</li> <li>• (PHH more crosses/DH/specific genetic resources?)</li> </ul>	<ul style="list-style-type: none"> <li>• CIRAD</li> <li>• Partners growing/crossing</li> </ul>	<ul style="list-style-type: none"> <li>• DTG</li> </ul>
Identify chromosome regions or genes involved in important agricultural traits	<ul style="list-style-type: none"> <li>• Identify genes for agricultural traits (pathogen and pest resistances, drought tolerance, fruit quality/ripening/post-harvest, parthenocarpy...)</li> <li>• Identify through segregation studies QTL, GWAS and genomic selection</li> <li>• Identify through translational genetic and candidate gene strategies</li> <li>• Develop molecular markers linked to traits of interest for breeding</li> </ul>	<ul style="list-style-type: none"> <li>• Bioversity</li> <li>• CIRAD</li> <li>• IEB</li> <li>• KUL</li> <li>• UNB</li> </ul>	<ul style="list-style-type: none"> <li>• ETG</li> </ul>
Characterize gene expression and elucidate gene function	<ul style="list-style-type: none"> <li>• Develop comprehensive gene expression data in various conditions</li> <li>• Improved annotation of the reference sequence</li> <li>• Utilize Mutation/tilling approaches to help elucidate gene function</li> <li>• Exploit new breeding technologies including transformation and gene editing, approaches to help elucidate gene function</li> </ul>	<ul style="list-style-type: none"> <li>• Bioversity</li> <li>• CIRAD</li> <li>• IAEA</li> <li>• KUL</li> <li>• UNB</li> </ul>	

Objectives	Proposed actions	Groups involved	Overlaps with other TGs
	<ul style="list-style-type: none"> <li>Utilize proteomics and metabolomics to help elucidate gene function</li> </ul>		
Study role of epigenetics and genome stability in <i>Musa</i> phenotypic diversity and somaclonal variation	<ul style="list-style-type: none"> <li>Characterize the epigenetic landscape and its impact on gene expression</li> <li>Characterize transposable element insertion/deletions and impact on somaclonal variation</li> <li>Structural variation link to transposable element movements</li> </ul>	<ul style="list-style-type: none"> <li>Bioversity</li> <li>CIRAD</li> <li>IEB</li> <li>ULeicester</li> <li>UNBrazil</li> <li>IAEA</li> </ul>	<ul style="list-style-type: none"> <li>DTG</li> <li>CTG</li> </ul>
Integrate microbiome and metagenomics studies with <i>Musa</i> genomic studies	<ul style="list-style-type: none"> <li>Identify microbiome and metagenomics under various conditions</li> <li>Study role of microbiome in biotic stress responses/disease</li> <li>Study role in abiotic resistance (including climate change)</li> </ul>		. CTG
Share information and knowledge	<ul style="list-style-type: none"> <li><i>Musa</i> Genomics annual workshop at Plant Animal Genome conference in San Diego, USA</li> <li>Promote discussions and information sharing</li> <li>Update contributions of each member annually</li> </ul>	<ul style="list-style-type: none"> <li>Bioversity</li> <li>CIRAD</li> </ul>	. All thematic groups

*Other comments:*

A common 'project' across all Thematic Groups: Collect, conserve, quantify and exploit *Musa* biodiversity.

## 10. Final discussion session

### Structure and organization of MusaNet Meetings

Nicolas asked the question - How often should we have TG meetings?

CTG: They are needed as necessary and should be with another 'go to' meeting.

DTG: Only on a needs basis or every 6 months. Anne suggested for projects that everyone could participate in, like standardization and classification issues. She would like to discuss this with the DTG and thinks it could result in a MusaNet document. However teleconference can be the wrong means to discuss any issue and with email one has more time to respond.

ETG: They are willing to have regular meetings.

GTG: They have one at PAG (every January) already, so would only need maybe one more during the year.

ITG: They have good communication by email so don't see much need for a meeting unless it is specific. For example, email sufficed when they took a poll to decide the name of MusaTab.

### Communication - website/newsletter

Rachel demonstrated the MusaNet website and newsletter. Some comments were:

- Add a direct link to Musapedia
- Remove link to GMGC or make clear that it is GTG
- Add link to MGIS for accessions tables on collection pages so that the two sites are not showing different numbers.

Mathieu demonstrated the MGIS website <https://www.crop-diversity.org/mgis/>

Among the main features presented were:

- Accession search
- Accession page including passport data
- Diversity study pages based on molecular markers
- How to order material online
- Collection pages and various ways to explore taxonomy
- Links to Banana genome hub and MusaBase

Mathieu mentioned some new features to come with next releases such as link to publications, management of SNP datasets and evaluation data.

## **11. Acknowledgements**

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## Annex 1. Meeting participants

List of participants at the 2016 MusaNet meeting. MusaNet Expert Committee members are in bold type.

No	Name	Institute	Country	Group	Email
1.	Agus Sutanto	ICHORD	Indonesia	DTG, ITG	<a href="mailto:bagusutanto.03@gmail.com">bagusutanto.03@gmail.com</a>
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## Annex 2. Meeting Agenda

Friday 14/10				
Time	Activity	Duration	Presenters	Chair
14h	<b>Welcome and Introduction of participants</b>	30 mins	Rachel Chase	Rachel
14h30	<b>Presentation - Implementation of the 2016 Global <i>Musa</i> Strategy</b>	15 mins	Nicolas Roux	
	<b><i>Regional Network Updates</i></b>			
14h45	<i>BAPNET presentation</i>	15 mins	Lavernee Gueco	
15h	<i>BARNESA presentation</i>	15 mins	Robooni Tumuhimbise	
15h15	<i>Innovate Plantain presentation</i>	15 mins	Gerard Ngoh Newilah	
15h30	<i>MusaLAC presentation</i>	15 mins	Charles Staver/Sirena Montalvo	
15h45	<i>ProMusa presentation</i>	15 mins	Inge Van den Bergh/Anne Vezina	
16h	<i>Discussion on regional network presentations</i>	15 mins		
16h15	Coffee Break	15 mins		
	<b><i>Thematic Group Updates</i></b>			Nicolas
16h30	<i>CTG presentation</i>	15 mins	Ines van den Houwe/John Thomas	
16h45	<i>DTG presentation</i>	15 mins	Jeff Daniells/Julie Sardos	
17h	<i>ETG presentation</i>	15 mins	Miguel Dita/Kodjo Tomekpe	
17h15	<i>GTG presentation</i>	15 mins	Jaroslav Dolezel	
17h30	<i>ITG presentation</i>	15 mins	Mathieu Rouard/Lavernee Gueco	
17h45	<i>Discussion on thematic group presentations</i>	15 mins		

18h-19h	<b>Meeting between MusaNet EC and ProMusa Steering Committee</b>	1 hour		
19h	Dinner for all participants in Montpellier			
Saturday 15/10				
<b>Time</b>	<b>Activity</b>	<b>Duration</b>	<b>Presenters</b>	<b>Chair</b>
9h-10h30	<b>Discussion</b>	1h30		Nicolas
	<i>Continue discussion from Friday sessions</i>			
	<i>Summary of the MusaNet EC/Promusa SC meeting</i>			
	<i>Sharing the lessons learned in the last 5 years</i>			
10h30	Coffee break and group photo	15 mins		
10h45-12h45	<b>Thematic group discussions in separate rooms</b>	2 hours		Each TG will choose a chair and note taker
	<i>4 key points:</i>			
	<i>1. Screen and prioritize actions from the Strategy to agree on a TG workplan for the next 5-10 years</i>			
	<i>2. Brainstorm potential projects and sources of funding for activities within the TG</i>			
	<i>3. What would these projects require in terms of support from other TGs?</i>			
	<i>4. What projects could involve all TGs?</i>			

12h45-14h	Lunch at Heliotel	1h15		
14h-15h15	<b>Each TG reports back to plenary (15 mins each)</b>	1h15	Representative from each TG	Rachel
15h30	Coffee break	15 mins		
15h45-17h	<b>Discussion on various topics</b>	1h15		Nicolas
	<i>Structure and organization of MusaNet</i>			
	<i>Meetings - EC, project and TG meetings</i>			
	<i>Communication - website/newsletter</i>			
	<i>Any other business</i>			
17h	Close of meeting and social dinner at Mas Rouge			Nicolas/Rachel