THE PERFORMANCE OF SIX CULTIVARS OF WHITE YAM DERIVED FROM THREE SOURCES AND EVALUATED ACROSS THREE ZONES IN SOUTHERN NIGERIA

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Abstract

Growers of yam demarcate certain areas as being suitable for yam culture and the factors responsible are suspected to relate to both prevailing soil and aerial environments. No empirical evidence to substantiate this suggestions has been documented.

Two popular cultivars were selected from each of the three major yam-growing zones in Nigeria: one in subhumid savanna (Zakibiam), one in hydromorphic and gravelly soil (Abakaliki) and one in riverine alluvial deposits along the river Niger (Atani). The yield of the six cultivars was evaluated across all three test sites using a split-split plot design with location (source), fertilizer and cultivars as the treatment factors.

The study showed that location, fertilizer, cultivar and location x cultivar interaction effects were highly significant. The mean yields indicated that Zakibiam was the best location for the production of virtually all the cultivars while Atani was the worst except for the cultivar Agatu (source: Zakibiam). Agatu is likely to be more tolerant to higher soil acidity and poorer aeration prevalent in Atani soils than other cultivars.

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The production of yams in the tropics is extremely important since they are essential in the dietary pattern of the people (Anazonwu-Bello 1977). Coursey (1967) and Onwuemem (1978) state that yams are second to cereals as the most important food crop in west Africa. According to Coursey (1971), the cultivation of *Dioscorea rotundata* in West Africa is indigenous and not known elsewhere except as a comparatively recent introduction.

Only 12 of the 600 identified species of *Dioscorea* have been found to possess edible tubers. The most popular edible species in the tropics according to Ene and Okoli (1985) are *Dioscorea rotundata/D. cayenensis* complex, *D. alata*, *D. dumentorum*, *D. bulbifera* and *D. trifida*. The most

important species in the world and the most widely grown and eaten in West Africa is *Dioscorea rotundata* (Okonkwo 1985). This species is generally referred to as white yam.

The 1974 FAO report indicates that Nigeria products 15 million tons of yams annually from 1.4 million hectares. This value, according to the report, represents 81, 73.4 and 76.8 percent of yams produced in West Africa, Africa and the world respectively. However, it has been predicted by Olayide (1979) that based on the 1984-1985 production level, the projected demand for yams in the country would continuously outstrip projected supply by 2.868 million tons and 4.508 million tons during the 1989-1990 and 1994-1995 periods respectively. This excess demand calls for an increased production of yams in the country.

Efforts made so far toward yam improvement have not been successful because of such problems among others as flower abortion and narrow genetic diversity, (Coursey 1967; IITA 1972; Sadik 1977; Onwueme 1978; Hahn and Honzyo 1983; Miege and Lyonga 1982; Okonkwo 1985). The selection of cultivars suited to the various ecological zones in the country would offer a promising alternative for increasing yam production to meet the ever-increasing demands. This approach requires a comprehensive ecological characterization and classification as well as on-farm trials in various ecologies with the participation of local farmers.

Three ecological zones may be identified in southeastern Nigeria where yam cultivation is prominent. These zones are within the area designated as the "yam zone" in West Africa (Ene and Okoli). The zone stretches from the coast up to latitude 12°N. It coincides with the rainforest, wood savanna and the southern parts of the open savanna forest of Nigeria where total annual rainfall exceeds 800mm and rains last for four months.

Yam growers and consumers tend to associate their preference for different cultivars of yam with their sources. Hence they believe that the sources of the tubers have a significant influence on the quality of the yam tubers. In Anambra State, for instance, such place names as Zak, Adani, Onitsha and Abakaliki are known to be associated with the yams from the places and consequently they attract different prices in the market. Furthermore, such statements as "yams are not grown there, or that soil is not good for yams," or "yams from that place are not good for pounding, but are better eaten boiled" are often heard among yam farmers and consumers. These statements suggest that different yam cultivars may require specific environments for optimal performance both in terms of tuber yield and quality characteristics. Empirical data

to substantiate these claims by yam farmers, marketers and consumers are lacking.

The objective of this study was to assess the performance of six popular cultivars of white yam derived from three sources across three locations in the major yam-growing areas of southeastern Nigeria.

Materials and methods

Selection of sites and cultivars

Three sites within the "yam zone" in southeastern Nigeria were selected for the trials. They include Zakibiam (lat. 7°27'N, long. 9°29'E) in the subhumid savanna area of Benue State; Abakaliki (lat. 6°25'N, long. 8°05'E) in the forest savanna ecotone of Anambra State and Atani (lat. 6°01'N, long. 6°44'E) in the riverine alluvial deposit along the River Niger Basin near Onitsha in Anambra State.

The two most popular cultivars of white yam were selected from each of the locations. All six cultivars were used for the trials in each of the test sites. The cultivars selected and their sources are shown in table 1.

Experimental design

A split-split plot design was used with location, fertilizer and cultivar as the treatment factors at three, two and six levels respectively. These trials were conducted under two sets of management regimes—one by the farmer and the other by the researcher. Three cultivars, Igun, Agatu and Aga, were used on the researchers' plots. The tuber of each cultivar was cut into three setts and each sett grown in each of the three test sites in order to allow for any variations that might occur in the tubers themselves. The farmers only showed interest in participating in the trials when they were promised whole tuber setts and then used such setts on their plots. However, the sett weights in each case were in the range 400-450g.

The participating farmers were allowed a free hand in carrying out all operations relating to sowing, weeding, fertilizer application, mulching and staking as they had been used to doing on their plots. On the researchers' plots these operations were carried out under the supervision of the researcher. All the setts were grown in conical mounds in each location, although the size of the mounds differed in each of the locations. Soils from the locations were examined and samples collected and analyzed for various physical and chemical

properties that might affect yam performance. The yield parameters assessed included tuber length, girth and weight; leaf area index (LAI); leaf density (LD—total number of leaves/length of vine); and number of tubers per plant. Tuber yield was assessed in kilograms per plant as well as tons per hectare.

Table 1. Selected cultivars and their sources

Source	Cultivar
Abakaliki	Igun (Nwopoko) Nyeji (Okpebe)
Zakibiam	Agatu Gbango
Atani	Aga (Adaka) Ekpe

Results and discussion

The results of the statistical analyses on the preliminary trial in 1985 and the 1986 data (table 2) indicate that location and fertilizer effects are highly significant (P = 0.001) on the girth of tubers; number of tubers per plant; yield in kilograms per plant and tons per hectare; final vine weight; and density. Furthermore, fertilizer effect is significant (P = 0.05) on length of tubers and leaf area index. The cultivar has a significant effect (P = 0.05) on length and girth of tubers as well as on leaf density.

Location x cultivar interaction effects are highly significant (farmer-managed trial, FMT) on the length of tubers, and yield in kilograms per plant and tons per hectare. This interaction effect is also highly significant (researcher-managed trial, RMT) on the girth of tubers

and weight of vines. Location x fertilizer and cultivar x fertilizer interaction effects are respectively significant (P = 0.05) and highly significant (P = 0.01) regarding girth of tubers and leaf density. Location x variety x fertilizer interaction effects are not significant except on the girth (FMT). The disparities in the results obtained from FMT and RMT in some parameters might be due to the type of setts used in each case. It has been shown that whole tuber setts perform better than cut setts (Onwueme 1973) and they are therefore likely to respond more to locational effects. The major reasons are that they sprout readily and are less prone to rotting since there are no cut surfaces.

The mean economic yields evaluated in terms of kilograms per plant and tons per hectare of harvested tubers (table 3) indicate that the best location for high yam production in southeastern Nigeria is Zakibiam. Abakaliki and Atani locations are similar.

The mean yields resulting from fertilizer treatment indicate that much higher yields are obtained in each location when fertilizer is applied. Though the reports on yam response to fertilizer application have been scarce and inconsistent (Juo 1985), the finding in this study shows that there is a highly significant increase in yield with fertilizer application. Obigbesan and Agboola (1978) have indicated that yams constitute a heavy drain on the land and pointed out that a liberal dressing of fertilizer is necessary for increased yields.

Apart from the generally low nutrient contents of the soils of the three zones, the constraints that are more severe in the Abakaliki and Atani locations compared with the Zakibiam location are: lower base status of the soils (higher acidity); lower amount of water released between field capacity and permanent wilting point (lower available water capacity, AWC); and relatively higher sodium adsorption ratio (results not presented) which are known to affect the other physical properties of soils.

The interaction effects of location and cultivar on the mean yields (table 4) suggest that the best cultivars for the Zakibiam location are Gbango/Aga (sources: Zakibiam/Atani) and the worst is Agatu (source: Zakibiam). The best cultivars for Abakaliki zone are Gbango/Ekpe (sources: Zakibiam/Atani) while Nyeji and Igun (source: Abakaliki) are the worst for Abakaliki. At Atani the best cultivars are Agatu/Nyeji (sources: Zakibiam/Abakaliki) and the worst are Igun and Gbango from Abakaliki and Zakibiam respectively. This finding suggests that the most productive yams in terms of tuber yields are not grown in the locations studied and opens the way to introducing exogenous varieties.

Summary and conclusion

An experiment set up in a split-split plot design was conducted in southeastern Nigeria to evaluate the performance of six cultivars of while yam (*Dioscorea rotundata*) derived from three sources. The trials were conducted in three sites with farmers from each site participating. The study revealed that location, fertilizer, cultivar and location x cultivar interaction effects were significant. Fertilizer application helped to boost yield in all the locations. Yams at present grown in some major yam-growing areas in southeastern Nigeria are not necessarily the highest yielding in these environments. Farmers in the test sites have already started asking for cultivars that were found to perform better in their respective locations.

Table 2. Statistical results on the yield parameters

	Yield parameter	Sources of variation	Probability level	
			FMT	RMT
1.	Length of tubers at harvest	Location x fertilizer	***	*
		Cultivar	***	*
		Location x cultivar	***	NS
2.	Girth of tubers at harvest	Location	***	**
		Fertilizer	***	**
		Cultivar	*	***
		Location x cultivar	*	***
		Location x fertilizer	NS	*
		Location x cultivar x fertilizer	***	NS
3.	Yield (kg/plant)	Location	***	**
		Fertilizer	***	***
		Cultivar	NS	NS
		Location x cultivar	***	NS
4.	Yield (ts/ha)	Location	***	***
		Fertilizer	***	***
		Location x cultivar	***	NS
		Cultivar	NS	NS
		Location x fertilizer	NS	NS
5.	No. of tubers/plant	Location	ND	***
		Fertilizer	ND	***
		Cultivar	ND	***
6.	Dry weight of vine/plant (g)	Location	ND	***
		Fertilizer	ND	***
		Cultivar	ND	NS
		Location x cultivar	ND	***
7.	Leaf area index (LAI)	Fertilizer	ND	***
		Cultivar x fertilizer	ND	**
8.	Leaf density (LD)	Location	ND	***
		Fertilizer	ND	*
		Cultivar	ND	*

Notes: NS,*,**,***, Not significant, significant at 0.5, 0.01, <0.001 levels of probability respectively; FMT, RMT, farmer- and researcher-managed trials repectively; ND, not determined.

Table 3(a). Summary of treatment effects on yam tuber yields averaged over fertilizer treatments and yam varieties

	Tons/ha	
Zakibiam	14.40	10.95
Abakaliki	7.08	6.07
Atani	9.10	5.97
S.E ±	0.532	0.604
CV %	36.15	38.58
LSD 0.05	1.503	1.734

Table 3(b). Yield averaged over location (source) and cultivar

Fertilizer	Yield (tons/ha)	
	FMT	RMT
NF	8.17	5.93
F	12.22	9.40
S.E. ±	0.264	0.412
C.V %	12.70	8.56
LSD 0.05	0.786	1.316

Table 4. Location x cultivar interaction effects on mean tuber yield (FMT)

	Tons/ha					
Zakibiam	14.70	8.57	16.30	13.06	18.62	15.13
Abakaliki	6.33	7.69	7.74	6.35	6.55	7.83
Atani	7.65	10.85	8.86	10.02	7.65	9.28
LSD 0.05 =	5.203					
Means	9.56	9.04	10.97	9.81	10.94	10.75
SE ±	4.50	1.63	4.65	3.36	6.67	3.86

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