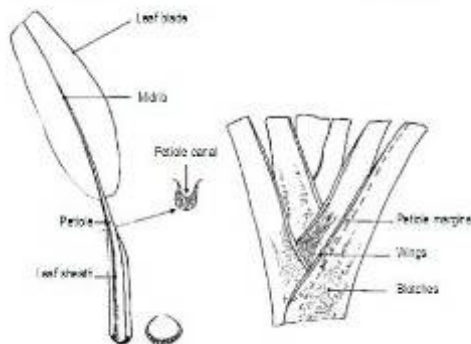


Morphological characterization descriptors : objectives, limits and appropriateness

J.P. Horry, S. Channelière

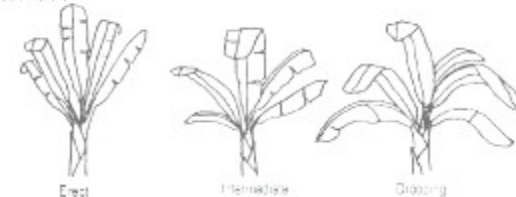
3. Petiole/midrib/leaf



4. Petiole canal leaf III



1. Leaf habit



Rationale and objectives

Conservation Strategy for Musa (2006)

Expected Output : “genetic diversity is comprehensively characterised and documented, taxonomy is harmonised, and collections are rationalised”

Taxonomy Advisory group (2006)

Implementation of the Strategy : « Limited characterisation is preventing users from rationalising collections, identifying accessions, understanding characteristics of subgroups and optimising the use of Musa diversity »

)S.Channelière, 2009(

Characterization : to describe the character of (a biological specimen)

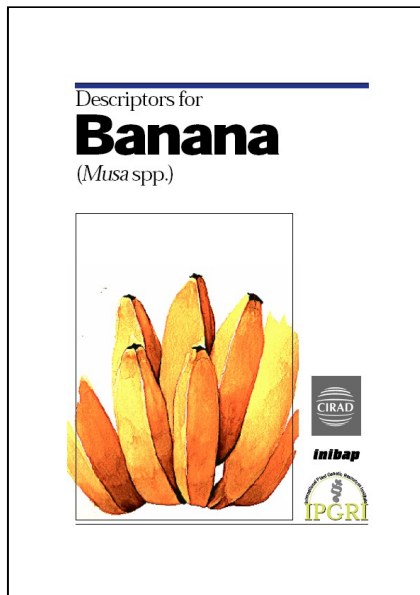
Identification : to determine the taxonomic position of (a biological specimen)

(source WEBSTER quoted by E. de Langhe)

Characterization

Characterization means using the necessary characteristics for *unequivocal description* of a particular cultivar.

- The descriptors booklet was published in 1996.
- Work from CIRAD/INIBAP/IPGRI, made in consultation with several Musa experts .
- Set of passport data descriptors, 121 morphological descriptors, evaluation descriptors.



- Many *Musa* collections have **not** been **systematically documented** ;
- Only **limited characterization** and evaluation data are available, and information may be scattered between several institutes ;
- The **descriptors** for *Musa* are often **ineffectively applied** where curators are working in isolation with little training.

Needs and constraints expressed at TAG

- Significant levels of **subjectivity** exist in applying descriptors even among experts, leading to different reading of the descriptors;
- **Little documentation** exists on how to use the descriptors and measure specific traits;
- **Illustrations and photographs** are missing that would vastly aid characterization;
- **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**.

Additional limits

- Heritability (broad sense) of the descriptors

A good characterization descriptor must be stable over environments.

The stability of the chosen descriptors have not been verified.

(if not heritable, the descriptors values could be dramatically different over environments)

- Growing conditions are not satisfying

To allow a good characterization, fertilization, pests and disease control, irrigation when needed, etc. are required.

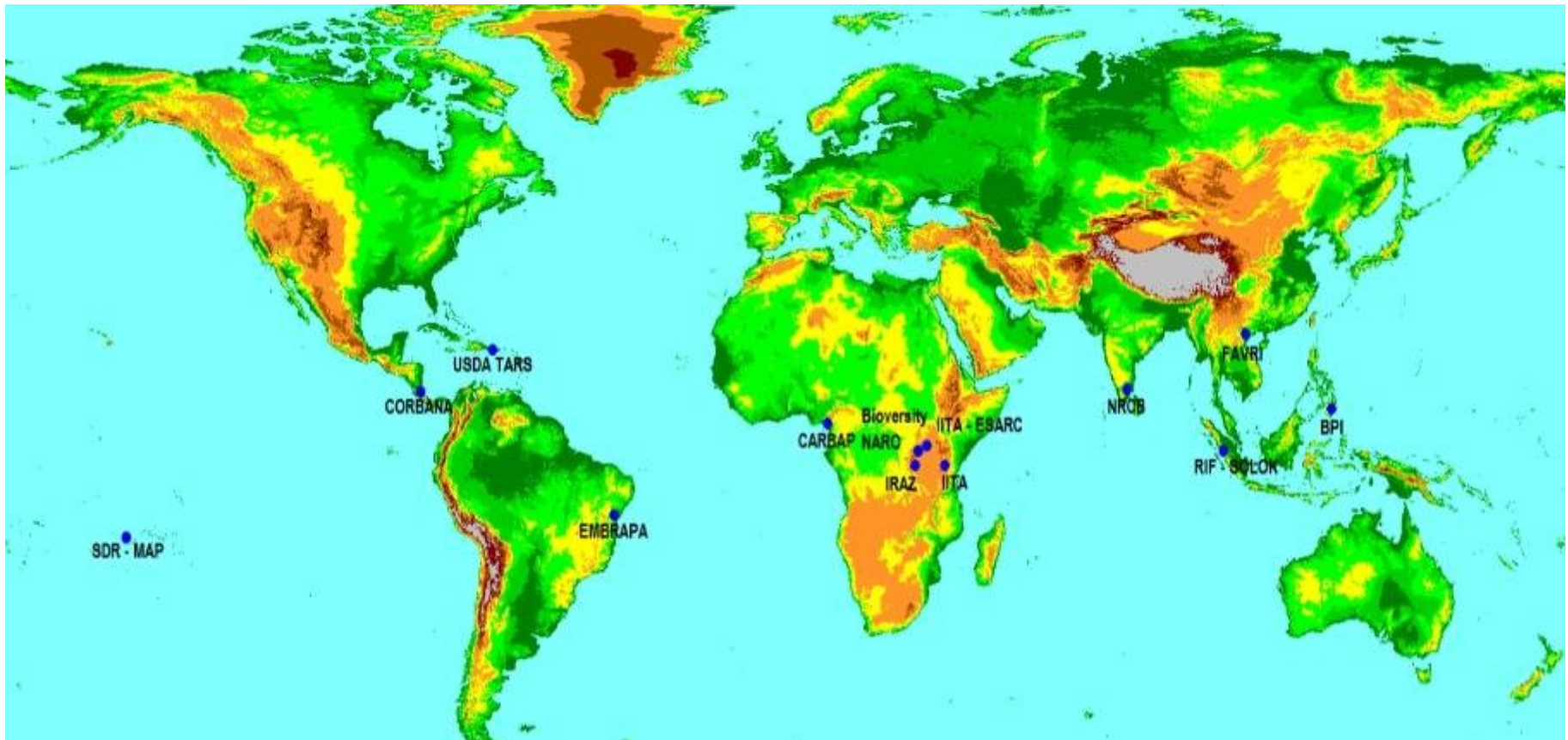
Accuracy of the descriptions : the reference collection

A set of reference cultivars representing the main Musa subgroups has been agreed at TAG 2006. This reference collection is to act as means for:

- Providing a **reference for comprehensive characterization** (with photographs) through which all collections may communicate
- **Training** at a national/subnational level.
- G x E studies: find out which are the most robust **descriptors across environments**
- Determine which descriptors are the most subjected to a **misinterpretation** by the observer.
- Enable the development / validation of a **standardized tool for classification** to a subgroup level >> use of a 'minimum set of descriptors' for ID to subgroup level.

Accuracy of the descriptions : the reference collection

Bioversity ITC is in the process of distributing this set of 36 accessions to 13 partner collections. These accessions will be described using the full set of characterization descriptors on the second cycle; a set of photos will be taken to illustrate the characteristics.



Accuracy of the descriptions : different readings



Collection 1	Collection 2
Bunch shape	
Assymetrical	With a curve in the bunch
Rachis position	
With a curve	Falling vertically



Bracts imbrication	
Young bracts overlap	Old bracts overlap



Accuracy of the descriptions : illustrating the descriptors

6.4.7 Bunch shape

1. Cylindrical with the bunch length $>$ to twice its diameter
2. Truncate cone shaped
3. Asymmetric - bunch axis is nearly straight
4. With a curve in the bunch axis
5. Spiral (all fruit are attached to a unique crown coiled around the stalk)
6. Cylindrical with the bunch length $<$ to twice its diameter



An alternative to the full descriptor list ?

- In 2006, a **minimum set of descriptors, including photos**, was developed empirically by TAG experts, as an attempt to establish a standardised procedure for routine morphological characterization of banana plants.
 - 30 minimum descriptors + illustrated guideline
 - 15 minimum photos

**Guidelines for documenting
the minimum set of descriptors for bananas**
Developed by the Taxonomy Advisory Group

INTRODUCTION

This document provides instructions on how to document with photos the most highly discriminating descriptors for bananas. Follow the sequence presented in these guidelines to determine when to take a photo and when to provide information on a given descriptor. Enter the value for each descriptor on the answer sheet provided separately. For those who have access to MGLS, enter the data in the database; otherwise send the answer sheet to Stephanie Chammone (scammone@cgiar.org) or Nicolas Roux (nroux@cgiar.org).

THE APPROPRIATE DEVELOPMENT STAGE FOR OBSERVATION

Between the bunch and the male bud, scars made by the fallen bracts (nodes) are arranged on the rachis along three interlarded spirals. Choose one of the spirals and count the number of nodes/scars along it. If there are 20 of them, the plant is at the right development stage for photos and description.

Bracts fall off at the rate of one a day. Counting 20 nodes on any of the three spirals means that the plant flowered 60 days ago. This is the point after which rapid change no longer occurs.



continue counting up to 20

The photo shows the first 10 nodes/scars of the first spiral, which continues on the back of the rachis. The spiral has to have at least 20 nodes/scars to be at the right development stage for photos and description.

The photos in this document were taken by: Angela K. Kasper, Hugo Volhaert, Inge Van den Bergh, Deborah Karamuna, Elizabeth Arnold and Richard Mackinnon.



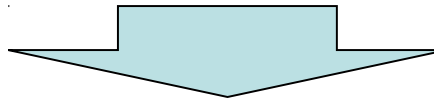
Workplan

Reference collection

- Which are the most robust descriptors among +120 (GxE, misinterpretation) ?
- Which are the most discriminating* ?

Minimum descriptors

- Do they satisfy the request for a reduction of the number ?
- Are they robust ?
- Are they sufficient ? (their capacity to discriminate* has been questioned)



Consolidated list of minimum descriptors

** at least at the subgroup level*

Identification

Identification means using the necessary characteristics (the same descriptors?) for **determining the taxonomic position** of an observed accession.

Identification requires far less descriptors than characterization

How?

- Expert knowledge, but few *Musa* taxonomists
- Hierarchical identification: based on Simmonds & Shepherd scoring system + keys to identify within subgroups (a development of this model is proposed by EdL)
- Probabilistic identification software (MUS.AIDwin) : comparison of a specimen to a reference database (MGIS)

Identification : hierarchical identification

“An experienced banana taxonomist, when puzzled about a new accession in collection or a cultivar in a village, will identify this progressively: the specimen belongs to what Group? then Subgroup? and then only: what cultivar? Why should any other user not learn to follow the same Identification/Determination sequence? “

)E. de Langhe(

Hierarchical cultivar identification system

Identification proceeding in three steps:

1. Group (AA/AAA, AAB, ABB...) based on Simmonds and Shepherd scoring system, using an extended list of 22 descriptors
2. Supgroup, using discriminant keys within an identified group
3. Cultivar, using discriminant keys within an identified subgroup

Pro's/contra's for developing the technique over the entire cultivar spectrum?

Identification : MUSA.AIDwin

Identification systems :

- global, based on a dissimilarity measure between accessions
- determination keys, based on some discriminant characters

MUS.AIDwin :

- an interactive determination system
- a probabilistic model

6.7.9 Fruit pedicel width

<i>True value</i>	1	2	3
1. Less than 5 mm	0.60	0.30	0.10
2. Between 5 and 10 mm	0.20	0.60	0.20
3. More than 10 mm	0.10	0.30	0.60

If the **2nd** modality is selected, the soft understands that the true value is :

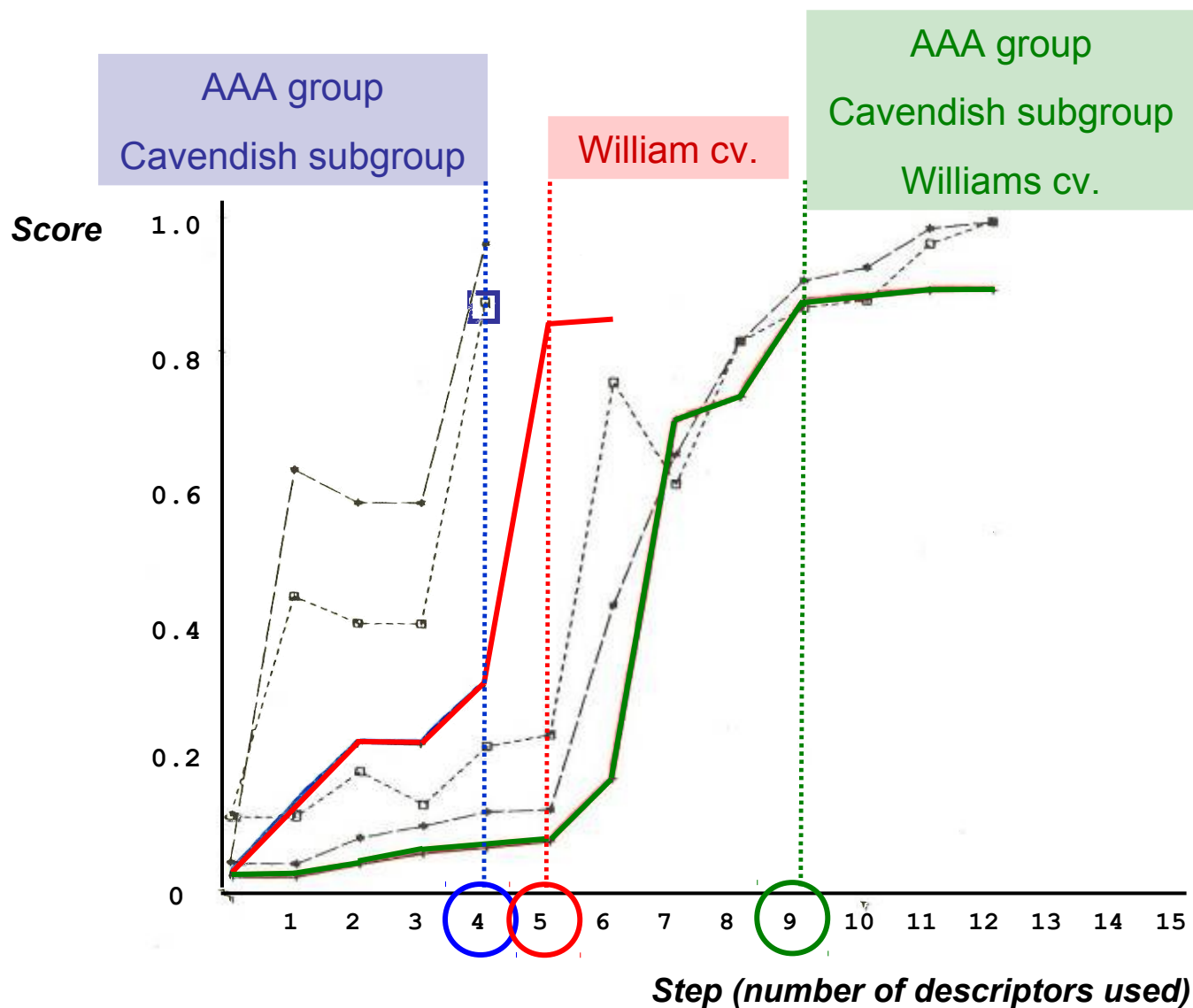
modality **1** with proba
modality **2** with proba
modality **3** with proba

0.20
0.60
0.20

Where a classical key understands :

0
1
0

Identification : MUSA.AIDwin



Discussion

Characterization

- To facilitate the scoring of the descriptors
 - Generalization of photo illustration?
- To simplify the descriptor list for a wider use
 - Adoption of a minimum set complemented with photos?
- To test the robustness of the descriptors
 - Reference collection project

Identification

- To help non-Musa expert in identifying specimen
 - Development of a hierarchical cultivar identification system
 - Generalize the use of MUS.AIDwin
 - Take into account the efficiency of molecular markers