A COLLECTION OF WEST AFRICAN YAMS

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SUMMARY

Yams collected in West Africa in 1971 are being intensively evaluated, and multiplied for distribution. Two seasons of observations have revealed important differences in disease resistance, seasonal responses, and yield potential. Preliminary selections have been made of cultivars suitable for distinct purposes, including mechanization. A comparison of accessions of the *rotundata-cayenensis* complex using methods of numerical taxonomy is expected to clarify the interrelationship between the two species. Virus diseases constitute the most serious problem found in the collection. Selected, disease-free cultivars will eventually be available for pantropical distribution.

RESUME

Des ignames collectionées en Afrique Occidentale en 1971 sont en cours d'évaluation intensive et sont multipliées pour être popularisées. Deux saisons d'observation ont révélé d'importantes différences de résistances aux maladies, de réponses saisonnières et de potentiel de rendement. Des sélections préliminaires de cultivars adaptés à des buts spécifiques, dont la mécanisation, ont été entreprises. On escompte que la comparaison de variétés du complexe de *rotundata-cayenensis* permettra, en utilisant la méthode de taxonomie numérique. de clarifier l'interrelation entre les deux espèces. Les viroses constitutent le problème majeur que comporte la collection. On finira par obtenir des cultivars selecionnes et indemnes de maladie qui seront distribues a travers les tropiques.

RESUMEN

Ñames colectados en Africa Occidental en 1971 están siendo evaluados intensivamente y multiplicados para su distribución. Las observaciones de dos temporadas han revelado importantes diferencias en cuanto a resistencia a enfermedades, respuesta a la época de siembra y rendimiento potencial. Se han hecho selecciones preliminares de cultivares para distintos propósitos, incluyendo mecanización. Se espera que usando métodos de taxonomía numérica se puedan comparar introduciones de un complejo *rotundata-cayenensis y* se clasifique la interrelación entre las dos especies. Las enfermedades virales constituyen el más serio problema encontrado en la colección. Evantualmente, se podrán tener cultivares libres de enfermedades virales para su distribución en el trópico.

INTRODUCTION

Although yams are now grown throughout the wet tropics, the most important region of the world where they have become a staple crop, and where they continue to hold an important, if tenuous, role is in West Africa. The species *Dioscorea rotundata* and *D. cayenensis* were domesticated in this area. Although their cultivation is very old, they are sexually fertile which suggests that they are not ancient clonal species, and that evolution is continuing. This is very important for plant breeding. In addition to the commonly cultivated species, others, such as *D. dumetorum* exist as both wild and cultivated forms, and are used in times of special need. Entirely wild species that can be used for food are also found.

In West Africa, yam, the staple food crop is now being replaced in most regions by the easier-to-grow cassava. Rice is usurping it in the river valleys. The culture of the yam will change, and may disappear completely from some regions. Concern for the germ plasm of the African yams, and its potential for contributing to feeding the hungry people of the world led therefore to the sponsorship of an expedition in 1971 to collect West African yams in their regions of origin. The Food and Agriculture Organization of the United Nations, and the Department of Agriculture of the United States collaborated in this expedition.

Because time and money were limiting, the area could not be collected exhaustively, and some noteworthy gaps in the collection occur. Most of the collection was made through existing institutions which had themselves made collections for many years. Introduced as well as native cultivars were obtained. Tubers were sent to Puerto Rico where they have been extensively studied for two years. It is our intention to evaluate these West African yams, to select cultivars for special purposes, and to distribute selections throughout the tropics to places where they can best be utilized.

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ACCESSIONS

The yam belt of West Africa extends from Cameroun to the Ivory Coast. The species and numbers of accessions of yams collected from this region are given in Table 1.

Accessions from the eastern Camerouns were highly desired, but were not obtained, since they might be expected to be extreme forms. Neither were collections received from the small country of Togoland. Nigeria was fairly well sampled although the northernmost areas were neglected. Sierra Leone proved to be a rich source of introduced species but the more common species of African yams are not apparently very important there. We feel that we have collected many, but not all, of the best cultivars and a broad range of germplasm.

MANAGEMENT OF THE COLLECTIONS

When tubers were received in Mayaguez, Puerto Rico, they were cut into setts and planted in the greenhouse in plastic bags. There the soil was treated with systemic insecticides to eliminate the possibility of beetle infestation, and the initial plants were observed for disease symptoms. Initial symptoms of virus disease in the greenhouse did not appear more severe than, nor distinct from, symptoms previously observed in yams of African origin grown in Puerto Rico. Subsequently in the field, severe virus symptoms occurred in many accessions. The affected plants were dug from the field and re-established in the greenhouse. During the second year, strongly virus-infected accessions were grown in an isolated area for observations. Plants propagated from tubers of plants with severe virus symptoms were often relatively free of symptoms.

During both years extensive notes were taken on the foliage, disease, reproduction, tuber and culinary characteristics of all accessions which are proving useful in sub-specific classification.

OBSERVATIONS ON NON-AFRICAN SPECIES

Dioscorea esculenta accessions received from five different countries of Africa all rather closely resembled one another and appear to have originated from one common source. Nevertheless, subtle differences among them suggest that some evolutionary divergence may have occurred. In comparison with accessions of this species from the Caribbean region, the African accessions performed very well. The African forms represent only a tiny fraction of the genetic potential of this species as already represented in available germplasm.

Since we had already studied over 150 accessions of *D. alata* from other regions we did not expect to find from Africa any superior clones of this species. However, of the 55 accessions received 10 were selected as possible superior types. The selections included clones giving superior yields, some with tuber forms adaptable to mechanization, and some that resisted leaf spot diseases for two seasons. Some of the best of these, and their characteristics, are given in Table 2.

OBSERVATIONS ON THE AFRICAN SPECIES OF THE *rotundata-cayenensis* COMPLEX

A typical cultivar of *D. rotundata* can easily be distinguished from a typical cultivar of *D. cayenensis*. Whereas the former has thin ovate leaves, few spines, long, narrow and white-fleshed tubers, the latter has thick, almost orbicular leaves, many spines, and compact yellow-fleshed tubers. However, both species can develop a second or seed tuber after the first harvest. Taxonomic problems arise because many cultivars show neither the typical traits of *D. rotundata* nor *D. cayenensis*, but a mixture of the two. We thus prefer to call all these yams the *D. rotundata-D. cayenensis* complex. Others have noted these discrepancies, but have regarded the atypical forms as the products of hybridization.

We shall attempt to illuminate this problem by the use of numerical taxonomy in which all the differences among accessions can be handled simultaneously. The principal components method will be our chief tool. In this method the similarities among accessions are determined on the basis of differences in mutual distance apart in a multi-dimensional space. Our hope is to identify the distinct (species) and their characteristics.

The descriptors we shall evaluate in this complex in order to help to standardize description include 6 stem characters, 6 petiole characters, 17 lamina characters, 13 culinary characters and 5 'laboratory' characters, as well as several 'characters' represented by ratios between metrics included in these main categories. The total number of descriptors being used is 83.

In the present analysis equal weight will be given to each characteristic, but we may need to find ways of weighing the characteristics, and perhaps of deriving a selection index.

There are a few characteristics that have not yet been evaluated. One is the suitability of the tuber for preparing fufu, a product prepared by pounding cooked yam. A second is the ability of the plant to grow a second tuber after the first harvest. Others are the ability of the plant to grow independently off season and the relationship between the ability of the tuber to germinate and the storability of the tuber. We also have not yet evaluated the suitability of the accessions for different climatic situations. Satisfactory systems of evaluating these characteristics cannot be worked out until more is known of their physiological basis.

On the information at present available, we have been able to make some judgments and to begin to reduce the collection to a more workable level. Table 3 presents some of the best accessions selected on the basis of yield, tuber and culinary characteristics.

DISEASE AND INSECT PESTS OF YAMS IN THE GERMPLASM COLLECTION

The yam collection was introduced mostly as small tubers. Since smallness may be associated with factors that inhibit growth, and in Puerto Rico small yams are often those that come from virused plants, by selecting small tubers we may have introduced many virused accessions to Puerto Rico that could have been avoided.

In one survey of the collection, every plant was found to show some virus-like symptoms. It would appear that all plants may already be infected with virus, but the type and severity of symptoms is variable. This could indicate either a virus complex or suggest that environmental factors influence symptom expression. In working with the sapogenin-bearing yams we have seen similar symptoms. Such yams can be grown from seed and we have been able to transmit the virus mechanically from old plants to new seedlings.

Viruses from species of edible yam, when transmitted to supposedly healthy seedlings of the sapogenin-bearing yam, have induced symptoms similar to those seen in the sapogenin-bearing yam, including mild mottling, severe mottling, green banding, little-leaf symptoms and Christmas tree effect.

To avoid introducing new viruses into yams already in Puerto Rico we have isolated virused plants into one area and the African yam collection is also isolated from other collections. As mentioned, plants from small tubers often appear to be virused and conversely, selection of large yams as seed material seems to be a useful method of reducing the incidence of virus expression. However, we cannot be sure that any apparently healthy plant is not a symptomless carrier of virus.

In 1972 we selected yam varieties that had the most severe virus symptoms. Storing these at somewhat higher than normal temperatures and until all were sprouting we obtained field plots that were free of virus-like symptoms. Judging from these results it should be possible to rid yams of virus-like symptoms at least, — and perhaps of viruses.

POTENTIAL FOR AFRICAN DIOSCOREA SPECIES

What is the place of the African yams, particularly *D. rotundata* and *D. cayenensis*, in the tropical world? As yet it is uncertain. In contrast with *Dioscorea alata*, the African yams have not yet been well tested throughout the tropics. As staple food crops that have formed the basis of a civilization, the African yams merit a wider trial.

TABLE 1

Accessions of West African yams by country and species

	D. rotundata	*D. cayenensis*	*D. dumetorum*	*D. alata*	*D. esculenta*	Other species
Cameroun	0	0	0	0	0	0
Nigeria	70	16	12	28	2	5
Dahomey	14	22	2	0	1	0
Togoland	0	0	0	0	0	0
Ghana	29	1	1	2	0	0
Ivory Coast	29	8	1	13	2	4
Sierra Leone	2	9	0	10	1	10
Other sources	7	0	0	2	0	1
Total:	151	56	16	55	6	20
Grand total:	304					

TABLE 2

Accessions of *D. alata* selected for superior characteristics, their names, origins, and special features

Our number	Local name	Name assigned	Country of origin	Special notes
15477	Pacala	-	Ivory Coast	Large, spindle shaped tubers
15478	V 7/1	Veeven	Ivory Coast	Large tapering cylinders
15539	Suidie	-	Ivory Coast	Spindle shape, best flavour
15545	Puka	-	Ghana	Compact tubers, strong bark
15547	Alowinrin	-	Nigeria	Medium cylinders with strong bark, excellent flavour
15555	Nae Onwula	-	Nigeria	Short, stout cylinders
15561	-	Nsukka	Eastern Nigeria	Short cylinders, thick bark
15571	Ewura Oya	-	Nigeria	Large, compact cylinders
15573	-	Leone Globe	Sierra Leone	Heart shaped single tubers
15575	-	Suave	Sierra Leone	Club-like

TABLE 3

Selected varieties of the *d. rotundata–D. cayenensis* complex

Number	Name	Source	Tuber notes
15085	Guinea Blanco	Puerto Rico	Smooth cylinders
15326	Guinea Blanco	Puerto Rico	Smooth cylinders
15484	Grosse Gaille Corrosol	Guadeloupe	Large cylinders
15487	Saint Prix	Martinique	Large cylinders
15489	Vedos	West Africa	Several tubers
15493	Negro	Jamaica	High yields
15605	-	Ivory Coast	Stout cylinders
15607	-	Ivory Coast	Very smooth short cylinders
15610	Besu	Ghana	Compact tubers
15618	Diaje	Ghana	Large cylinders
15625	Borofoo	Ghana	Early, large tubers
15629	Bombetinga	Ghana	Long cylinders
15633	Punakonna	Ghana	Elongated heart shapes
15637	Ekepe	Dahomey	Long, smooth cylinders
15643	Soussou	Dahomey	Uniform cylinders
15646	Douba Yeserou	Dahomey	Large, well-shaped cylinders
15647	-	Dahomey	Very large, branched
15654	Pape	Nigeria	Large, irregular shape
15655	Dagi	Nigeria	
15656	Zaria	Nigeria	Very large, irregular shape
15657	Awure	Nigeria	Elongated globe
15658	Gbare	Nigeria	Smooth tapering cylinders
15660	Etentu	Nigeria	Heavy tapering cylinder
15662	Iyawoolorun	Nigeria	Heavy tapering cylinder
15665	Fele	Nigeria	Large cylinders
15666	Efon	Nigeria	Elongated heart shape
15667	Boki	Nigeria	Smooth cylinders
15668	Lakoko-Ayin	Nigeria	Smooth, compact cylinders
15669	Iro	Nigeria	
15672	Jocha	Nigeria	Smooth cylinders
15673	Inowe	Nigeria	Stout cylinders
16774	Alafulu	Nigeria	Long, smooth cylinders
15677	Awudo	Nigeria	Large, conical
15682	Ejiji	Nigeria	Large globes
15686	Unegba	Nigeria	Large, somewhat irregular
15691	Aga	Nigeria	Long, smooth cylinders
15693	Ukom	Nigeria	Smooth, stout cylinders
15702	Obiatorogu	Nigeria	Pointed globes
15705	-	Nigeria	Early germination and maturity
15707	-	Nigeria	Irregular cylinders
15708	-	Nigeria	Long, conical
15709	-	Nigeria	Many tubered
15710	-	Nigeria	Many tubered
15714	-	Nigeria	Long,smooth cylinders
15718	Abani	Sierra Leone	Top shaped
15719	Abana	Sierra Leone	Large smooth globes
15720	-	Ghana	Long cylinders
15724	Dodo	Dahomey	Compact cylinders
15729	Beterou	Dahomey	Long, club shaped
15731	Foucou	Dahomey	Short, stout cylinders
15736	Yassou Sika	Dahomey	Several cylinders per plant
15740	Baniowre Bagarow	Dahomey	Irregular cylinders
15744	Igangan	Nigeria	Large cylinders
15769	Akandou	Ivory Coast	Smooth cylinders