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# THE PROCEEDINGS OF THE 9TH CONGRESS OF THE PAN-AFRICAN ASSOCIATION OF PREHISTORY AND RELATED STUDIES

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# REPORT ON WILD YAM DOMESTICATION EXPERIMENT

– *V.E. Chikwendu and C.E.A. Okezie*

Gaining insight into the origins of yam domestication has engaged the attention of scholars, especially archaeologists, botanists, linguists, ethnographers and historians. Archaeo-ethnobotanical and linguistic evidences tend to assign great antiquity to the domestication of yam in West Africa, especially in the area lying east of the Bandama River in the Ivory Coast and west of the Cameroun range *(Alexander 1975)*. Recovering botanical evidence of yam in archaeological contexts, though possible, is yet to be realized.

A few useful suggestions have been made in this direction such as the use of starch structure for inferring the presence of domesticated species, naematoid cysts in fragments preserved in carbonized form and entomological indicators *(Alexander 1975)*. As far as we know, the only association of tools found in archaeological context with yam domestication was made in relation to the Ugwuagu Rockshelter at Afikpo (Chikwendu 1979).

The elusive nature of yam and the nature of West African tropical soils require that we revise the methods we use in archaeological excavations in this region. The many tiny cavities we see in the soil may provide the only clue which we may ever have on yam for a long time. Though time consuming, it is necessary that we produce casts from these holes for identification. Instead of using expensive grease and plaster of Paris for this purpose, one can use palm oil (or palm oil slush) as grease and wet mud as the filling agent. This method was used with great success at the Ogbodu-Aba site, though most of the casts were identified as termite nests.

In the absence of concrete evidence for early yam cultivation, hypotheses and guesses have become rife. How was the yam domesticated? It has been claimed that:

> "... the tubers of yams could germinate during the appropriate season. Observation of the development of the yam head in this way might have led to planting of yams especially where camps were occupied for long period or permanently" (Okigbo 1980).

This view is also shared by Davies (1967). Domestication through protection has been adduced by Coursey (1967) and Harris (1969).

We are rather inclined to believe that the *tail stump* of the yam which usually snaps off during careless or hurried harvesting, would have been seen to germinate at the onset of the rainy season. Man would have observed that any part of the yam, head, tail and middle, once buried in favourable conditions could germinate. This observation could have led to the vegetative propagation of the yam.

Geneticists are not left out in the search for the origin of yam domestication. Basing their arguments on chromosome numbers, it has been claimed that cultivated species are high polyploids, with those highly developed in cultivation topping the list in chromosome counts. Even a few cultivated forms appear to have abnormal counts based on multiples of 9, e.g. 2n = 36 or 45 *(Sharma et al. 1956)*.

The argument concludes by suggesting "that such high polyploidy in cultivated forms is associated with long periods of continuous vegetative propagation" *(Alexander & Coursey, 1969)*. Even the hope pinned on the use of palynology to help establish early yam domestication was greatly shaken when it was discovered that pollen samples which were being collected for use in establishing the fossil pollen assemblage of the Delta Region of Nigeria conspicuously lacked the yam pollen *(Sowunmi 1973)*. She suggested that micro-organisms might have attacked the yam pollen or that their outer wall was too fragile to survive in the delta soil. Moreover, domesticated yams tend not to flower much.

## History of the Project

In the face of all these problems, we decided to mount an experimental project on Wild Yam Domestication at the University of Nigeria, Nsukka. Summed up, the aim of the research is to ascertain those factors responsible for the dormancy enablement of the wild yam. Dr. F.N. Anozie initiated the project in 1976 and handed it to Dr. V.E. Chikwendu in 1977 because of the latter's interest in food production. The project has been going on with varying fortunes and at the beginning of this year a botanist, Dr. C.E.A. Okezie, joined in the research.

## Specimen Collection

Initially, wild yam tubers have been collected from areas near the university campus, particularly from Obollo-Eke, Ovoko, Ibagwa Ani, Edem Ani and Owerre Ezeorba forests. All the specimens have been taken from thick forests to ensure that they are wild and not ferral. Some laboratory tests are also carried out. The tubers were brought back to the laboratory, identified and catalogued before storing them away in the shade. Their enormous sizes militate against stacking them up on stakes in barns as domesticated species are preserved. There is now a spread of activities farther afield to collect specimens from the whole of south-eastern Nigeria.

## Identification of Specimens

Yams are members of the genus Dioscorea, family Dioscoreaceas, and other Dioscoreales which are classified among the monocotyledons (Ayensus 1972; Okonkwo 1983). Most edible yams have been clearly classified to the species level. However, each species has usually a number of cultivars which are far from being adequately studied and characterized, a situation which calls for further investigations (Okonkwo 1983).

Yams are grouped into sections according to the direction of twining of the growing shoot (vine) on a support (Coursey 1964). Among the yams of major importance as food plants, those of the section Enantiophyllum, for example *D. alata, D. cayenensis, D. opposita, D. japonica* and *D. rotundata*, twine to the right. The other sections, namely Opsephyton, Lasiophyton, Combilium and Macrogynodium have vines which twine to the left.

Most of the wild Dioscorea members which we have so far collected from different parts of south-eastern Nigeria have vines which twine to the right and these definitely belong to the section Enantiophyllum. There are a few which have vines that twine to the left which we have difficulty in placing in any of the other four major sections.

It is difficult to identify all the specimens we have collected to their exact species but based on the index of Coursey (1967) and Burkill (1960) and the observations we have made of their morphology and growth pattern, we have identified five species, namely D. sansibarensis (Macroura). *D. odoratissima* (Macrogynodium), *D. hirtiflora* (Asterotricha), *D. praehensilis* (Enantiophyllum) and *D. preussii* (Enantiophyllum).

## Choice of Experimental Farm Site

When we applied to the Landscape Office for a portion of land for the experiment, the authorities referred us to the Agricultural Farm Management to negotiate for a portion of land. This suggestion was not acceptable to us because artificial fertilizers have been heavily applied to the land. We needed land unadulterated with artificial chemicals as these can bring about radical changes in the experimental specimens.

To avoid this, we chose to confine the experiment to the area lying west of the Archaeology building which has not been visibly altered or tampered with for agricultural purposes. We also use other places as our experimental controls may dictate.

## Pre-planting Data Collection

Tubers collected from the forest are weighed and recorded. The length of the thorns both on the vine and on the roots is measured. A 2cm. cube is taken from the mid-section of the tuber and squashed and the fibre strands counted to give us the fibrosity index. The toxicity level is also measured. Before planting, the tubers are cut into setts and each is weighed for recording. Smaller seed yams are planted whole after weighing. In this way we are able to monitor the yield curve from the inception of the experiment.

## Controls

For domesticated yams, there are several agronomic practices involved in their cultivation. Such practices would include clearing of the land, tillage, ridging or mounding, sowing of seed yams or setts, mulching, watering if necessary, staking, weeding, and fertilizer application. Such practices are absent for wild yams or other forms growing in virgin forests.

In our studies on wild Dioscorea plants, we have therefore devised the following controls:

1. *Propagation Materials* The propagation materials are yam setts of known fresh weights as well as small whole tubers (seed yams). This control was found necessary because in the domesticated forms both small tubers (seed yams) and cut-up yams (setts) are used as propagation materials for cultivations.

2. *Location of Experimental Sites* While some propagation materials (seed yams and setts) were planted in open fields prepared the same way as for domesticated Dioscorea species, some others were planted right in the forest from which some of the wild yams were recovered, and still others were planted in an open environment with no previous history of cultivation. Planting in an open field exposes the yams to the same conditions as domesticated forms while those planted back in the forest remain in an environment in which they have to compete with other forest plants for sunlight as well as other resources of the forest environment.

3. *Mounds and Ridges versus Flats and Holes* Mound or ridge making is a very normal practice in domestic yam cultivation. Such is absent in the wild from which we have derived our experimental materials. Some of them were therefore planted on mounds, either singly or a number of setts on one large mound as done in some parts of southern Nigeria. Some others were planted on ridges, others on flats that had been tilled

and harrowed while still others were planted in holes (flats that were not tilled or harrowed).

4. ***Tending of the Plants*** Another control we employed was on the method of tending the plants while they grew. Operations like mulching, manuring (farm yard manure only) and watering were employed for one set and absent in another set of plants in order to see how these wild species would react to such normal agronomic practices.

5. ***Time of Planting*** Current practices in yam propagation is that yams are planted either in the dry season or at the onset of the rainy season and, depending on the locality, the calendar dates of these operations may vary (Onwueme 1978). Our observation is that in most parts of south-eastern Nigeria, yams are normally planted in March at the onset of the rainy season. For the purposes of this study, we have divided our planting times into 'early', 'normal' and 'late'. We therefore have three sets of control with regard to time of planting. One set was planted between January and February (early planting), another set between march and April (normal planting), and the third set between May and June (late planting).

6. ***Sole Cropping versus Inter-Cropping*** It is normal practice to inter-crop cultivated yams with other crops such as maize and okra. Sole cropping is absent in the wild yam species and in place of other crops the wild yam stand will be growing with other forest trees and shrubs. A control was set up in which sole wild yam were allowed to grow along and some inter-cropped with those crops also grown with cultivated forms. This was done in order to find out the kind of interactions that could go on between the wild yams and the crops allowed to grow around them.

7. ***Harvesting*** It is normal practice to harvest yams every year at the end of the rainy season or during the early part of the dry season when vegetative growth is finished for the year (coursey 1967). But it is known that wild forms are left to grow perennially since they are not usually harvested for food. We have therefore decided to harvest annually, biennially, quinquennially and decennially in order to notice what effects such harvest would have on the size and morphology of tubers of such wild forms.

Based on visual observations made over the past six years of study, we would want to report the following:-

1. ***Leaf Morphology*** Leaves are simple, cordate and borne on comparatively long perioles as in domesticated forms. No compound leaves have been noticed so far. The tips of the leaves are usually pointed and there is variation in leaf sizes even on the same plant. In some of the stands many glands were noticed on the leaves. Leaf arrangement on the vine *(phyllotaxy)* is opposite in the upper portions of the plant and alternate in the lower portions. Generally, the foliage is as profuse as in the domesticated form.

2. ***Stem (vine)*** Thorniness of the vine has been drastically reduced in the third and fourth year specimens. Vine length and thickness is also reduced relative to pure wild forms. More cataphylls are borne on vines relative to the situation in domesticated forms but fewer than in pure wild forms.

More specimens have vines which twine to the right showing that they belong to the section Enantiophyllum. Only very few specimens had vines that twine to the left showing that they belong to the other sections.

3. ***Flowering and Fruiting*** More profuse flowering and fruiting occurred in the wild plants grown in the open field than would be expected for domesticated forms. We counted over two hundred fruits on one stand.

4. ***Tubers*** There was reduced size of tubers relative to that in the wild. The tubers also showed reduced thorniness.

5. ***Entomological Data*** Care has been taken to observe the kinds of insects which visit these plants right from the time they are planted until they are harvested. The commonest pests are the smelling grasshopper *(Zenosorius variegatus)* the grading snail *(Limicolaria)* and various types of beetles. A preying mantis nest is lodged in the foliage, while the nest of a bird (wren) adorns the top of one of the yam stands. We hope that since the hard parts of these insects have greater chances of preservation, the presence of a number of their remains in archaeological context may be an indicator of the presence of yam.

This report is designed to generate comments, criticisms and suggestions which will enable the reappraisal of the methods and aims in the research.

## Pattern of Tuber Dormancy

It is known that freshly harvested yam tubers cannot be made to sprout immediately (Onwueme, 1978). They go through a period of dormancy during which they cannot sprout (Campbell, Chukueke, Teriba and Ho-A-Shu 1962; Coursey 1967), with the dormancy getting progressively less with time after harvesting. As such, if tubers that were harvested at the same time are planted at different times, the earliest planting will require a very long time before it can sprout, while later plantings require progressively shorter times to sprout (Onwueme 1975).

The period of dormancy may be only a month or two with forest species conditioned to a short dry season such as *D. cayenensis* and *D. wattii*, the new stem begins to grow almost as soon as the old one has died down. At the other extreme, the members of Testudinaria are adapted to semi-desert conditions

and are dormant for more than half the year, the growth of the stems and leaves being comparatively transient *(Coursey 1967)*.

It is clear therefore that the dormancy period is one in which the tuber stays without sprouting during the dry periods of the year which usually coincide with the post-harvest period. If the yam tuber were to overcome dormancy, sprouting of vines would expose them to the post-harvest dry season period which might be so hot and dry as to scorch the vines and lead to the eventual death of the plant. Tuber dormancy should therefore be seen as a natural way by which the plants tide over the season, which is unfavourable to yam growth.

We are not aware of any report on tuber dormancy of wild *Dioscorea* species. We have therefore embarked on serial planting of wild tubers. Such a study will help us monitor the length of time between tuber planting and sprouting of vines as they relate to different months and seasons of the year. This should give an indication of the pattern of tuber dormancy (if any) in such wild species. In the future we hope that available data will enable us to compare the tuber dormancy patterns in the wild and domesticated species.

## Results

The results we are reporting in this study so far are based on visual observation of the morphological changes that we have monitored in our various planting locations. More detailed biochemical and physiological analyses are going on in our various laboratories in the University of Nigeria, Nsukka and such will be reported in subsequent papers.

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