Minutes of the 2nd meeting of the Taxonomy Advisory Group
Tiruchirapally, India, 20-25 October 2008

Introduction

The TAG meeting was scheduled to overlap with the 6th Steering Committee Meeting of the Banana Asia-Pacific Network (BAPNET) to discuss the implementation in Asia and the Pacific of a project funded by the Global Crop Diversity Trust on strengthening the network of priority collections. The agenda and list of participants may be found in Annex 1. For the purpose of this report, the summary of the discussions is grouped under two themes: Taxonomic issues (including the tools used to resolve them), and Germplasm management and conservation.

Taxonomic issues

Cultivars

Presentations on AA cultivars, Pacific plantains and Indian ABBs, and the ensuing discussions, underscored the difficulty of drawing boundaries around subgroups as long as the extent of the full variability has not been documented. But even then, cultivars representing intermediate cases will probably resist grouping into discrete units. The Maoli and the Popo'ulu, for example, are distinct in the Eastern Pacific, but plants exhibiting intermediate characteristics are found in the Western Pacific and may be at the origin of the true Maoli and Popo'ulu, according to Jeff Daniells.

Uma reported on their own analysis of the ABB diversity in the NRCB collection. She presented the main characteristics of the Monthan and Bluggoe subgroups, the Bontha subgroup, which they created to classify the accessions that fell in between, and the Peyan subgroup (Annex 2). Certain accessions were unique and couldn't be classified into either subgroup.

For the edible AAs, it was decided to initiate a project to identify clusters using the available characterization data. The collections with the most AAs are Agus Sutanto's collection in Indonesia and the Laloki collection in Papua New Guinea (the FAVRI collection in Vietnam also has AAs). Agus has the characterization data from his collection while the data from Laloki are in MGIS. As much data as possible will be compiled and analysed and, if possible, compared with the results of molecular characterization. The study could be the topic of a PhD.

Assigning accessions to subgroups is complicated by synonyms and lack of knowledge on the genetic make-up of the cultivars. Morphologically similar plants, for example, can be genetically different just as morphologically different plants can be genetically similar. Not seeing differences at the molecular level, however, does not mean that there are none, just that they may be hard to detect using high-throughput methods and may require sequencing the genome. The question then becomes whether these genetic differences are significant and worth tracking down, notes Hugo Volkaert, who analyses specific DNA sequences in the nuclear and chloroplast genomes to trace the origin of edible bananas.

Saraswati, a PhD student working on the morphological and molecular characterization of B-rich *Musa* genomes in India, pointed out that the mutant forms are generally stable but sometimes revert to the parental types. Hugo suspects that bananas have jumping genes, which may explain why certain plants flip back and forth. Morphology will necessarily be the starting point of any classification, but

looking at the genetics should help identify which morphological characters are reliable for taxonomic purposes.

To sum up, the existing subgroups are artefacts of the keys developed by Simmonds and do not cover all types of bananas. Even though a subgroup is an informal category that is not officially recognized and is not common in other crops (a subgroup is defined as representing the varieties generated from a common ancestor by somatic mutation), the TAG acknowledges that it is a useful way of organizing the variation observed in bananas. But as long as the subgroups have not been clearly defined, it will be difficult to go below that level. The TAG is in the best position to review the classification into subgroups and set some standards. It was decided to assign to TAG experts the task of providing information on the defining characteristics of the main subgroups.

Edible BBs

While wild *Musa balbisiana* produce fruits that are full of seeds and little pulp, Hugo has encountered in southern Thailand a type of *balbisiana*, called Pongla, which has fewer seeds that are soft or empty. Although the pulp is delicious, nobody seems to be eating the fruits. The pseudostem, however, is eaten. It tastes like the pseudostem of *Musa itinerans*, which is eaten in northern Thailand but absent in the southern part of the country. Pongla only has the B genome but its ploidy has not been established. Based on the photos, it is different from Bhimkol, according to Uma.

Hugo has no evidence that BBBs exist. All the B-rich accessions he analysed had some *acuminata*. The chloroplasts of most AB, AAB and ABB hybrids he analysed have an *acuminata* genome, but a few have a *balbisiana* genome. Since chloroplasts are maternally inherited and the first letter usually refers to the maternal parent, shouldn't those hybrids be designated BBA?

Wild species

Hugo presented the highlights of a series of reconnaissance missions he conducted with Edmond de Langhe in Thailand. The subspecies of *Musa acuminata* they observed are *truncata* in the extreme south, *malaccensis* in peninsular Thailand and western mountains and a *burmanica – siamea* complex in the western mountains, north, northeast and east (variation in bunch and male bud shapes make reliable differentiation impossible). *Malaccensis* is highly polymorphic and some plants found near mangroves, in regularly flooded areas, could be tolerant to salt. The three *acuminata* subspecies do not seem to interbreed.

Hugo thinks that people used the presence of *Musa balbisiana* as an indicator of a good place to grow plants and settled near them, rather than transplant them near their habitations.

Hugo and Edmond also observed tall *Musa itinerans* (over 10m tall) and an unidentified hybrid, "*terminiflora*", whose male bud aborts. Hugo thinks it could be related to the *Musa yunnanensis* described by Markku Hakkinen in China.

Markku, who gave a presentation on the Musacea he observed in China between 2005 and 2007, confirmed that the male bud of *M. yunnanensis* aborts more or less early. Although common, this species and its varieties had never been described before. Those growing at higher elevations, between 1550 and 2250 meters, tolerate frost without any apparent damage. Most wild *Musa* are located in mountainous areas or in

nature reserves. Tall *Musa itinerans*, up to 12 m high, were among the other species observed.

Markku also gave a presentation on the diversity of Callimusa species he encountered in Borneo, Sumatra and the Malaysian peninsula, and in southern China (close to the border with Vietnam). Borneo is where he observed the highest diversity of species: *Musa azizii, M. bauensis, M. beccarii, M. borneensis, M. campestris, M. hirta, M. lawitiensis, M. monticola, M. muluensis, M. tuberculata* and *M. voonii.* Some of the species, like *Musa azizii* and *Musa campestris* in Sarawak, were found in only one location, while *Musa lawitiensis*, which was thought to be rare, is actually fairly common in Kalimantan. In addition, *M. lokok* and *M. sakaiana* were recently rediscovered.

Musa checklist

In a recently published paper, "Typification and checklist of *Musa* names (Musaceae) with nomenclatural notes", Markku reviews all the published *Musa* names to date. Altogether, 439 names are listed, out of which Markku extracted a tentative list of 72 'valid species' to be refined by the TAG (see section on MusaTree below).

Sections

Different studies have come to the same conclusion, that the sections Callimusa and Australimusa can be merged. According to a study by Wong and colleagues based on AFLPs, the Rhodochlamys and Musa sections can also be merged. Markku notes that Rhodochlamys is an invalid name and the name of the Eumusa section was changed to Musa in the 1950s to conform to nomenclature rules. For the time being, the TAG will continue using the four sections, even if the section is not a recognized taxon, but will use the term Musa instead of Eumusa.

Subspecies vs varieties

The taxa subspecies and variety are both used to classify variation within a *Musa* species, but how they are used seems to be left to the judgment of the taxonomist. Variety seems to be used to describe plants that are closer to the type species, whereas subspecies tend to be used for more plants that look more different but not enough to qualify as a separate species. That logic, however, does not follow from the rules of nomenclature, which specify that a variety has to be tacked on to a subspecies (e.g. *Musa balbisiana* ssp. *balbisiana* var. *balbisiana*). As a rule of thumb, Hugo suggests that varieties interbreed more readily than subspecies.

Tools to help resolve taxonomic issues

Minimum descriptors

After the first TAG meeting, a list of 30 minimum descriptors were chosen for identification to subgroup level and are being used in the on-going field verification of the ITC accessions. The results will be entered in MGIS but there is no clear plan on how to use them to develop identification tools.

Before the meeting, Edmond de Langhe sent out a discussion paper proposing a hierarchical system using specific descriptors to arrive at an identification at the genome group level (along the lines of the Simmonds scoring system), the subgroup level and cultivar level. We would need to identify among the descriptors which ones would be useful, but no specific action was proposed.

Genotyping

Jaroslav Dolozel proposes to set up a *Musa* Genotyping Centre at the Institute of Experimental Botany. The service provided on a cost-recovery basis would be PCR with SSR markers (initially 22 microsatellite markers from CIRAD) and DNA fragment analysis using capillary electrophoresis. The samples would have to be provided as purified genomic DNA (lyophilized or dissolved in ethanol).

Reference collection

After the last TAG meeting, 35 ITC accessions were chosen by a panel of TAG experts to form a reference collection representing the main range of diversity of *Musa*. In addition to being available at the ITC, the chosen accessions had to be available for distribution, that is virus free. Since these accessions were part of the field verification exercise, they have been examined for their trueness to type. The results, presented by Nicolas Roux, show that three accessions need to be replaced because they were either mislabeled (Pisang Klutuk Wulung and Pisang Raja Bulu) or off-type (Yangambi km 5). Kalapua, which had been selected by the panel had not been sent for field verification since it was virus infected (Annex 3). Characterization data and photos are still being received. In the meantime, 23 institutes which either gave these accessions to the ITC or received them have been asked to send photos and characterization data.

The TAG suggested replacing PKW by Tani (ITC 1120), Pisang Raja Bulu by Pisang Rajah (ITC 0587) and Yangambi km 5 by Khai Thong Ruang (ITC 0662). No recommendation was made regarding the addition of groups of bananas, like the Fe'i, which are not represented in the reference collection. Even if the chosen accession is not necessarily the best one, theoretically any accession in a subgroup should be representative of the subgroup. Even though the collection will need revising, it is felt that we need to move on and get the accessions in field collections as soon as possible. The ones selected should be good enough to start documenting the different subgroups. It was proposed to send them to 5 collections. The countries mentioned were the Philippines, Indonesia, India, Uganda, Vietnam.

MusaTree

Inge Van den Bergh presented MusaTree, a collection of web pages using the Wiki technology to enable people to contribute or modify content on wild and cultivated *Musa*. The Wiki pages are accessed through a structured menu representing the different taxonomic subdivisions. It is possible to browse through the taxonomic tree without loading the associated pages. The MusaTree is currently part of the website being developed by Bioversity for the MusaNet community.

At first, access to the Wiki pages will not be regulated, but the contents will be monitored and ultimately validated by the TAG. It may be necessary in the future to require that contributors log in. The objective is to produce an easy-to-use, and to update, guide to the diversity of *Musa*. The experts contributing photos and text will be acknowledged. One of the objectives of the pages is to establish the TAG as the best source of authoritative knowledge on *Musa*. The website should also be used to explain why the way of naming cultivars, which does not follow international rules of nomenclature, is different for bananas and should remain so.

MGIS

A more user-friendly version of MGIS is available on CD-ROM. It integrates many of the comments made by curators over the years. An online version to make queries is being developed.

The task of correcting mistakes in the existing database, as well as before the data are entered in MGIS, will fall on the Genetic Resources Specialist being hired by Bioversity. To facilitate the provision of data, the possibility of importing data in Excel spreadsheets will be explored.

GIS

Prem Mathur gave a presentation on DIVA-GIS, a free-access software that enables people to make maps integrating information on the sites where a species has been observed or collected. This tool can be used to calculate the probability of finding a species in a previously unexplored area and to identify conservation priorities.

Germplasm management and conservation

Genebank management

There is a lot more to genebank management than collecting accessions and planting them. It is a lot a work Maintenance in field collections is often poor. There is no recipe to fit all situations. Guidelines need to be tailored to suit particular sets of circumstances.

Kodjo Tomepke and Emmanuel Fondie recently prepared regeneration guidelines for the Trust. They could be used as a starting point for a more in-depth look at issues like pests and diseases, which are the biggest problem confronting collections. ProMusa members could be asked to provide input. These field collection management guidelines can be developed on the MusaNet website.

Implementation of the Global Conservation Strategy for **Musa**

The Global Crop Diversity Trust is funding a series of activities to fill gaps in the ITC collection, secure the conservation of threatened accessions, support the long-term sustainability of priority collections and improve the knowledge on accessions held in genebanks to facilitate the use of diversity and rationalize holdings.

Participation in the project is predicated, among other criteria, on a willingness to share germplasm and a proven capacity for germplasm conservation and management. The participating collections are listed in Annex 4, along with the number of accessions they are planning to regenerate and duplicate regionally and at the ITC. The TAG is expected to help in the selection of the 200 or so accessions that are planned to be sent to the ITC to avoid duplication with the ones already held.

ITC impact assessment study

Ines Van den Houwe presented the preliminary results of an impact assessment study of the ITC being conducted by Hildergard Garming. The objectives of the study are to document and assess the impact and cost effectiveness of ITC, make recommendations for improving service and use the information to develop a strategy for rationalization.

An analysis of the number of accessions distributed by the ITC between 2000 and 2007 revealed that more than 80% of the accessions available for distribution have

been requested at one time or another during that period. Sixty-three percent of germplasm requested were cultivars, 20%, improved hybrids and 17% wild species.

Respondents to on-going survey expressed the need for evaluation data and good photos. Many would also like to see the establishment of core field collections, an increase in the diversity of the collection, namely wild species, and in the number of plantlets provided (10).

Ines said that they are planning to estimate the impact of reducing from 20 to 10 the number of plantlets per accession for the ones that are not frequently requested. However, since labour is their main cost, they don't foresee significant savings.

Another potential cost-saving measure would be to remove from medium-term storage the least requested accessions and regenerate them from the cryopreserved samples when they are requested. A cryo collection, however, is a back up collection, in case accessions are lost from a collection. It is not meant to be a working collection, as reflected in the small number of tubes cryopreserved. Moreover, the genetic integrity of the ITC cryopreserved material has only been tested under greenhouse conditions, where it was shown to be stable. Anarudha Agarawal reported that their own field trials indicate that cryopreserved plants perform as well as the mother plants, at least the Monthan varieties they are testing.

There seem to be little scope for reducing the number of accessions. There are duplicates and synonyms, but they probably represent a small percentage of the entire collection. The first step would be to go through the list of accessions to identify potential duplicates and synonyms. The cost of growing them side by side in the field to verify that they are would need to be estimated. The exercise would also help standardize the names of the accessions at the ITC.

Gaps at the ITC and acquisition strategy

The 1245 accessions held at the ITC cover 15 genome groups, 40 subgroups, 19 wild species and 117 improved varieties. Some 300 accessions, coming from the Trust-funded project and a number of collecting missions (30 AAA from Kenya (2006), 88 AAA, ABB, BB and *M. itinerans* from South China (1996), 28 accessions from Indonesia (1996, 2002) and 40 from northeast India). Moreover, the 33 accessions identified as mislabelled during the field verification, as well as the 16 off-types, will need to be replaced.

The criteria that could be considered for making decisions regarding future acquisitions are: new contribution to the already conserved genetic diversity, threatened status, potential usefulness, required by users, wild relative, capacity of the genebank (physical, human resources, financial). Can the TAG assist?

For historical reasons, the ITC collection has a good representation of plantains. It should now focus on other diversity, like Pacific bananas and wild species. In view of climate change, material tolerant to abiotic stresses should also be targeted. Possible sources of missing diversity is presented in Annex 5.

Any new acquisition, should be accompanied by a minimum set of information, including the location where it was collected and the reason why it was collected. More efforts should be made to get evaluation data.

Would it be useful to replace species/cultivars about which we know nothing with accessions that are probably the same but for which we have more information? For

virus-infected material, there might be cases when it might be more economical/faster to go re-collecting instead of going through virus therapy.

Conversation strategy for Asia

There is currently no germplasm exchange between countries and seemingly little need for a regional strategy since material from other countries can be accessed through the ITC. It may be easier for countries to set up bilateral exchanges than participate in a regional network.

To facilitate the dissemination of clean planting material, Bioversity's CfL office in the Philippines has established with partners a network of National Repository, Multiplication and Dissemination Centres. The material is kept in screenhouses to protect it from viral diseases, especially BBTV, which is widespread in many places.

Conservation strategy for the Pacific

Mary Taylor presented the draft of a conservation strategy for the Pacific, a rich source of both wild species and cultivated varieties, only part of which is represented in banana collections. Fiji, French Polynesia, New Caledonia, Papua New Guinea, Pohnpei (FSM), Samoa and Solomon Islands have collections that vary in size and the extent of diversity represented and documented. Only PNG has provided material to the ITC. In general, the accessions have not been duplicated and resources for conservation are scarce. Some of the islands, however, present an excellent opportunity for developing a system of community genebanks. There is no regional collection and no capacity for the cryopreservation of bananas.

Nutritional analyses have shown that some Pacific varieties have high levels of beta carotene, a precursor of vitamin A. These and other varieties had become rare because of a lack of use, but some varieties are also demanding in terms of agronomic management, a factor that has led to their loss from traditional field collections.

In 2007, it was agreed to focus a Pacific conservation strategy on the Fe'i, Maoli Popo'ulu and Iholena types of bananas. The need for more collecting (e.g. in Vanuatu and the Solomon Islands), to rationalize the collections, provide access to clean planting material, share germplasm and promote use through better documentation.

Since then, the Solomon Islands have started collecting and Vanuatu has funds to start collecting soon. However, there are insufficient funds to cover all collecting needs. As part of the Trust-funded project 100 'unique' accessions should be sent to SPC (70 of which to be duplicated at the ITC). PNG and possibly Solomon Islands, will be provided with support to relocate and regenerate their collections.A regional genebank will be established and the SPC will receive training in virus-indexing from QDPI. So far, five SPC countries have signed the International Treaty on PGRFA and four have signed the Solemn Undertaking. There is concern, however, over the tight timing and the selection of accessions to ensure that what is sent to the SPC and ITC from the various collections is unique.

Capacity building and awareness raising still required regarding the implementation of the Treaty. There is also a need for training on pests and diseases and issues of clean planting material and the issue of wild species needs to be addressed.

Jeff Daniells expressed concerns over the acceptability by consumers of the high-carotene varieties outside the region. Moreover, these varieties are often slow growing (crop cycle about 2-2.5 years) and need a pure tropical climate. They have been established successfully in some places (CARBAP, NRCB) but since Fusarium wilt is

not really present in the Pacific, little is known about their reaction to the disease. They should be evaluated in standardized trials.

Conservation strategy for Eastern and Southern Africa

Deborah Karamura presented the strategy for Eastern and Southern Africa. All countries have genebanks. Recording the origin of the material, names and characterization data has been partially done and the majority of the data are not in MGIS. The diversity held on farm in the Great Lakes region is in decline. They tend to maintain the diversity they have a use for (13-30 cultivars per farm). Collections are also losing accessions.

There is a lack of supportive policies at national and regional levels for germplasm exchange and to guide resources mobilization. There is also limited financial and human resources for collection and characterization, field maintenance and evaluation of germplasm.

As part of the implementation of the strategy, best practices will be adopted for all aspects of conservation, documentation and evaluation and clean germplasm will be provided upon request to BARNESA countries through the signing of an SMTA. The regional collection will be continuously evaluated to assess its coverage of the regional diversity. The results of research done with donated germplasm will be provided to the donating country.

The NARS of the ESA countries will provide technical and management support for the strategy, including staff infrastructure and financial resources. The CGIAR centers will provide technical backstopping and will make their genebanks accessible to regional genebanks and the ITC.

Conservation strategy for threatened cultivars

Landraces have traits that are important to local people (drought tolerance, therapeutic value) but these are replaced by commercial cultivars. Uma reported on a successful project to conserve hill bananas threatened by BBTV, but stories like this are rare, especially when the landraces are grown by local tribes (hill bananas are grown by rich people). Uma is making a list of threatened cultivars in India and suggests that the same be done for other countries. Historical documents describing landraces could be used as a baseline to determine whether they have disappeared. In addition to India, the TAG experts can come up with the information for Thailand, Indonesia, the Philippines, Eastern, Central and Western Africa, and the Pacific.

It should also be documented whether they are in collections, but we need a strategy beyond bringing the landraces to a collection and the ITC. For example, promoting local food in parts of the Pacific is helping the Fe'i bananas.

Conservation strategy for wild species

The first step in developing a conservation strategy for wild species would be to collect all the georeferenced data on where species have been collected or observed. These distribution maps could be overlayed with maps of threats (like deforestation) and protected areas, to prioritize actions. To get species put on the IUCN Red List, we also need to document population size.

Priorities for collecting are different seen from a scientific or a threatened point of view. Myanmar would be a priority from a scientific point of view because its diversity has been little explored but it doesn't seem threatened although shifting

cultivation could pose a threat (the Chinese and the French might organize missions there next year). The diversity in Kalimantan, on the other hand, is immediately threatened by oil palm plantations, Large areas are being cleared. The *Musa* seeds in the soil germinate but the plants are cleared before they have had a chance to set seeds again.

Is there any action we can take to prevent the lost of these natural seed banks? Should there be more research into seed biology and conservation? The factors that trigger or inhibit germination are not well known. Can seeds be cryopreserved? There is one report of *balbisiana* seeds being cryopreserved. Embryonic sacs have also been successfully cryopreserved. Uma agrees that there is a need for research on seeds, but it should be done as part of a comprehensive programme.

Can we already identify priorities for collecting? Indonesia has been surveyed, but not completely. Sulawesi, Irian Jaya, Borneo, the Moluccas and the Lesser Sunda Islands (Nusa Tenggara) should be explored further. The southern part of the Philippines, for wild *balbisiana* and some other wild species, would also need exploring.

Musa from Cambodia and Laos are under-represented in the ITC but Cambodia is difficult to explore (lack of roads and presence of mines) and Laos is not a priority. It is unlikely to hold unique diversity. North-East India is slated for exploration by the NRCB, but it is a dangerous area and collecting has had to be postponed. The Indo-Bhutan area is also dangerous.

Uma says that there is no guideline for exploration, but you need to talk to the local people who will know where the wild *Musa* are. Exploring for traits (tolerance to drought, salt or cold)will require a different strategy. Climate envelope models might help but GIS is usually not detailed enough to identify small areas that have particular climatic features (a hill, a dry spot or proximity to salt water). Local people could also be useful in pointing to species that have survived extreme weather, like drought.

However, before going collecting somewhere, we have to make sure that the facilities are there to conserve the germplasm, so that at least the material can be conserved at the national level if it cannot be sent outside the country.

Wild species are easy to keep in vitro. Uma points out that in field collections, they tend to develop abnormalities after several years of sucker propagation. She says that they have selfed them and started again from seeds. Repeated selfing, however, is not recommended since wild species are heterozygous. Agro-forestry settings might be more appropriate for wild species. Uma says that in one instance she gave suckers to somebody living near the collection site. That person is paid to maintain the material and if he sees a new species, he will collect it. The government is not involved but maybe MusaNet can help with this type of community-based conservation.

The other issue about keeping wild species in ex situ genebanks and field collections is regarding the numbers that need to be maintained to adequately reflect the genetic diversity. Field collections, however, have limited space

A wild species task force coordinated by Anne was set up to develop a workplan, compile the available information on the distribution of species to evaluate their status.

Wrap-up

After an initial burst of activity, the discussion forum has been little used. People seem to prefer communicating through emails. D-groups seem to combine both

technologies. Participants are alerted by emails, but the content of the discussions are stored on the Internet.

The five working groups will be abandoned to better focus on the action points (Annex 6). Bioversity has an important role to play in encouraging interactions. It is hoped that progress on the MusaNet website will stimulate collaboration. People are not clear about the difference between the TAG and MusaNet. Anne sees the TAG's main role as sorting out the taxonomy. Its advisory role on the implementation of the conservation strategy falls more within the realm of MusaNet and may draw on different expertise. The idea of creating a TAG steering committee was left hanging.

During the meeting there has been talk of having a meeting on taxonomy during the ProMusa symposium in China next September.

Annex 1: Programme and list of participants

Time	Agenda item	Presenters
Monday	**Session 1 – Welcome and setting of the scene**	
09.00 - 09.05 hrs	Invocation	NRCB Staff
09.05 - 09.20 hrs	Welcome	Mustaffa
09.20 – 09.35 hrs	About TAG	Nicolas
09.35 – 09.45 hrs	Remarks by Chief Guest	Dr. John Britto
09.45 – 09.55 hrs	Introduction and meeting agenda	Anne
09.55 – 10.00 hrs	Vote of thanks	Uma
10.00 – 10.30 hrs	*BREAK*	
	Session 2 – Cultivars (action points 1, 2, 5, 6, 8) **Taxonomic issues and tools to resolve them**	
10.30 – 13.00 hrs	Classification of AAcvs, Pacific plantains and ABBs	Agus, Jeff, Uma
13.00 – 14.00 hrs	*LUNCH*	
14.00 – 15.30 hrs	Minimum descriptors Morphological and molecular characterization of reference collection Cultivar MusaTree	Anne Nicolas Inge
15.30 – 16.00 hrs	*BREAK*	
16.00 – 17.30 hrs	Strategy to collect characterization data through the MGIS CD-Rom	Max
Tuesday	**Session 3 – Germplasm management** (action point 7)	
08.30 – 10.00 hrs	Implementation of Conservation Strategy: Trust-funded project ITC impact assessment (including gaps in collection)	Nicolas Ines
10.00 – 10.30 hrs	*BREAK*	
10.30 – 13.00 hrs	Field collection management (planting density, crop management, monitoring identity and eliminating duplicates, documentation)	Jeff
13.00 – 14.00 hrs	*LUNCH*	
14.00 – 15.30 hrs	Regional strategies for Asia and Pacific	Gus/Mary
15.30 – 16.00 hrs	*BREAK*	
16.00 – 17.30 hrs	Regional strategy for East Africa	Deborah
Wednesday	**Field trip to NRCB collection**	
Thursday	**Session 4 – Wild species** : (action point 9)	
08.30 – 10.00 hrs	Presentations on Callimusa Missions in Thailand Missions in South China Sections: should Callimusa and Australimusa be merged?	Markku Hugo Markku Markku
10.00 – 10.30 hrs	*BREAK*	
10.30 – 13.00 hrs	Subspecies versus variety (definition and criteria) Do edible BB exist and impact on existence of BBBs? Wild species checklist	Markku Hugo Markku
13.00 – 14.00 hrs	*LUNCH*	
14.00 – 14.45 hrs	Wild species MusaTree	Inge
14.45 – 15.30 hrs	Sharing characterization data through the MGIS online version	Max

Time	Agenda item	Presenters
15.30 – 16.00 hrs	*BREAK*	
16.00 – 17.30 hrs	Molecular characterization of wild species and cultivars (DArT)	Nicolas
Friday	**Session 5 – Joint TAG/BAPNET session**	
08.00 – 10.00 hrs	Mechanisms of germplasm exchange within the framework of the Treaty Update on Musa Conservation Strategy Summary of TAG meeting Discussion	Singh Nicolas Anne
10.00 – 10.30 hrs	*BREAK*	
	Session 6 – Threatened Diversity (action point 9)	
10.30 – 13.00 hrs	Conservation strategy for wild species (unexplored areas, threats)	Anne
13.00 – 14.00 hrs	*LUNCH*	
14.00 – 15.30 hrs	Threatened cultivars: What, where and what to do?	Uma and others
15.30 – 16.00 hrs	*BREAK*	
16.00 – 17.30 hrs	**Wrap up** Looking to the future: TAG and MusaNet	Anne

Last name	First name	Address	Telephone	E-mail
Agarawal	Anuradha	National Bureau of Plant Genetic Resources PUSA Campus New Delhi India, 110012	Tel: (+91-11) 25849208	anuradha@nbpgr.ernrt.in anuagrawal1@yahoo.co.in
Daniells	Jeff	Department of Primary Industries Agency for Food and Fisheries, Horticulture & Forestry Science PO Box 20 South Johnstone Australia, 4859	Tel:(+61-7) 4064 1130 Fax: (+61-7) 4064 2249	Jeff.Daniells@dpi.qld.gov.au
De la Cruz	Felipe S.	Institute of Plant Breeding UPLB Laguna Philippines, 4031	Tel: (+ 63-49) 576 0045	fsdelacruz58@yahoo.com
Hakkinen	Markku	University of Helsinki Botanic Garden (Jyrängöntie 2) PO Box 44 University of Helsinki Finland, 00014	Tel: (+358-5) 217038	markku.hakkinen@kymp.net
Karamura	Deborah	Bioversity International PO Box 24384 Plot 106, Katalima Road Naguru Kampala, Uganda	Tel : (+256-41) 286 213 Fax : (+256-41) 286 949	d.karamura@inibap.co.ug
Mathur	Prem	Bioversity International- India c/o CG Centres Block, Ch. Devi Lal National Agriculture Research Centre, Dev Prakash Shastri Marg, Pusa Campus, New Delhi, 110 012	Tel: (+91-11) 25847546	p.mathur@cgiar.org
Molina*	Agustin	Bioversity International- c/o IRRI, Rm 31 GS Khush Hall Laguna Philippines, 4031	Tel: (+63-49) 5360532 Fax: (+63-2) 8911292	a.molina@cgiar.org
Nayar	N.M.	Kerala University Botany Department Kariavattom 695 581 Trivandrum, India	Tel: (+91) 9444 090 393	nayar.nm@gmail.com nayarnm@dataone.in

Last name	First name	Address	Telephone	E-mail
Ngezahayo	Ferdinand	Institut de Recherches Agronomique et Zootechnique CEPGL BP 91 Gitega, Burundi	Tel: (+257) 403020 Fax: (+257) 402364	ngezafrd@yahoo.fr
Nghiem*	Nguyen	Food and Vegetable Research Institute Trau Quy, Gia Lam Hanoi, Vietnam	Tel: (+84) 48 765626	nghiemvrq@yahoo.com
Roux	Nicolas	Bioversity International Parc Scientifique Agropolis II Montpellier Cedex 5 France, 34397	Tel: (+33) 4 67 61 13 02 Fax: (+33) 4 67 61 03 34	n.roux@cgiar.org
Ruas	Max	Bioversity International Parc Scientifique Agropolis II Montpellier Cedex 5 France, 34397	Tel: (+33) 4 67 61 13 02 Fax: (+33) 4 67 61 03 34	m.ruas@cgiar.org
Sutanto	Agus	Indonesian Fruit Research Institute Jl. Raya Solok Aripan Km 8, PO. Box 5 Solok, Indonesia	Tel: (+62) 755 20137	bagusutanto_02@yahoo.com
Taylor*	Mary	Secretariat of the Pacific Community Private Mail Bag Suva, Fiji	Tel: (+679) 3370733	MaryT@spc.int
Uma	Subbaraya, Binita	NRCB Thayanur Post, Thogamalai Road Trichy- 620 102 Tamilnadu, India	Tel: (+91) 9444 090 393 Fax: (91) 431 2618115	umabinit@yahoo.co.in
Volkaert	Hugo	Kasetsart University Kampaengsaen Campus Nakornpathom 73140 Thailand	Tel: (+66) 34282494 Fax: (+66) 34282498	ohugo@ku.ac.th
Van den Bergh	Inge	Bioversity International Parc Scientifique Agropolis II Montpellier Cedex 5 France, 34397	Tel: (+33) 4 67 61 13 02 Fax: (+33) 4 67 61 03 34	i.vandenbergh@cgiar.org
Van den Houwe	Ines	Katholieke Universiteit Leuven Laboratory of Tropical Crop Improvement Kasteelpark Arenberg 13 3001 Leuven Belgium	Tel: (+32-16) 321420 Fax: (+32-16) 321993	ines.vandenhouwe@biw.kuleuven.be

Last name	First name	Address	Telephone	E-mail
Vézina	Anne	Bioversity International Parc Scientifique Agropolis II Montpellier Cedex 5 France, 34397	Tel: (+33) 4 67 61 13 02 Fax: (+33) 4 67 61 03 34	a.vezina@cgiar.org

* BAPNET participants who attended the first two days of the TAG meeting

Annex 2: Characteristics of the Monthan, Bluggoe and Bontha subgroups

Trait	Monthan	Bluggoe	Bontha
Stature	Tall and robust	Medium tall and robust	Medium tall and robust
Pseudostem colour	Light Green	Green with light wax coating	Green with wax coating on the petiole base
Leaf colour	Green	Dark green	Dark green
Bunch shape	Truncated cone	Cylindrical	Cylindrical/ truncated cone
Male bud colour	Brownish pink	Pinkish purple	Pinkish purple
Male bud shape	Lanceolate	Intermediate	Intermediate
Fingers	Large, feeding bottle shape with bold tip	Short or long with pointed tip	Small or medium size, neither pointed nor feeding bottle shape
Fruit arrangement	Loosely packed	Compact	Loosely packed

Annex 3: Reference collection

ITC code	Accession name	Sp./Group	Subsp./Subgroup	Suggested replacements
ITC0249	Calcutta 4	acuminata	burmannicoides	
ITC0766	Paliama	acuminata	banksii	
ITC1177	Zebrina	acuminata	zebrina	
ITC1187	Tomolo	AA	Cooking AA	
ITC1063	Pisang Klutuk Wulung	balbisiana	type 4	ITC1120 Tani
ITC0247	Honduras	balbisiana	type 1	
ITC0312	Pisang Jari Buaya	AA	Pisang Jari Buaya	
ITC0653	Pisang Mas	AA	Sucrier	
ITC0082	Intokatoke	AAA	Mutika/Lujugira (beer)	
ITC0084	Mbwazirume	AAA	Mutika/Lujugira (cooking)	
ITC0575	Red Dacca	AAA	Red	
ITC0277	Leite	AAA	Rio	
ITC0654	Petite Naine	AAA	Cavendish	
ITC1123	Yangambi km 5	AAA	Ibota	ITC0662 Khai Thong Ruang
ITC1122	Gros-Michel	AAA	Gros Michel	
ITC1287	Pisang Berangan	AAA	Philippine Lacatan	
ITC0335	Popoulou	AAB	Maia Maoli/Popoulu	
ITC0649	Foconah	AAB	Pome / Prata	
ITC0769	Figue Pomme Géante	AAB	Silk	
ITC0843	Pisang Raja Bulu	AAB	Pisang Raja	ITC0587 Pisang Rajah
ITC1441	Pisang Ceylan	AAB	Mysore	
ITC0450	Pisang Palembang	AAB	Pisang Kelat	
ITC0825	Uzakan	AAB	Iholena	
ITC0109	Obino l'Ewai	AAB	Plantain-French	
ITC1325	Orishele	AAB	Plantain-False Horn	
ITC0121	Ihitisim	AAB	Plantain-Horn	
ITC1483	Monthan	AAB	Monthan	
ITC0245	Safet Velchi	ABcv	Ney Poovan	
ITC1138	Saba	ABB	Saba	
ITC0020	Ice cream	ABB	Ney Mannan	
ITC0472	Pelipita	ABB	Pelipita	
ITC0767	Dole	ABB	Bluggoe	
ITC0123	Simili Radjah	ABB	Peyan	
ITC0659	Namwa Khom	ABB	Pisang Awak	
	Kalapua No 2	ABB		

Virus infected, needs to be reintroduced
Off type
Mislabelled

Annex 4: Collections participating in the Trust-funded project

Collection	No. of accessions maintained	No. of accessions regenerated in the field	No. of accessions duplicated in vitro	No. of accessions duplicated at the ITC	No. of accessions virus-indexed	No. of accessions characterized
CARBAP (Cameroon)	702	50	50	50	N/A	60
NARO (Uganda)	260	260	100	10	N/A	150
IRAZ (Burundi)	265	40	100	N/A	N/A	40
NRCB (India)	400	200	200	60	60	200
UPLB (Philippines)	155	N/A	131	30	131	N/A
BPI (Philippines)	87	146	N/A	N/A	N/A	146
FAVRI (Vietnam)	90	90	30	20	N/A	43
ITFRI (Indonesia)	202	100	50	20	50	100
SPC (Fiji)	20 + 100 to come	100	100	70	70	100

N/A: not applicable

Annex 5: Potential sources of germplasm to fill gaps at the ITC

Missing or requested types	Potential donor
Fe'i	Pacific
AA (Lakatan)	Philippines
ABs	India
AAB (Pacific plantains)	Pacific
Silk	India
Mysore	India
Nangka	Indonesia
Raja	Indonesia
Saba	Philippines
Eumusa x Australimusa hybrids (AT, AAT, ABBT)	
Budless Kepok and Pisang Awak	Indonesia/Philippines
Dwarf Pisang Awak	
Gros Michel (Lowgate)	FHIA
Dwarf Silk	CIRAD (Guadeloupe)

Annex 6: Action points

Action point 1

Edible AA diploids are the closest living relatives to the ancestral bananas that gave rise to triploid cultivars and as such probably represent a valuable pool of genetic traits but little progress has been made on their classification into subgroups. An analysis of the extent of morphological variation, with the view of identifying subgroups, will be conducted using the available characterization data. When possible, the results will be confirmed with molecular characterization.

Task leader: Agus Sutanto

Action point 2

The TAG is in the best position to review the classification of subgroups and set some standards. TAG experts have been assigned the task of providing information on the defining characteristics of the main subgroups.

Task leader: Anne Vézina

Action point 3

The TAG will use the checklist produced by one of its members, Markku Hakkinen, as a basis to produce, on the MusaNet website, web pages on wild species that reflect the most up-to-date classification.

Task leader: Anne Vézina

Action point 4

The set of 35 ITC accessions agreed on to provide a reference for comprehensive molecular and morphological characterization will be sent to five collections.

Task leader: Nicolas Roux

Action point 5

A renewed effort will be initiated to facilitate the provision of standardized data to MGIS, the database on accessions maintained in *ex situ Musa* collections.

Task leader: CfL's genetic resources specialist

Action point 6

Develop a field collection management manual with input from experts outside the TAG for topics like pests and diseases.

Task leader: Anne Vézina

Action point 7

Identify potential duplicates and synonyms among the ITC accessions to rationalize the collection and standardize the names.

Task leader: Ines Van den Houwe

Action point 8

Develop an acquisition strategy for the ITC to ensure that in the future the material introduced meets one of the identified criteria, such as not being represented at the ITC, being threatened in the field, requested by users and/or possessing potentially useful traits.

Task leader: Ines Van den Houwe

Action point 9

Wild *Musa* species, in which most of the genetic diversity reside, are under-represented in genebanks and threatened by deforestation in their natural habitat. A wild species task force has been established and its first task will be to analyse the available information on the distribution and status of individual wild species.

Task leader: Anne Vézina