

SOME DATA ON THE GENETIC ORGANISATION OF
THE DIOSCOREA CAYENENSIS-ROTUNDATA COMPLEX
IN IVORY COAST

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SUMMARY (voir résumé français à la fin)

The culture of yams in Africa involves the preferential use of two species. One is of Asian origin, *Dioscorea alata*, and has not been discussed. The other is a native of Africa, *Dioscorea cayenensis-rotundata* and is the subject of this detailed study.

A collection including more than 800 samples has been constituted by a series of trips in Ivory Coast. The natural variability encountered was examined using two complementary tools, one involving a grid of morphological descriptors, the others the analysis of starch gel electrophoresis for four enzyme system.

The results showed the following :

- 1.- The *D. cayenensis-rotundata* complex can be subdivided into a limited number of groups.
- 2.- The precise morphological description of each is possible and a list of characteristics is given.
- 3.- The electrophoretic zymograms confirm the structure in identical groups and also lead to an intragroup genetic discrimination.

INTRODUCTION

Yams (*Dioscorea* spp.) is a genus composed of about 600 species according to Knuth (1924). The domestic species, with exclusively vegetative reproduction, are localized primarily in the intertropical belt. There are two main species in West Africa, one *D. alata* originating in Asia and the other *D. cayenensis-rotundata* which is native.

As is true of all of West Africa, Ivory Coast is an ethnic mosaic with yams as a traditional staple. This is true from the simple gathering in the western forest regions (the Guéré, Yacouba and Bété ethnic groups) to vast farming enterprises in the center and East (the Baoulé, Agni, Koulango ethnic groups).

The extension of arable land and increases exchanges of plant material have led to the introduction of new names and, in parallel, considerable taxonomic confusion. It follows that the same clone may have different vernacular names, and similarly, the same name may be attributed to different clones. Thus, MARTIN and SADIK (1977) estimated that there were between 500 and 2 500 varieties in this complex. This imprecise and overestimated number is the direct result of the above phenomenon. The description of several clones (MIEGE, 1952), followed by work on the organisation of the complex (MARTIN and RHODES, 1978 ; AKORODA, 1983 ; AKORODA and CHHEDA, 1983) have not enabled the groups in question to be precisely identified.

Using a collection including more than 800 samples from the entire Ivory Coast, we have attempted to define and elucidate the internal organisation of the *D. cayenensis-rotundata* complex.

The use of a simple morphological characters and of enzymatic characters (enzyme electrophoresis) has shown that this complex is in fact limited number of groups which can be distinguished with relative ease.

MATERIALS AND METHODS

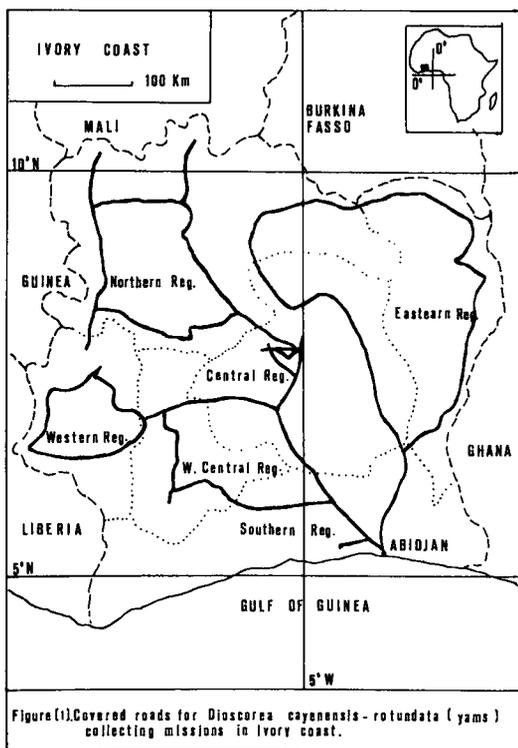
1.- Plant material

Yams investigated were from an old collection (1974), including 97 samples from Ivory Coast and Benin, to which were added 734 accessions collected in Ivory Coast (figure 1) between 1983 and 1985 by HAMON and AHOUSSOU (Abidjan University), with the financial assistance of the I.B.P.G.R. These samples all belong to the *D. cayenensis-rotundata* complex.

2.- Methods

- Morphological descriptors :

Observations carried out for several successive years using the grid of descriptors proposed by the I.B.P.G.R. (1980), enabled us to define a set of characters leading to a reliable determination of the varietal groups.



- Enzymatic descriptors : Enzyme electrophoresis)

Isoenzymes from four enzyme systems were detected after starch gel electrophoresis according to HAMON and TOURE (1982). The four systems investigated were : (Malate dehydrogenase, MDH ; Isocitrate dehydrogenase, ICD ; 6-Phosphogluconate dehydrogenase, PGD ; and phospho-glucose isomerase, PGI).

Typical zymograms of each enzyme system are shown in Figure 2 where M, P, I and p correspond to MDH, PGD, ICD, and PGI. The index corresponds to the type of zymogram observed.

RESULTS

Among the groups encountered in the Ivory Coast, we describe here the characteristics of seven of them. We designate them by the most popular vernacular name used by local peasants.

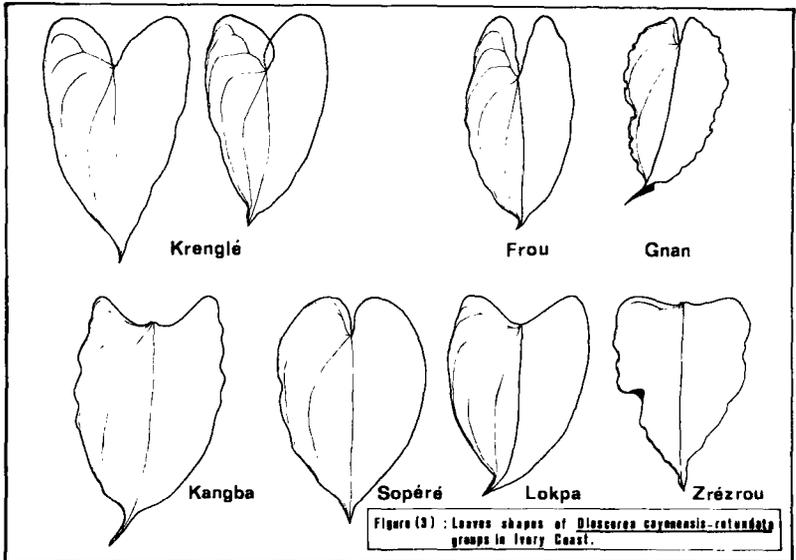
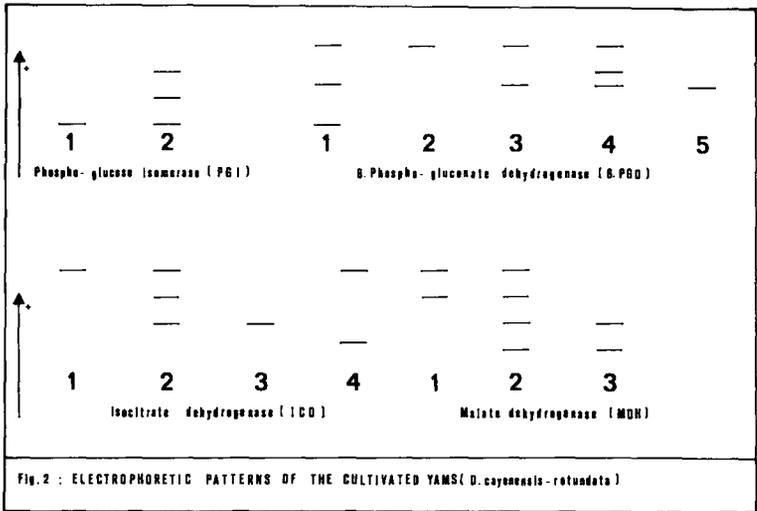


Table (1) presents the modalities of several descriptors enabling groups to be recognised as a function of the organ observed and the stage of plant development. The most highly discriminating among them are underlined. Adult leaves shapes are represented in figure 3.

Before classifying an individual, however, it is necessary to verify concordance with the other descriptors, since individuals exist (*) which simultaneously possess the characteristics of several groups.

The classification of domestic yams

1. KRENGLE group

Widespread in Ivory Coast, it is also present in Benin. It is extensively marketed and its name is known in almost all the regions of the Ivory Coast, except in the East, where the terms most often used are "Tami, Tambi, Mapan". More than 30 vernacular names are known, including "Gnangnougou, Déguéba, Sérésséré, Mississim, Kroba, Awôko, Savié", etc...

It is relatively homogeneous in terms of its morphological and enzymatic characters. The form of the tuber and the colour of the pulp vary, corresponding to types probably arising from somatic mutations, conserved and amplified by the peasant.

It is easily distinguished from the others groups by its aerial and underground vegetative characters. The young stem stage is characterized by a violet colour and the violet thorns, short and broad at the base. The adult is marked by short internodes on the stem and the following foliar characters : dark green, borne by secondary twigs, lobes folded towards the interior and closed laminae.

2. SOPERE and LOKPA groups

Sopéré is encountered throughout Ivory Coast, while Lokpa is localised primarily in the Central region. This results in more common names for Sopéré group (about 25 vs. a dozen for the other). The following are equivalent to Sopéré : "Logobéré, Sépéli, Djélo, Oper, Tomgou, Diokouakou, Bayéré, Banaro", etc. The equivalents of Lokpa are "Koto, Mangou, Fiolo, Badigbè, Midongbo" etc....

They are monomorphic and similar in terms of the tuber but the leaves present morphological differences (size

(*) These individuals will be discussed in a future paper.

Table (1) : Characterisation of the Dioscorea cayenensis-rotundata groups encountered in Ivory Coast

CHARACTER	YOUNG STEM	ADULT STEM	ADULT LEAVES	UNDERGROUND TUBER	ELECTROPHORETIC PATTERNS	SEX TYPES	PARTICULARITIES
KRENGLE	*pruinose	*green + light violet	*dark green	* <u>rough</u>	M3 I1 P3 pl	female	*aerial tubers
	*purplish	*light green or	* <u>closed laminae</u>	* <u>thick skin</u>		sometimes	observed in
	* <u>violet thorns</u>	maron-red thorns	* <u>lobes foldes</u>	* <u>broad head</u>		male	1984
	* <u>short and</u>	* <u>short internodes</u>	* <u>towards the</u>	* <u>prickly roots</u>			*normally one
	* <u>broad at the</u>	(5-10cm)	* <u>interior</u>	*white or light			tuber per plant
	* <u>base</u>	*pruinose	(L/l=1.04)	yellow pulp			but several
				without oxydation			clones give 2
			when to air			or 3.	
			*4 tuber's type				
			*late maturity but				
			two harvest are				
			possible				
SOPERE	*pruinose	*green + little light	*dark green	*long cylindrical	M2 I3 P4 pl	female	*one tuber per
	*green + violet	violet	*undulated edges	*prickly roots	M2 I3 P3 pl	male	plant
	*light green	*light green thorns	* rounded lobes	*white pulp slow	M2 I2 P3 pl		
	thorns, long	* <u>long and thin</u>	*light red or	oxydation to air	M2 I2 P2 pl		
	and thin	*internodes : 20-30cm	light violet	*early maturity	M2 I2 P5 pl		
		spot on the					
		petiole					
		(L/l=1.38)					

Table (1) continued

LOKPA	<p>*pruinose *green + violet light green thorns, long and thin</p>	<p>*light green *<u>thorns long and thin</u> <u>at the base, puncti-</u> <u>form about one meter</u> <u>up on the stem</u> *internodes : 20-30cm</p>	<p>*light green *<u>pointed lobes</u> *undulated edges *closed laminae *light violet spot on the petiole (L/l=1.5)</p>	<p>*long cylindrical *prickly roots *white pulp with slow air oxydation</p>	<p>M2 I2 P3 p1 M2 I3 P3 P1 M2 I1 P3 p2 M2 I1 P3 p1 M2 I2 P4 p1</p>	<p>female male</p>	<p>*normally one tuber per plant</p>
ZREZROU	<p>*pruinose *purplish-pink *few violet <u>thorns, thin</u> and short</p>	<p>*purplish or green + violet, with the <u>base of the stem</u> light brown *<u>long internodes</u> (40 to 50 cm) *second ramifications quickly very long *few violet thorns</p>	<p>*dark green *undulated edges *closed laminae *red spot on petiole (L/l=1.39)</p>	<p>*long cylindrical *spineless roots *white pulp <u>very</u> <u>fast oxydation</u> <u>to air</u> *early maturity</p>	<p>M2 I1 P4 p1</p>	<p>male (first flowers appear 3 month after planting)</p>	<p>normally one tuber per plant</p>
GNAN	<p>*bright green *<u>broad thorns</u> <u>converging</u> <u>brown, then</u> <u>violet then</u> <u>green from</u> <u>apex to base</u> *spot at the base of the thorn of the same color *pruinose</p>	<p>*white green or green *thorns green *pruinose *internodes :20-25cm</p>	<p>*green *<u>very undulated</u> <u>edges</u> *lobes folded towards the exterior *<u>lightly closed</u> laminae *thorns on the petiole (L/l=2)</p>	<p>*long cylindrical sometimes finger like in the third terminal part *hairiness *<u>very fissured</u> <u>light and thin</u> skin *prickly roots *white and <u>very</u> <u>hard pulp</u> without oxydation to air *late maturity but two harvest are possible</p>	<p>M1 I2 P4 p1</p>	<p>male</p>	<p>*aerial tubers observed before 1980 *normally 2 to 4 tubers per plant</p>

Table (1) continued

FROU	<p>*pruinose *bright green or dark green *thorns of the same colour broad and converging</p>	<p><u>*dark green</u> <u>*rougt especially</u> <u>at the base</u> *dark green thorns *pruinose *internodes : 20-25cm</p>	<p>*dark green *lightly undulated edges <u>*closed laminae</u> <u>*long rounded</u> <u>lobes</u> (L/1.5)</p>	<p>*long cylindrical *fissured and hairiness *very light and thin skin *some prickly roots white pulp without oxydation to air *late maturity two harvest possible</p>	M1 I1 P2 p1	male	*normally 1 or 2 tubers per plant
KANGBA (sub. gr.)	<p>*few or not pruinose <u>*yellow green</u> *long thorns of the same colour</p>	<p><u>*yellow green</u>, some- times scored *thorns of the same colour *most often, <u>few</u> <u>secondary</u> <u>ramifications</u></p>	<p>*green *undulated edges *thorns on the petiole <u>*pointed lobes,</u> <u>highly spread</u> (L/1= 1.18)</p>	<p><u>*blackish and</u> <u>thin skin</u> <u>*spineless roots</u> *white or light yellow or dark <u>yellow or violet</u> <u>pulp</u> without oxydation to air *4 tuber's type *late maturity</p>	M1 I4 P4 p2	male	*normally 1 tuber per plant but very big

and colour). Electrophoresis results have substantiated their similarities and differences, indicating that they are pluriconal with two common genotypes.

Adults plants can be differentiated on the basis of light green thorns, long and thin along the entire stem of Sopéré, while Lokpa they are punctiform about one meter up on the stem. Adult leaves also enable the distinction to be made : they are dark green and cordate in Sopéré, light green with pointed lobes in Lokpa. According to these similarities, we think, they have the same wild parental species.

3. ZREZROU group

It has a more restricted geographical distribution, primarily the Center and Center East. Marketed little or not at all, it is not very important, expressed as cultivated area. Five vernacular names could be identified : "Longbo, Koffikan, Dionguédéríkongo, Dombiro, Kranza".

It is relatively homogeneous from the morphological and enzymatic standpoints. It is probably monoclonal.

It is easily identified by the special colour of the young stem and by its sparse habit, due to long internodes. The tuber is rather similar to those of Lokpa or Sopéré, but differs by the rapidity of oxidation of the pulp when exposed to air.

4. GNAN group

Extensively marketed, it is encountered throughout Ivory Coast. Nevertheless, its name is remarkably invariant, since we are able to identify only four synonyms : "Djaté, Pélékou, Nararaka, Koulamagno".

It is highly uniform, both morphologically and enzymatically. It appears to be a single clone widely spread by commercial practices and which, for an unknown reason, is called by all the same name by the ethnic groups.

Occasionally confused with the Frou group at the very young stem stage, it is unambiguously differentiated from all others by the colour of its thorns : brown, then violet, then light green, from the extremity towards the base of the stem, and the spot at the base of the thorn of the same colour. The characters of the adult leaves (narrow, highly undulated edges) and the tuber (fissured, light skin, white and very hard pulp) are also discriminating characters.

5. FROU group

Its importance in Ivory Coast is low, in terms of planted surface. It is encountered primarily in the Center and in the East, as well as in Benin. The synonymous names are "Adola, Kagourou, Wonoutoma, Worou Binsi, in Benin and "Mbébouloupou" in Ivory Coast.

In spite of this broad geographical distribution, it is very homogeneous morphologically and all specimens examined have identical electrophoretic profiles.

The Frou is similar to the Gnan by the appearance of the tuber and sometimes the young stem. It is differentiated from the latter by the consistency of the pulp, the colour of the adult stem (dark green) and the dark green leaves with long rounded lobes and closed laminae.

6. KANGBA group

This group is distinguished by the habit of the plant (few or not secondary ramifications, reduced or inexistent bud scales) and / or by the tuber (irregular shape, large, sometimes typical, blackish skin, pulp sometimes highly pigmented). It is very heterogeneous and we have subdivided it, studying only the Kangba subgroup here.

* Kangba subgroup

It is not commercialized but has a large geographical distribution, being found in all the regions of the Ivory Coast. It is known in the East as Kangba and in the Center and Northwest it is encountered as Fotchérgué, Péten-tien, Djéroué, Bakabani, Samassé, Gbangan, etc...

Its aerial vegetative apparatus is relatively homogeneous, but the colour of the pulp varies considerably, e.g. white, light yellow, dark yellow, violet, white with violet and yellow points, white with violet points. The shape of the tuber varies as well. The enzymatic systems examined do not always reflect this heterogeneity, demonstrating only three "clones".

It is unambiguously differentiated from the other groups by the colour of the adult stem (yellow green) and the large leaves with pointed lobes, highly spread and forming a very special indentation.

CONCLUSION

In the present study, we have used morphologic and enzymatic descriptors to differentiate seven groups among the most often encountered in Ivory Coast. Some of them are probably representative of Africa.

For each group, we sought the most discriminating characters, and show the intragroup morphological variability.

The four enzyme systems (malate dehydrogenase, isocitrate dehydrogenase, phospho glucose isomerase, and 6-phosphogluconic acid dehydrogenase) are sufficient to identify them and to discriminate between a monoclonal and pluriclonal nature. These two modalities exist in the groups with broad geographic distribution, as well as in those with a restricted distribution.

Several samples collected in Ivory Coast between 1983 and 1985, clearly in the course being domesticated and not classified are unambiguously derived from *D. praehensilis*, while others are derived from *D. mangenotiana*. Similar observations have been made by MIEGE (1952). Another wild forest species, *D. burkilliana*, is mentioned by HLADIK et al. (1984).

This multispecies character, predicted by MIEGE (1952, 1958, 1978), BURKILL (1960), COURSEY (1976) and MARTIN and RHODES (1978), is incontestable today and constitutes one of the reasons for the complexity of *D. cayenensis-rotundata*.

This establishment of genetic relationships between domestic and spontaneous forms is a very important point to elucidate and should orient the establishment of hybridization programs via classical selection schemes. The use of monoclonal groups automatically implies intergroups hybridizations, explaining the necessity of using those with the same spontaneous origin. Pluriclonal varieties permit intragroups hybridizations.

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RESUME

*Quelques données sur l'organisation génétique
du complexe *Dioscorea cayenensis-rotundata**

La culture des ignames en Afrique repose avant tout sur deux espèces. L'une, d'origine asiatique, *D. alata*, n'est pas abordée ici. L'autre originaire d'Afrique, *D. cayenensis-rotundata* fait l'objet de l'étude détaillée qui suit.

Une collection de plus de 800 échantillons a été constituée au cours d'une série de parcours en Côte-d'Ivoire. La variabilité naturelle rencontrée a été examinée avec deux techniques complémentaires, l'une comportant une série de descripteurs morphologiques, l'autre l'analyse en électrophorèse sur gel d'amidon de quatre systèmes enzymatiques.

Il en résulte que :

1. Le complexe *D. cayenensis-rotundata* peut être subdivisé en un nombre limité de groupes.
2. La description morphologique de chacun est possible et une liste de caractéristiques est donnée.
3. Les zymogrammes électrophorétiques confirment la structure en groupes identiques et conduit aussi à une discrimination intragroupe.

