Developing a strategic approach to the conservation and use of *Musa* diversity: First meeting of the Taxonomic Advisory Group

Cameroon, 29 May – 03 June 2006

INIBAP is a network of the International Plant Genetic Resources Institute (IPGRI), a center of

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Background

In March 2006, after a year-long consultation process, INIBAP submitted the Global Conservation Strategy for *Musa* to the Global Crop Diversity Trust. At the same time, INIBAP and partners were reaching the final stages of the project, *Improving the conservation and management of Musa genetic resources in Africa* funded by the Gatsby Charitable Foundation (GCF). Both of these initiatives adopt a rationalized approach to conserving *Musa* diversity for more effective use by researchers and growers; the former at a global level and the latter at a regional level.

The complementarity of these initiatives and the momentum that each has generated have provided a unique opportunity to advance further this strategic approach to conservation and, in particular, to address some of the bottlenecks created by constraints in characterization, nomenclature and information management, which are preventing better use of genetic diversity. Through the support of the GCF, IPGRI core funding and contributions from *Centre africain de recherches sur bananiers et plantains* (CARBAP), *Centre de coopération internationale en recherche agronomicque pour le développement* (CIRAD) and the International Institute of Tropical Agriculture (IITA), INIBAP was able to organize an expert meeting of taxonomists and curators, covering morphological and molecular disciplines, genetic improvement, *in situ* and on-farm conservation.

The meeting agenda and list of participants may be found in Annexes 1 and 2. The discussions were intended to contribute to the following activities and outputs:

- Addressing constraints in characterization and developing a shared *Musa* taxonomy;
- Rationalizing conservation efforts, especially at the ITC;
- Developing, improving and ensuring expert validation of the *Muse* Germplasm Information System (MGIS);
- Developing a conservation strategy for Africa;
- Identifying priority gaps for collecting, conservation or research;
- Information outputs (new *Musa*logues, revised descriptors, articles, checklists, web pages, etc.) ;
- An established advisory group for overseeing the implementation of the *Musa* strategy.

The discussions at the meeting were highly constructive and represent a pivotal point whereby an expert group decided to establish a range of actions for the rationalization of *Musa* conservation. This report represents a synthesis of the discussions at the meeting (in approximate chronological order) and an important reference document. However, some of the elements contained, therein, still require further discussion and consolidation with a wider group. In

this sense this report is a working document and the group intends to deliver a more consolidated status report shortly. In this report, we provide a summary of the discussion points, and the most significant 'Action points' for which there was general agreement. Several themes (such as MGIS and characterization) were recurrent subjects of discussion throughout the week and are reported in one place in the report rather than in any chronological sequence. Further important points made during discussions are underlined in the text below but do not relate to specific actions at present.

Day 1 – Monday 29 May

Session: Focus on taxonomy

The knowledge on *Musa* diversity is incomplete:

The findings of recent collecting missions suggest that variation between species and between subspecies is still poorly known and that there is a need to collect more genetic diversity of wild species. Relatively few population studies have been carried out on wild species in contrast to other crops.

Genetic studies are well advanced, except for wild species and edible diploids, but phenotypic/epigenetic diversity of cultivars still needs more study. GCF could potentially fund research on African diploids or those from Papua New Guinea in the CARBAP collection in 2006. GxE (genetic by environment) trials will be important to establish the stability of traits.

The urge for collecting tends to be insatiable and there is a need for focusing missions on specific priority areas, whether geographical or taxonomic. While new diversity is being discovered, a broad range of *Musa* diversity is known and <u>any lack of information should not inhibit immediate efforts to improve tools and methods</u>.

> **Action point 1**: Edible AA diploids represent the range of ancestral genotypes of most cultivated *Musa* and an important source of genetic traits, but they are still a significant source of taxonomic uncertainty. They should, thus, be a priority for further research (especially molecular characterization using SSR markers).

Molecular characterization has an important application up to the level of subgroup but molecular tools are presently not sufficiently powerful to distinguish cultivars within subgroups:

SSR markers are useful molecular tools because of their reliability and transferability between laboratories. Ten polymorphic loci could be sufficient to distinguish subgroup or subspecies. DArTs may be used to complement SSR and hypothetically may provide tools for distinguishing diversity at a finer level. There is also potential that SSR markers have an application for distinguishing within subgroups depending on the number of members in the subgroup and the number of markers made available.

The disease status of material could have a potential influence on the application of DArTs markers but not SSR but this is not confirmed.

Flow cytometry is useful in verifying the ploidy levels of uncertain accessions in national collections. As it is a relatively cheap technology small numbers of accessions could be analysed at the Insitute of Experimental Biology (IEB) at little cost. More systematic studies will need project funding.

Markers should be identified to characterize quality traits for breeding but this topic is beyond the scope of the meeting.

The potential availability of new markers was noted – more SSR markers should become available with *Musa* sequencing. SNPs are not yet available but will potentially become available from ESTs. The availability of SNPs markers may help in intra-subgroup characterization. Further potential markers may be useful in intra-subgroup characterization (e.g. cpDNA markers).

Additional descriptors and tools for morphological characterization may be useful:

Photo descriptors will be an important tool to ensure improved characterization and knowledge. The question of using fruit quality or biochemical markers to distinguish subgroups (e.g. African plantains) exhibiting negligible polymorphism at the DNA level was raised but it was stressed that morphological and molecular characters should be confirmed first because they are more robust.

There is no defined reference collection for research:

The point was made that accessions of *Calcutta 4* from three different collections, which were used as reference material in molecular characterization, appeared to have genetic differences. The need for one reference accession to represent key cultivars in research and working collections was stressed.

The reference materials should be provided by the INIBAP Transit Centre (ITC) to all collections from the same accessions. The origin of these accessions is less significant than the fact that just one accession is agreed for each representative cultivar/subspecies.

A total of 30 reference cultivars was selected in a previous INIBAP-led exercise to set up a reference collection and disseminated by ITC to six collections. Of these 26 were used by Francoise Carreel for characterization using RFLP markers. A further 51 reference cultivars are also subject to molecular characterization as a 'minicore' collection in the project for the Generation Challenge Programme. A corresponding DNA collection is maintained at the *Musa* Genome Resource Centre at the Institute of Experimental Botany.

The participants agreed that a set of reference cultivars should be established to represent subspecies, subgroups and/or clusters. The set should preferably be included in the 51 accessions used in the 'Generation Challenge Programme and

*Musa*logue, and be available for distribution from the ITC. To make a first draft list of reference cultivars, a working group of Edmond de Langhe, Ines van den Houwe and Elizabeth Arnaud was organized. This working group reported back to the plenary group on Friday morning and the draft reference list resulting from their discussions is found in Annex 3. This list will be disseminated and reviewed by subgroup specialists.

This reference set of accessions (or possibly a comprehensive set of photos relating to the reference cultivars) should be sent to 3-4 expert collections. Each expert will characterize the cultivars from the photos or the plant and a standardized set of morphological and molecular characters and procedure for characterization will be agreed and disseminated to all collections. The reference cultivars and the comprehensive dataset of their characterization should be made available in MGIS.

Action point 2: A set of reference cultivars should be agreed to act as means for:

- GxE studies
- Providing a reference for comprehensive molecular and morphological characterization (with photos) which may be used as a basis for standardizing both procedure and information
- Training at a national/subnational level.

Different classification systems exist – how should MGIS respond to revisions:

The recent propositions to merge the four (unofficial) sections in *Musa* into two were discussed. In a communication after the meeting, Markku Hakkinen mentioned that he intends to typify the sections and subsections of *Musa* according to the procedures of the International Code of Botanical Nomenclature. The TAG should help the *Musa* community and those seeking information on *Musa* to access an acceptable classification and checklist for use as a basis for priority setting, research and dissemination of information.

The 'orphan' species (*incertae sedis*) in the *Musa*logue classification should remain where they are until further research consolidates their grouping (e.g. molecular characterization could be carried out on *Musa boman* and *Musa lasiocarpa* from ITC accessions grown out in the field or greenhouse - *Musa ingens* would have to be recollected from the wild). *Musa beccarii* may possibly be moved from Callimusa to *incertae sedis* because it is almost certain to be 2n=18 (rather than 20 as in Callimusa). This result of ploidy analysis needs to be confirmed.

New species from India, Borneo, China and elsewhere have been described by different scientists. These potential new species should be added to the MGIS classification with a footnote to indicate that they are new species and their status might be reviewed. Review of the newly published species may occur through the TAG with the aim of developing a common understanding of the genus and concepts behind the publication of newly-discovered species or species

complexes. There is a proliferation of *acuminata* subspecies names, resulting either from the horticultural interest of having unique names for different populations of the same subspecies or simply from the oversight of botanists lacking experience of the entire genus.

Developing an agreed checklist for use in the *Musa* community demands communication and negotiation and the possibly the adoption of agreed methods and criteria for reclassifying known species or accepting new species or subspecies. A proposal was made that TAG should link with ongoing efforts (e.g. International Plant Names Index, Global Biodiversity Information Facility) to update the *Musa* checklist. This agreed checklist would function as the framework for MGIS.

> **Action point 3:** TAG is in the best position to review the taxonomic status and nomenclature of *Musa* and actively develop an acceptable *Musa* checklist, building on checklists already available (e.g. David Constantine's internet-based checklist, Kew's Monocot checklist). Additions or changes to the checklist should occur through an accepted procedure (e.g. by providing both molecular and morphological evidence. Mass propagation and the selfing of F1 progeny were also proposed).
>
> **Action point 4**: An article should be produced in INFO*MUSA* introducing the concept of TAG, providing a statement of the current status of *Musa* taxonomy and suggesting a framework within which the *Musa* community might carry out research.

Day 3 – Wednesday 31 May

Session: Characterization and rationalization

Existing descriptors and tools are adequate for classification to the subgroup level:

There are two main uses of descriptors: one is to identify a specimen and the other is to describe it. These two uses demand different tools. Much of the workshop discussions focused on the use of descriptors in terms of identifying accessions rather than describing them.

The published 121 morphotaxonomic descriptors for *Musa* have an application in describing accessions. However, experience strongly suggests that a global list of descriptors are not appropriate as an identification tool applicable to all *Musa*. An exhaustive list of the potential descriptors for classification within subgroups would be unworkably long. The suggestion is that a 'tool kit' of minimum descriptors, methods and associated tools should be tailored for use in classification at 1) a subgroup level and 2) a within-subgroup level.

Some of the needs and constraints concerning morphotaxonomic descriptors were expressed as follows:

- Significant levels of subjectivity exist in applying descriptors even among experts;
- Long lists of descriptors are clearly unworkable for 'less detailed' work or for inexperienced researchers - a minimum set of descriptors to ascertain the subgroup may be more appropriate;
- More specific descriptors are needed for characterization within subgroups;
- Further descriptors are needed for wild species;
- Little documentation exists on how to use the descriptors and measure specific traits (ensuring the freshness of subject material as a starting point);
- Illustrations and photographs would vastly aid identification.

In terms of identification, the Simmonds Scoring system of the 15 minimum descriptors is still applicable to attain a first approximation of A:B ratio. Ploidy analysis, chromosome counting and SSR markers provide complementary tools to confirm group and subgroup identity.

As part of the exercise to obtain a standard characterization of the reference set of cultivars, a minimum list of robust (i.e. stable across environments) descriptors, together with photos, should be derived that will confidently allocate accessions to a subgroup or subspecies. Other descriptors show variability and are therefore of research interest, but should not be relied upon for identifying accessions.

The approaches used in applying descriptors should also be documented better to enable more standardized characterization. Photos promise to be a valuable tool, which up to now has been little exploited, to help standardize and illustrate characterization. An illustrated identification key also might be interesting. MUSAIDWIN, the identification tool developed by CIRAD, appears to have been little used and has no photos.

> **Action point 5**: For classification up to a subgroup level researchers should eventually have at their disposition a minimum set of descriptors, photos, ploidy levels and 10 SSR markers to aid correct identification. Photos, in particular, will play a key role in improving understanding of essential issues and standardization of characterization. These minimum sets need to be determined and compiled together in a tool kit. The study of the reference set of cultivars will provide the opportunity to achieve this objective.

More collecting and taxonomic work is needed to adequately define and classify within subgroups:

The morphotaxonomic descriptors for wild species need review in the light of new knowledge and several subgroups are also still not adequately studied to enable, for instance, the confident allocation of a representative accession(s) for whole subgroup. In posing the question: 'What is a subgroup?' it was suggested that a subgroup might be defined as a group of cultivars that are 90% genetically identical and most of the variation is epigenetic. Such a suggestion requires further scientific backup and general consensus.

Within-subgroup specialists identify and rely on additional morphological descriptors to the 121 published *Musa* descriptors for identifying accessions. Further methodologies and approaches for clarifying the classification at intra-subgroup level might be proposed. For instance, numerical taxonomy (as used in East African Highland bananas) and epigenetic studies both offer approaches for cluster analysis. The AA edible cultivars should be studied as a priority as results will help to elucidate the situation in other subgroups (see Action point 1). Additional subgroups requiring attention include Pacific plantains, Pisang berlin and Pisang mas. Specialists of subgroups should ultimately attempt to put together a set of specific reference characters for use within the subgroup. As a general principle, minimum 'shortlists' of characters are practicable for identification purposes. Long lists should be limited for use in describing accessions.

> **Action point 6:** For classification within subgroups individual specialists should develop a range of complementary methods and descriptors (including molecular markers, photos, etc.) specific to the subgroup which should be reviewed by experts (TAG). To aid the process, INIBAP should generate more dialogue between experts and curators.

The form and purpose of existing or potential *Musa* collections and subcollections need to be clarified and better defined:

There is a conservation imperative that suggests that all forms of diversity, whether genetically distinct or not, should be safeguarded for unforeseeable future applications. Ines van den Houwe indicated that 80% of the available ITC collection has been requested in the past six years. [This contrasts with the quote in the *Musa* strategy document that states only 30% of accessions are demanded. This latter figure corresponds to requests within a single year.] The expense of keeping an *in vitro* collection in medium- and long-term conservation is considerable and efforts to rationalize the collection need to be considered carefully in the context of future and previous uses of the collection. In order to know how to proceed with rationalization of conservation efforts, we need to know in more detail for what purposes the ITC collection is being or could potentially be used. INIBAP's planned impact assessment to take place in 2007 will be an important step in developing any kind of core collections.

Ines stressed the point that once cryopreserved any samples removed from cryopreservation will automatically reduce the accepted levels of security for ensuring regeneration. This implies that the cryopreserved collection cannot necessarily be relied upon to stock the in vitro active collection for accessions that have 'run-out' or been removed for the purposes of rationalization, and that accessions in medium-term conservation may not be easily reduced in number without completely removing accessions from circulation or incurring significant costs in re-cryopreserving new samples. This point clearly needs further investigation.

While duplicates exist in the ITC there is little indication of what proportion of the 1200 might be easily eliminated as duplicates. The number of replicates for each accession could similarly be reduced from the current number of 20 for little-used accessions. The procedure for eliminating duplicates will need to be planned and overseen in more detail. By contrast, clear gaps are identified in the ITC collection (see Annex 4), particularly for wild species. As part of the rationalization exercise the collection should also be strengthened by proactively filling important gaps.

A 'core collection' in the conventional sense is the minimum set of varieties to represent maximum genetic diversity for breeding. However, this interpretation of a core collection is less appropriate to vegetatively-propagated crops where non-genetic diversity is more significant. The discussion on purposes of different kinds of collection was difficult to continue without clarifying further the definitions and purposes of different collection types. It was decided that the best way to proceed was to ask a small group to develop the definitions and terms. Jean-Pierre Horry, Franck-Christophe Baurens, Ines van den Houwe and Nicolas Roux subsequently formed a subgroup and met during the evening to draft the terms and definitions for collections. The results of the discussion of this working group were presented in a plenary session on Friday and are provided below.

> **Action point 7**: A working group should be set up to devise a procedure for the rationalization and use of the ITC collection and subcollections, both to eliminate duplicates and to ensure cost-effectiveness in the conservation and use of the base collection. The impact assessment planned by INIBAP will be essential to understand the use to which disseminated germplasm is being put.

Definitions of collections

Drafted during the TAG meeting by the working subgroup: Jean Pierre Horry, Ines Van den Houwe, Franc Christophe Baurens, Nicolas Roux with further editing provided by the report author.

BASE COLLECTION: represents the entire ITC collection. It is expected to encompass all *Musa* diversity. Accessions in this collection are for long-term conservation and are not distributed. The most cost-effective method for long term conservation will be used (Cryopreservation).

ACTIVE COLLECTION: are all accessions at ITC that can be disseminated including those under restrictions (e.g. Banana Streak Virus (BSV)-contaminated material is generally unavailable but can be distributed for research on BSV). Accessions in this collection are maintained for medium-term conservation (*in vitro* slow growth conditions). Material that cannot be distributed at all is not included in the active collection.

INACTIVE COLLECTION: are those accessions that are not available for dissemination (e.g. those which are not held under the FAO 'in trust' agreement or are unavailable because they are newly-received or undergoing virus-indexing or therapy). This collection has no specific purpose but simply represents those accessions in the base collection that are not in the active collection. These accessions are kept in cryopreservation and also may be kept in medium-term storage depending on their status.

CORE COLLECTION: is a limited collection of 5-20% (less than 200 accessions) of the entire collection, which represents the genetic/epigenetic diversity of a large collection with minimum similarity between entries. The core collection should provide the:

- structured sample of the collection;
- priority set for distribution;
- source material for research to improve the understanding of the crop;
- material of preference to develop new methodologies and technologies.

The factors that determine the composition of the core collection are as follows:

1. The core collection should include
    - 20% of wild species diversity - at least 1accession/spp;
    - 5% of edible varieties, at least 1 cultivar/subgroup;
    - An appropriate number of entries to represent a subgroup or cluster (= k x log(number of accessions in the subgroup/cluster)).
2. Accessions selected for the core collection should:
    - Represent major traits within each cluster (subsp/subgp);
    - Be exhaustively documented;
    - Be accompanied with evidence of its classification within the cluster.

The core collection should include virus contaminated material even though it may not be available for general distribution. The core collection does not yet exist and its composition should be agreed by extension of the process that will be used to develop the reference set of cultivars.

The core collection should be cryopreserved as a priority and efforts made to improve the quality of information relating to core accessions and to fill gaps in the collection (e.g. for wild species). Information on the core collection should be comprehensive and made available through MGIS.

REFERENCE COLLECTION (see Action point 2): is a limited subset of the core collection (c.35 accessions), which represents morphotaxonomic diversity of (Eumusa) cultivars. These accessions should be comprehensively characterized at a small number of 'expert' collections using morphological and molecular methods and eventually evaluated as well. The results of this exercise will yield a standardized working characterization for all subgroups. The germplasm and associated data will be made available to all collections for training, research and reference. The accessions in the reference collection should be:

- Clean and available for distribution from ITC;
- Representative of morphotaxonomic variation within their subgroups;
- Ideally part of the list of 51 varieties in the 'minicore' collection, also undergoing field verification and documented in *Musa*logue.

Within national collections it is envisaged that the reference collection would provide a general overview of *Musa* morphological diversity. Individual collections would amplify their collections within specific subgroups according to the indigenous diversity of the country or region (e.g. as is the case for plantains at Centre africain de recherches sur bananiers et plantains (CARBAP) in Cameroon, and for ABB at National Research Centre on Banana (NRCB) in India).

Session: *Musa* Germplasm Information System

The divergence between what MGIS was designed for – information exchange between curators – and what users would like to ask of the database is recognized:

- There is a recurrent problem of lack of training in the use of descriptors and those who have been trained are no longer those who are in touch with the collections in the field;
- There are limitations in the data provided – quality checking at source has been poor in places;
- The perspective of some curators is that MGIS was set up as an INIBAP initiative and that data were for INIBAP's use rather than for sharing and exchanging among curators;
- There was no agreed procedure for expert checking of data;
- MGIS has developed a somewhat negative image – any relaunching of the database should take consideration of the need to change the image that it has attached to it.

Each participant was asked how they would like to use MGIS. The following list represents the group's response:

Data sought		
At the variety level	At accession level	Other information & technical considerations
• Use: commercial & indigenous knowledge • Importance/value • Post-harvest, especially fruit quality & properties, biochemical characteristics • Photographs • Pest & disease resistance • Summary statistics of agronomic characteristics & performance • Adaptative range • Yield • Morphological description • Cytogenetic characterization • Molecular characterization • Free text comments, general information • Genealogy in breeding lines • Synonyms • Geographical distribution	• Comparative characterization at different collections • Similar to the above – the capability to view a range of data values in different sites in order to study potential environmental effects • Channels to exchange information with other curators • Availability of germplasm from specific collections? Where it is in the field? • Free text comments, general information • Georeferenced collecting sites • Photos • Evaluation data	• Bibliographic references for specific data or quotations • Classification system – to look up a variety and know what group or subgroup it belongs to. • Internet access is slow & not feasible for many African curators • Lack of hardware • Being able to select data for printing out hard copies would be useful • Importing/exporting data from/into electronic spreadsheets • The search mechanisms is still unfriendly. If you search for 'Pisang Mas' you receive too many other accessions that are somehow linking to the words 'pisang' or 'mas

MGIS has undergone a number of revisions to respond to the feedback and needs of curators gathered during workshops. The revised version is under a process of validation but the use of the system will always rely on the quality of data gathering and entry at source in the collections. Elizabeth remarked that one of the conceived objectives of MGIS to highlight gaps in *ex situ* conservation and also potential inconsistencies in characterization had never been achieved, mainly because of needs for inputs from experts. The responsibility for achieving this objective was unclear and INIBAP, alone, does not have the taxonomic expertise required.

There appear to be three main user categories of MGIS with individual needs:

- ***Germplasm curators*** are wishing to exchange information and seek reference information. Some are also using MGIS to manage data.
- ***Expert researchers*** wish to see raw but good quality information on accessions from a range of collections.
- ***General users*** would like good quality reference information on varieties and a summary of their characteristics and uses.

To encompass all these uses in one system is extremely challenging and would demand substantial efforts in data gathering and standardization as well as changes in the existing database. The group endorsed the need to maintain both accession and variety level information. Either a survey of the MGIS users or a test group should be set up to assess explore the feasibility of different avenues of development of the MGIS database and other related datasets.

> **Action point 8:** There is a need for a subgroup of experts within the TAG to provide oversight for MGIS not only for taxonomy but also for the development of the content of the database. Priority uses and users for the database should be clarified and new datasets developed to address priority needs either within the existing database structure or as a separate database.

There is a need to improve the gathering of data:
One of the most important factors underpinning the development of a more useful system is ensuring that data are gathered and are of good quality. The following suggestions to address this issue were proposed:

- Providing reference data on key cultivars to improve identification to a subgroup level;
- Using photos to improve characterization and understanding among experts and non-experts alike;
- Using technology to gather computerized data directly from the field;
- Improving data exchange mechanisms (MGIS, GIS-DIVA);
- Giving advice as to how to measure characteristics at the same development stage and other best practices.

Day 4 – Thursday 01 June

Session: Priorities for complementary conservation

Ex situ conservation is not enough—a suite of alternative options should be considered in a conservation strategy for wild species:

Presentations about diversity in the Pacific, Indonesia and India all drew attention to the fact that cultivated and wild diversity is disappearing at rapid rate. Discussions focused firstly on wild species. Wild species are now confined largely to national parks in Indonesia. In India, an impressive diversity of cultivars each with specific applications and uses was held in localized tribal areas. More than 90% of tribal hamlets are estimated to have halted cultivation of these lesser-known 'landraces' and very few have been commercialized and cultivated on a wider scale. Some species and cultivars, including some only recently-discovered, can no longer be found in the original collecting sites, for instance in the Andaman and Nicobar Islands. Fe'ii and Pacific plantain are similarly poorly collected and conserved.

For various technical and political reasons, wild species are poorly represented in crop *ex situ* collections. Ideally wild species should be conserved *in situ* in protected areas, where species-specific management measures are in place. Examples exist in India where wild relatives of commercial species provide prominence to certain protected areas. Conservation *in situ* is the only means of supporting processes that allow the species to adapt and evolve.

Seed conservation may be possible but it is clear that there has not been enough research into germination capacity. India and INIBAP initiatives on seed conservation have not produced positive results (except for *Musa nagensium*) but there is some indication from research at CIRAD to suggest that *Musa* seed conservation may be possible.

Field and *in vitro* collections also play a role in wild species conservation. In both cases the conservation of wild species presents practical constraints. Botanic gardens provide an alternative to crop genebanks as a means of *ex situ* conservation. The Forest Research Institute in Malaysia is building a collection of wild banana species and collections are held in Chinese and Hawaiian botanic gardens. There are possibilities for crop genebanks to collaborate with botanic gardens more closely, although it was remarked that many botanic gardens do not have the capacity to ensure appropriate levels of security for long-term conservation. For instance, many are unable to hold sufficient numbers of individual plants of any one species. Also coordination of conservation efforts between botanic gardens and crop genebanks might be challenging. A Global Botanic Garden Congress will be taking place in 2007 in China and this might be a useful venue to present the perspectives of the *Musa* group relating to the conservation of crop wild relatives.

Indigenous knowledge of wild species is also important to maintain: Indigenous knowledge provides valuable perspectives on the potential use and value of wild species. It was suggested that species that are being 'used' may be borderline *wild* species—perhaps more semi-wild or cultivated. There would be a particular objective in focusing conservation efforts on purely wild populations (if/where they exist) to represent genetic diversity in the evolving natural system.

Providing basic information on the genus *Musa* should be one of the responsibilities of the TAG:

The National Research Centre for Banana is taking the lead in providing details of threatened *Musa* species for the Indian Red Data Book. The suggestion is that a global *Musa* red list should be produced to identify priorities and monitor genetic erosion. To monitor genetic erosion in wild populations demands that those collecting germplasm should ensure appropriate levels of detail are gathered on geographical location (using a global positioning system), environment, habitat and population status information. There is also a newly-

available technique that allows field collectors to capture DNA by pressing the leaf on a sheet of specialized paper. INIBAP has provided a report[1] which goes one step towards giving a country-by-country account of species, their distribution and rarity. This might be developed more fully into a *Musa* red list, which would contribute to setting priorities for *in situ* conservation. Any form of red list is underpinned by the agreed classification and nomenclature of species (see Action point 3).

> **Action point 9:** Wild species and threatened traditional cultivars should be more proactively conserved through an approach of prioritization and strategic use of complementary conservation approaches. A 'wild' task force will be set up, made up of collectors and taxonomists, to develop information on wild species and prepare a session for more in depth discussion at the next TAG meeting.

On-farm conservation may play a stronger role in conserving cultivated diversity:

The loss of traditional cultivars and 'landraces' (the term is used in India to refer to traditional cultivars in localized areas, mostly safeguarded by tribal people) is strongly apparent. A large number of cultivars have retreated from once geographically-wide distributions to increasingly localized and remote areas. There are still communities that preserve traditional cultural practices and a significant range of cultivars, but we cannot rely on these communities alone to conserve genetic diversity. Improved policy, government support, new technologies and income-generating opportunities are needed and demand a cohesive, strategic approach leaning on *in situ* and *ex situ* capacities.

Conventional conservation efforts need to be better coordinated with national seed systems. The experiences of the small number of on-farm conservation initiatives involving *Musa* provides important learning that should be shared among the wider community. One of the major concerns of on-farm conservation projects is their sustainability. Conservation has to be linked to income-generation and organized communities that already have strong, diverse production systems. Experiences and expertise in this area should be shared with the wider *Musa* community.

Session: A conservation strategy on Africa

The global conservation strategy was discussed during the BARNESA meeting in September 2005, during which several constraints and issues concerning *ex situ* conservation in Sub-Saharan Africa (SSA) were raised. The report of the meeting

[1] *Pollefeys, P., Sharrock, S. and E. Arnaud. 2004 Preliminary analysis of the literature on the distribution of wild Musa species using MGIS and DIVA-GIS. unpublished report 68pp.*

discussions was shared with the TAG, who then provided comment on the ideas to address major constraints that had been formulated by the BARNESA group.

At a national level, collections have two main purposes:

i. Maintaining and characterizing local and regional diversity (assuring quarantine by passing germplasm through ITC, and safety duplication)
ii. Providing a working collection of accessions in high demand.

Experiences need to be shared by the successful collections and exchange of information and germplasm between collections encouraged.

The TAG added the following comments:

I. Management and maintenance of *ex situ* collections

a. Use international standards for management and adapt them to national/local needs. These standards are available – for instance as IPGRI publications – but they need to be made more relevant to banana and to collections with limited means;
b. Successful curators often may be distinguished by their passion and tenacity for the subject. However, incentives and encouragements, belonging to an international network of curators and developing a culture of good practice are important means of improving standards;
c. Key collections should have a mandate for specific subgroups (e.g. EAHB, plantains);

II. Characterization

a. Characterization links directly to good management of collections. By identifying and eliminating duplicates and synonyms the number of accessions and consequently management costs can be reduced. Data exchanges are essential to establish a process of eliminating synonyms. Duplicates may also be held in regional collections.

II. Collecting

a. Priority areas for collecting in Sub-Saharan Africa are:
    i. The Congo basin (Democratic Republic of Congo, Gabon, Guinea Conakry, Southern Cameroon, Congo)
    ii. Kenya (Taita hills and Gikuyu Mountains)

   It would be interesting to prioritize the collecting and conservation of plantains according to their ecotypes or ecosystems (e.g. drought tolerance, resistance to Banana Xanthomonas Wilt (BXW)). Approaches should be strategic and based on long-term thinking to address future challenges.

III. Distribution of clean material

a. Two regional multiplication centres should be set up for SSA:
    i. One for West & Central Africa
    ii. One for Eastern & Southern Africa;

b. Distribution between countries should be restricted strictly using virus-indexed material originating from ITC;
c. It is of equal importance that a strategy for distribution within country takes account of diseases like Banana Bunchy Top Virus and BXW. Commercial propagation centres need to be monitored. Some technologies are available in the form of:
    i. Virus indexing kits used by certified national laboratory (e.g. Univ. Bujumbura in Burundi)
    ii. Screen houses (e.g. under study in the Philippines)
    iii. Rapid multiplication (ex: PIF technique in Cameroon);
d. The national capacity to handle *in vitro* plantlets needs to be strengthened;
e. Better facilities and training for international quarantine is needed and standards followed (e.g. FAO phytosanitary programme and the Inter-African Phytosanitary Council);
f. The material most frequently requested should be used to set up a multiplication centre using low cost propagation systems (e.g. National repository, multiplication and dissemination centres in Asia).

Developing the strategy documents at regional and global level:

The development of the strategy document was discussed. It was recognized that the role of collections and the procedure to achieve the four objectives need to be elaborated. It will be relevant to incorporate some of the outputs of this meeting into the document. Regional strategies should be developed for geopolitical areas to complement the global strategy. Individuals in the TAG should be identified to lead the development of strategies specific to different regions (e.g. Jeff Daniells for Pacific, Deborah Karamura for SSA) and these individuals should work with the TAG to ensure that the regional strategies are rationalized, based on a sound taxonomic basis and complementary to the global level strategy. The regional strategies will provide a means to elaborate on the role of collections, the detailed procedures for achieving the four objectives and the hotspots and priority activities specific to each region. The regional strategies should be presented and discussed at the regional network meetings.

Day 5 – Friday 02 June

Session: Promoting the use of diversity

Breeders (in the widest sense of the term) are the most important users of information on diversity:

Ines informed the group that 5% of the users are breeders but 50% of the users are requesting materials for evaluation. This indicates the need to think of

breeders in the broadest sense of the term, including national breeding programmes.

The feedback loop between collections, breeders and the ITC is not strong and it will be important to understand how materials are used and what impact they are having. Other collections are rarely asked by breeders for materials or information on their materials. The networking between collections and breeders needs to be strengthened and INIBAP could play a role in helping breeders to target their work, broaden the genetic basis of breeding efforts and identify market potential.

Addressing the information needs of germplasm users requires more strategic thinking in terms of data gathering, quality control, analysis and provision:

There is no analysis of the information in MGIS and its use depends very much on the guesswork of experts as to what should be taken as good information and what is lacking in accuracy. Furthermore the information breeders need relates to fertility, post-harvest qualities and use of cultivars elsewhere, which is not available in MGIS. The reference set of cultivars may provide a starting point for gathering complementary data on quantitative traits, uses, etc. However, we should be realistic in our expectations of MGIS and care should be taken to assess what are priority datasets and how they should be analyzed. Thought should also be given to the practicalities of collecting these data. In some cases, researchers may not be willing to share evaluation data.

Evaluation has an important role in promoting use:

An organized programme for the evaluation of a range of traditional cultivars and wild species to abiotic and biotic stresses would be highly useful. A new, well-targeted phase of IMTP may be appropriate. The traits for evaluation and the germplasm to be evaluated should be carefully considered in consultation with an expert group. The importance of analyzing the results using strong statistical methods was stressed. INIBAP mentioned that there has been some difficulty in getting back good-quality data from participants in previous IMTP phases.

As a community, we need to know what we are talking about in terms of the classification of germplasm subject to research and evaluation. There is a clear need to ensure the broad characteristics of diversity to subgroup level are understood at large (ref. to Action point 2). While there is some logic in waiting for this common understanding of the diversity to be achieved first, we should not hesitate to start work on evaluating materials. A new phase of IMTP would be welcome to study a range of cultivars for specific traits. The reference set of cultivars would be appropriate subjects for evaluation.

The use of the ITC code as a general reference would help in the understanding of varietal research and evaluations:

A general reference is needed to identify accessions. The ITC code is widely used and it should become standard practice to quote the ITC code for any germplasm under research or evaluation. The accession code from the original collection should also be quoted, especially where the material is not present in the ITC collection. Where no code is available it might be appropriate to apply the ISO country code and a 3 digit number (e.g. VIE 001 for an accession from a Vietnam collection). In summary the ITC code should be used as a general reference together with the accession code from the original collection.

The importance of the issue of legal and physical accessibility of material to promoting use of diversity was recognised but not explored.

Finally, a point was made that national collections need hardware to manage data. By raising awareness of the value of MGIS and associated data this may support curators to lobby their research managers.

Session: Open session

Using Simmonds Scoring card system:

A presentation of Simmond's 15 descriptors was made, which stimulated discussion on its applicability in the context of present-day knowledge. The Simmonds score system is limited in some areas because it was formulated at a time when researchers had access to less knowledge and diversity than is available now. While it is recognised that some descriptors are more effective than others and there are idiosyncrasies in their application for different subgroups or in different parts of the world, the tool is still effective for routine, rough approximation. It was agreed that the system was still valid to derive a first approximation of the degrees of A and B in the genome and therefore possible genome groups.

It is stressed that Simmond's system is not designed to precisely confirm subgroups and that other tools are complementary. Nevertheless Angela Kepler's presentation illustrated very well the different descriptors, the variation existing within subgroups that sometimes evades easy classification and the fallibilities of the system. This presentation might be further worked on to provide a training tool and reference for the use of the Simmond's system.

Determining a minimum set of photo descriptors to illustrate morphological descriptors

The proposed minimum set of photos developed for expert verification of varieties for trueness-to-type (see Annex 5) was presented and discussed. It was agreed that the proposed photo set, while adequate for the range of varieties in the trueness-to-type verification, should be further developed for use in characterization.

Further photos are likely to be necessary for wild species or within subgroup characterization and will be specific to the subgroup studied. Further advice is reported in the adjacent box.

Additional guidelines for taking photographs for use in identifying or verifying trueness-to-type provided by the TAG

- The setting of the camera should be noted and the macro setting is best for close-ups.
- The bunch should be taken from the side to get the general shape instead of from the front. Photos should be taken as close as possible to maturity.
- For the hand, the third hand is preferred. Cut off the hand and take a shot from above.
- Cut the leaf for a shot of the petiole base
- Take a shot of the entire plant with someone or an object for the scale.
- Leaf number at flowering is constant at the cultivar level and should be noted.
- Photograph the accession label first and then the sequences of related photos to ensure correct identification when the photos are downloaded.
- Complete the data form to highlight any points that may not be obvious in the photos, including comments on anything unusual.
- The seed can provide crucial information and should be photographed where present.

Confirming the procedure for verifying trueness-to-type

The procedure for verifying the trueness-to-type of ITC accessions to be carried out by the five participating institutes was presented to the TAG. Advantages of taking data on the first or second cycle or both were discussed and the following steps were agreed:

1. During first cycle obvious off-types (OT) and mis-labelled (ML) accessions should be screened out from those which are true-to-type (TTT). At least a minimum set of photos of all the accessions should be taken during the first cycle. For the OT and ML accessions, photos and a description of the non-corresponding characters should be taken.
2. Observations of the first cycle (photos and descriptors list) will then be submitted to the TAG to confirm their status.
3. All accessions (TTT, OT and ML) should remain in the field for the second cycle observation.
4. During the second cycle, all accessions (TTT, OT and ML) should be described using the minimum set of photos (15) and the full descriptor list (121).
5. The complete list of descriptors and photos for each accession will be submitted to the TAG to confirm the TTT accessions.
6. All data will be entered into the MGIS database
7. At ITC, the OT and ML accessions will be discarded and if possible the original genotype should be sought.

Day 6 – Saturday 03 June

Session: Follow up steps

Continuing the activities of the TAG:

There is clear support to continue the activities of the TAG. Its purpose would be to function as an expert advisory group to provide guidance to INIBAP in the implementation of the activities of the Strategy. A core group should be identified of molecular and morphological experts representing the range of taxonomic subgroups. Other disciplines, for instance breeding, will be to some extent represented in the group by default but otherwise will be called upon as necessary. In this respect linking with the Pro*Musa* working groups would be important and achievable either through members of TAG or through INIBAP. Similar Pro*Musa* may wish to call upon the TAG.

It is proposed that the TAG operates through the use of:

- A web forum and emails
- Tasks with attributed moderators
- Meetings

TAG web forum:

TAG members will communicate through a closed web forum. Additional experts, who are not present at the meeting, will be invited to participate. In addition, further non-taxonomic expertise may be invited to contribute. INIBAP will host the site and provide general moderation. The example of the forum in the coffee genomics group was used as a model. A site in which photographs could be downloaded and shared was also considered to be useful. The potential use of a kind of wikipedia to allow the gradual evolution of datasets related to the reference cultivars through interactive definition was proposed and considered a possible approach for future development of information products.

Immediate tasks for the TAG:

The TAG has assigned itself tasks. These will be led by a moderator in consultation with the group. The discussions will be held through the web forum and all participants in the forum will be invited to contribute. The task moderator will be responsible for guiding the discussions and bringing in external expertise as necessary. If no activity is apparent after six months the moderator will be asked to provide an update of progress.

Identified tasks are as follows:

1. **MGIS & *Musa*logue:** *To develop information tools for accessing accurate characterization data at the accession and variety level to aid the selection and use of* Musa *diversity* (moderator: Jean-Pierre Horry & Elizabeth Arnaud).

This task relates to discussions and recommendations made regarding MGIS earlier in the meeting. The development of *Musa*logue should also be included. A proposal is made to use the reference cultivars and the characterization data collected as part of Task 3 to develop a third *Musa*logue, which will include more photos plus additional evaluation information and application of the Simmonds scoring system. The model might be expanded to specific subgroups which might be published subsequently.

2. **Wild species and threatened cultivars:** *To evaluate the status of wild species and threatened cultivars with the aim of ensuring that genetic diversity is conserved for present and future use* (moderator: Uma S. & Charlotte Lusty).

   The aim of this group is to validate wild species and underutilized cultivars or landraces, which may provide an important source of genetic diversity and assess their status (e.g. Pacific plantains). Reference was made to the need for using molecular tools to help verify the unique status of the species. The IUCN Red List categories should be used to highlight the degree of threat affecting these populations. Priority areas or 'hotspots' for collection should be identified. The group should as a first step identify how they wish to address the issue and present an 'issue paper' to the forum.

3. **Improving characterization:** *To improve the characterization of* Musa *(initially up to the subgroup level) through the comparative study and documentation of a set of reference cultivars* (moderator: Jeff Daniells & Nicolas Roux)

   This task relates to Action point 2.

4. **Rationalizing collections:** *To agree and implement a procedure for rationalizing the collections within the ITC* (moderator: Ines van den Houwe & Charlotte Lusty).

   This task involves providing advice to the field verification process and discussing the rationalization and strengthening (filling gaps) of the ITC collections (as defined on P. 11)

5. **Nomenclature and synonymy:** *To develop an accepted nomenclature and glossary of terms by which the Musa research community and beyond may communicate and understand each other* (moderator: Edmond de Langhe & Elizabeth Arnaud).

   A nomenclature which responds to botanical standards should be developed. INIBAP will then play a role in eventually ensuring the agreed nomenclature is regularly applied.

Using standard terminology (e.g. 'landraces'):

A discussion was held on the understanding of 'landrace'. The term in the correct sense should not be applied to a clonal crop because of the absence sexually reproducing populations. However, it is recognized that the term (as it is used in India) refers usefully to traditional cultivars that are not commercially important but have been developed and are used by marginal groups. Other terms such as traditional cultivar or underutilized crop are more generic.

Future steps:

1. The meeting report will be produced in draft form by INIBAP and circulated for review by the meeting participants.
2. The web site and forum will be set up (3-6 months) using the model of the coffee genomics group and organized according to the identified tasks. One of the first tasks will be to finalize the draft list of cultivars to be included in the reference set.
3. The timing of the next meeting will be determined by the degree of progress or achievement of tasks. Deadlines for tasks were discussed. Most were considered to be relatively lengthy activities. The nomenclature task should be one of the first to be completed. It was thought this might take one year and that a meeting may be held some 6 months after that. The idea of holding the next meeting in India will be pursued.

Summary of Action points

The Action points of the discussions are summarized here. Most actions fall naturally within the remit of one of the Tasks described above. Special attention should be given to Action points 1 and 6 for which responsibilities and actions have not been identified. These points should be the focus of discussions in the TAG forum to determine how they should be addressed. It is recognized that many of these activities will need to be 'projectized' and receive funding.

Action point 1: Edible AA diploids represent the range of ancestral genotypes of most cultivated *Musa* and an important source of genetic traits, but they are still a significant source of taxonomic uncertainty. They should, thus, be a priority for further molecular characterization using SSR markers. This action does not relate to one of the TAG tasks but could be achieved through a relatively simple research project. How this action will be carried out and who will take responsibility should be discussed and agreed in the TAG forum.

Action point 2: A set of reference cultivars should be agreed to act as means for:

- GxE studies
- Providing a reference for comprehensive molecular and morphological characterization (with photographs) through which all collections may communicate

- Training at a national/subnational level.

This reference set of accessions (or possibly a comprehensive set of photos relating to the reference cultivars) should be sent to 3-4 expert collections. Each expert will characterize the cultivars from the photos or the plant and a standardized set of morphological and molecular characters and procedure for characterization will be agreed and disseminated to all collections. The reference cultivars and the comprehensive dataset of their characterization should be made available in MGIS. Action to be taken by TAG task 3.

Action point 3: TAG is in the best position to review the taxonomic status and nomenclature of *Musa* and actively develop an acceptable *Musa* checklist, building on checklists already available (e.g. David Constantine's internet-based checklist, Kew's Monocot checklist). Additions or changes to the checklist should occur through an accepted procedure (e.g. by providing both molecular and morphological evidence. Mass propagation and the selfing of F1 progeny were also proposed). Action to be taken by TAG task 5.

Action point 4: An article should be produced in INFO*MUSA* introducing the concept of TAG, providing a statement of the current status of *Musa* taxonomy and suggesting a framework within which the *Musa* community might carry out research. Action to be taken by INIBAP in collaboration with the TAG.

Action point 5: For classification to subgroup level researchers should eventually have at their disposition a minimum set of descriptors, photos and 10 SSR markers to aid correct identification. The *Musa* Genome Resource Centre at IEB holds the DNA samples for the GCP minicore and would be willing to safekeep and distribute the SSR primers. The study of the reference set of cultivars will provide the opportunity to consolidate the minimum sets and compile a minimum characterization toolkit. Action to be taken by TAG task 3.

Action point 6: For classification within subgroups individual specialists should develop a range of complementary methods, descriptors (including molecular markers) and best practices for identification specific to the subgroup which should be reviewed by experts (TAG). To aid the process INIBAP should generate more dialogue between experts and curators. This action is not specifically attributed to a task but may be considered as a longer term task to follow on the activities of TAG task 3.

Action point 7: A working group should be set up to devise a procedure for the rationalization and use of the ITC collection and subcollections, both to eliminate duplicates and to ensure cost-effectiveness in the conservation and use of the base collection. The impact assessment planned by INIBAP

will be essential to understand the use to which disseminated germplasm is being put. Action to be taken by TAG task 4.

Action point 8: There is a need for a subgroup of experts within the TAG to provide oversight for MGIS not only for taxonomy but also for the development of the content of the database. Priority uses and users for the database should be clarified. Action to be taken by TAG task 1.

Action point 9: Wild species and threatened traditional cultivars should be more proactively conserved through an approach of prioritization and strategic use of complementary conservation approaches. A 'wild' task force will be set up, made up of collectors and taxonomists, to develop information on wild species and prepare a session for more in depth discussion at the next TAG meeting. Action to be taken by TAG task 2.

Unresolved issues remaining at the end of the workshop

- Data are already available from RFLP analysis of PNG material as part of the World Bank Banana Improvement Project in Tropgene and molecular characterization of AA diploids carried out by Francoise Carreel should also be made available. GCP could have a role in analyzing all available data but we should not wait for the latest GCP results to make use of already existing datasets.
- What to do with Ensete?
- Evaluation of disease resistance in wild species is also priority.
- Separation of Maoli from Pōpō'ulu

Annex 1 — Actual meeting agenda

Approx times	Discussion item	Presenters/ Facilitators
MON	**Session 1 - Welcome & setting the scene**	
8.30	***Being strategic about conservation.*** General presentation of the Global Conservation Strategy for *Musa* with a focus on the four main elements: characterization/rationalization, conservation, safe exchange and promoting use. Given the successful implementation of the strategy ideas what are the hoped-for outputs and outcomes? What activities and projects are under way today which contribute to the aims of the strategy.	*Presenters:* *C. Lusty,* *E. Arnaud* *N. Roux*
9.05	**Brief introduction to the meeting agenda and outputs**	*C.Lusty*
9.15	**Overview of the evolution and taxonomy of *Musa.*** A comprehensive overview of the evolution of the cultivated crop. Summary of each major cultivar group and commentary on where difficulties or grey areas exist.	*Presenter:* *E. de Langhe*
BREAK		
	Session 2 - Focusing on taxonomy: morphological and molecular perspectives	
10.30	***Characterization of germplasm using flow cytometry and chromosome analysis***	*Presenter:* *J. Dolezel*
11.00	***Twenty years of molecular markers in Musa research:*** Overview of research using molecular markers	*Presenter:* *F-C. Baurens*
11.20	***First results of the Generation Challenge Programme***	*Presenter:* *N. Roux*
11.40	***Pacific Plantains: basic morphological descriptors for Maoli, Popoulu and Iholena sub-groups***	*Presenter:* *E. de Langhe for A. Kepler*
12.00	***Genetic and epi-genetic diversity of African plantain***	*Presenter:* *F-C. Baurens*
LUNCH		
14.00	**DISCUSSION**: a) Understanding potential contributions and limitations of molecular research, defining any areas of taxonomy needing further research; b) Reviewing the *Musa*logue classification system, data quality validation processes, identifying a set of reference varieties for molecular research and morphotaxonomy;	*Facilitator:* *C. Lusty* *Chart-writer:* *N. Roux*

TUE	**Field Trip to Njombe collection**	
WED	**Session 3 – Characterization & rationalization**	
8.30	***INIBAP Transit Centre: Approaches to verifying and rationalizing the collection.*** Present processes for medium & long-term conservation and verifying accessions for trueness-to-type. Future direction for rationalizing conservation efforts.	*Presenter:* *I. van den Houwe*
9.00	***Characterization in national collections: present status and constraints in Indonesia***	*Presenter:* *A. Sutanto*
9.30	***Characterization of plantain in West and Central Africa***	*Presenter:* *K. Tomekpe*
10.00	**DISCUSSION:** a) Reviewing a minimum 'package' for characterization; revisiting IPGRI descriptors. What tools: identification key, minimum set of photos, *Musa*logue? b) What should be the key constituents and process for developing a core collection for the ITC?	*Facilitator:* *J-P Horry* *Chart-writer:* *E. Arnaud*
BREAK		
11.00	**DISCUSSION CONT:**	
LUNCH		
	Session 4 – *Musa* Germplasm Information System	
14.00	***MGIS: data quality, validation and analysis****:* Developing standards, improving data quality and facilitating the use of MGIS, including the development of a taxonomic key. Linkages to other information portals (e.g. SINGER, Global Biodiversity Information Facility).	*Presenter:* *E. Arnaud*
14.30	**DISCUSSION:** a) Brief review of the main objectives, strengths and weakness of MGIS; b) Collecting and making data of quality available to the broad range of potential users– tools and searches.	*Facilitator: C.Lusty* *Chart-writer:* *I. van den Houwe*
THU	**Session 5 - Priorities for complementary conservation**	
8.00	***Collection and status of wild species in Borneo and China***	*Presenter:* *E.de Langhe. for M. Hakkinen*

8.30	***Species and cultivars in India: priorities for collection and conservation***	*Presenter:* *S. Uma*
9.00	**DISCUSSION**: a) What is the conservation status of wild species: the levels of threat of extinction of wild populations? b) How might wild species be most cost-effectively conserved?	*Facilitator:* *J. Daniells* *Chart writer:* *C. Lusty*
BREAK		
10.30	***Coordinating conservation efforts in the Pacific.*** Challenges posed by the Pacific and the caveats in conservation there. How these challenges might be addressed.	*Presenter:* *J. Daniells*
11.00	***A case study for complementary conservation mechanisms.*** Conservation on-farm in East Africa. How does it work and how might it complement or be coordinated with *ex situ c*onservation efforts.	*Presenter:* *D. Karamura*
11.30	**DISCUSSION** a) What role might complementary mechanisms play in specific regions or parts of the conservation strategy?	*Facilitator:* *S. Uma* *Chart-writer:* *E. Arnaud*
LUNCH		
	Session 6 – An African Conservation Strategy	
14.00	***Ex situ* collections in Eastern Africa and issues affecting their management.**	*Presenter:* *D. Karamura*
14.30	**Constraints and opportunities surrounding the collection in Burundi**	*Presenter:* *F. Ngezehayo*
15.00	**Constraints and opportunities surrounding the collection in DR Congo**	*Presenter:* *B. Dhed'a Djailo*
15.30	**DISCUSSION**: **Target discussion outputs** a) Major constraints for conservation in Africa. Essential constituents for the conservation strategy for Sub-Saharan Africa (consider germplasm movement, health, availability and links to seed systems). b) Needs for collecting material?	*Facilitator:* *D. Karamura* *Chart-writer:* *N. Roux*
FRI	**Session 7 - Promoting the use of diversity**	
8.30	***Responding to the needs of users.*** Overview of constraints to using diversity in breeding and how they might be addressed.	*Presenter:* *J-P Horry*

9.00	***Responding to the needs of users.*** Using molecular tools in breeding. What are the information needs of the grower or processor?	*Presenter:* *A. Tenkouano*
9.30	***Adding value to diversity using information tools:*** **MGIS, GIS**	*Presenter:* *A. Sutanto*
10.00	**DISCUSSION**: a) How to address constraints to using diversity? b) What information and tools are needed to promote the use of diversity to different users? c) How to ensure the feedback loop functions from breeders/users to collections so that the priority varieties being conserved and evaluated are those that will be used?	*Facilitator:* *J. Dolezel* *Chart-writer:* *C. Lusty*
BREAK		
	Open Session 8	
11.30	Feedback from working group on collection terms and definitions	*Presenter: J-P. Horry*
12.00	Feedback from working group to determine the cultivars and species for inclusion in the reference set	*Presenter: E. de Langhe with E. Arnaud & I. van den Houwe*
LUNCH		
14.00	***Overview of Simmonds Scoring system***	*Presenter: E. de Langhe for A. Kepler*
14.30	***Further introduction to epigenetics***	*Presenter: F-C. Baurens*
15.00	**DISCUSSION:** 1. Minimum set of photo descriptors 2. Field verification	*Facilitator:* *C. Lusty*
SAT	**Session 9 – Workshop summary & role and next steps of the TAG**	
9.00	**DISCUSSION:** Determining the tasks and responsibilities of the TAG	*Facilitator:* *C. Lusty* *Chart-writer:* *N. Roux*
BREAK		
11.00	Finalize next steps	*Facilitator:* *C. Lusty*

Annex 2 — List of participants

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The following participants were unable to attend the meeting but provided presentations that were given on their behalf				
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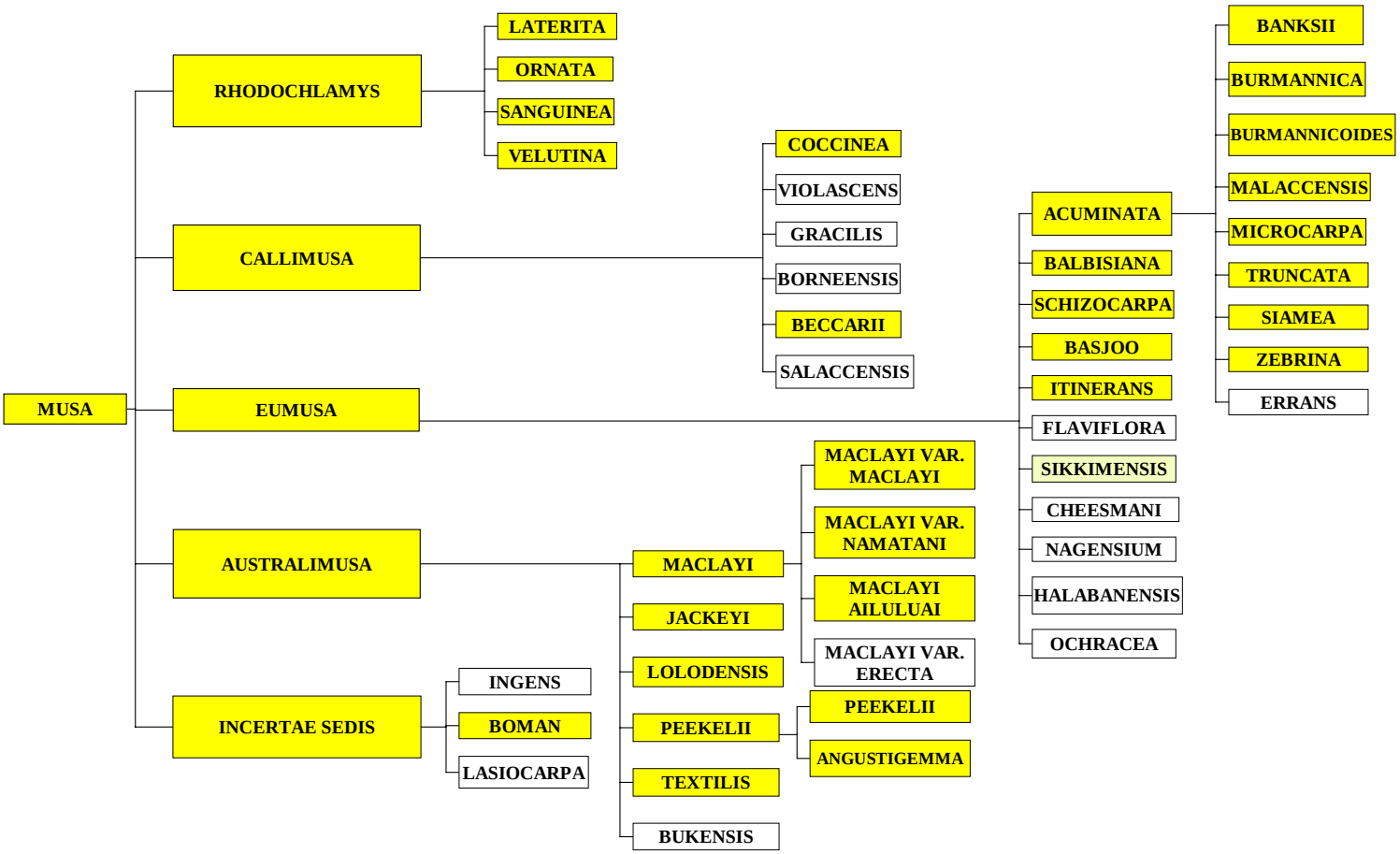
Annex 3 — List of reference cultivars drafted during the workshop

	Section	Species/ group	Sub-species/ subgroup	Name	ITC code	Record number in MGIS	Remark
1	Eumusa	*acuminata*	*burmannicoides*	Calcutta 4	ITC0249	NEU0017	
2	Eumusa	*acuminata*	*banksii*	Paliama (PNG067)	ITC0766	NEU0079	
3	Eumusa	*acuminata*	*zebrina*	Zebrina	ITC1177	NEU0029	
4	Eumusa	AAcv	Cooking AA	Tomolo (PNG023)	ITC1187	NEU0082	
5	Eumusa	AAcv (18)	type P.jari buaya	Pisang Jari Buaya	ITC0312	NEU0117	
6	Eumusa	AAcv (2)	type P.mas	Pisang Mas / Figue Sucrée	ITC0653	NEU0108	
7	Eumusa	AAA	Lujugira/Mutika (beer)	Intokatoke	ITC0082	record to be sent	
8	Eumusa	AAA	Lujugira/Mutika (cooking)	Mbwazirume	ITC0084		
9	Eumusa	AAA	Red	Red Dacca	ITC0575		
10	Eumusa	AAA	Rio	Leite	ITC0277	NEU0226	
11	Eumusa	AAA	Cavendish	Petite Naine	ITC0654	NEU0174	
12	Eumusa	AAA	Ibota	Yangambi KM5	ITC1123	NEU0212	
13	Eumusa	AAA	Gros Michel	Gros Michel	ITC1122	NEU	
14	Eumusa	AAA		Pisang Berangan	ITC1287		
15	Eumusa	AB cv		Safet Velchi	ITC0245	NEU0152	
16	Eumusa	AAB	Popoulu/Maia Maoli	Popoulu	ITC0335	NEU0277	
17	Eumusa	AAB	Pome / Prata	Foconah	ITC0649	NEU0298	
18	Eumusa	AAB	Figue Pomme / Silk	Figue Pomme Géante	ITC0769	NEU0285	
19	Eumusa	AAB	Pisang rajah	Pisang Raja Bulu, IDN 093	ITC0843	NEU0276	
20	Eumusa	AAB	Mysore	Pisang Ceylan	ITC1441	NEU0284	
21	Eumusa	AAB	P. Kelat	Pisang Palembang	ITC0450		
22	Eumusa	AAB	Iholena	Luba (ITC0802) (PNG) or Rukumanb (ITC0831) (PNG) or Tumay (ITC0874) (PNG) or Bira (ITC0875) (PNG)			
23	Eumusa	AAB	Plantain-French	Obino L'Ewai (0109) or Maiden Plantain (ITC0322)			
24	Eumusa	AAB	Plantain-false horn	Orishele	ITC1325	NEU0256	
25	Eumusa	AAB	Plantain-Horn	Baka (ITC0098) or Gabon 2 (ITC0017) or Ihitsim (ITC0121)			
26	Eumusa	AAB	Monthan				no virus-free Monthan acc in ITC
27	Eumusa	ABB	Saba	Saba	ITC1138	NEU0361	
28	Eumusa	ABB	Ney mannan	Ice Cream	ITC0020	NEU0353	
29	Eumusa	ABB	Pelipita	Pelipita	ITC0472	NEU0360	
30	Eumusa	ABB	Bluggoe	Dole	ITC0767		
31	Eumusa	ABB	Peyan	Simili Radjah	ITC0123	?	
32	Eumusa	ABB	Pisang Awak	Namwa Khom	ITC0659		
33	Eumusa	ABB	Kalapua				no virus-free Kalapua acc in ITC
34	Eumusa	*balbisiana*	type 4	Pisang Klutuk Wulung (IDN 056)	ITC1063	NEU0054	
35	Eumusa	*balbisiana*		Honduras	ITC0247		

Annex 4 – Representation of diversity at the ITC

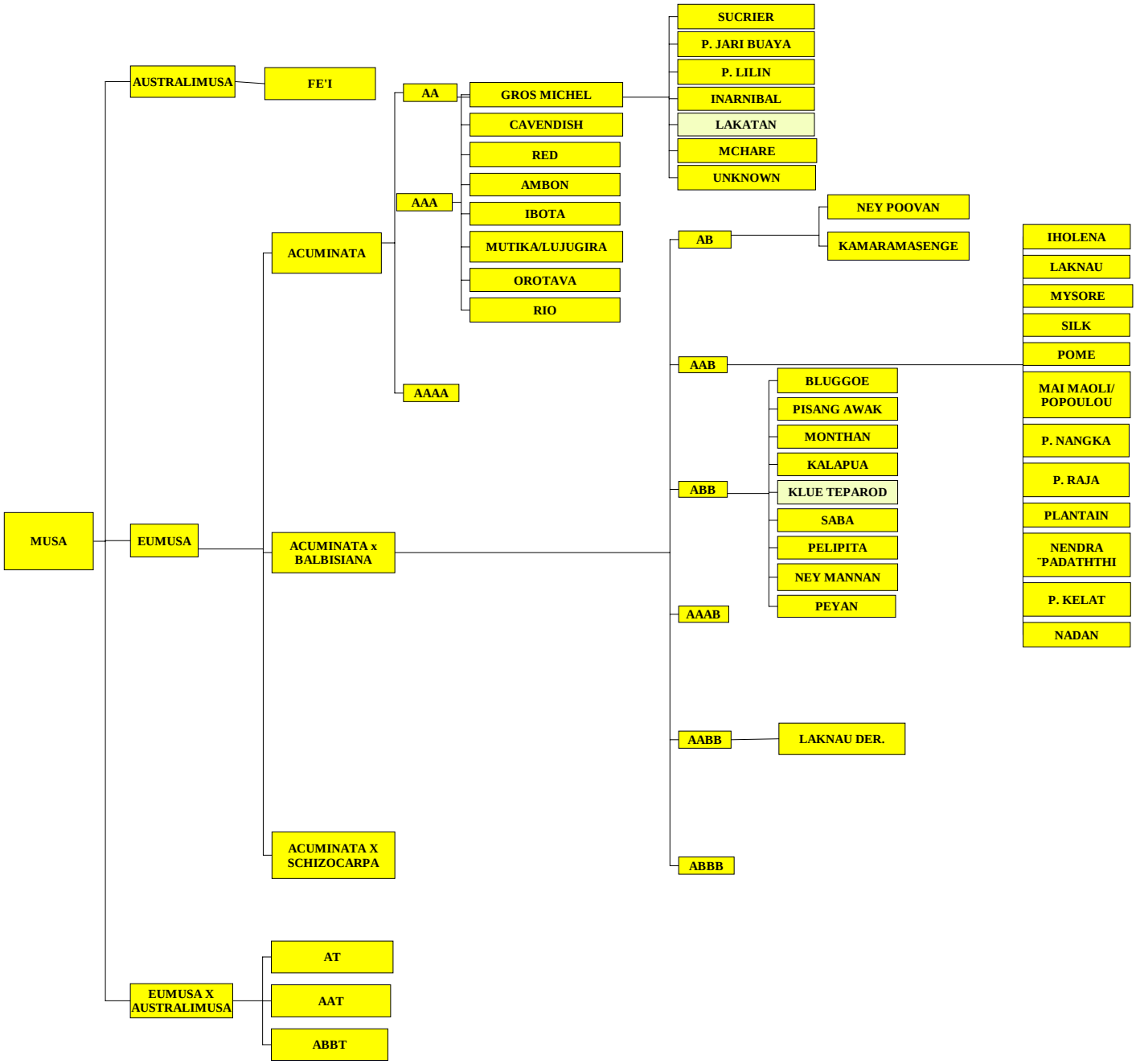
Wild species diversity currently represented in the ITC collection

(Yellow boxes are represented by accessions; white boxes have no accessions)



Cultivated species diversity currently represented in the ITC collection

(Yellow boxes are represented by accessions; white boxes have no accessions).



Annex 5 – Minimum photo descriptors

A.Bunch/flowers

Choose a plant for which the bunch has around 20 nodes on the rachis. Count them on one spiral starting from the last banana up to the male bud. It will ensure that the bunch is sufficiently developed.

1) **Male bud photo**. (never take the bud in shadow; reflect the light with a reverberating plate near the basis of the plant, oriented so as to get the light on the bud) Make sure (close up if needed) that the imbrications of the bracts is visible.

   - Remove one bract and see the internal colour (use colour cart as well) + the flowers in picture.

   - Lift flowers slightly: *for balbisiana, the colour changes at the basis* - Open one flower in order to see the colour of the anthers.

   - See the bract shape on one photo

   Comments: ABB, flowers show a reddish colour in various degrees.

2) **Bunch photo.**
   - Take it entirely in order to see the bunch orientation and the full rachis.
   - Close up
   - Take note of the number of hands/fingers second hand
3) **One Hand photo**.
   - Remove one hand in order to see how the one underneath is attached. Look at the pedicels to see how they are attached to the rachis (long, short, inexistent, etc)

   - The pedicels and the apex of more than one fruit on the removed hand should be visible on the photo. When fruit are really curved take **separate pictures** of the pedicel and apex. Do not forget to take several fruits (around 5) on the same picture so as to see the apex variation within one hand.

   C*omment: several ABB have fused pedicles*

B. Vegetative part to be observed on a younger plant

1) Take the zone where leaf sheaths separate (= the 'neck of the pseudostem'). Make a close up on the petiole basis in order to see the black line on the border, the petiole wings and the blotches at the petiole basis. See if the leaf canal is opened or closed.
2) Take the full plant under several angles.
3) Plant measurement:

   - Pseudostem height

   - Pseudostem girth at the base