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Full Length Research Paper

Selection of yam seeds from open pollination for adoption in yam (*Dioscorea rotundata* Poir) production zones in Nigeria

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Yam improvement through hybridization has suffered a lot of challenges over the years. Poor or non flowering of candidate parents, lack of synchrony in flowering of male and female genotypes, flowering intensity that varies with season and location, pests and diseases and other factors have serious obstacles limiting progress in yam hybrid production. This paper discussed the origin, germination and seedling characteristics, flowering and tuber formation and yield of yam landraces collected for improvement. Morphological variations were noticed among the yam landraces collected. With exception of *Obiaoturugo* and *Amula*, others produced male flowers only. *Obiaoturugo* gave highest leaf number, weight of tuber and vine length while *Amula* gave highest tuber shape index. Seeds obtained from these open pollinated fields have genetic variations from which desirable selections could be made. Also, the landrace of *Dioscorea rotundata* could be used as putative parent for genetic improvement.

Key words: Nigeria, hybrid, accession, flowering, diversity.

INTRODUCTION

Selection and domestication of wild yams have given rise to some species of food yams in the different continents where they were selected. *Dioscorea alata* probably originated in the tropical Burma and Thailand, while the American species *Dioscorea trifada* originated in the South America, and African yams (*Dioscorea rotundata*, *Dioscorea cayenensis* and *Dioscorea duometorum*) originated in eastern bank of the river Niger (Degrass, 1997; Alexander and Coursey, 1969). Africa has the largest yam biodiversity with wider growing belt which stretches from the central region of Cote d'Ivoire, through the central and southern region of Ghana, to the republic of Togo, Benin, Nigeria, and western region of Cameroon (Hahn et al., 1987; Orkwor, 1992). The origin of yam species could be elicited by the presence of perennial wild and semi-domesticated types. This, in addition to prehistoric information on the traditional or ritualism developed over centuries around the production and consumption of such crop as could be seen in the case of *D. rotundata* Poir which has its origin in the eastern bank of the river Niger (Uzozie, 1991). Yam plays important roles in the nutritional, social, cultural, and economic life of Nigerians. Nutritionally, yam is a major staple providing food for the billions in the Caribbean countries. It is eaten in different forms as fufu, boiled, fried, and roasted. Economically, yam is important in the local commerce in West Africa and accounts for about 32% farm income earned by farmers (Chukwu and Ikwelle, 2000). They serve as source of foreign exchange and are used as raw materials for starch industries and pharmaceutical companies.

Despite the importance of yam, improvement has not gone beyond selection of genotypes based on tuber size, yield, and culinary qualities.

Reproduction has remained vegetative, which kept recycling the same old material, thereby leading to breakdown to pest and diseases, low yield, and genetic erosion. To meet the every increase demand for yam, cultivars with high yield, resistance to pest, and disease, bunchy types demanding no staking and good cluing qualities are highly desirable.

In the past, hybridization in yam has been limited by the

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Table 1. Origin of some important cultivars and percentage of farmers interviewed.

Cultivars	Origin of cultivars	Percentage
Ekpe	Abakiliki	80
Abii	Enugu	65
Nwaopoko	Ibarimiria	70
Obiaoturugo	Uturu-Okigwe	95
Okwuocha	Mbaise	61
Amula	Northery	83

nature and characteristic habit of yam (as a C4 crop,) characterized by sparse, irregular, small flower production (Akoroda, 1983), and lack of understanding of dormancy phenomenon in sexual yam seeds. The discovery of dormancy phenomena and successful germination of sexual yam seeds in 1966 opened new possibility for yam improvement. Early hybridization, after the discovery of dormancy phenomena, centered on controlled pollination which involved hand pollination, bull pen methods and spatial isolation plots.

This method is reported to be limited by incompatibility, abortion and sterility, thereby turning out few new genotypes.

The knowledge that some genotypes flower and seeds are produced freely in some environmental conditions (Sadik and Okereke, 1975) makes hybridization possible through open pollination.

Open pollination, on the other hand, has been reported to be a more effective tool of hybridization than controlled pollination, as it contains greater genetic diversity and gives higher possible means of selection (Akoroda, 1983). This work was aimed at collecting and studying the preferred farmers' yam landraces for the possibility of selecting desirable cultivars for genetic improvement.

MATERIALS AND METHODS

A sample survey was carried out in the yam production zones of Eastern Nigeria to identify the popular landraces which flower, and the frequency of flowering and fruiting. In March 2001, a second survey was carried out and open pollinated capsules harvested. The capsules were sun dried and stored to break dormancy. In the second year of the work, the seeds from each of the two female lines were established in the eastern farm of NRCRI, Umudike on latitude 5° 25' N, longitude 7° 35' E and at 122 m above sea level. The processed seeds were dusted with fungicide (approx. at 0.9 g/kg) to prevent seed decay. Seeds were planted on ridges and covered with a thin layer of soil. Water was applied and then covered with plastic mulch. The seeds were allowed to germinate. The seedlings were transplanted at 3 leaves stage at a row spacing of 30 cm x 1m by gentle digging up the seedlings with small ball of earth to avoid damages to the roots. Shades were raised over the seedling to avoid direct heat.

The shades were removed at 4 weeks after planting (WAP) in order to stake the seedling and fertilizer was not applied. Data collected were analyzed and important aerial parameters likely to influence tuber trait were correlated using pension correlation analysis method.

RESULTS AND DISCUSSION

Origin of yam landraces

An interview was conducted to ascertain the origin of some important yam landraces. The areas surveyed were Abakaliki, Okigwe and Uturu. The result showed that 80% of the respondents (farmers) affirmed that *Ekpe* originated from Abakaliki, while 65% of the respondents agreed that *Abii* originated from Enugu zone. *Nwaopoko* originated from Ibarimia and *Obiaoturugo* originated from Okigwe and Uturu with 70% of the respondents agreeing for their popularity in the zones (Table 1). Variations were noticed in the origin of the landraces surveyed. *Ekpe*, *Abii*, *Nwaopko* and *Obiaoturugo* yam varieties had different origins. This could be as a result of favorable conditions of the zones which supported the growth and their acclimatization. Orkwor (1992) observed such differences in the origin of landraces in Africa, West Africa, and Nigeria respectively. Figure 1 shows the distribution of some of the Nigerian landraces evaluated.

Flowering status of landraces

With exception of *Amula* and *Obiaoturugo* varieties, all other varieties produced male flowers (Figure 2). Majority of the yam landraces do not produce female flowers. The assessment of flowering ability of landraces showing that landraces with male flowers were predominant, with sex ratio 5:1, (Sadik and Okereke, 1975) had the same result. This could be explained by the fact that there is an inherent genetic problem, such as reduction or abortion of sex organ primordial (Dellaporta and Urrea, 1993), genotype of the plant as well as physical factors such as method of propagation (Akoroda, 1993). Generally, there were five major landraces identified during the survey as shown in Table 2.

Germination and seedling characteristics

The seeds were observed germinating after seven days after planting and 50% germination was recorded after 21 days. A month after transplanting, some of the plants

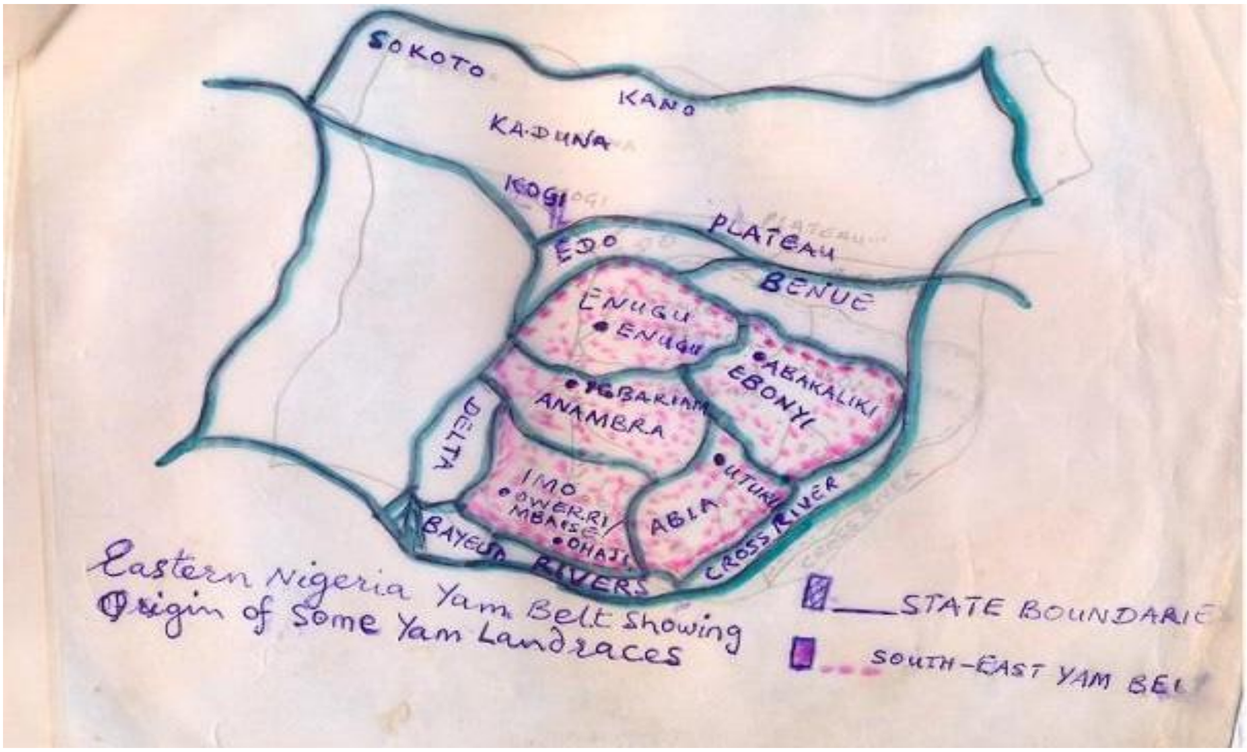

Figure 1. South-eastern Nigeria major yam growing belt.

Figure 2. Yam flowers (bearing both male and female flowers).

showed only the primary leaf without internodes, while some attained a length of 30 cm and were already twining. Seven months later, some plants were still 24 cm, while others had attained a height of 138 cm. Agbo and Okoli (1984) obtained similar result in their trials (Figure 3).

Table 2. Flowering status of the common landraces.

Cultivars	Flower pattern
Ekpe	Staminate
Okwuocha	Staminate
Abii	Staminate
Nwaopoko	Staminate
Obiaoturugo	Pistillate

Figure 3. Yam seedling at nursery stage.

Vine length and tuber characteristics

Among the capsules collected during the survey, those from *Amula* and *Obiaoturugo* were selected and established for morphological characteristic (vine length, leaf number, and tuber weight evaluation). Out of the sixty plants, 15 promising ones were selected from each of the lines of *Amula* and *Obiaotorugo* (Table 3). Accession numbers 4 and 15 gave the highest number of leaves: 105 and 94, while accession 17 gave 75 leaves. Other accessions had leaves number less than 60. Accession numbers 4 and 15 gave equal length of vines. All other accessions, except accession number 25, gave vine length less than 67 cm. Generally, the growth and productivity of the landraces planted out in the field showed variations across varieties. Vine length, leaves number, tuber weight and tuber shape index varied across the accessions studied. This is as a result of different genetic make-up of each of the varieties. *Obiaoturugo* maintained consistently higher leaf number, weight and vine length than *Amula*. Eke-Okoro and Amanze (2003), reported similar result in their work.

Tuber shape index

Among the *Amula lines*, accession numbers 9, 28, 17, 11, 10, 30 and 18 had outstanding tuber shape index. Others have relatively average tuber index (Table 3). There are variations in tuber weight. Accessions 4, 17, 18, 20 sustained the highest tuber weight. Eighteen (18) promising progenies were selected and evaluated (Table 4). Accession numbers 14, 3 and 29 gave the highest number of leaves, while accessions 58, 40, 51, 23 and 36 had leaves number of 60 and above. All the other accessions had leaves number below 60. Accession numbers 3, 5 and 23 had vine length more than 100 cm, while accession 29, 38, 17, 14, 58 and 40 had vine length of

Table 3. Morphological characteristics of F1 progenies.

Amula					Obiaoturugo				
Acc. No.	TSI	Tuber (kg)	Leaf No.	Vine Ht. (cm)	Acc. No.	TSI	Tuber (kg)	Leaf No.	Vine-Ht (cm)
4	0.60	24.990	105	90	3	0.695	10.465	113	183
28	1.00	5.876	50	56	60	0.885	3.478	21	52
9	1.73	1.266	37	50	5	1.16	7.082	33	129
10	0.82	2.061	22	55	46	1.00	6.440	57	64
2	0.57	2.722	55	66	7	0.850	4.650	33	82
6	0.68	3.745	25	52	38	0.685	15.690	62	85
17	0.950	10.807	75	60	51	0.611	20.224	80	42
18	0.863	18.05	23	24	58	0.818	10.365	95	78
20	0.577	11.705	29	35	40	0.764	17.504	80	73
11	0.89	2.971	59	39	22	0.878	3.603	24	54
25	0.588	8.031	41	68	23	1.071	4.679	64	117
15	0.517	8.03	94	90	45	1.083	1.308	42	60
27	0.72	4.300	11	56	37	0.857	4.926	55	54
30	0.833	7.803	31	47	29	0.68	5.144	102	86

TSI = tuber shape index; Acc. No = Accession number.

Table 4. Phenotypic correlation of tuber and aerial plant components.

	Population	R	P
Leaf number versus tube weight in grams	30	0.40,0.57	***
Leaf number versus vine height	30	0.39	*
Tuber weight (g) versus tuber diameter	30	0.45	**
Leaf area per plant versus tuber weight (g)	29	0.42	*

70 cm and above. All others had vine length less than 70 cm. Accession 12 also had high tuber shape index (TSI), while other accessions had TSI above average.

Though there were variations in tuber weight within varieties, some accessions had outstanding tuber shape index (yield ability) than others. The phenotypic correlation analysis showed positive significant relationship among aerial feature of the F_1 (first filial generation) progenies of the open pollinated seeds shown in Table 4. For example, the leaf number per plant was significantly associated with tuber weight ($r=0.40$; $p< 0.05$ and $r=0.57$; <0.01). This result shows that effective photosynthesis and sink strength in crops with high canopy level give high tuber yield. These are desirable traits in breeding yam for higher productivity (Terry, 1977).

Conclusion

The continuous use of the old, highly susceptible, and poor yielding yams as planting material has been identified as major factor acting against yam production. Yam improvement using controlled hybridization has not been able to provide adequate progress required.

This work studied the yam improvement through open pollination and come out with the findings that seeds obtained from open pollinated fields have genetic variables from which desirable selections could be made. The landrace *D. rotundata* could be used as putative parent for genetic improvement.

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