Relationship between wild and cultivated yams: Case study of yam domestication in Benin

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Presentation of Benin

African country
Yam as important food tied-up with the cultures and tradition
Yam production (1000 tonnes) in 2004 is 1,025.51
Yam Area harvested (1000 Ha) in 2004 is 172.03
Yam Yield per hectar (tonnes/Ha) in 2004 is 13.12

Yam Genetic Diversity

Large genetic diversity of *Dioscorea cayenensis* Lam.-*D. rotundata* Poir. complex.

- Based on morphological markers : A total of 560 accessions of cultivated yams corresponding to 90 morphotypes were classified into 26 cultivar groups (Dansi et al. 1999).
- Based on isozymic markers : 467 accessions were identified as 227 different cultivars (Dansi et al. 2000).

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Very few cultivars are in a good situation

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Yam Genetic Diversity

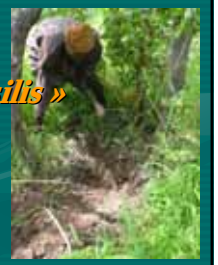
Linkages between varieties and wild species were established through a process named domestication which is practised by farmers.

Yam Domestication and Phylogeny

Collect of wild yam tubers

« *D. abyssinica* and *D. praehensilis* »

« 3 to 6 years of special cultivation practices »



Planting in farmers' fields

If satisfied with yam morphotype
(ie morphology and tuber food quality)

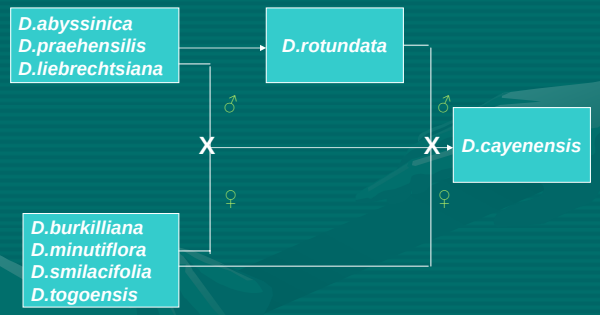
Multiplied and cultivated

« *D. cayenensis-D. rotundata* »

Yam Domestication and Phylogeny

- The starting point of domestication is a population of wild morphotypes characterized by very developed aerial part, a high capacity of flowering and setting fruits and a bitter tuber at various degree, not very bulky but difficult to collect because often very long. The effect of domestication is to attenuate or make disappear these disadvantages (Dumont et al. 2005).

Yam Domestication and Phylogeny(Continued)



Terauchi et al. 1992

Yam Genetic Diversity Constraints

- Yam farming landscape is changing : development of commercial production, based on limited number of varieties threatens the biodiversity.

GENETIC EROSION

- Domestication currently practiced by few farmers 1 to 15% depending on the culture area : Domestication is declining especially where yam production is market-oriented.
- Domestication practice can not be reproduced by researchers
- Taxonomic confusion

Purpose of this Work

- Translate farmers'criteria on morphological and/or molecular markers.
- Investigate the yam phylogeny.

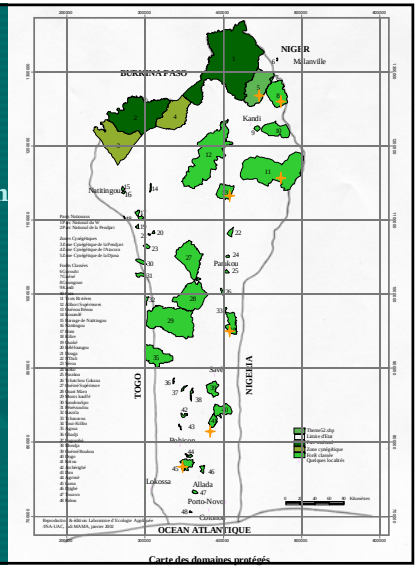
Survey to collect domesticable/non domesticable yams

Using a participative approach

- North : Ouénou/Bénou and Trois rivières.
- Centre : Toui-Kilibo.
- Sud : Lama, Ketou

53 *D. abyssinica* domesticables
38 *D. abyssinica* non domesticables
19 *D. praehensilis* domesticables
18 *D. praehensilis* non domesticables

Supplementary material :
Goungoun and Djona beyond the 12 parallele *D. abyssinica* wild type : 11 accessions



Carte des domaines protégés

Methods

- IPGRI descriptors : 44 descriptors.
- Ten Nuclear SSR markers developed on yam by CIRAD & IRD (Tostain et al. 2006)
- Three cpSSR markers (Bryan et al. 1999, Weising and Gardner 1999).

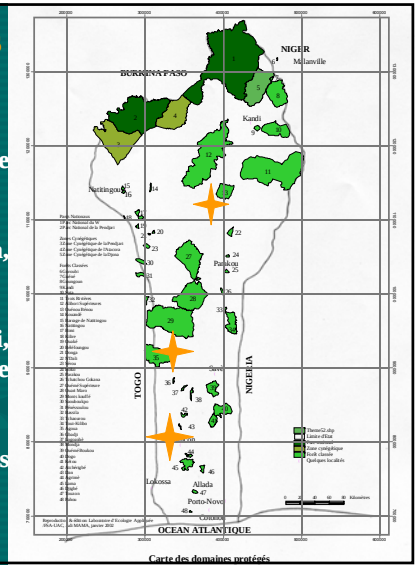
Survey to collect yams for phylogeny studies

North : Yarra, Wari, Fo-Boure and Gorobani villages

Centre : Banon, Lougba, Djagballo and Galata villages

South : Djaloukou, Konkondji, Lahongbon, Gohougbehoue and Djidja villages

A total of 148 accessions was collected.



Carte des domaines protégés

Methods

- **Five cpSSR markers (Bryan et al. 1999, Weising and Gardner 1999).**
- **Details on Chair et al. 2005**

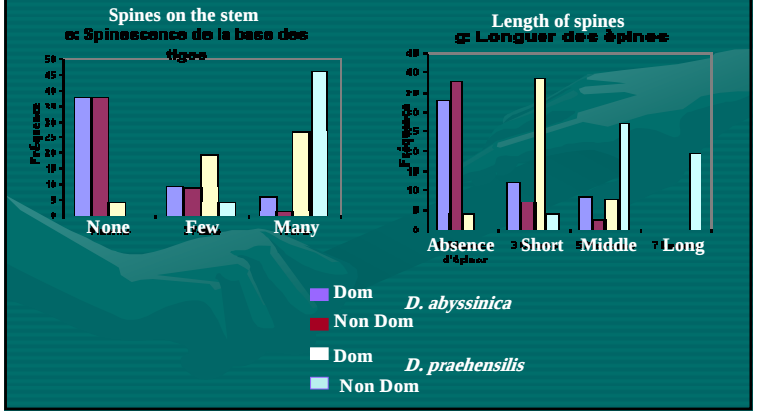
Farmers'knowledge

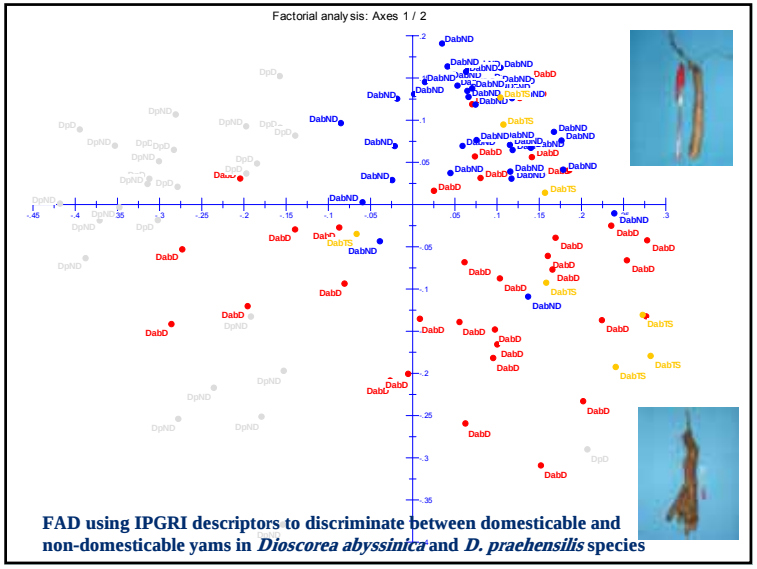
NORTH		Tuber	Stem	Leaves
Domesticable	**Digui Teingni**	Many roots	Stem slightly thorny	
	Digui Waaha	Very long, Without roots Many calli	Stem slightly thorny	
	Digou Wongourou	Strong roots at the head and small roots at the bottom part.	Thorny stem at the lower part. Cataphylls	
	Worou Dogorogou	Very long, Strong roots at the head and small roots at the bottom part.	Thorny stem at the lower part. Cataphylls	
Non domest	**Dika Yamberekou**	Tuber very small in diameter and very elongated. Rarely roots.	Stem slightly thorny bearing very small cataphylls.	big leaves with very distinct lobes

Farmers'knowledge

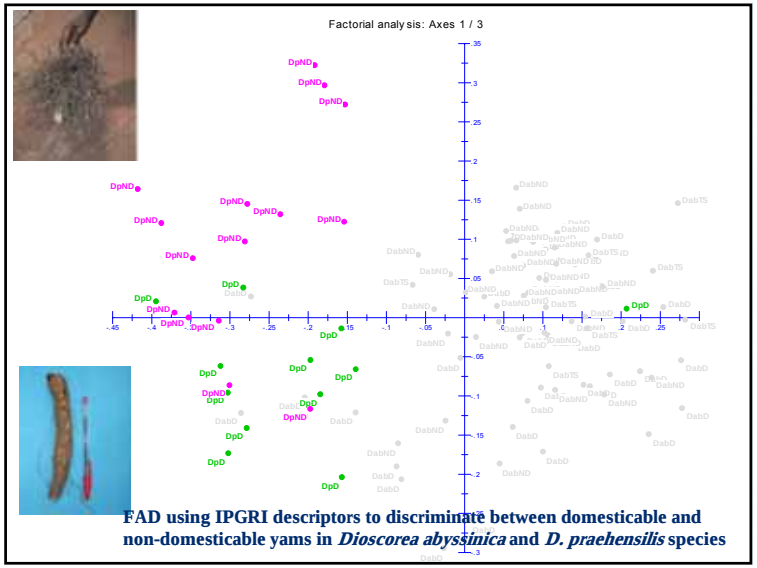
			Tuber	Stem	Leaves
CENTRE	Dom.	*D. abyssinica* more than *D. praehensilis*	*D. abyssinica*	*D. abyssinica*	*D. abyssinica*
	Non dom.	*D. dumetorum, D. togoensis, D. hirtiflora,D. smilicifolia, D. bulbifera, D. preussi*			
SOUTH	Domest.	**Dohoun Assi**	White flesh Poor in fibres Small crown of spiny roots	Small diameter Small Spines Cataphylls	
	Non domest.	**Dohoun Assou**	Reddish flesh Rich in fibres. Strong crown of spines can reach the soil surface	Thorny stem Large diameter Long Spines Big cataphylls	

Morphological characterisation





FAD using IPGRI descriptors to discriminate between domesticable and non-domesticable yams in *Dioscorea abyssinica* and *D. praehensilis* species



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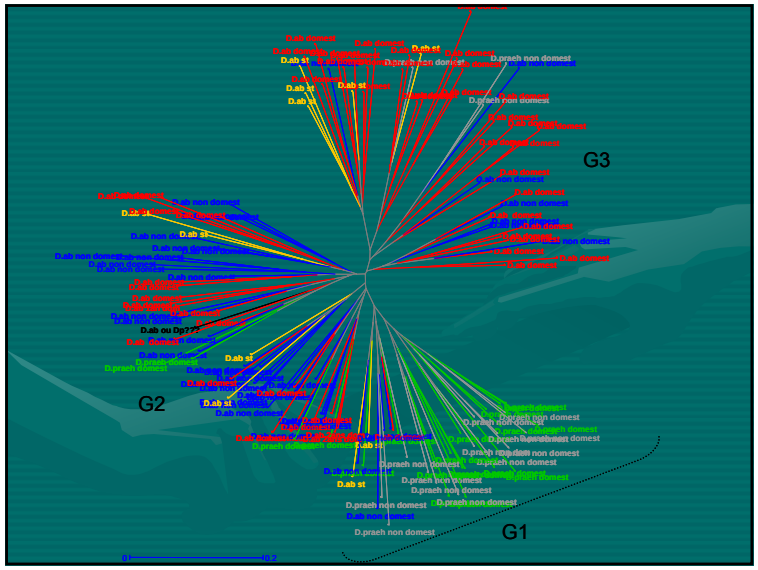
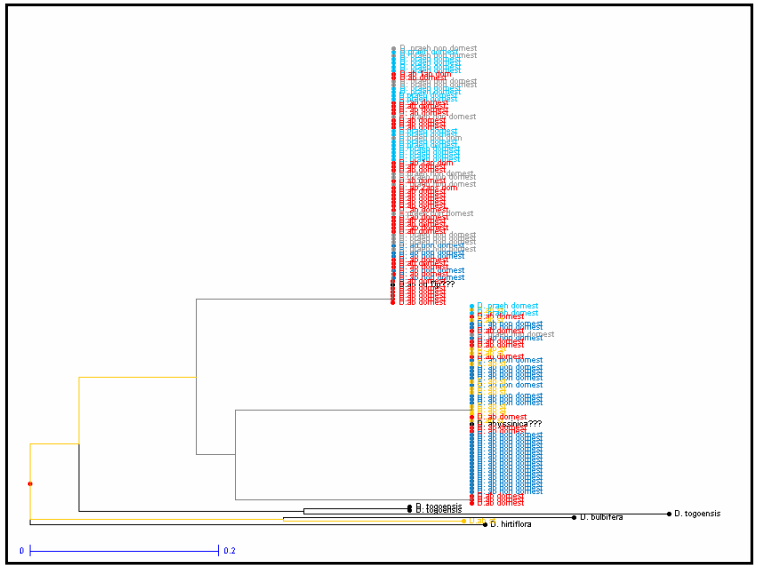


Molecular characterisation using cpSSR markers



PRODUCT OF DOMESTICATION

P.Vernier

FUTURE

- More investigation are needed to discriminate between domesticable and non-domesticable *D. praehensilis*.
- Supervising which yams were really successfully domesticated.
- To understand how different cytoplasms of *D. abyssinica* are related to domestication ability.

Yam Domestication

- The use of sexual reproduction of wild yams will increase the genetic diversity of cultivated yams by introducing new alleles and new combinations.

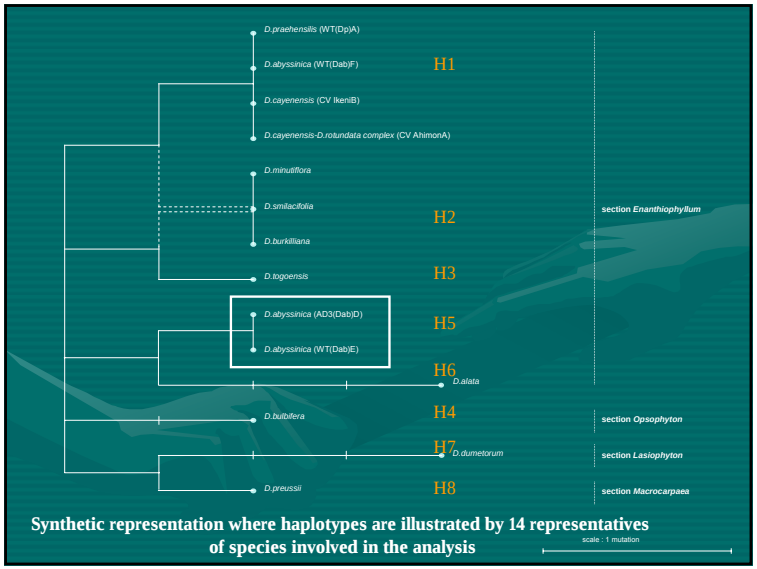
Yam Domestication

- Relative long-term advantage of sexuality : the potential for future adaptation will be preserved thanks to diversity created by recombination.
- Immediate advantage of asexuality : suitable set of phenotypic / genotypic characteristics preserved.

- Importance of preserving farmers'knowledge as one of the indicators for sustainable management of plant genetic resources *in situ*.
- Importance of preserving not only the cultivated yams but also the wild yams.

Yam phylogeny

- **In Enanthiophyllum :**
  - **68 accessions of *D. cayenensis-D.rotundata***
  - **26 accessions under domestication**
  - **9 accessions : Product of domestication (from *D. abyssinica*)**
  - **11 accessions : Product of domestication (from *D. praehensilis*)**
- **Accessions from 4 sections :**
  - **Enanthiophyllum (*D. cayenensis-D.rotundata, D. abyssinica, D. praehensilis, D. togoensis, D. smilacifolia, D. minutiflora, D. burkilliana)***
  - **Opsophyton (4 accessions of *D. bulbifera*)**
  - **Lasiophyton (3 accessions of *D. dumetorum*)**
  - **Macrocarpaea (1 accession of *D. preussii*)**



Synthetic representation where haplotypes are illustrated by 14 representatives of species involved in the analysis

Main Results

- ***D. smilacifolia, D. minutiflora,* and *D. burkilliana* share the same haplotype, H2. According to these results, these 3 species might be considered as one "genetic group" that diverged later than other *Enantiophyllum* species.**
- ***Dioscorea togoensis* (H3) is the most uncertain species. Its uncertain relation with species sharing haplotypes 2 and 3 does not enlighten its classification.**
- **The *D. abyssinica* subset H5 is clearly separated from H1, but, more surprisingly, share alleles with *D. alata* (H6) that originates from Asian and Pacific continents.**

Future

- **Efforts are still required to attain a better understanding of the evolution of African species.**
- **Combined molecular and botanical studies will certainly pave the way for an updated revision of the *Dioscorea* spp. taxonomy.**


Thank you for your attention