

Evaluation of Yield Productivity and Economic Returns of Some Yam (*Dioscorea esculenta* Poir) Genotypes Grown in a Kaolinitc *Ultisol*

Angus Ikeh[1], Nyaudoh Ndaeyo[1]*, George Uduak[2], Eno Udoh[3], Lawrence Obinaju[4], Kesit Nkeme[5]

1. Department of Crop Science, University of Uyo , Uyo, Nigeria.
2. Department of Soil Science, Akwa Ibom State University ,Obio Akpa Campus, Nigeria.
3. Department of Crop Science and Horticulture, Akwa Ibom State University Obio Akpa Campus, Nigeria.
4 .Department of Agricultural Economics and Extension,,University of Uyo , Uyo, Nigeria.
5. Department of Agricultural Economics and Resource Management, Akwa Ibom State University,Obio Akpa Campus, Nigeria.

* Correspondence author: Email: dr_nundaeyo@yahoo.com
The research was financed by the authors.

Abstract

A two-year (2008 and 2009) study was carried out at the University of Uyo Teaching and Research Farm, Use-Offot to evaluate yield productivity of eight yam genotypes (TDr 200/3/7A, M_2/75/3, M_2/25/1, M_2/50/5x, 99/AMO/053, 99/AMO/094, 95/18894, and local -*Eteme*).and their economic returns to management. Randomized Complete Block Design with three replicates was used. Results of the study indicated significant differences in all the yield and yield components of the different yam genotypes considered in both years., Cost of production in 2009 was 2% above the cost of production in 2008 due to increase in cost of land preparation. The cost -benefit ratio of all the genotypes were above 10.00 except in local variety, *Eteme* with values of 4.9 and 6.3 in 2008 and 2009, respectively. The average cost- benefit ratio of 14.25 recorded in TDr 95/18894 suggesting strongly that the genotype is more adaptable to Uyo, agro- ecology than others.

Keywords; yield productivity, economic returns, yam, genotypes

1. Introduction

Yam (*Dioscorea* sp*)* is ranked second (82%) to cassava as major staple food and it is accorded high priority due to its cultural attachments. Yam, a tropical crop of the *Dioscoreaceae* genus has about 600 species out of which six are economically important staple species (Purseglove, 1972). Among the eight *Dioscorea rotundata* (white yam) is considered first in ranking. Yam provides about 200 calories of energy per capita daily (Kenyon, 2006). It contributes substantially to Nigeria's food security. In the major yam producing areas in Nigeria, it is consumed at least once a day during yam season, from October to March of succeeding year (Ugwu, 1990). It is also a major source of income to small scale farmers in West Africa (Dansi *et al.,* 2001).

Yam remains the most preferred starchy staple for many people in yam belt of West Africa (Kenyon, 2006; Ikeorgu *et al.,* 2002), However, productivity of yam in the main yam growing belt of West Africa is continually on the decline and cannot meet the present demand. FAO-SAT (2005) stated that, in Nigeria, the average yield of yam appears to have been steadily declining over the last 8-10 years. Many factors such as cost of planting material, planting of low yielding varieties/species, poor soil fertility, pests and diseases in field and storage have been implicated as responsible for the decline.. Udoh *et al.* (2005) and Kenyon (2006), stated that the cause of this decline is often cited as being the declining soil fertility due to shorter fallow periods and use of more marginal land for yam production because of the increasing demand on agriculture to feed the increasing human population Besides, yam is also the most expensive root crop to produce because of high cost of labour demand for land preparation, planting, staking, weeding harvesting and transport to market (Kenyon, 2006). Yam also has low multiplication ratio unlike cereals. Ikeh (2010) stressed the need to select a genotype that would perform better to a particular location, cropping system and respond well to fertilizer application.

Yam is also a cash crop and has a place in the socio-cultural setting of the people. In the savanna zone of Nigeria, which approximates the Nigeria yam belt, yam producing households earned about N4,200 (N17=US $1) per

household from yam production in 1992 (Ugwu, 1996; Nweke *et al.,* 1991). Although it was only 17% of the household cash income from all food crops, it accrued to nearly 75% of the producing households.
According to Ugwu *et al.* (2001), yam production is labour intensive, and that the cost of production will vary depending on the amount of labour, time of the year, and location. This explains, why there need to select the genotype(s) that would yield better or have comparative advantage in a given location so to compensate the high cost of production and guarantee higher economic return to management Against this background, this study was conducted to evaluate the yield productivity and economic return to management of some yam genotypes grown in a kaolinitc ultisol of Uyo, southeastern Nigeria.

2. Materials and Methods

The study was carried out during the 2008 and 2009 cropping seasons at the University of Uyo Teaching and Research Farm located at Use Offot, Uyo (Latitude $5^0$17' and $5^0$27'N, Longitude $7^0$27' and $7^0$58'E and altitude, 38.1m above sea level). This rainforest zone receives about 2500 mm rainfall annually. The rainfall pattern is bimodal, with long (March - July) and short (September - November) rainy seasons separated by a short dry spell of uncertain length, usually during the month of August. The mean relative humidity is 78%, atmospheric temperature is 30^0C and the mean sunshine hours is 12 (Peters *et al.,* 1989).

A randomized complete block design with three replications was used. . The entire experimental area was 56 x 20m, each plot size was 5x5m. The replication and plot alley ways were by 2m and 1m, respectively. Eight yam genotypes; TDr 200/3/7A, M_2/75/3, M_2/25/1, M_2/50/5x, 99/AMO/053, 99/AMO/094, 95/18894, and local (*Eteme*) constituted the treatments

In both cropping seasons, plantings was done in May. The yam genotypes obtained from National Root Crop Research Institute, Umudike, Abia State, Nigeria were planted on mounds at 1 x 1m spacing with tuber size weighing 180g. Weeding was done manually three times at 1, 2 and 5 months after planting (MAP). A compound fertilizer (NPK-15:15:15) was applied at 2 months after sprouting. The following data were considered; number of tubers per number plant, number of seed tubers per plant „number of ware tubers per plant, seed tuber yield (t/ha), ware tuber yield (t/ha), and total tuber yield (t/ha). Cost of production (planting materials, soil test, land preparation, fertilizer , weeding and harvesting) and economic return were also assessed. Data collected were analysed using analysis of variance and means that showed significant differences were separated using least significant difference (LSD) at 5% probability level. Cost- benefit ratios and economic returns to management were determined using partial budgeting.

3. Results and Discussion

The yield and yield components of the yam genotypes considered varied significantly in number of seed and ware tubers per plant in both cropping seasons (Table 1). The TDr 95/18894 produced highest number of seed and ware tubers per plant, 4.31 and 2.36 in 2008 and 4.33 and 2.41 in 2009 ,respectively, followed by TDr 99/AMO/094, 3.30 and 2.33 in 2008 and 3.31 and 2.34 in 2009 ,respectively. The least number of seed and ware tubers on the average was obtained from the local variety *Eteme*), 2.03 and 0.00 in 2008 and 2.30 and 1.00 in 2009, respectively. The TDr 95/18894 produced 23-53% and 23-47% more number of seed tubers than other genotypes in 2008 and 2009, respectively. It also had 1-100 and 3-75% more ware tubers than other yam genotypes. The seed and ware tuber yields also indicated significant differences (Table 1), TDr 95/18894 genotype also maintained superiority in seed and ware tuber yields, 20.11 and 7.63 (t/ha) in 2008 and 22.26 and 8.75 (t/ha) of seed and ware tuber yield in 2009 ,respectively.

The TDr 95/18894 genotype exceeded other yam genotypes in seed tuber yield by 6-50% and 13-50 % in 2008 and 2009, respectively. It also out-yield other genotypes in ware tuber yield by 1-100% and 1-76 % in 2008 and 2009, respectively. Comparing the total tuber (seed and ware) yield, TDr 95/18894 genotypes produced the highest in both cropping seasons, 27.74 and 31.01 t/ha, respectively, followed by 99/AMO/094, 26.83 and 27.30 t/ha in 2008 and 2009, respectively, TDr 99/AMO/053, 26.63 t/ha in 2008 and M_2/50/5x, 27.26 t/ha in 2009. The least total tuber yield in both cropping years was obtained from local genotype (*Eteme)*, 10.13 and 13.16 t/ha in 2008 and 2009, respectively.

The cost of production and economic returns to management are presented in Table 2. The cost of production was higher in 2009 than 2008 by 2%. . The highest cost-benefit ratio in both planting seasons was recorded in TDr 95/18894 (13.6 and 14.9 at 2008 and 2009, respectively), followed by 99/AMO/053 and 99/AMO/094, 13.0 and 12.1 in 2008 and 12.8 and 13.1 in 2009 ,respectively. All the improved yam genotypes had cost- benefit ratio above 10.0 in both cropping seasons. The local variety, *Eteme* ,had lowest cost- benefit ratio of 4.9 and 6.2 in 2008 and 2009, respectively.

The yield of the different yam genotypes differed in number of seed tubers, ware tuber, and total tuber yield. This could be attributed to genetic differences and inherent varietal characteristics of the yam genotypes. These findings are in consonance with the findings of FAO (2000), that different varieties of crop differ in their nutrient requirements and response to treatments like fertilizer and that a local crop variety will not respond so well compared to improved variety. Also, Kapinga *et al.* (2007) reported that there is a great diversity, including contributions from wild and semi-domesticated species of yams which provides opportunities for selection to such various ecologies, production system and mode of utilization. The differences observed in yield and yield components of the yam genotypes is also in line with the findings of Onwueme and Charles (1994) that the yield of tuber is variable and depends on the variety cultivated, soil and cultural practices and as such have effect on yam yield. Asadu *et al.* (1996) also affirmed that apart from location, and fertilizer, cultivars significantly affect tuber yield. These findings also agree with Ugwu *et al.* (2001) that total revenue in yam production varies within the cultivars planted.

4. Conclusion

The cost of yam production is usually high but with appropriate agronomic practices and ability to select adaptable genotype that could yield high, farmers can have reasonable economic returns. This will in turn to improve standard of living and welfare of farmers in rural areas where yam are dominantly grown at subsistence level.

References

Aighewi, B. A. Akoroda, M. O. & Asiedu, R. (2003). Seed Yam (*D. rotundata* Poir) Production, Storage and Quality in Selected Yam Zones of Nigeria. *African Journal of Root and Tuber Crops*, **5**, 20-23.

Asadu, C. L. A., Akamigbo, F. O. R., Nweke, F. I. & Ezumah, H. C. (1996). Evaluation of Six Cultivars of white yam (*Dioscorea rotundata*) across three yam-growing areas in South Eastern Nigeria. *Journal of Agricultural Science*, **127** , 463-468.

Dansi, A., Mignouna, J., Sangara, A., Zoundjihekpa, J., Asiedu, R. & Quin, F. M. (2001). *Characteristics and Conservation of Yam biodiversity for sustainable use for food and Agriculture in Benin Republic.* In: Processing of 7th Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch (ISTRC-AB) Centre International des Conferences, Cotonou, Benin Rep. 11-17 October, 1998.

FAO (Food and Agriculture Organisation of United Nation) (2000). *The State of Food Security in the World*, FAO Rome, pp 31.

FAO (Food and Agriculture Organisation of United Nation) (2005). *Bulletin of Statistics* **1** (2), 49.

Ikeh, A. O. (2010). Effects of intercropping melon (*Colocynthis citrullus)* and fertilization on performances of yam (*Dioscorea rotundata)* genotypes on an ultisol, Southeastern, Nigeria. M.Sc. Dissertation, Department of Crop Science, University of Uyo, Uyo, Nigeria.

Kapinga, R., Nangera, N., Asiedu, R., Chirimi, B., and Kaare, S. (2001). Yams *in the Tanzanian Food and Farming systems: Implications for Research and Development.* In: Processing of 7th Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch (ISTRC-AB) Centre International des Conferences, Cotonou, Benin Rep. 11-17 October, 1998.

Kenyon, L. (2006). Up-*scaling Sustainable "Clean" Seed Yam Production Systems for Small Scale Growers in Nigeria. DFID Crop Protection Programme*, Final Technical Report, Project R8416. Natural Resources Institute

(NRI), University of Greenwich, Chatham, Kent, UK. 19pp.

Nweke, F. I., Ugwu, B. O., Asadu, C. I. A. and Ay. P. (1991). *Production Costs in the Yam-Based Cropping Systems of Southeastern Nigeria*. RCMP Research Monograph No. 6. Resource and Crop Management Programme, International Institute of Tropical Agriculture, Ibadan, Nigeria.

Onwueme, I. C. and Charles, W. B. (1994). *Tropical root and tuber crops: Production Perspective and Future Prospects.* FAO, Rome, Italy. pp. 40-51.

Peters, S. W. Usoro, E. J., Udo, E. J., Obot, U. W. and Okpon, S. N. (eds), (1989). Akwa *Ibom State: Physical Background, soils and land use and ecological problems*. A technical report of the task force on soils and land use survey, Akwa Ibom State. 603p.

Purseglove, J. W. (1972). *Tropical Crops Monocotyledons.* Longman. London pp.97 117.

Udoh, D. J. Ndon, B. A. Asuquo, P. E. and Ndaeyo, N. U. (2005). *Crop Production Techniques for the Tropic*s. Concepts Publications Limited. Lagos, Nigeria. 446pp.

Ugwu, B. O. 1990. *Resource Use and Productivity in Food Crop Production in Major Yam Producing Areas of Southeastern Nigeria.* Ph.D Dissertation, University of Nigeria, Nsukka,,Nigeria.

Ugwu, B. O. 1996. Yam and Cassava Productions as Income Generating Activities for Households. *African Journal of Root and Tuber Crops* , **1** (2), 43.

Ugwu, B. O. Ezulike, T. O., Orkwor G. C. and Nwauzor, E. C. (2001). *Comparative Analysis of Costs and Returns in Dry and Wet Season Planted Yams in Benue State Nigeria*. In: 7th Symp. ISTRC-AB 11-17 October, 1998 Contonou, Benin Republic. pp. 167-173.

Table 1. Yield and yield components of the different yam genotypes

	2008					2009				
Yam genotypes	Number of seed tubers/plant	Number of ware tubers/plant	Seed tuber yield (t/ha)	Ware tuber yield (t/ha)	Total tuber yield (t/ha)	Number of seed tubers/ plant	Number of ware tubers/ plant	Seed tuber yield/(t/ha)	Ware tuber yield (t/ha)	Total tuber yield (t/ha)
200/3/7A	2.39	1.00	16.17	5.13	21.30	2.33	2.00	17.33	5.63	22.96
M2/75/3	2.39	1.33	14.93	6.33	12.26	2.40	1.93	16.31	4.85	21.116
M2/25/1	2.11	1.33	18.03	5.61	23.64	2.33	1.33	18.52	5.75	24.27
M2/50/5x	3.10	2.30	18.31	7.33	25.64	3.30	2.33	19.05	8.21	27.26
99/AMO/053	2.21	2.30	19.21	7.42	26.63	2.33	2.03	19.35	5.11	26.76
99/AMO/094	3.30	2.33	18.36	8.47	26.83	3.31	0.39	18.59	8.71	26.30
95/18894	4.31	2.36	20.11	7.63	27.74	4.31	2.41	22.26	8.75	31.01
95/19531	2.30	0.00	18.82	0.00	18.82	2.38	0.53	18.90	2.75	21.65
75/1/2	3.03	1.33	17.61	5.73	23.34	3.43	1.83	17.83	4.25	22.08
Eteme	2.03	0.00	10.13	0.00	10.13	2.30	1.00	11.05	2.11	13.16
LSD ($p \leq 0.05$)	1.12	0.53	3.11	3.04	3.62	1.03	0.95	3.06	2.52	3.31

Table 2. Cost of production and economic return to management (N ha^{-1}) as influenced by the different yam genotypes.

Farm operation		Yam genotypes 200/3/7A		M2/75/3		M2/25/1		M2/50/5x		99/AMO/053		99/AMO/094		95/18894		*Eteme*	
(A)	Farm Operation	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
1	Land preparation	45000	48000	45000	48000	45000	48000	45000	48000	45000	48000	45000	48000	45000	48000	45000	48000
2	Fertilizer	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000	34000
3	Planting materials	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300	35300
4	Staking materials	30500	31500	30500	31500	30500	31500	30500	31500	30500	31500	30500	31500	30500	31500	30500	31500
5	Labour	86300	87100	86300	87100	86300	87100	86300	87100	86300	87100	86300	87100	86300	87100	86300	87100
	Total cost of Production (TC)	231,100	235,900	231,100	235,900	231,100	235,900	231,100	235,900	231,100	235,900	231,100	235,900	231,100	235,900	231,100	235,900
(B)	Yield (tha^{-1})	21.30	22.96	21.36	21.16	23.64	24.27	25.64	27.26	26.63	26.76	26.83	27.30	27.74	31.01	10.13	13.16
(C)	Gross Revenue (GR)	2406 900	2594 480	2402 380	2391 080	2671 320	2742 510	2897 320	3080 380	3009 190	3023 880	3031 790	3084 900	3134 620	3504 130	1144 690	1487 080
(D)	Return to Management (GRT)	2175 800	2348 580	2171 280	2155 180	2440 220	2506 610	2666 220	2844 480	27780 090	2787 980	2800 690	2849 000	2903 520	3268 230	913 590	1251 180
	Benefit/Cost Ratio	10.4	11.0	10.4	10.1	11.6	11.6	12.5	13.1	13.0	12.8	12.1	13.1	13.6	14.9	4.9	6.3

a. Labour cost are planting, weeding, fertilizer, purchase, transportation, and application
b. Yield x unit price of N113,000 per tonnes of yam based on prevailing market price at time of sales.