SWEETPOTATO PROMOTION GROUP
UNIVERSITY OF IBADAN

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Sweetpotato in Nigeria

Proceedings of the First National Sweetpotato Conference
Held during 16–18 September 2008 At the First Bank Hall
Faculty of Agriculture and Forestry, University of Ibadan, Nigeria

Under the Auspices of the
Sweetpotato Promotion Group

Edited by

Malachy AKORODA & Ijeoma EGEONU

Supported by

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NATIONAL CENTRE FOR GENETIC RESOURCES & BIOTECHNOLOGY
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FEDERAL DEPARTMENT OF AGRICULTURE
RTEP
ROOT & TUBER EXPANSION PROGRAMME
NIGERIA / IFAD PROJECT

A cross-section of participants at the Sweetpotato in Nigeria Conference held at the First Bank Hall, Faculty of Agriculture of Forestry, University of Ibadan, Oyo State fro 16-18 September 2008.

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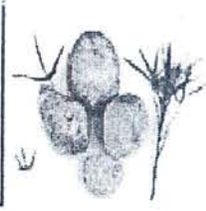

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September 2009

SPG

The Sweetpotato Promotion Group (SPG), headquartered at the Department of Agronomy, University of Ibadan, was initiated in 1986 following the urge to promote short season food crops among growers in enclaves, researchers and various development agencies in recognition of sweetpotato's role in contributing food, feed and raw materials for local industry.

In 2005, it received support from several sou encouraging the need for a consolidation of the dispa efforts across the country to organise into a recogniz forum of discussion, planning and collaborative rese and development. The Conference of 16–18 Septen 2008 is the culmination of these efforts by many represent the SPG, now numbering hundreds stakeholders.

Preface

We present herewith the book of proceedings of the First National Conference on Sweetpotato in Nigeria held at First Bank Building of the Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria during 16–18 September 2008. The meeting of sweetpotato scientists, traders, farmers, transporters, development agencies, NGOs and other stakeholders across Nigeria represented 13 States of Nigeria. It is hoped that this Conference could or should be annual. It was well attended by a total of 203 registered participants contributing a total of four plenary presentations, 15 discussion group reports, and 30 submitted papers.

The opening ceremony which started the Conference witnessed the advice of the Dean of the Faculty of Agriculture and Forestry, University of Ibadan, Prof. Kola Ewete who was representing the Vice Chancellor of the University. There were goodwill messages from the Executive Director of National Root Crops Research Institute (NRCRI), Dr. Kenneth Nwosu (ably represented by Dr. T.N.C. Echendu), Director of Nigeria Agricultural Quarantine Service Mrs Onwuaduegbo (ably represented by Mrs Funke Awosusi), Hellen Keller International Interim Country Director Dr. Stephen Adah (represented by Mr. Peter Aimakhu), as well as the President of the All Farmers' Association of Nigeria, Oyo State Chapter Apostle Elegbede.

Following rapidly after the opening ceremony, four plenary papers were presented by Prof. G.O. Obigbesan (University of Ibadan), Mr. Solomon Afuape (NRCRI, Umudike), Dr. Stella Odebode (Secretary to SPG), and finally by Mr. John Atoyebi from National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan. General discussions, questions and interactions in groups representing Field Production, Research, Extension and Outreach, Development/Government Policies, Marketing and Economics, as well as Processing and Utilization continued till the end of the first day. Day two of the Conference was all about interactions in parallel group discussions for each of nine zones of the cour Each discussion group had a chairperson and rapporteu facilitate the discussions and the production of the gr reports that are presented in this book of proceedings.

On day three, the group reports were presented to participants for reactions, questions, comments and fur discussions before a committee was formed to cons and prepare the communiqué for the three days presentations, zonal discussions and discussions technical groups. Finally, the venue for the r conference was discussed and election conduc resulting in the agreement for National Root Cr Research Institute (NRCRI), Umudike, Abia State to h the next Sweetpotato in Nigeria Conference sometime 2009. The Conference closed with renewed zeal greater interest in the utilization of sweetpotato in as m ways as were depicted and demonstrated by dozens products, some of which are documented in this book. potential of the crop is, therefore, enhanced by grea awareness not only by this conference, but also by publication of this book of proceedings and the four-pi video cd produced in collaboration with the University Ibadan Media Centre, which are now being distributed.

Orange-fleshed sweetpotato has been highly appreciated a new supplement to various food preparations includ its use in bread-making and other confectioneries, whet fresh, boiled, mashed mass or flour from dried chips; ratios ranging from 10–25% with acceptable produ among consumers. The future of sweetpotato in Nigeria bright; however, greater promotion efforts are required tackle challenges identified by various group discussio during this conference.

The Local Organizing Committee comprised:

Registration: Ms. Ijeoma Egeonu (University of Ibada and Ms. Opeyemi Ayanrinola (University of Ibadan)
Publicity: Mr. Rasheed Adegbola (Oyo State Agricultu Development Programme, Ibadan)

Refreshments (food): Dr. Stella Odebode (University of Ibadan)

Refreshments (drinks): Ms. Biola Amao (University of Ibadan) and Ms. Yinka Jimoh (Promasidor Nigeria Ltd., Oke-Bola, Ibadan)

Logistics: Mr. Ambrose Chineke (Nigerian Agricultural Quarantine Services (NAQS), Moor Plantation, Ibadan) and Mr. John Atoyebi (National Agency for Crop Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan.

Publications/Rapporteuring: Prof. Malachy Akoroda, Ms. Ijeoma Egeonu (University of Ibadan), and Ms. Isi Egbele (Food Basket Organization, Bodija, Ibadan)

Accommodation: Ms. Ijeoma Egeonu, Ms. Opeyemi Ayanrinola and Mr. Omotosho Folorunsho (University of Ibadan)

Hall decoration: Ms. Yetunde Fawusi and Ms. Opeyemi Ayanrinola (University of Ibadan)

Exposition Corner: Mr. Olukayode Yekeen (Federal Department of Agriculture and Rural Development, Moor Plantation, Ibadan)

Rapporteurs for Research and Development Committees:

Field Production of Sweetpotato: Dr. Ivo Acha

Sweetpotato Research: Dr. Jire Dare

Sweetpotato Extension and Outreaches: Dr. Stella Odebode and Mr Ajiboye

Sweetpotato Development and Government Policies: Mr. Ambrose Chineke and Mr. John Atoyebi

Sweetpotato Marketing and Economics: Mr. Rasheed Adegbola and Mr. Wale Olayide

Sweetpotato Processing and Utilization: Ms. Isi Egbele and Mr. Segun Kupoluyi

Editors of the book of proceedings for the conference: Prof. Malachy Akoroda and Ms. Ijeoma Egeonu (University of Ibadan).

This landmark event launched the maiden issue of Sweetpotato in Nigeria publication supported by the gracious donations of venue, staff, security, and electricity by the University of Ibadan. This was followed by cash donations from the following: Helen Keller International, Nigeria Agricultural Quarantine Service, National Agency for Crop Genetic Resources and Biotechnology, International Potato Centre, University of Ibadan and Root and Tuber Expansion Programme. We also hope that many of those who made good promises should not forget to act as is needed.

M.O. Akoroda and I.N. Egeonu, September 2009

Communiqué

Communiqué

Members of the Communiqué Drafting Committee were:

Dr. Mrs. K.A. Agbaje	Chairperson
Dr. Talib A. Oyejobi	Secretary
Mr. Abioye Akerele	
Mr. Abiodun Arowolo	
Miss T.L. Ayodele	

The following challenges and problems have been identified by the Conference and are highlighted as follows:

1. Non-availability of planting materials (vines, tubers, etc.) of improved high-yielding sweetpotato varieties to farmers for cultivation.
2. Insufficient hectarage of land for production purposes.
3. Inadequate plant quarantine and control of trans-border pests and diseases.
4. Poor state of rural infrastructure, e.g. roads, electricity and water.
5. Poor mechanization facilities resulting in low productivity.
6. Inadequate funds for research purposes e.g. breeding improved materials and multiplication of small quantities of breeders' materials produced for delivery into the production chain. Other areas of research include pest and disease control and soil management.
7. Insufficient number of research personnel for conducting research.
8. Threats of pests and diseases on the field.
9. Inadequate processing and storage facilities e.g. flash dryers; solar dryers; grading, sorting, and packaging facilities.
10. Incidence of glut following increased production of cassava has rendered farmers sceptical of the sweetpotato campaign.
11. Lack of efficient marketing communication and information techniques.
12. Poor standardization and quality control in the production chain.
13. Inadequate number of extension workers and mobility tools to reach farmers in remote areas.
14. Poor or marginal soils resulting in low yield
15. Utmost disregard for environmental safety and sustainability issues.
16. Non-consideration for agro-ecological adaptability of varieties.
17. Lack of collaboration among research institutions.

In view of the above-stated problems, the follo recommendations are proffered:

A. Establishment of effective certified multiplication outfits in every sweetpotato-gro community.
B. Review of government farmland acquisition poli favour of farmers for crop production purposes.
C. Recognition of active Farmers' Associations w members are practicing farmers in their communit
D. Improvement of Plant Quarantine Services and t border disease control to forestall incidence foreign pests and diseases in Nigeria.
E. Provision of mechanized farming equipment dir to farmers in their farming communities for incre crop production.
F. Improvement of existing rural infrastructural facil and provision in farming communities that lack th
G. Disbursement of sufficient funds to research insti to conduct relevant research on improved sweetp technologies.
H. Recruitment of more researchers to facilitate rese programmes.
I. Multiplication of adequate quantities of impr breeders stock for release into the production chai
J. Strengthening of the Research Extension Far Inputs Linkage System (REFILS) to enable far gain access to research benefits.
K. Establishment of efficient marketing communicat and information system on sweetpotato.
L. Aggressive awareness campaign on to cl misconceptions about sweetpotato and project various nutritional and industrial benefits.
M. Strengthening of cottage industries for proces storage and value-addition to enhance local international marketing and forestall glut.
N. Recruitment of adequate number of exten personnel and provision of mobility facilitie facilitate efficient extension service delivery farming communities.
O. Networking and collaboration among ht e var research institutes, universities and farm associations (AFAN).
P. Active participation and involvement of NGO agricultural development.
Q. NRCRI should establish outstations in all part South-Western Nigeria, and collect data relevant t stakeholders on the production of sweetp throughout Nigeria.
R. Advocacy and awareness campaigns on the nutriti value, therapeutic benefits and other uses sweetpotato are needed. The consumption of tuber per person per day is hereby recommended.

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Welcome Address

Sweetpotato in Nigeria: Past, Present, and Future

Professor Malachy O. Akoroda
Scientific Advisor, Sweetpotato Promotion Group

Many Thanks and Deep Appreciation go to the following groups of persons:

1. Participants who came and those who communicated their interest but had no funds.

2. Members of LOC who sacrificed and suffered to achieve this *noble* and significant event.

3. People who provided information and ideas that helped make this conference possible.

4. Every donor in the past, present and in the near future.

5. Those who will work after the conference to produce the book of proceedings.

History of Sweetpotato Introduction

Christopher Columbus took sweetpotato from America to Spain in 1492. Sweetpotato cultivation was first mentioned in Africa in Sao Tome in 1520 (Mauny 1953). Portuguese traded along the coast of Nigeria, and brought the crop around 1558.

Sweetpotato Production Status

A total of 516,000 ha is cultivated in Nigeria producing 2,516,000 tonnes of fresh tuberous roots. Roots yields are obtained in 4–5 months with an average yield of 4,876 kg/ha (FAO 2005). It is noted that about 90.1 % of world sweetpotato tonnage is from China while all the other 156 nations account for 9.9 %.

Sweetpotato Germplasm

Some 120 clones assemble and being characterized at University of Ibadan duplicated in part at:

RTEP, Ijebu Ife, Ogun State
UNAAB, Abeokuta, Ogun State
NRCRI, Umudike, Umuahia, Abia State
Farm of the Faculty of Agriculture and Forestry, Universit of Ibadan, Ile-Igbo, Osun State
NACGRAB, Moor Plantation, Apata, Ibadan (planned)

E-mail Survey on Sweetpotato Conference

Questions were sent to knowledgeable sweetpotato k stakeholders and their responses were taken verbally, paper, and by email answers. We rejected all verbal a paper responses leaving 15 email responses that came before the consultation end-date of 30 July 2008 were th analyzed as follows:

Dr Femi Aina suggested the committees but did n answer the three key questions of date, duration location.

Name of Email Respondent	Proposed period and suggested location	No. of days
Dr. Oyin Olukunle	22–27 Sep or 15–19 Dec Ibadan	5–6
Mrs. S. O. Onwuaduegbo	2nd week Sep. Umudike	3
Dr. O. A. Abu	12–14 Aug. IITA, Ibadan	3
Julie Aham	2nd or 3rd week Sep. Umudike	2–3
Ijeoma Egeonu	Last week Aug. Ibadan	2
Prof. J. O. Igene	Late Aug/early Sep. Benin City	-
Solomon Afuape	30 Sep–2 Oct. Umudike	3
N. A. Onunka	Oct/Nov. Umudike	14
Dr. T. N. C. Echendu	3–4 Sep. Umudike	2
Dr. Adesola Ajayi		5
Mr. O. A. Badmus	4–6 Aug. Ibadan	3
Mr. O. A. Idowu	4–6 Aug. Ibadan	3
H. K. Akwashiki	Sep. Lokoja	-
Dr. Femi Aina	-	-
Toyin Peter	26–28 Nov. Ibadan	3

The conference shall hold in Aug (26.7 %), Sept (46.7 % Oct (10.0 %), Nov (10.0 %), and Dec (3.3 %).

Duration shall be 3 days (54.2 %).

Location of the Conference to be at: Ibadan 46.2%; Umudike 38.5 %.

Committees for discussion of themes should include: Research, Development, Production, Extension, Marketing, Processing, and Utilization.

No funding is available so participants shall be sponsored by self or their respective agencies.

Sweetpotato Research Nexus in Nigeria
The Federal Government mandate for research on sweetpotato in Nigeria belongs to the National Root Crops Research Institute, Umudike, Abia State.

But, it is important to note that some scientists that devote time to sweetpotato research are spread across 93 universities and 17 research institutes spread across six geo-political zones. No one knows for sure who is doing what and the distribution of disciplines covered

Sweetpotato Situation Reports
Whatever information you have or know about sweetpotato should be *written* and *photographs* brought along to the conference. Also bring along reprints or photocopies of sweetpotato articles, essays of past work, whether published or not. Write a small 1-3 page briefing note or essay on the status or experience you have with the crop in your current or former locality or any other locality specified by name that you know well.

Sweetpotato Promotion Group
In 1986, it dawned on us that sweetpotato in areas north of latitude 10° N in West Africa will be the main crop to pursue for meeting food security among cereal producers who suffer frequently failed crops. The Plant Breeding and Seed Production Laboratory of the Department of Agronomy called for a national grouping of all sweetpotato workers in science, technology, and development. The response was huge. But no funds were forthcoming from the agencies we contacted. In 2005, SPG evolved from the Faculty of Agriculture & Forestry, University of Ibadan. But lack of funds restricted work to South-West zone of Nigeria with a strong aim to do something national and tangible. However, in 2008, the move of Bill and Melinda Gates Foundation to support the crop in Africa catalyzed the re-awakening of our drive. Today, Nigeria becomes the first in Africa to hold a national sweetpotato conference.

Future Prospects
Human food and livestock feed has remained the target of sweetpotato production in the past and at present. But the future will include its use in vitamin A enrichment, and ethanol production for food beverages and in bio-fuels.

Raising our Efforts
The conference of September 2008 would be the first ever to be held on the sweetpotato crop in Nigeria, since its introduction at about 1558 AD. Why these 450 yea neglect and low emphasis?

Developing Sweetpotato Science
Observations. Examine who, where, when, why, v which, and describe with records such as photogr mode of growing, storage, every form of use, co prices, weights, volumes, locations where fc

Modelling. Data on experience from many LGAs many years is studied and used to explain what we around the country.

Estimation. Forecast the unknown and help develop crop in a quantitative way for total use by humans livestock, and industry.

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Opening Speech

Professor F.K. Ewete
Dean, Faculty of Agriculture and Forestry,
University of Ibadan, Ibadan, Nigeria

Dear participants,

It is a thing of joy to warmly welcome you to this fac from your different destinations across Nigeria. faculty was established in 1949 as a one-departn faculty, and now has seven departments, namely: A Economics, Agric Extension and Rural Developm Agronomy, Crop Protection and Environmental Biolc Wildlife and Fisheries, Animal Science and Fo Resources Management. Teaching started in 1950 v only one student and 8—10 lecturers. The fac graduated its first student in 1953. Thereafter, population of intakes steadily increased. Since 1953, have trained graduates in different disciplines agriculture to serve other universities and agencies Nigeria and in Africa. Our graduates have served agricultural world in many international fora, resea institutes and tertiary Institutions, and it is a thing of pr to welcome you to the faculty that can be described as mother faculty of agriculture in Nigeria.

This conference is on sweetpotato, a crop of importance some enclaves of the country but has attained the status a staple in some areas like Rivers State, Offa area Kwara State and Oyan area of Osun State. There is doubt that this crop can do well in the food basket states Nigeria such as Nassarawa, Benue, Kogi and Niger Stat It is my hope and expectation that your deliberations w

help our country produce a plan that can be sent to donors that will add on to our local efforts to move the crop forward as a contribution to the on-going food crises or shortages and rising prices.

I note that by majority demand the conference was voted to be held at Ibadan (46.2 %) or Umudike (38.5 %). This spotlights the importance of Ibadan and Umudike in the struggle to make the crop more useful to Nigerians. I look forward to your book of proceedings which I know will contain much knowledge on how to grow, process, package, and market the crop for human consumers, livestock feed, and industries.

As flour, sweetpotato can replace wheat flour in bread, and confectionaries, and can enter into the production of ethanol for food beverages, as well as bio-fuels.

The low number of scientists working on the crop who are well-funded has made the strength of the support to farmers even more unreliable compared to the case for cassava and maize. The potential of the crop has been well exploited in Eastern and Southern Africa, but much less so in West Africa. The factors affecting this relate to falling emphases in agriculture, great interests in imports from agriculturally progressive nations that are even less endowed compared to Nigeria.

Every suggestion on how sweetpotato culture and use can be advanced in Nigeria would do a world of good to raise the value and appreciation of the crop among many communities of farmers particularly in the central and northern agro-ecological zones of Nigeria, that suffer frequent cereal crop failures.

I wish you all fruitful deliberations over the three days while also hoping you find sometime to visit the different spots on this beautiful campus. Also kindly accept my best wishes for your family when you return home.

.....

Keynote Address

Dr. Kenneth I. Nwosu
Executive Director, National Root Crops Research Institute, (NRCRI), Umudike, Abia State, Nigeria, (Presented by Dr. T.N.C. Echendu, Co-ordinator, Sweetpotato Programme).

It is indeed a great pleasure for me to be here today at memorable occasion of the first ever Sweetpo stakeholders' conference in Nigeria. This conference long been overdue, but has been waiting for an opportu like this to become manifest. So much attention has b given to cassava and yam in Nigeria to the utter neglec other root and tubers crops like sweetpotato and I potato. Sweetpotato is a crop that has not received level of attention that it correctly deserves. It has b grossly under-researched, not only in Nigeria but glob: yet it is a crop that holds so much promise for the futur

As you may be aware the National Root Crops Rese Institute, Umudike, South East Nigeria has the Nati mandate for Root and Tuber crops. This institute came existence on 1 January 1923 as a provincial Agricu Station. It underwent series of changes. However, in 1 it was upgraded to a Federal commodity research insti The mandate of the N.R.C.R.I includes research intc genetic improvement, production, processing, stor utilization and marketing of root and tuber crop economic importance. These crops include sweetpc cassava, yam, potato, ginger, sugar beet and other n root crops. As part of the management structure, institute has established a compact scientific progra for each of these crops. Sweetpotato programme is or them. It has a crop of young scientists in virtually al fields on whose shoulders rest the task of pushing this to greater heights.

The potential of sweetpotato as poverty alleviation, h nutritional crop with growing importance in the preve of malnutrition in children, are not in doubt. It is a with very high energy production per unit area whicl very important characteristic. These potentials are l addressed at the N.R.C.R.I Umudike, through focuse applied research.

In order to increase farmers' productivity, three yielding sweetpotato genotypes have been offi registered. These cultivars are resistant to the h damaging sweetpotato virus diseases. Feed back farmers from the use of these material (TIS 87/0087 and TIS 2532.op.1.13) are encouraging. introductions have led to a marked increase in av

farmers' yields from 1-2 tons to the present 6-8tons per hectare. Additionally, many production packages have been put in place to ensure maximum productivity in farmers' field. These have led to Nigeria being the highest producer of sweetpotato in Africa. Some of the other technologies developed by the sweetpotato programme include the use of four node cuttings for planting, earthing-up during weeding for the control of sweetpotato weevils *(Cylas* spp.*)*, adequate plant population of about 33,333 stands per hectare under our production system and the optimal fertilizer rate of 400kg NPK 15:15:15 per hectare. In order to add value to production, different food forms have been developed by the post harvest programme of the institute from sweetpotato. These included sweetpotato chin-chin, bread, sweetpotato flour, starch, flakes, jams and other food forms. These are being introduced to women groups in the different communities in the south east and south-south regions of Nigeria. This year, funds are being secured to ensure that more communities nation wide benefit from these training opportunities. With the focus of the institute on the crop, we hope to replicate the achievements in cassava and yam that have made Nigeria the highest producer of both crops in the world.

With regards to this Crop we have a dream. The institute dreams to make Nigeria one of the great players in the global community of sweetpotato exporters and net utilizers. We are beginning to focus on the development of high quality sweetpotato starch for the emerging noodle industry in Nigeria. A lot of work is also being envisaged with respect to the development and dissemination of the orange fleshed sweetpotato (OFSP) which are nutritionally superior to the white fleshed varieties currently in use. The orange fleshed varieties have the potential to prevent Vitamin A deficiency because of their beta-carotene contents. These will no doubt impact positively on the socio economic life of out people through increased employment, also reduction in the foreign exchange spent on the importation of wheat for the confectionery industry in Nigeria.

Other serious challenges facing us include the problem of the sweetpotato virus diseases (SPVD). Recent surveys have shown that this disease is prevalent in most parts of the South east and south-south. Many of the cultivars are infected and yields are consequently being affected. The endemic problem of the sweetpotato weevil (*Cylas punticollis)* in storage has not been addressed and therefore needs attention. The general attributes of the crop and comparative advantages have to be showcased.
As a crop with high dry matter and sugar content, we hope to be the prime movers in the research on sweetpotato as a source of bio fuel. The establishment of advanced biotechnology laboratory with advanced equipment usher in the unlimited ability provided by biotechnolo the improvement of sweetpotato. This will also in positively on the economy.

My dear stake holders in the sweet industry, distingui guests, fellow participants, ladies and gentleme welcome you all to this conference which is b organized as part of the efforts being made globally b Bill and Melinda Gates' initiative to improve on the lo the poor and needy especially in sub tropical A through improvements in crops that can substant reduce hunger and make positive impact in the lives o rural poor. I therefore implore you all to contribute own little or big quota towards the success of conference so that a very compact and accep document can be put in place. The benefits will be fo entire Nation.

Once again, I wish to thank the organizers of conference especially Prof. M. Akoroda for all efforts. We had hoped to host this conference at NRCRI Umudike, however we had to bow to maj opinion and settle for Ibadan. It would have afforded the opportunity of having a first hand insight into wha institute is doing in its area of mandate and the ob challenges in sweetpotato. Five years from today would like to look back to this day, this meeting, anc yes "it has been well". Thank you and God bless you.

Goodwill Message

Dr. Steve Adah
Interim Country Director, Helen Keller International, Plateau State, Nigeria (Presented by Mr. Peter Aimakhu)

Distinguished Professors, Members of the Acad Institutions, Farmers without whom we would all st Nutritionists and members of the Industrial commu Distinguished Ladies and Gentlemen.

Helen Keller International had always shown commit in the prevention of avoidable blindness in the Co and nutritional blindness is one of such. This conferen a timely one since all hands are on deck to meet one o millennium development goals which is "reductio infant mortality". Orange-fleshed sweetpotato is ric Vitamin A which is good in boosting child immunity vision.

The call had been for NGOs and Government agencies involved in child mortality reduction in the country to embrace the long term measure of making available Vitamin A to our children and one of such is dietary diversification. The encouragement of the production and propagation of sweetpotato will go a long way to increase Vitamin A uptake among our children.

I thank the organizers of this conference which would no doubt increase the awareness of members of the public, our government and members of the international community that Nigeria has taken the lead in addressing the reduction of infant mortality through the encouragement of the consumption of orange-fleshed sweetpotato.

It is my belief that at the end of this conference, we would all know where to access this vital source of Vitamin A and if possible, how to cultivate it among other crops in our gardens.

Thank you very much and God's blessings.

.....

Goodwill Message

Apostle Elegbede
President, All Farmers Association of Nigeria (AFAN),
Oyo State Chapter

The sweetpotato conference is a landmark event in the effort of researchers cum farmers in agricultura development in Nigeria. Researchers and farmers are co-workers and partners in progress in agriculture.

Sweetpotato is an important crop with which farmers are familiar. Its importance is the reason why sweetpotato is one of the 28 crops in which the Oyo State (AFAN) has a commodity association.

I am challenged by the statistics of sweetpotato productior and utilization in other countries and I am assuring you that Nigeria and Oyo State in particular will soon join the League of Nations making tremendous impact in sweetpotato both in producing for local consumption and also for export.

I, therefore, solicit for more interactive sessions betweer farmers and researchers in this effort to move sweetpotato production to greater heights. We implore you to keep us (farmers) informed on your research findings so that we can make rapid progress.

Thank you.

.....

Plenary Papers

Package for High Quality Sweetpotato Production: Do's and Don'ts

Professor G. O. Obigbesan
Department of Agronomy, University of Ibadan, Nigeria

Origin and Spread

Sweetpotato originated in South America and spread to the West Indies and Africa, China and Eastern Asia. It is an important tropical root crop that is widespread across the world, and is cultivated all over the tropics and subtropics. Today, sweetpotato is widely cultivated in China, Japan, Indonesia and Southern U.S.A.

Botany

Sweetpotato, *Ipomoea batatas* belongs to the Family Convolvulaceae. In the Genus Ipomoea, there are over 400 species, but only sweetpotato is of economic importance.

Whole plant. The crop is a creeping annual vine with dark green leaves, soft heart-shaped to deeply indented leaves with various sizes on some plants.

Flower. The flower is funnel-shaped, white to red or purple in colour. Through continuous vegetative multiplication in the tropics, sterile flowers developed. Seeds which form eventually are only useful for breeding purposes, just as with cassava.

Tubers. Sweetpotato tubers could be cream, yellow, purple, red, white skin/flesh and develop in the upper 20cm soil depth through thickening of adventitious roots. Mature tubers contain sugar, protein, low fat, but above all, starch.

The types and varieties could be grouped into:

i) Tubers with majorly yellow flesh, which are powdery and mealy after cooking.
ii) Tubers with white or strongly yellow coloured flesh that is soft and sweet after cooking and produce watery and gelatinous pulp.
iii) Tubers which are only useful as fodder.

Climate and Soil

Sweetpotato is relatively not demanding on soil and climate, but does best in the tropics and subtropical climates. During its relatively short vegetation period of 3.5–5 months, it requires average temperatures of 20-22°C. Frost is not tolerated, and plants die off below 10° Being a typical sunny crop, sweetpotato does not toler shade, so avoid shades and utilize open fields. Particular the young growth stages require high moisture.

In West Africa, rainfall of 500–1250 mm is required, l too high rainfall leads to excessive vine development. T tubers rot and their storage is strongly impaired. The b soil for sweetpotato is humus-rich, light soil with gc underground drainage. Unsuitable soils are heavy clay s swampy and very muddy soil, soil with high alkaline salt content. Heavy, poorly-aerated soils prev satisfactory development of tubers, and poorly-sha tubers result. Such heavy soils give low yields, and ren harvesting difficult. Optimum soil pH for the crop 5.8–6.0. Sweetpotato can be cultivated even in h elevations as high as 1500 m above sea level in the tropi

Crop Rotation

Best yields are obtained from freshly-opened farmlar Because of its rapid foliage development and sh vegetation period, sweetpotato is a suitable intercrop obstructs erosion. Once the intercrops supp sweetpotato through shade, yield declines drastica Generally, crop rotation with sweetpotato should be d for not more than 3–4 years. This is not the practice v small farm-holders who hardly follow any regulated c rotation. In certain seasons, sweetpotato is cultivated second crop.

Production Methods

Sweetpotato multiplication is done by vegeta propagation and can be as follows:

a) **Planting of whole or cut tubers.** Tubers sprout very fa the soil to produce new plants. There are several eyes tuber, so cut portions of a tuber are also useful as plan material. Use of tubers for propagation leads to loss of l quantity of edible material, but lucky for us, we have vin

b) **Planting of rooted seedlings.** Seedlings raised from tu are planted close together on seedbeds and covered sand 7–15cm high. Constant watering is done for 4–6w till about 15–20cm long seedlings develop. These removed from the mother tuber and finally transplanted. 1ha, we need 250kg tubers to produce the requ seedlings. This is the practice in the U.S.A. and C because of climate limitation.

c) **Stem or vine cuttings**. The green vines of approxim 30cm length with at least 3 leaf nodes are cut as plan material, and about 1/3 of this length is planted into the Older stem vines are useful owing to their resistance. young stem vines could be damaged by insufficient moisture or strong solar radiation, or dry up comple

Most suitable are stem cuttings already rooted from their mother plant. This type of vegetative propagation costs least. Luckily, this is the practice here in most parts of Nigeria.

Soil preparation. Soil depth of 20 cm is satisfactory. Planting is done on heaps, ridges or on the flat. Heaps and ridges are absolutely necessary in heavy rainfall areas, so that unutilized water does not damage the plants. Ridges produce higher yields in Nigeria than on the flat, and harvesting is easier.

Plant spacing. Plant spacing is 45–120 cm along rows of 30–60 cm width. Plant population varies: 45 x 45cm = 49,000 plants/ha while 60 x 120 cm = 13,000 plants/ha and 30 x 60 cm = 55,000 plants/ha. Strive at closest spacing in accordance with given soil location.

Manuring and Cultivation

Like all tuber crops, sweetpotato requires relatively high nutrient level for good yield performance. A sweetpotato crop of about 16.8 t/ha removes about 74 kg N, 19 kg P_2O_5, and 108 kg K_2O. Thus, every kg fresh sweetpotato deprives the farm of 4.4 g N, 1.13 g P_2O_5, and 6.4 g K_2O. Phosphorus promotes tuber weight, while N and K determine the number of tubers. High and one-sided N application reduces the yields drastically and promotes strong foliage production and insufficient tuber. The most favourable nutrient ratio is 1:2:3–1:3:6 of NPK.

Muriate of potash reduces dry matter content of tuber. Kraal manure or one-sided organic fertilizer can also lead to prolific foliage growth and therefore be applied to previous crop in the rotation. Magnesium is necessary in light sandy soil. Recommended fertilizer rates are:

N	35–67 kg/ha as $(NH_4)_2SO_4$
P_2O_5	50–100 kg/ha as Super phosphate
K_2O	85–170 kg/ha as Sulphate of potash (50 % K_2O)

Experience from Nassarawa, Kwara, (Umudike) Abia and Imo States.

Cultivation. Like all field crops, keep the soil loose and weed- free. Ensure the vines are not soil-covered during weeding. Weeding is done during young growth stages mostly. Exposed tubers should be covered to prevent attack by weevils (*Cylas* spp.)

Diseases and Pests

A large number of pests and diseases attack sweetpotato. Literature is replete with information. Most importantly, tubers are damaged by weevils *Cylas formicarius* F. and *Cylas brunneus* F. The larvae of 7 mm long beetles b into the tuber, forming numerous tunnels, and pup already after 15 days. The pupae rest for only 8 days a soon multiply rapidly. In West Africa, *C. brunneus* mainly found. Control of sweetpotato weevil is purposeful crop rotation, removal of affected tubers a use of contact insecticide.

Diseases in underground plant parts include:
Black and Root rot caused by fungi *Sphaeronei fimbriatum* and *Phymatotrichum omnivorum*. Virus include Sweetpotato mosaic virus and Federmosaic virus Storage rots include Soft rot caused by *Rhizopus nigrica* and Dry rot caused by *Diaporthe batalis*.

Harvest and Tuber Yields

Tuber is mature when leaves and stems/vines devel yellow colour and most vines die off. Independent of th daily ration can be harvested when sufficient size reached. Some authors insist the tubers are mature when cut surface dries up within a few minutes.
Harvest period in some locations is illustrated:

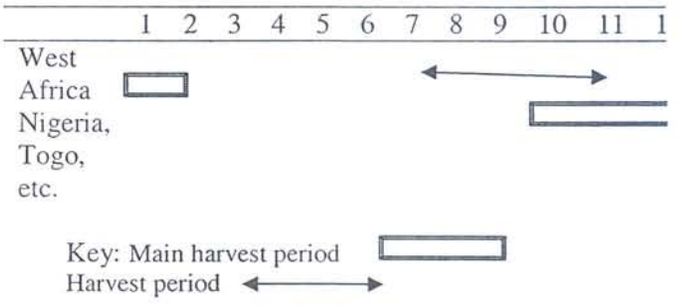

Figure 1. Harvest period of sweetpotato in some locations

Handling at harvest. It is vital to handle the tube carefully, because they are sensitive. Digging is done wit hoes, cutlass, spades and horse-drawn traction. Harve mostly on rain-free days to enable the tubers dry on th bed. Leftovers in the soil may sprout and constitute weed to the following crop. They are best removed by allowin swine to clean them up.

Mature tubers could weigh between 500 g and 1 kg eac (Table 1). Ware (marketable) tubers could range betwee 45–78 % of total harvest. Non-marketable tubers are bes fed to livestock. Vines and stems are used for planting o silage. Mean tuberous root yield on-farm is 6 t/ha but goo yields should aim at 15–40 t/ha.

Storage and Utilization

Sweetpotato constitutes an important food item in severa tropical areas, next to cassava and yams. The greates challenges/ obstacles are that:

1) Harvested tubers do not store for long.
2) Mature tubers I the soil also sprout very quickly.
3) Mature tubers are easily attacked by pests.

Unlike cassava, sweetpotato cannot be harvested at will as needed reserve for famine periods. This is part of the reason why sweetpotato does not constitute a major food in regions of production. In Japan, U.S.A. and China, however, technology for few months' storage has been developed.

Provided that we ensure good maturity, careful harvest, storage warehouses where temperature, and aeration, ventilation are regulated, storage loss is low. Composition of sweetpotato tuber shows extreme variation as shown in Table 2. In the tropics, sugar content of sweetpotato is greater than starch content.

Utilization. Immediate use as vegetable – boiled, roasted or fried in oil. Production of chips, flour, starch, syrup or alcohol. Leaves as spinach. Every part of sweetpotato—leaves, vines and tubers—is suitable as livestock feed.

Table 1: Average tuber yield of sweetpotato variety TIb 4 harvest at University of Ibadan Teaching and Research Farm

Bed No.	No. of stands	Tuber yield (t/ha)
13	15	15.8
14	16	12.9
15	14	17.2
16	14	8.9
17	15	21.1
18	13	13.3
19	16	25.3
20	15	13.1
21	14	18.5
22	16	14.4
Mean	14.8	16.04

Note: Growth period was 19 May 1975 to 22 August 1975.
Tubers were removed, and feeder roots were left intact in the soil.
Source: G.O. Obigbesan, unpublished data.

Table 2. Composition of fresh sweetpotato tuber and leaf dry matter

	Fresh tuber	Leaf dry matter
Water	60-85%	-
Fat	0.5-1.0%	3.3%
Protein	0.8-2.0%	12.6%
Sugar	2.0-34.0%	
Starch	8.0-22.0%	45.5% Carbohydrate
Pectin	About 9.0%	10.2% Mineral nutrients

Sweetpotato: A Food for All Seasons

Dr. Stella O. Odebode
Department of Agricultural Extension and Rural Developme
University of Ibadan

Major Issues in Nigeria

The major issues of concern in Nigeria as regards peop welfare relate to:

a) Nutrition insecurity
b) Poverty and its consequences such as inadequate consumption and poor quality foodstuff.
c) HIV/AIDS
d) Unemployment

VITAA deficiency in Nigeria. In Nigeria, 3million children under the age of 5 suffer blindness caused by l of vitamin A. Nigeria is among the countries with high mortality figures in under-fives, mean rate being 116 p 1000 live births. Major Contributors to this high figure include:

a) Diarrhoea,
b) protein-energy malnutrition,
c) acute respiratory infections and
d) measles for which treatment with vitamin A has been advocated by WHO and UNICEF, among others.
e) VITAA project provides a food-based approach to allevia of vitamin a deficiency.

Importance of Sweetpotato in Nigeria

In Nigeria, sweetpotato has an important role to play in food security and nutrition because:

a) It withstands environmental extremes such as droug
b) Sweetpotato roots are rich in beta-carotene especiall the yellow/orange flesh variety.
c) 18g of dried sweetpotato per person per day are required.

The proximate composition of fresh sweetpotato tuber i shown in Table 1, while Table 2 highlights the mineral vitamin content of sweetpotato tubers (mg/100g tuber). Sweetpotato has the following advantages over other ro and tuber crops:

a) Low demand on soil nutrient.
b) Tolerance of drought.
c) Capability of providing reasonable yields in agro-ecological zones where other crops would fail.
d) Low requirements for external inputs such as fertiliz

Sweetpotato and its Potentials

Sweetpotato is an important staple food crop in Afric general and Nigeria. It contains Vitamin A with suffic quantities of a precursor known as beta-carotene. Vita

A deficiency is a particular problem for children under five and for pregnant and lactating women.

Table 1: Approximate composition of fresh sweetpotato tubers

Nutrient	Percent composition
Water	0.5–7
Starch	8–29
Protein	0.95–2.4
Ether extracts	1.8–6.4
Reducing sugar	0.5–2.5
Mineral matter	0.88–1.38
Fat	-

Source: FAO, 1994

Table 2: Mineral and Vitamin content of sweetpotato tubers (mg/100g root)

Nutrient	Value (mg/100g)
Thiamine	16.510
Phosphorus	31.201
Riboflavin	0.025
Carotene or vitamin A	0.0078
Niacin	0.561
Ascorbic acid	26.250
Calcium	16.571

Source: Odebode (2004)

Serious Vitamin A deficiency can lead to blindness; chronic deficiency reduces a child's capacity to fight other diseases with sufficient negative long-term effect on the health of human. It is therefore important to know the potentials of sweetpotato so as to improve its utilization in Nigeria.

Forms of Utilization of Sweetpotato

Sweetpotato is being utilized in various forms as shown below:

Sparri: Sweetpotato has been successfully made into sparri (coined from 'sweetpotato garri').

a) This is grated sweetpotato that is subsequently fermented for 1–2 days and then roasted in the same way as garri is produced from cassava.
b) The product is as tasty as cassava garri and keeps well.

Confectionaries: Sweetpotato can be made into various confectionaries including buns, cakes, rolls and puff-puff by utilizing dough made from the parboiled and grated tubers.

Flour: Sweetpotato flour could be used for baking on its own or as a supplement to cereal flour, as well as a stabilizer in the ice-cream industry (FAO, 1990).

Table 3: Distribution of Sweetpotato production in different ecological zones of Nigeria

Ecological Zone/ States	Form of utilisation
South-West Oyo, Ondo, Ekiti, Lagos, Ogun, Osun	snacks, sweetpotato flour (spafun), vines and leaves given to livestock, boil and eat, fry into chips and eat, pound, mix with yam and eat with vegetable soup.
South-East Anambra, Imo, Abia, Enugu, Ebonyi	Boil and eat, fry and eat as chips, roast, or pound
South-South Edo, Bayelsa, Delta, Akwa Ibom, Cross River, Rivers	Fufu, made into porridge, snacks, starch, small tubers used for animal feed, roast or fry in cooking oil before eating
North-Central Benue, Kwara, Niger, Kaduna, Plateau, Nassarawa, Kogi	Boil, roast and eat, fry and eat as chips, used in preparing 'Kunnu'drink, fufu with vegetable soup, usinsin dankali', snacks, sweetpotato flour mixed with cassava flour to make amala
North-East Borno, Bauchi Adamawa, Yobe Gombe, Taraba,	Boil and eat, used as sweetener, Dried and fed to livestock, Kunnu drink
North-West Kano, Jigawa, Kebbi, Sokoto, Zamfara, Katsina	Eaten boiled with rice, processed into kunuzaki, sweetening agent, boiled and eaten with groundnut cake

Animal feed: Both roots and tops apart from being used fresh, could be made into a dried meal and fermented silage and fed to livestock, including pigs, cattle and poultry. This use is quite significant in China, the USA, Taiwan and India (Scott 1992; Woolfe 1992).

Starch: Starch can be produced from sweetpotato in the same way as from the other starchy roots except that the solution is kept alkaline (pH 8) by using lime, which helps to flocculate impurities and dissolve the pigments. Sweetpotato starch is used in the manufacture of starch syrup, glucose and isomerized glucose syrup, lactic acid beverages, bread and other confectionaries, as well as distilled spirits called *shochu* in Japan. Noodles and isomerized saccharides as a sweetener for soft drinks are also made from sweetpotato starch in China, Japan and Vietnam (Prain et al. 1997).

Sweetpotato beer: The Koedo Brewery Kawagoe, of Kawagoe in Japan has been producing sweetpotato beer from roast local sweet potatoes since 1996. It contains 7% alcohol and tastes like something between beer and wine, with a faint sweetness (JRT 2000).

Sweetpotato beverage: Marketing of sweetpotato beverages and yoghurt started in 1997 in Japan and these products are now quite popular (JRT, 2000). Technology transfer and adaptation from this country into Nigeria for sweetpotato beverage production in commercial quantities is an important initiative to be taken.

Promotion of the Crop

Promotion has to be done to ensure the crop is grown and consumed adequately. There is need to develop more innovative sweetpotato products targeting the consumers. An intervention option for nation-wide advocacy campaigns should highlight health and socio-economic consequences of VAD, and cost effectiveness and benefits of sweetpotato.

Sweetpotato Products

Sweetpotato can be consumed fresh, boiled, roasted, fried, mashed with cereals or legumes or made into dried chips (for flour,) crisps and cakes among others (Plates 1–2). There is need for more innovative recipes e.g. designing baby foods rich in beta-carotene. Future possibilities include: sweetpotato beverages and jam as well as juice drinks and inclusion in foods, among others.

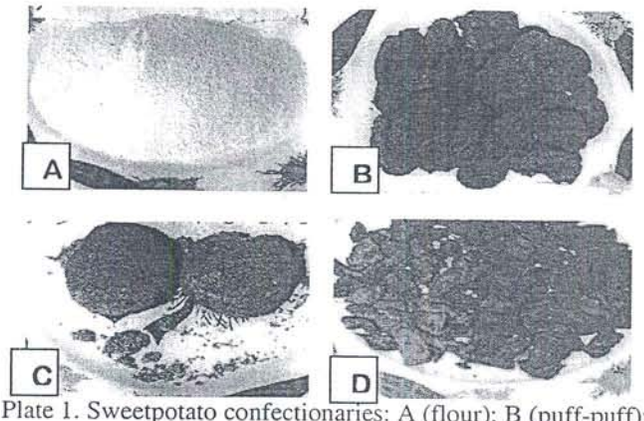

Plate 1. Sweetpotato confectionaries: A (flour); B (puff-puff); C (cake); D (chin-chin)

Field trials with farmers (Plate 3) are essential for selecting what is acceptable for general cultivation. The storage of fresh sweetpotato roots is another way to safe-guard the out put for a longer period so that food supply can be assured. Pit storage or storage on the soil with soil layer over healthy roots (Plate 4) is practiced in some areas where production exceeds immediate requirements of the family and for local markets.

Plate 2: Consumers eating boiled orange-fleshed sweetpotatc

Plate 3. On-farm assessment of performance of sweetpotato clones among farmers helps to show which ones should be promoted, multiplied and distributed

Plate 4: Demonstration of heap storage of fresh sweetpotato tubers

8. Provision of assistance to women in post-harvest technologies, and imitation of technologies that will reduce the drudgery associated with day-to-day activities of women.

This paper therefore examined how the number of times of training on sweetpotato processing enhance low-income women productivity and improve the chances of achieving the overall, economic and social objectives of WIA unit, thus, increasing their income and bringing them into the mainstream of development.

Objective of the Study

The main objective of this study is to examine the place of extension training programme of the WIA unit of the ADPs in enhancing low-income women through sweetpotato snacks production in Nigeria.

The specific objectives were:

1. To examine the effect of some selected socio-economic characteristics of the sweetpotato snacks processors on the number of times they attend training programmes of the WIA unit of the ADPs in the study area.

2. To examine the level of participation of respondents in extension training programme in the study area.

Hypothesis of the study. There is no significant relationship between effect of selected socio-economic characteristics of respondents and the number of times respondents attend extension training programmes on sweetpotato processing of the WIA unit of the ADPs.

Methodology

Study area. The study was conducted in three geo-political zones of Nigeria: South-East, South-West and North-Central. This was to ensure a national coverage as it is necessary to sample several areas to capture the socio-cultural and ecological differences as they affect rural dwellers in various localities sampled for sweetpotato training in sweetpotato-growing zones. A brief description of the selected communities is shown in Table 1.The natural vegetation of these areas is characterized by the mixed moist tropical rainforest lowland in the central and the southern parts of the geo-political zones which is good for the growth of sweetpotato unlike the semi-deciduous rainforest of the north (Table 1) The population for this study include all the women involved in sweetpotato processing training programme in all the selected sweetpotato-growing geopolitical zones (South-East, South-West and, North-Central).

Data collection. The primary data were collected using both quantitative and qualitative methods. The qualitative methods used in the study include: Focus Group Discussions (FGD), In-depth Interviews (IDI) with the officials of the State ADPs and the women leaders, community mapping, and seasonal calendars. The secondary data were in the form of official documentation at the Local Government Area (LGA), State and national levels. This was in order to gain insight into the perspective of the local population in three States where sweetpotato is being grown and consumed. Structured interview schedules were used to collect data from respondents. Simple random sampling was used to select 80 % of each of the processors from three out of the six geo-political zones of Nigeria, to give 120 processors proportionately. The questionnaires were analyzed using multiple regression statistical tools.

The middle belt has socio-cultural diversity. The major ethnic groups include the Tiv, Idoma, Nupe and Kwari, Wagga, Mudang, Kilba, etc. The South-West is dominated by the Yorubas, and the women are generally involved in processing of crops to make a living.

The qualitative methods used in the study are:

a) *Focus Group Discussions (FGDs).* The Focus Group Discussions (FGDs) were held with 15 women groups participating in Women-In-Agriculture activities from 15 States. Eight women processors were interviewed per group, and different topics on sweetpotato processing and products were raised with the assistance of a moderator for each group. A total of 15 groups of eight women each per State were used for the FGDs in the study areas covered. The focus group discussions helped to get information on sweetpotato production and processing from the respondents across geopolitical zones to be able to proffer solutions to identified problems to enhance the respondents' income across geo-political zones.

b) *In-depth Interviews (IDIs)* with the officials of the State ADPs and the women leaders involved in sweetpotato processing intervention programme. This also helped in eliciting information on sweetpotato processing techniques from the ADP officials and the women leaders to identify variability in their responses and to enquire from officials and women leaders who have been working for long in these zones. This information will help in providing further insight on sweetpotato production and processing to enhance the income of the low-income women in the sweetpotato growing zones identified.

c) *Community Mapping.* The community mapping was used as a tool to provide enough and adequate information on the physical linkages of communities with sweetpotato farms, rivers, roads, electricity and other infrastructural facilities across geo-political zones. Knowledge of the physical linkages will enhance how the products are transported and marketed within and across geo-political zones. Major

rivers were identified to know where sweetpotato would be planted since sweetpotato production will be increased when it is planted near a source of regular water supply. Increased production will lead to increase in processing activities and income subsequently.

d) *Seasonal Calendar.* The seasonal calendar helped in providing information on the activities the women were engaged in different seasons i.e. it helped in knowing the season-specific nature of their production and processing activities for enhanced income.

Structured interview schedules were used to collect data from respondents. Simple random sampling was used to select 80 % each of processors from three out of the six geo-political zones of Nigeria to give 120 processors. The questionnaires were analyzed using multiple regression statistical tools.

Analytical technique. The quantitative data were described using the frequency counts and percentages and analyzed using multiple regression statistical analysis. One hundred and twenty sweetpotato processors were randomly selected for the purpose of this study from sweetpotato growing states. The multiple regression analytical tool was then used to find out whether there is any association between the sweetpotato processors selected social-economic/ personal characteristics and the training received by the WIA unit of the ADPs in Ni

Results and Discussion

The results and discussion of this study are pre below. Table 1 shows the sampled States and the r of processors interviewed, FGDs and IDIs conducte

Table 2 shows the extension training activities Women-In-Agriculture unit of the Agri Development Programme of Nigeria. Most of the t activities include sweetpotato processing (Plate 1), uses of sweetpotato (4 %), problems encountered v processing of sweetpotato products (8 %), teacl nutritional value of sweetpotato (46 %), and identi of sweetpotato products (29 %). All the swe processors were trained on how to process swe 'sparri' (roasted granules), sweetpotato puff-p sweetpotato cakes.

Age distribution of respondents. Table 3 pres ages in years of the women respondents. Mos processors in each state were middle age percentages of the younger processors are small. the need to encourage more middle-aged women younger women to participate in this type of programme. This is because a lot of financial gain achieved through the sale of sweetpotato snacks.

Table 1. Distribution of sweetpotato processors according to geo-political zones and States

Geo-political Zones	State	ADP States Selected for Study	Dominant Ethnic Groups	Ecological Zones	WIA Directors	ADP Location	FGDs Female Groups	IDIs for Women Leaders
South East	Imo, Abia, Anambra, Enugu, Ebonyi, Cross River	Imo, Anambra, Enugu, Abia, Ebonyi	Mostly Igbo	Forest	1 1 1 1 1	Owerri Awka Enugu Umuahia Abakaliki	1 1 1 1 1	1 1 1 1 1
South West	Lagos, Ogun, Oyo, Osun, Ekiti, Ondo, Edo	Lagos Ogun, Oyo Osun, Ekiti	Mostly Yoruba	Derived Savannah, Forest	1 1 1 1 1	Ikeja Abeokuta Ibadan Osogbo Ado-Ekiti	1 1 1 1 1	1 1 1 1 1
North Central	Benue, Kogi Kwara, Niger, Kaduna, Plateau, Nassarawa	Kwara, Kogi, Benue Plateau, Nassarawa	Many Groups	Savannah, Derived Savannah, Forest	1 1 1 1 1	Ilorin Lokoja Makurdi Jos Lafia	1 1 1 1 1	1 1 1 1 1
Total	20	15			15	15	15	15

Source: Field Survey, 2006

Table 2. Distribution of respondents based on participation in extension activities of Women-In-Agriculture (WIA) Unit in 2006

Extension activities of the WIA Unit during Sweetpotato training programmes	Frequency	Percentage
1. Teaching of Sweetpotato processing	15	13.0
2. Teaching of several uses of sweetpotato	5	4.0
3. Teaching of problems encountered with processing of sweetpotato products.	10	8.0
4. Teaching of nutritional values of sweetpotato	55	46.0
5. Identification of sweetpotato products	35	29.0
Total	120	100.0

Source: Field Survey, 2006

Table 3. Distribution by age of sweetpotato processors during the survey carried out in 2006

S/No	State	20–29 years	30–39 years	40–49 years	50–59 years	≥ 60 years	Total	Mean age
1	Imo	1 (12.5)	5 (62.0)	2 (25.0)	–	–	8(100)	37.75
2	Anambra	2 (25.0)	4 (50.0)	1 (12.5)	1 (12.5)	–	8(100)	35.75
3	Enugu	1 (12.5)	6 (75.0)	1(12.5)	–	–	8(100)	34.50
4	Abia	–	3 (37.5)	3 (37.2)	1 (12.5)	1 (12.5)	8(100)	40.75
5	Ebonyi	–	5 (60.5)	2 (25.0)	–	1 (12.5)	8(100)	40.75
6	Lagos	–	4 (50.0)	3 (37.5)	–	1 (12.5)	8(100)	42.00
7	Ogun	–	6 (75.0)	1(12.5)	1 (12.5)	–	8(100)	31.44
8	Oyo	–	5 (62.5)	2 (25.0)	1 (12.5)	–	8(100)	39.50
9	Osun	–	6 (75.0)	1 (12.5)	1 (12.5)		8(100)	38.25
10	Ekiti	–	5 (62.5)	2 (25.0)	1 (12.5)	–	8(100)	39.50
11	Kwara	–	7 (87.5)	1 (12.5)	–	–	8(100)	35.75
12	Kogi	2 (25.0)	4 (50.0)	1 (12.5)	–	1 (12.5)	8(100)	35.19
13	Benue	1 (12.5)	3 (37.5)	2 (25.0)	2 (25.0)	–	8(100)	40.75
14	Plateau	2 (25.0)	5 (62.5)	1 (12.5)	–	–	8(100)	33.25
15	Nassarawa	1 (12.5)	6 (75.0)	–	–	1 (12.5)	8(100)	37.00
	Mean							37.48

Figures in parentheses are percentages
Source: Field Survey, 2006

Educational level of respondents. Education is an important parameter in training through extension education. This is because a literate population is easier to teach than an illiterate population. The highest educational level among the processors was primary school. Functional education is higher in the Southern States of Nigeria than in the North-Central States.

Results of FGD interviews. Agricultural extension activities during sweetpotato training include: teaching of sweetpotato processing, the several uses of sweetpotato, the nutritional values of sweetpotato, and the identification of sweetpotato products, all of which fall in line with the agricultural extension activities of the ADPs. This agrees with the findings of Ladele *et al.* (1999), of the services rendered by agricultural extension in Nigeria. Moreover, females in all the study areas engaged in food crop processing and sales of snacks and cooked foods.

Results of Multiple Regression Analysis. Regression analyses include four functional forms: linear, semi-log, double-log and exponential. These were applied to analyze the data to achieve the main objective. The functional models are as follows:

Implicit function for the regression model:

$$Y=f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, U)$$

where Y = Number of times respondents attended WIA unit extension training on sweetpotato processing
X_1 = Age of the sweetpotato processors (in years)
X_2 = Religion of the sweetpotato processors (dummy: 1 = Christian; 0 = Muslim)
X_3 = Duration of training activities (dummy: 1 = Length of time; 0 = Otherwise)
X_4 = Marital status of the sweetpotato processors: (dummy: 1 = Married; 0 = Otherwise)
X_5 = Secondary occupation of the processors (if farming =1; Otherwise = 0)
X_6 = Educational level of the processors (Formal Education = 1; No Formal Education = 0)
X_7 = Benefits of sweetpotato to the processors (Financial Benefit = 1; Otherwise = 0)
X_8 = Ethnicity (if Yoruba = 1; Otherwise = 0)
U = Error term

Linear:
$Y=a+b_1X_1+b_2X_2...b_nX_n$

Double-log function :
$\text{Log } Y= a + b_1 \log X_1 + b_2 \log X_2 +...+ b_n \log X_n + u$

Semi-log function:
$Y= a + b_1 + \log X_1 + b_2 \log X_2 +...+ b_8 \log X_n + u$

Exponential function:
$\text{Log } Y= a + b_1 X_1 + b_2 X_2 +...+ b_n X_n + u$

The model that provides the best fit was chosen for further discussion on the basis of the following:

i. The magnitude of the coefficients of multiple determination (R^2),
ii. The magnitude and statistical significance of the regression coefficients,
iii. Signs of the regression coefficients as they conform to a priori expectation.

Results show that there is a significant relationship between the number of times respondents attended extension training and some selected personal characteristics of sweetpotato processors. At 5 % level of probability, $R^2 = 0.141$, which shows that the variation in the number of times respondents attended extension training programmes is explained by 14 % of the independent variables. It explains that 14 % of the variation in the number of times of extension training from sweetpotato processors is caused by the independent variables such as age, education, duration of training, religion, etc. The results show that there is a significant relationship between the frequency of extension training programme on sweetpotato processing, and education, secondary occupation and benefits derived from sweetpotato processing, This implies that each of the variables influences the frequency of attending the extension training by the WIA unit of the ADPs.

Education exercised the greatest influence in predicting the dependent variable by independent variables with a beta value of 0.2136 (t = 2.0294, P< 0.05). This shows a positive relationship with the dependent variable. This indicates that if the women have a high level of education, it will improve the number of times they attend trainings on sweetpotato processing. This is because education is one of the powerful tools in the teaching-learning process. Hence, the higher the level of education, the higher the level of understanding extension training activities and the higher the frequency of attendance of training programmes on sweetpotato processing activities.

The next contribution to frequency of training le extension is secondary occupation (t = 1.152, P< Those who have secondary occupations also gain fr extension training activities and attendance of t programmes on sweetpotato processing. This sho secondary occupation reinforces the number of ti training attendance by respondents on swee processing. Moreover the duration of training (t = P<0.05) has a positive but non-significant effect number of times of training on sweetpotato proc This implies that the longer the duration of traini less the tendency of the respondents to attend a t programme and vice-versa. Age (t = -2.252, P > religion (t = -0.628, P >0.5), marital status (t = -1. >0.05) and ethnicity (t = -2.252, P = 0.05) are neg related to the dependent variable; hence do not con to the variation in the number of times swee training programmes are attended by the respondent

The results further show that age, religion, marital and ethnicity had no influence on the freque attendance at training on sweetpotato processing act This means that irrespective of the age, religion, status and ethnicity, the respondents will still extension training on sweetpotato, hence, thei significance in the regression model. The sec occupation of respondents significantly affects frequency of attendance at extension training becau would have more income-generating capacity to b new techniques at the training programmes, hen positive coefficient of the variable in the reg equation. Benefits derived from sweetpotato proc must have been evident to the respondents, t resulting in the significant positive relationship w dependent variable (frequency of respondents' atte during extension training programmes).

The regression model for the relationship betwe selected demographic characteristics and freque respondents' attendance during extension t programmes on sweetpotato processing in the WIA ADPs in Nigeria shows that 14 % variance in the l training could be explained by the selected socio-ec characteristics. Since the functional form that best model is double log, by implication, the coeffici education, secondary occupation, duration and b derived from sweetpotato processing are the elasticities showing the rate of change in any o variables [$Y(a + b_1\log X_1 + b_2\log X_2 +....+ b_n \log X_n$ Hence, the respondents' attendance can be impro this elasticity margin if these variables are increa one unit. This implies that training enhances respo potentials to generate income.

Information on seasonal calendars in all the States is given in Table 4. The seasonal calendars in all the selected states stated below provide information on which activities are engaged in at particular times. It also indicates the season-specific training demand on sweetpotato processing. The calendars show variability in the number of times training activities will be organized by the WIA unit. These activities include production, processing, and marketing activities since the time at different geo-political locations in Nigeria are different. The knowledge of the calendar will guide the WIA unit on the time of training and also will affect the number of times of attendance by the respondents as indicated below.

There are variations in the timing of production processing, and land preparation in the three geo-politica zones selected. It is very essential to know that trainin enhances the potential to generate more income. If th period of production and processing varies according t geo-political zones, training programmes organized durin a wrong season will not be effective, as it will affect th respondents' frequency of attendance. Variabilities exist i some zones especially in the drier north. Problem identified by the sweetpotato processors during the focu group discussion in order of severity include lack o capital, lack of control over land, food insecurity, lack o market, bad roads, and irregular visits by extension agents

Table 4. Seasonal Calendars of farming / processing activities of sweetpotato processors in studied geo-political zones in 2006

Month	Farming Activities		
	South-Eastern zone	South-Western zone	North-Central zone
January	Land Preparation	Land Preparation	Land Preparation
February	Land Clearing, Processing of sweetpotato	Land Clearing	Land Clearing / Ridge making
March	Ridge making / Planting of sweetpotato	Ridge making / Planting of sweetpotato	Planting of sweetpotato vines
April	Weeding, Planting of sweetpotato vines	Weeding, Planting of sweetpotato vines	Weeding, sweetpotato processing
May	Weeding, processing of sweetpotato	Weeding, processing of sweetpotato.	Weeding
June	Harvesting of sweetpotato	Harvesting of sweetpotato, Sweetpotato processing	Harvesting of sweetpotato roots
July	Harvesting of sweetpotato Sweetpotato processing	Harvesting of sweetpotato	Harvesting of sweetpotato roots continues, sweetpotato processing
August	Planting of sweetpotato vines	Planting of sweetpotato vines	Planting of sweetpotato vines
September	Weeding / Harvesting of other crops, sweetpotato processing	Weeding / Harvesting of other crops	Planting of sweetpotato vines
October	Weeding of sweetpotato plot/ land	Weeding of sweetpotato plot/land	Weeding of sweetpotato plot/land, sweetpotato processing
November	Harvesting of sweetpotato root Sweetpotato processing	Harvesting of sweetpotato root	Weeding of sweetpotato plot/land
December	Harvesting of sweetpotato / Land clearing	Harvesting of sweetpotato / Land clearing, processing of sweetpotato	Harvesting of sweetpotato / Land clearing

Recipes for Sweetpotato Products

The training programmes by the WIA unit of ADPs involve preparation of sweetpotato products (Plate 1).The recipes for sweetpotato cake and puff-puff are given below. Plates 2 and 3 show samples of these products.

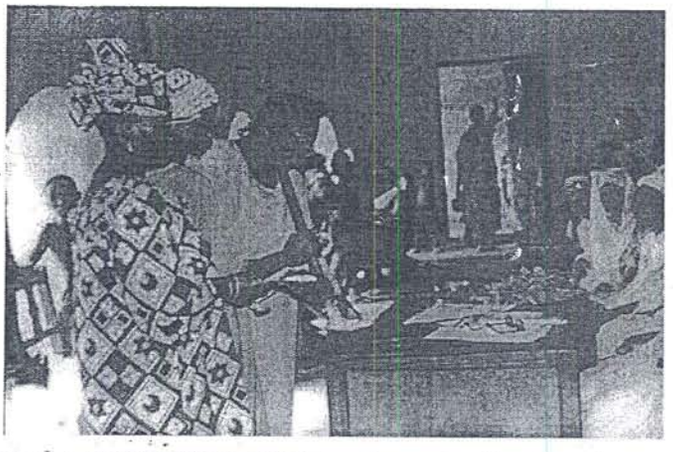

Plate 1. Typical Women Training Programme in a Nigerian Community in 2006

A. Sweetpotato Cake

Materials	*Quantity*
Whole Wheat flour	350 g
Sweetpotato flour	50 g
Baking powder	1 tablespoonful
Sugar	200 g
Fat	350 g
Eggs	4
Lemon rind	a little
Milk	150 ml to mix
Water	10ml

Method:

1. Sieve all dry ingredients together i.e. wheat flour, sweetpotato flour, and baking powder.
2. Add sugar to margarine and beat until mixture turns cream colour.
3. Mix wheat flour, baking powder and sweetpotato flour.
4. Add beaten eggs in bits by degree.
5. Add water little by little to mixture until a flowing consistency is obtained.
6. Take two tablespoons of the dough and put into each section of a cake tray.
7. Bake in a moderate oven until brown.

B. Sweetpotato Puff-Puff

Materials

Wheat flour	Sugar
Yeast	Sweetpotato flour
Margarine	Vegetable Oil
Salt	Water

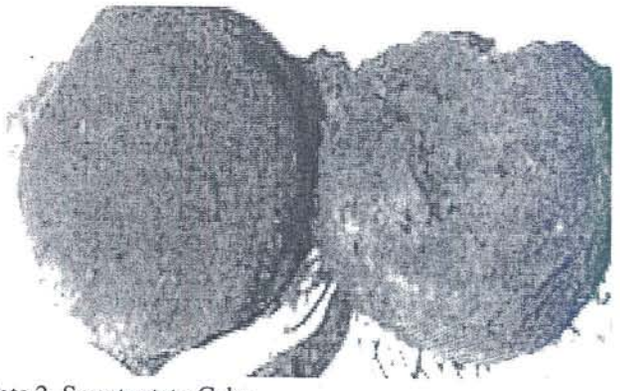

Plate 2. Sweetpotato Cake

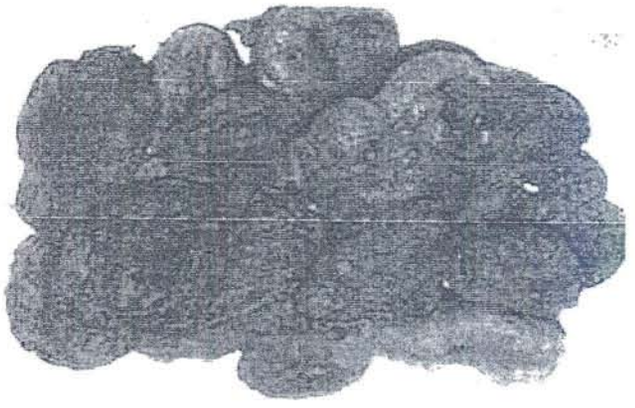

Plate 3. Sweetpotato Puff-Puff

Conclusion

The main conclusion of this study is that the WIA uni ADP in Nigeria provides several trainig services farmers in Nigeria. Moreover, the respondents' freque of attending training on sweetpotato processing organi by the WIA unit does not depend on age, religion, ma status, or ethnicity. However, education exercised greatest influence on respondents' frequency of attenc training on sweetpotato processing, since it enhances level of understanding of the training programmes, as \ as the derivable benefits. Level of education also enhar the potential of women to generate income thro attending the training programmes.

Participants in the WIA programmes enjoy a numbe benefits. They have greater knowledge and easier acces new information through training program Government at the Federal, State and Local levels sho therefore, ensure that all agricultural programmes projects include women in both planning and execu stages, since a large proportion of rural women involved in agricultural activities. The WIA unit of ADPs should give all-round training to all rural women.

Recommendations

It is recommended that the policy promoting women education should be encouraged, since education has a positive effect in the training of sweetpotato processors in Nigeria. Furthermore, farming activities should be encouraged since it has a positive influence on the sweetpotato processing training. Regular training programmes should be organized for all staff in the WIA unit to update them on improved processing techniques, so as to enhance their performance.

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Briefs and Notes

Sweetpotato Experience in Umudike, Nigeria

D.S. Korieocha and J. Amajor
National Root Crops Research Institute, Umudike,
Abia State, Nigeria

Sweetpotato Roots

Shortly after planting a sweetpotato vine cutting, it develops adventitious roots. These roots grow quickly into fibrous roots. The roots grow up to 2 cm into the soil. As the plant grows and crawls on the ground, several other roots grow from the nodes of the stem (vines). The ability of these roots and fibrous roots to go deep into the soil enables the plant to absorb nutrient and water from the lower layers of the soil. Each plant also develops several roots that have 5 or 6-pronged xylem. These are the roots that eventually grow into tuberous roots. The sweetpotato plant produces tuberous roots, which are the part of the plant used as food and other purposes, such as flour used for baking and other new value-added products. They also supply vitamins C and β-carotene to humans.

Climatic Conditions

Sweetpotato cannot be grown in a cold temperate region, since the climatic conditions do not encourage fast growth and formation of tuberous roots. Sweetpotato is better grown in warm tropical regions such as North-Central and North-Eastern zones of Nigeria. The warm temperature in these regions encourages fast growth and high root yield. Sweetpotato plants require a temperature of 24—28^{0}C for optimum growth, a lot of sunshine, and moist nights.

Rainfall. Sweetpotato requires at least 50 cm of rain during the growing season and an annual rainfall of 75—100 cm is considered to be the best with a low humidity as the crop reaches maturity. The crop can tolerate considerable periods of drought but yield reduction occurs when there is water stress shortly after planting especially at the period of root initiation. Root yield is reduced if the crop experiences drought conditions during the first 6—7 weeks of growth. Rainfall should be evenly distributed.

Soil

Sweetpotato does not grow well in a clay loam soil which is normally water-logged. The crop does better if grown in well drained sandy loams with high organic ma content and permeable subsoil which allow good aerati

Nitrogen. Excess nitrogen in soils delays formatior sweetpotato tuberous roots. It is important to know soil nutrient status or history before planting sweetpo in a given soil.

Varieties

Some varieties of sweetpotato like TIS 8164 and Tanz cannot do well in this region. This may be as a resul non-availability of planting materials, storage marketing constraints, as well as pest and dise problems.

Storage and marketing constraints

Like all root and tuber crops, sweetpotato roots have sl storage life, there is need to extend its storage life for f to be available year-round. Bruising during transporta and marketing reduces tuber quality and pre-disposes product to pathogenic organisms such as *Rhizo stolanifi.*

Weeds

Weeds constitute a problem sweetpotato production. dominant weeds found in the experimental fields Umudike were: *Cynodon dactylon, Digitaria horizonte Mimosa invisa, Eleusine indica, Panicum maxim Calapogonium muconoides, Chromolaena odor Ipomoea invulucrate, Mariscus alternifolius Fimbristylis hiltoralis.* Failure to remove these we during the first 6 weeks of the crop growth causes stur growth, yellowing of leaves and reduction in yield.

Pests and Diseases

Insect pests such as *Chrysometidae* and *Coccinellidae* known to eat up sweetpotato leaves in the South-Eas part of Nigeria. They attack the foliage and roots. Ot pests are beeties, termites, and sweetpotato weevil (*C puncticollis*). The most damaging insect pest is *Lasiadiplodia theobramae* which transmits viruses, s as sweetpotato virus disease (SPVD) sweetpotato feath mottle virus (SPFMV) and sweetpotato chlorotic st virus (SPCSV). All these diseases result in spoilage low root yield.

Advancing Sweetpotato Culture and Use in Nigeria

Suggestions for better sweetpotato cultivation and us Nigeria are as follows:

1. The production of sweetpotato roots and their use ca advanced by growing varieties with resistance to pests

diseases in place of former clones that are susceptible to pest and diseases.

2. The provision of a tissue culture laboratory in various research institutes and universities will go along way in improving the cultivation and use of sweetpotato. In tissue culture laboratories, micro-propagation of sweetpotato will result in the production of millions of virus-free sweetpotato explants which can be distributed to farmers to improve production and food supply.

3. Training of research officers in the cultural techniques will help to retrain others for transfer of technology.

4. Provision of new culturing materials and equipments will help to advance sweetpotato cultivation in Nigeria.

The Uses and Potentials of Sweetpotato (*Ipomoea batatas* {L.} Lam)

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Introduction

Sweetpotato belongs to the Family Convolvulaceae. It contains lots of fibre, protein and low calorie, but differs in skin colour. There are two main varieties of sweetpotato in Nigeria — purple- and yellow-skinned types. The yellow-skinned variety is rich in beta carotene as compared to the purple-skinned variety. Beta-carotene is known to play a big factor in reducing the risk of cancers.

Sweetpotato is a very simple food: quick and very easy to cook and thus saves time and energy. It could be boiled, fried, roasted, baked, or included in a wide range of tasty and famous recipes, nutritive first courses, delicious soups, main dishes and desserts. The mouth feel of processed sweetpotato is moist and this makes it ideal as baby food.

Sweetpotato, as the name implies, is very sweet and its sweetness makes it very useful in production of bread, biscuits, cookies and other pastries. It is also mostly used as fillers in pies, salads, etc. Apart from the stated, the tubers are used as additives in culinary preparations to add colour and nutrients. Sweetpotato blends well with vegetables, spices and flavourings, producing delicious dishes of all types. Health-wise, sweetpotato is an economical and nutritious food. It contains twice the recommended daily requirement of Vitamins A and C, Calcium, Iron, Thiamine, etc and yet contains a very low calorie, making its consumption ideal for weight watchers. The high fibre content stimulates peristalsis action which facilitates bowel movement and makes defecation very easy. In pharmaceuticals, sweetpotato is used as raw material in the production of glucose, alcohol and acetic acid. Other medicinal claims for its use are yet to be substantiated scientifically.

Lastly, sweetpotato is an attractive plant and thus could be a beautiful house plant. As a matter of fact, indigenes of Offa town in Kwara State, chant praises of indigenes thus "omo kukudunku to sewe gerugeru, nba ja o mafi o dala" which indicates that they are children of sweetpotato with its leaves well spread and beautiful and would have loved to use the leaves to cook okra. It is notable of the Ghanaians to use sweetpotato leaves in soup making. Having stated the various uses of sweetpotato, it is important to note that when peeled or cut, immerse in water to avoid darkening or oxidation.

Observations Made in Making Sweetpotato Bread (25% Sweetpotato flour substitution)

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Sweetpotato bread was made by using 25% sweetpotato flour substitution in the normal recipe for wheat bread. In the course of sieving, sweetpotato flour appeared lighter in texture than wheat flour. Kneading of the dough following normal procedures for bread-making took longer period to get a smooth consistency as it was not fluffy, compared to 100% wheat flour. The dough-making took a little less quantity of water than the 100% wheat flour.

Rising time of the dough made with 25% sweetpotato flour before baking was 20 minutes longer than for dough from 100% wheat flour. While of baking, a strong aroma was perceived when compared with that of 100% wheat flour bread.

Bread Making with Sweetpotato Flour

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Ingredients

Flour	10oz
Sugar	1 dessert spoon
Salt	1 large pinch
Yeast	2 heaped teaspoons
Oil	1 dessert spoon
Water	6oz

Sweetpotato bread had 50 % wheat flour and 50 % sweetpotato flour.

Method

Mix all dry ingredients together in a large mixing bowl after sifting the flour twice. Add oil and water and mix to stiff dough. Place on the table and knead for 10 minutes. Lightly oil the mixing bowl and place the dough inside. Cover with polythene and leave to rise for 45 minutes. Knock dough back and shape. Place in oiled tins, cover, and leave to double in size after 45–60 minutes. Pre-heat oven until moderately hot and bake until golden brown (35–45minutes) depending on the size of the loaves. Remove from tins, allow to cool, and wrap in polythene bags.

Results

During the preparations and baking, the following observations were made:

a. The sweetpotato flour sample used was dustier than wheat flour during sifting.
b. Sweetpotato flour was light brown in colour as compared with the whiter wheat flour and produced light brown dough.
c. The sweetpotato dough was softer to the touch and started sticking towards the end of the 10minutes of kneading.
d. The pure wheat dough was getting stronger and more elastic during kneading whilst the sweetpotato dough was getting softer but at the same time more viscous (much like soft chewing gum).
e. The sweetpotato dough rose faster than the pure wheat dough but stopped swelling before the 60minutes of rising time given.
f. The weather was cool during the entire bread-making process.
g. Both types of loaves took 45 minutes to bake.

.....

Planned Activities for the Export of Sweetpotato to the United Kingdom

Ujusaru A. Gwamne
Project Manager, NEPDC Keffi, Agro-Export Proces:
Development Centre, Keffi, C/o Ministry of Agricul
Natural Resources, Nassarwa State, Nigeria.

Agro-Export Processing and Development (Keffi

The Centre is meant for conditioning of ya sweetpotato. The project is a partnership betw Federal Government of Nigeria and Nassaraw Government. The construction if the centre has rea advanced stage hoping that the constructic installation of equipment by the first Quarter of 2(be carried out.

The State Government has engaged the services of based company First Produce, U.K. to advice her Federal Government of available customs in U. State Government, in collaboration with First I U.K. and NRCRI Umudike, has trained both y: sweetpotato farmers in December 2007. By 2009 be running O.F.A.R trials and model farms of varieties of sweetpotato, to be recommended by NI

In 2009, the Centre intends to have its first trials e: sweetpotato tubers, using the red skin variety. training of sweetpotato farmers will take place i There shall be a possible entering into M.O.U. t First Produce U.K. and farmers. Engaging of swe out-growers shall be done to encourage mass proc Arrangements will be put in place for buyback fi categories.

.....

Situation Report on Sweetpotato Production and Utilization: Root and Tuber Expansion Programı (RTEP) Experience

O.M. Jimoh
Programme Manager, Root and Tuber Expansion Progr
Ijebu-Ife, Ogun State, Nigeria

RTEP's objective is to ensure sustainable incr production of potatoes (sweetpotato and Irish pot enhance their end-products, thus contributing to fo sufficiency and food security as well as enhance f income. The first strategy is to develop improved v with high root yields, disease and pest resistance, a

sugar content through activities at the National Root Crops Research Institute (NRCRI), Umudike, Abia State. So far, seven varieties have been developed by NRCRI.

The second strategy is to make the improved varieties available to farmers in the right quantity and in a timely manner. The improved varieties are multiplied in the four foundation farms at Ajase-Ipo (Kwara State), Igbariam (Anambra State), Ijebu-Ife (Ogun State) and Lafia (Nassarawa State). So far, 85.45 ha had been put under cultivation, from which 57,686 bundles of sweetpotato vines have been distributed to 16,130 farmer beneficiaries. We realise that sweetpotato vines are always scarce at the start of the annual planting season. RTEP has planned to initiate a programme that will ensure conservation of vines by embarking on dry season farming in Fadama areas, and the use of irrigation facilities.

In the case of Irish potato, groups and individual farmers were identified in Plateau, Kaduna, Taraba and Cross River States. The RTEP project provided 55 % of the cost of production to the farmers to promote the sustained production of this important crop. Also, a potato storage technology known as Diffuse Light Storage House (DLSH) was demonstrated in conjunction with the National Stored Products Research Institute (NSPRI) Ilorin, Kwara State. Through these efforts, losses of potato tubers during storage were reduced by 50 %.

Potato Growers, Processors and Marketers Association, Nigeria (POGPMAN) and Its Efforts

Hon. Bayo A. Ajibade,
National President, Potato Growers Processors and Marketers Association of Nigeria (POGPMAN), Abuja.

Introduction

Potato Growers Processors and Marketers Association of Nigeria (POGPMAN) is an affiliate member of All Farmers Association of Nigeria (AFAN). Its office is situated at No. 21, IBM Haruna Crescent, Utako, Abuja.

POGPMAN Cooperative Societies/Units

POGPMAN has been organizing Potato Farmers all over the Federation from Unit/ Cooperative Society Level to individual State Levels. We have started Potato Vine/Creeper exchanges from State to State.

Potato Markets have been established in five locations ir Lagos and business is good for the marketers. Lago currently portends insatiable market for sweetpotat coming from Oyan, Osun State, where potato farming i age-long. Traders from Republic of Benin have also bee coming to Lagos to purchase our sweetpotato tubers Likewise, traders from Niger Republic come to bu sweetpotato from Sokoto.

Exhibitions

POGPMAN and Federal Polytechnic, Offa jointl exhibited raw Irish and sweet potatoes, as well a processed composite bread, cake, meat Pile, doughnut chin-chin, etc, at the year 2005 World Food Da witnessed by FIIRO and NSPRI, among others and 200 World Food Day at Nassarawa State witnessed by th Honourable Minister of Agriculture and Water Resource Dr. Sayyadi Abba Ruma.

Federal Intervention

Despite all the above efforts, POGPMAN lacks th financial capacity to make potato cultivation trul national, at least by vine multiplication and distributio The whole proposals above are capital intensive to mak Nigeria a great potato producing, processing an exporting nation, and the costs are better fixed by th Federal authorities.

Hence, we hereby call on the Federal Ministry o Agriculture and Water Resources for positive interventio to make Nigeria a potato basket of Africa and the Worl create employment, save foreign exchange and promot potato exports to boost foreign exchange earnings.

Wonder Plant

Sweetpotato has been dubbed a wonder plant because c the following properties:

1. Veritable Crop of food security
2. Free of hydrocyanic toxin
3. Ready for harvest three months after planting
4. Vitamin A content
5. Medicinal potency for cure/prevention of diabetes, arthriti asthma, etc.
6. Bio-plastics as raw materials for carpets, upholsterie utensils, etc., (vide attached leaflet).

National Menu

Food and Agriculture Organisation (FAO), and Bill an Melinda Gates Foundation have separately recommende sweetpotato as a veritable food item for the whole c Africa. This shall complement rice. While rice is wholl carbohydrate, sweetpotato rather reduces glucose in th blood to help prevent / cure diabetes. (vide attache leaflet).

Hence, governmental intervention to promote the complementality of potato and rice shall build a more healthy and virile nation.

Awareness

Today, potato is like Australia: every body knows where it is, but only very few people go there. Similarly, Nigerians know potato but only a few eat it. Therefore, we need government funding to create awareness for potato cultivation, processing and consumption. Our as Potato Growers Processors and Markers Asso Nigeria is very ready to partner with Gover implementing all the above.

Conclusion

The Potato Growers Processors and Marketers A of Nigeria is looking to your granting the above while we are ready to answer your calls any time.

.....

ALL FARMERS ASSOCIATION OF NIGERIA - AF
(National Umbrella for All Nigerian Agro-Commodities Associations)
OFFICE OF THE VICE NATIONAL PRESIDENT ON ROOT AND TUBER CRO
AFAN'S NATIONAL OFFICE:
Plot 871, Tafawa Balewa Way,
Opposite Nicon Luxury,
Area 11, Garki, Abuja.
Tel: 08033892813.
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08037003916
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RESIDENCE:
Orere House,
Near OANDO Petrol
Old Ilorin-Jebba Roa
Sango, Ilorin Kwara S

REF: AA/AFAN 27th April, 2009.

Prof. M.O. Akoroda,
University of Ibadan,
Ibadan, Oyo State.

Dear Sir,

INTRODUCTION OF HONOURABLE BAYO ATOYEBI AJIBADE, NATIONAL PRESIDENT OF POTATO GROWERS PROCESSORS AND MARKETERS ASSOCIATION OF NIGERIA

I write to announce and introduce to you Honourable Bayo A. Ajibade as the National President of Potato Growers Processors and Marketers Association of Nigeria (POGPMAN). His mandate covers growing, processing, marketing and export of SWEET and IRISH POTATOES throughout the 36 States, including the FCT, of Nigeria.

This has become necessary because of the Certificate of Incorporation of Trustees Number CAC/IT/31836 dated 24th Day of March, 2009 just received. The photocopies of the Certificate and the attending Constitution duly issued/stamped by the Corporate Affairs Commission (CAC), Abuja are herewith attached for your esteemed perusal and kind retention.

This has come at the heels of the declaration of 2008 as the International Year of Potato and the dubbing of sweetpotato, a **wonder plant** by Food and A Organization (FAO) of United Nations. A wor not only for food security, but also for its **med bio-plastic** properties.

Empirical findings have confirmed sweetpotato protein, as cure and prevention of Diabetics. Pulmonary Diseases and child blindness. It cyanide toxin and contains **BETA** minerals vitamin A deficiency. Moreover, its **BIO-** property competes already favourably with pe the making of upholstery, linoleum, jugs and v US, Germany and Japan in particular.

More importantly is the notion of Bill and Mel to make sweetpotato a veritable menu for security and vitality of Africa.

Therefore, I enjoin you sir to proclaim sweetpc **national MENU** and give all possible as: POGPMAN and the National President, Honou Atoyebi Ajibade.

Thank you.

Yours very truly,

Chief Adebayo Ajayi
National Vice President, AFAN (Roots & Tube

Att:

CONSTITUTION

OF THE

POTATO GROWERS PROCESSORS AND MARKETERS' ASSOCIATION OF NIGERIA
SWEET & IRISH POTATOES
POGPMAN
For Food Medicine & Exports

CORPORATE AFFAIRS COMMISION
ASSESSMENT
05 MAR 2009
ASSESSED BY
Name:
Sign:

POTATO GROWERS PROCESSORS AND MARKETERS' ASSOCIATION NIGERIA (POGPMAN)

Member of All Farmers Association of Nigeria (AFAN)

Motto: Sweet &Irish Potatoes for Food Security Medicine Bio-plastics and Exports (Hydrocyanic Free)

30 MAR 2009
Incoperated Trustees Officer
Corporate Affairs Commission

CORPORATE AFFAIRS COMMISION
VERIFICATION
05 MAR 2009
APPROVED BY
Sign

Prepared by Bayo A. Ajibade
bjibscom @ yahoo.com
November 26, 2008

CAC/IT/NO 31836

CORPORATE AFFAIRS COMMISSION
FEDERAL REPUBLIC OF NIGERIA

Certificate of Incorporation

of the Incorporated Trustees of

POTATO GROWERS PROCESSORS AND MARKETERS ASSOCIATION NIGERIA

I hereby certify that

HON. BAYO ATOYEBI AJIBADE, ALHAJI BUKAR NGAMDU, CHIEF ADEBAYO AJAYI,

the duly appointed Trustees of POTATO GROWERS PROCESSORS AND MARKETERS ASSOCIATION NIGERIA *have this day been registered as a corporate body, subject to the below mentioned conditions and directions.*
Given under my hand and the Common Seal of the Corporate Affairs Commission at Abuja this Twenty-Fourth day of March, 2009

CONDITIONS AND DIRECTIONS

This certificate is liable to cancellation should the objects or the rules of the body be changed without the previous consent in writing of the Registrar General or should the body at any time permit or condone any divergence from or breach of such objects and rules.

Note:
This certificate does not bestow upon the Organization the right to establish any institution, engage in any business and the like without permission from the appropriate authority.

A. ALMUSTAPHA
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253924

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Sweetpotato Puff-puff: Sweetpotato for Poverty Alleviation and Food Security

Department of Food Technology, Federal Polytechnic,
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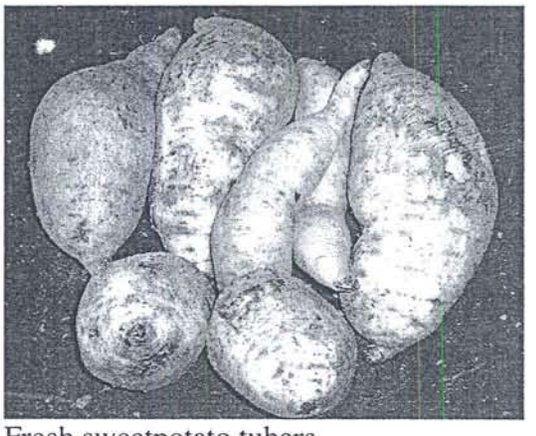


Fresh sweetpotato tubers

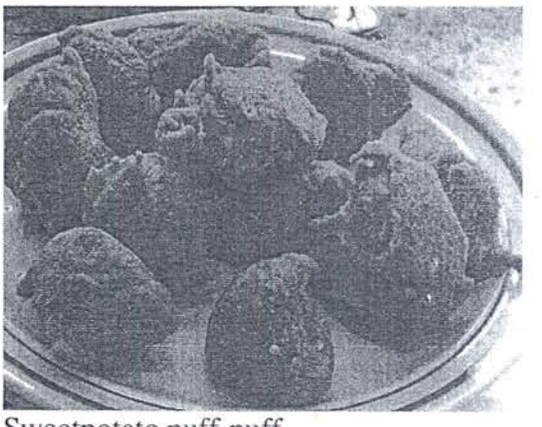
Production of sweetpotato flour

Raw sweetpotato tubers —> Peeling —>
Washing —> Drain/Shredding —>
Sweetpotato chips —> Drying —>
Milling —> Sieving —> Sweetpotato flour

*Precaution: To prevent browning of the chips/flour, soak inside water with 1% Sodium metabisulfite.

Ingredients

Wheat flour	1400 g	Sweetpotato flour	600 g
Sugar	250 g	Vegetable oil	5 litres
Margarine	250 g	Eggs	6
Yeast	3 teaspoons		



Sweetpotato puff-puff

1. Prepare the yeast in lukewarm water.
2. Add all the ingredients together, and mixed with prepared yeast.
3. Allow to proof for 4–5 hours.
4. Cut to shapes and deep-fry in vegetable oil.

For further in formation, contact:
The Office of the Rector, or
The Department of Food Technology,
Federal Polytechnic, Offa, P.M.B. 420,
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Annexes

NATIONAL CONFERENCE ON SWEETPOTATO 16–18 September 2008

Programme of Events

Day 1 (Tuesday 16th September)

Session I – Opening Ceremony

Chairman (Dean, Faculty of Agriculture and Forestry, University of Ibadan)

09.00–09.30 - Registration

09.30–09.45 - Introduction/Opening prayer

09.45–10.00 - Welcome Address: Prof. M.O. Akoroda – Scientific Advisor, SPG

10.00–10.15 - Keynote Address: The Executive Director, NRCRI, Umudike

10.15–10.35 - Goodwill Messages (NACGRAB, RTEP, NAQS)

10.35–10.40 - Closing prayer

10.40–10.45 - Group photograph

10.45–11.00 - Tea break

Session II – Paper Presentations

11.00–11.15 - Prof. G.O. Obigbesan

11.15–11.30 - NRCRI, Umudike

11.30–11.45 - Dr. Stella Odebode

11.45–12.00 - Bells University, Ota

12.00–12.15 - NACGRAB

12.15–13.00 - General Discussion: Questions and Answers

13.00–14.00 - Lunch Break

14.00–15.30 - Interactive Sessions (in six committees)

- Field Production
- Research/Scientist
- Extension and Outreach
- Development/Government policies
- Marketing and Economics
- Processing and Utilization

15.30–15.40 - Announcements

15.40–16.00 - Closing

Day 2 (Wednesday 17th September)

09.00–09.15 - Introduction of activities

09.15–10.30 - Interactive Session 1 (Parallel Gr Discussions)

10.30–11.00 - Tea break

11.00–13.00 - Interactive Session 2 (Parallel Gr Discussions)

13.00–14.00 - Lunch break

14.00–15.30 - Interactive Session 3 (Parallel Gr Discussions)

15.30–15.45 - Announcements/Tea break

15.45–16.00 - Closing

Day 3 (Thursday 18th September)

09.00– 09.15 - Introduction of activities

09.15–10.45 - Presentation of group reports

09.15–09.45 - Group 1

09.45–10.15 - Group 2

10.15–10.45 - Group 3

10.45–11.00 - Tea break

11.00–13.00 - Presentation of group reports

11.00–11.30 - Group 1

11.30–12.00 - Group 2

12.00–12.30 - Group 3

12.30–13.00 - Matters arising from group reports

13.00–14.00 - Lunch break

14.00–15.30 - Release of Communiqué

15.30 - Closing

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5.	Mr. Rasheed Adegbola	M	OYSADEP
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Sweetpotato Publications Displayed the Expo Corner

O.R. Yekeen
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1. Sweetpotato papers from Tropical Sc. Journal 2000–Vol. 44, 2004. Compiled by Ijeoma N Egeonu
2. Sweetpotato papers from Proceedings of the Afric Congress 2000. Compiled by I.N. Egeonu. 2006
3. Eighteen years of Sweetpotato Research at IITA 1988). Compiled by I.N. Egeonu
4. Tropical Root and Tuber Crops by I.C. Onwueme.
5. Twenty years of Sweetpotato research in Natio crops research institute (NRCRI) Umudike, Ab (1972–1991) Compiled by I.N Egeonu, 2006
6. Descriptors for Sweetpotato Z. Huaman CIP/AVRDC/IBPGR 1991.
7. Sweetpotato Nutrient Physiology and cultivati Yukindo Isumo, Faculty of Agric, Ehimo University
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13. Sweetpotato Postharvest topics, CIP, Lima, Peru 199
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19. Impact on a changing world. 1997 Report, CIP, Lima, Peru.
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23. Status Report of VITAA (Vitamin A for Africa). Regina Kapinga, Silver Tumwegamire and Joseph Ndunguru (eds).
24. Sweetpotato in Africa and the World Trends of Vital Statistics, 1965-1984. Tesfaye Gebremeskel and DF.B Oyewole.
25. Improvement of Sweetpotato (Ipomoea batatas) in Asia. Report of the Workshop on Sweetpotato Improvement in Asia held at ICAR Trivandrum, India. 1988.
26. Sweetpotato *Ipomoea batatas* (L). Abstracts of Selected Research and Development Literature, 1949 –1979 By G.O Ibekwe
27. Cost and Returns of Acre Technology Packages. Sweet Potato. By Jaswant R. Jinda *et al.*
28. The Tropical Agriculturalist, Sweetpotato by L. Degrees
29. Sweetpotato scores success copied from African farming May/June 2008.
30. Pattern of stake weight along the stem axis from its base and non-emergency of planted stakes. By M.O. Akoroda *et al.*
31. Nutrient Disorders of Sweetpotato. By J.N.O Sullivan *et al.*
32. CD for: Sweetpotato DiagNotes. A Diagnostic key and information Tool for Sweetpotato problems.
33. Sweetpotato Field Production Guide. By Chitundu & R Soenarjo 1997. (Seed Multiplication Component).
34. Sweet Potato. By A. Jones
35. Sweet Potato in the USA by Barry Dwell
36. The use of Orange fleshed Sweetpotato to combat Vitamin A Deficiency in Uganda by David Yanggen and Stella Nagujja.
37. Sweet Potato: Nigeria. History and Overview
38. Sweet Potato Production Guide for the Top End. By M. Traynor.
39. Guide to Improved Sweetpotato Production in Nigeria. By H.N. Anyaegbunam *et al.* June 2006 N.R.C.R.L; Umudike.
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42. Biofortification in Sweetpotato: The case of Orange–fleshed Sweetpotato in Nigeria. By I.N. Egeonu, M.O Akoroda & R.E. Kapinga.
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SPG-POGPMAN Initiative

O.B. Oladejo
Department of Agronomy, University of Ibadan, Ibadan, Nigeria

The small group consisted of: Professor M.O. Akoroda, Dr. (Mrs.) Fawole, Mr. J.T. Adebgite, Mr. Abioye Akerele and Mr. Olajide Oladejo (as rapporteur).

The discussion took place in front of the First Bank Building, Faculty of Agriculture and Forestry, University of Ibadan; venue of the Sweetpotato in Nigeria Conference. The subject of discussion was the establishment of sweetpotato shop in a major market in Nigeria. The supermarket will serve the purpose of buyi raw (harvested) sweetpotato tubers from farm marketing and advertising the different sweetpot products to Nigerian markets.

The representatives of Potato Growers Processors Marketers Association of Nigeria (POGPMAN), Mr. Adegbite and Mr Abioye Akerele, explained that there different problems that the farmers are encountering which transportation of the harvested sweetpotato tu was identified as the main concern. They also sugge that the academic and research institutes should investigate the economics of producing the crop. T finally informed the group that the Association plan buy-off harvested sweetpotato tubers from farmers' fi to control the price, and process into different prod which will be sold in the sweetpotato supermarket.

In her contribution, Dr. (Mrs.) Fawole suggested POGPMAN should approach food companies like makers of "Maggi" and "Onga" to sponsor the proce and advertisement of the different sweetpotato prod since some of their programmes are shown on Nat T.V. stations. She also suggested that the Associ could approach different restaurants to advertise diff sweetpotato products.

Prof. Akoroda applauded the intention of establi sweetpotato shop in a known market in Nigeria. however, stated that government will not take initi for farmers but it will only support when the farmer the initiative of establishing the shop and displayin different products. An estimate of what is usually sp cost of labour in the field production of sweetpotat requested for. He concluded by saying tha Sweetpotato Promotion Group (S.P.G.) would can investigations into the reduction of production costs.

SWEETPOTATO PROMOTION GROUP | **S P G**

UNIVERSITY OF IBADAN

Date: 17 September 2008

INSTRUMENT OF FORMAL REQUEST TO HOST THE NEXT SWEETPOTATO *IN NIGERIA* CONFERENCE

The First Sweetpotato *in Nigeria* Conference held at the First Bank Building, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan from 16 to 18 September 2008 has by majority vote decided that the Second Sweetpotato in Nigeria Conference be held at the National Root Crops Research Institute (NRCRI), Umudike, Abia State, Nigeria. To this end, the undersigned, being representatives of the Sweetpotato *in Nigeria* Conference, have been herewith instructed to formally request NRCRI, Umudike to prepare to host the said Conference at a suitable date next year (2009). We, therefore, seek your kind accent to this request in writing to the undersigned to enable us also prepare for the conference and make space for the same in our time scheduling.

Please kindly accept our most distinguished salutations and respect.

Signatories to the Request on behalf of 200 participants of the Sweetpotato in Nigeria Conference

Sweetpotato Promotion Group, Nigeria
Cellphone: 08035829286,
m_akoroda@yahoo.com

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Moor Plantation, Ibadan, Nigeria
Cellphone: 08036281963
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Oyo State Potato Farmers Association
Ibadan, Nigeria
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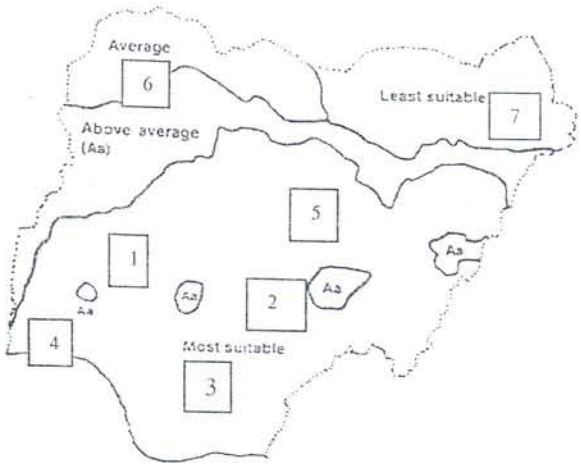
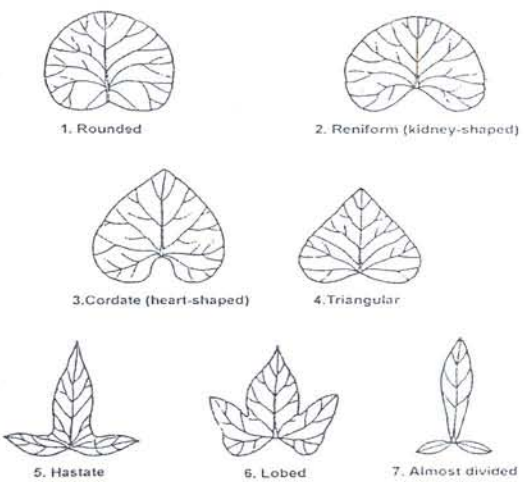
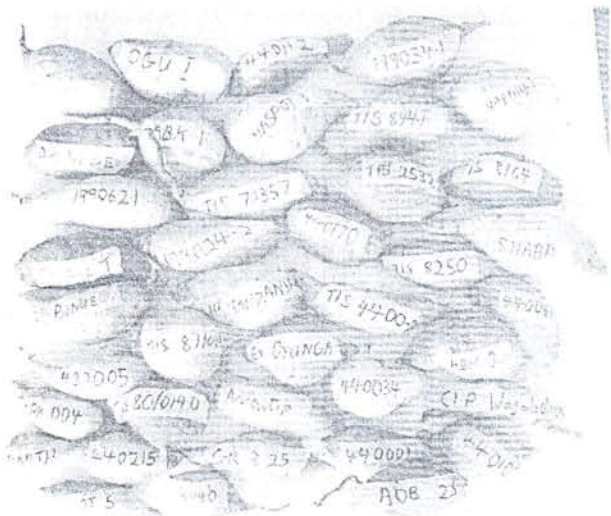


Major sweetpotato growing areas in Nigeria
1=Offa and Oyan; 2=Benue; 3=Afikpo, Egbema and Bende;
4= Ikorodu; 5= Bokkos, Jos; 6=Talatu Mafara; and
7= Lake Chad Region, Toro LGA

Sweetpotato market at Nkalagu, Ebonyi State



Different leaf shapes of sweetpotato



Tubers of sweetpotato varieties at University of Ibadan

Welcome to Offa, home of sweetpotato

Potato Growers Processors and Marketers' Association of Nigeria (POGPMAN)

The Sweetpotato Promotion Group seeks to promote the crop through research and development in any aspect that improves the livelihood of people in any locality.

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P
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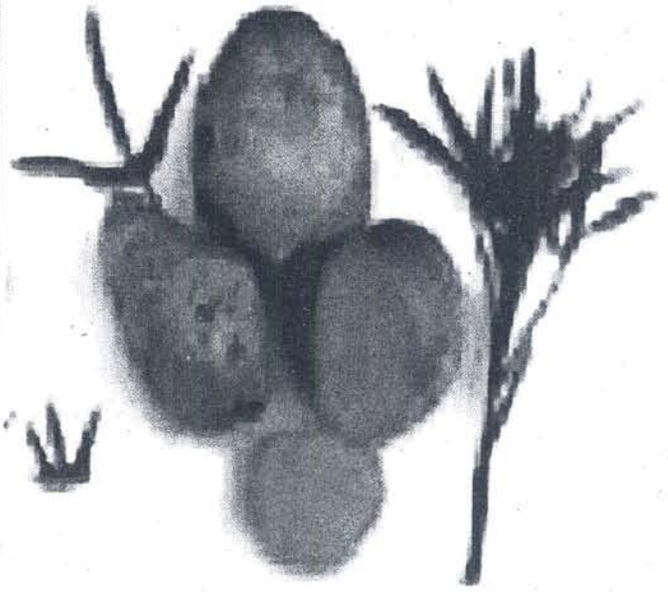

This issue contains the essence of about four plenary presentations, 15 discussion groups reports, 30 submitted papers, and list of bibliography on sweetpotato relating to Nigeria of 74 documents, reports and papers from the participation of 203 participants representing 13 States of Nigeria. The three-day conference was the first ever meeting of sweetpotato researchers, traders, farmers, development agencies, NGOs and interested new entrants into the sweetpotato promotion, utilization and advancement system of this country.

Orange-fleshed sweetpotato (Plates 5 and 6) is not widely available on farmers' fields or markets. Sweetpotato varieties now being tested include:

Zapallo (420027), Salyboro (187017.1), Tainung No 65 (440216), Nemanete, Kandee (440140), Centennial (440112), Excel (440016), Japon Tresmesino (42009), TIB-4 (440060), Jewel (566638), SPK 004, Tainung 64 (56632), Resisto 440001, 187015.1 (Comensal), 199004.2 (CIP breeding line), 199034.1 (CIP breeding line), and 199062.1 (CIP breeding line).

Plate 5: Tops and tubers of a freshly harvested sweetpotato orange-fleshed sweetpotato variety

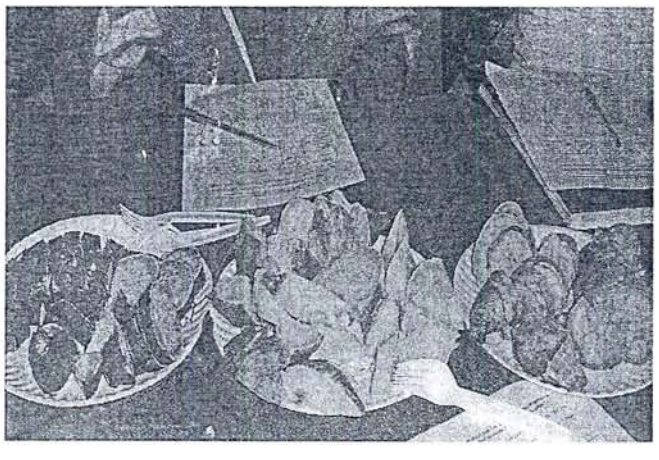

Plate 6: Sensory evaluation of boiled tubers of yellow- and orange-fleshed sweetpotato varieties

Sweetpotato leaves (Plate 7) are nutritious, but are not common in Nigerian diet. They can be prepared just like other common Nigerian leafy vegetables and consumed in almost the same ways. The slightly slimy consistency makes it very similar to *Corchorus olitorius* (ewedu).

Plate 7: Preparation of sweetpotato leaves for use as vegetable

Nigeria Experience

A study of extension training on sweetpotato processing was conducted in three out of the six geo-political zones in Nigeria. The primary data were collected, using both quantitative and qualitative data collection methods.

Analytical technique. The qualitative tools used in the study were:

1. Focus Group Discussions (FGDs)
2. In-depth Interviews (IDIs): In-depth Interviews (IDIs) were conducted with the officials of the State ADPs and the women leaders. The interviews helped in eliciting information on sweetpotato processing techniques from the ADP officials and the women leaders.
3. Community mapping: The community mapping was used as a tool to provide enough and adequate information on the physical linkages of communities with sweetpotato farms, rivers, roads, electricity and other infrastructural facilities.
4. Seasonal Calendar: The seasonal calendar helped in providing information on the activities the women were engaged in at different times, i.e. it helped in knowing the season-specific nature of their activities.

Quantitative data were collected by using Interview schedule. The quantitative data were summarized using the descriptive statistics and analyzed using multiple regression statistical analysis. One hundred and twenty sweetpotato processors were purposively selected from sweetpotato growing states. Regression analysis was used to find out whether there was any significant association between the sweetpotato processors' selected social-economic/ personal characteristics and the training received by the Women-in-Agriculture unit in Nigeria.

Results and Discussion

Table 4 shows the extension training activities of the WIA unit of ADP of Nigeria. The training activities largely included provision of information to women (Plate 8) on sweetpotato processing (46 %), and home management and nutrition (13 %), arrangement of literacy classes for women (13 %), identification of farming problems (4 %), advice on agricultural problems (8 %), teaching and dissemination of innovative information (17 %).

Table 4. Distribution of respondents based on the extension activities of the Women-in-Agriculture in Oyo State.

Extension activities	Frequency	Percent
Arrangement of literacy classes for women	15	13.0
Identification of farming problems	5	4.0
Advice on agricultural problems	10	8.0
Training on home management and nutrition	15	13.0
Provision of information to women	55	46.0
Teaching and dissemination of innovative information	20	16.0
Total	120	100

Plate 8: Training of women sweetpotato processors in Ondo State, Nigeria

Varieties grown by farmers come from different localities and require collection (Plate 9A), field assessment (Plate 9B), and extension to farms (Plate 9C).

Sale of sweetpotato tubers on the road-side (Plate 10) is a common channel for disposing small quantities of roots produced by gardeners that are insufficient to load vehicles for transit to major markets.

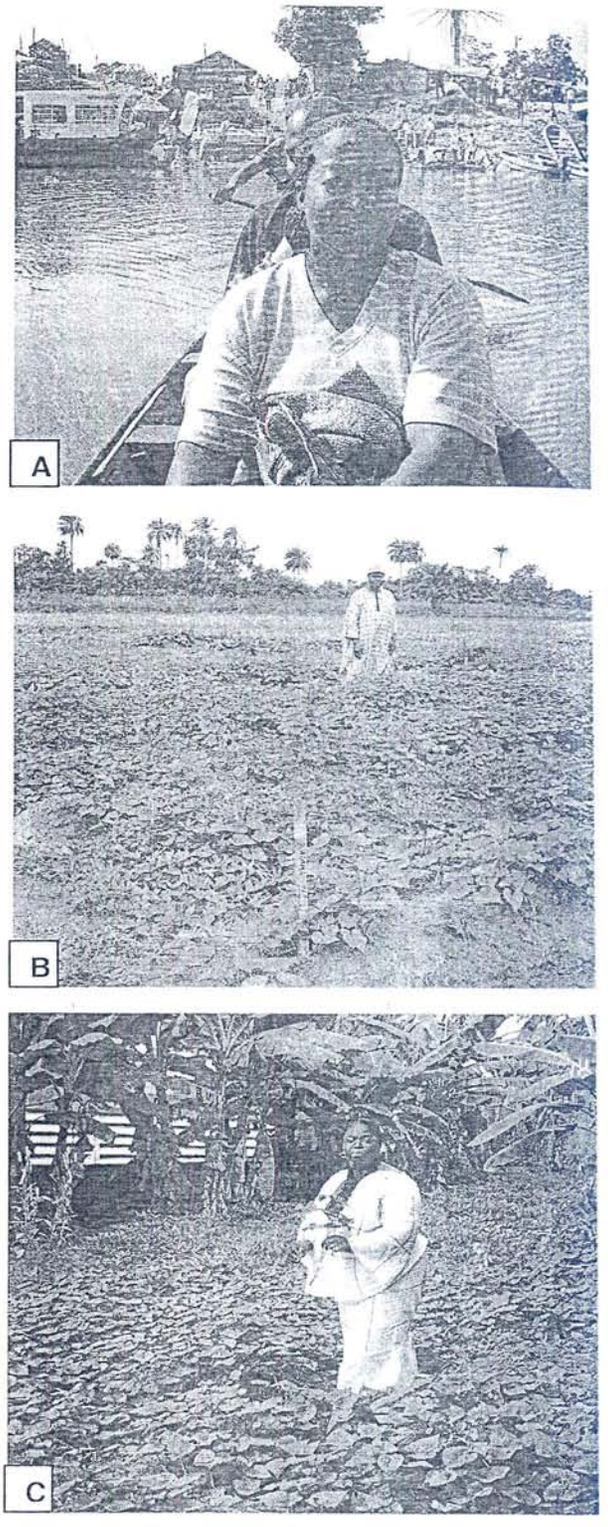

Plate 9. Searching for germplasm (A), assessing germplasm and extension of suitable types for end-uses (C)

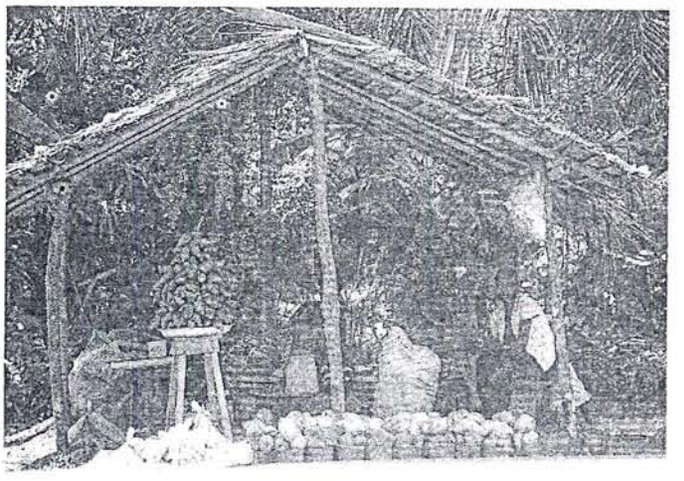

Plate 10: Sweetpotato tubers on display for sale at Odhiolugboji, along East-West Express Road, Rivers State

Issues

Major issues affecting sweetpotato post-harvest relate to:

- Food safety
- Nutrient loss in stored products
- Packaging problem
- Lack of planting materials

Strategies

The strategies for tackling the issues include:

- Use of participatory techniques with the communities (Mobilize the community members)
- Linking farmers to the market.
- Diversifying products
- Developing and promoting new products.
- Improving product quality
- Adopting private sector business approach.

Research Areas

Relevant research themes should cover aspects of:

- Production
- Post-harvest processing
- Nutrition (bio-availability and bio-efficacy)
- Gender issues
- HIV/AIDS
- Enterprise development

Way Forward

The way forward for enhancing sweetpotato production and consumption in Nigeria includes:

1. Product diversification
2. Non-food industrial and animal feeds production
3. Develop business plans.
4. Hasten progress on biotechnology in Nigeria

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Sweetpotato research at the National Root Crops Research Institute (NRCRI), Umudike, Abia State

S. O. Afuape
Sweetpotato Breeder
National Root Crops Research Institute (NRCRI), Umudike, Abia State

Introduction

The Sweetpotato Programme was established in 1975, an Research staff that cut across disciplines have bee employed to work on the crop. Presently, the Programm can boast of: a full time breeder, a weed scientist, tw entomologists, an agronomist, a nematologist, and microbiologist.

Mandates

The Sweetpotato Programme at NRCRI has key mandates that include the following:

1. Genetic improvement of sweetpotato,
2. Production of improved production packages that will sustain high yields,
3. Formulation of disease and pest control strategies,
4. Development of post–harvest technologies, and
5. The extension of findings to end users through established channels.

Highlights of Research Achievements

The production, marketing and utilization of sweetpotat has expanded in the last decade to almost all ecologic zones of Nigeria. Presently, over 600,000 ha of land ar under sweetpotato cultivation in Nigeria. Yields hav increased from farmers' pre-research era of 2-3 t/ha to 8-1 t/ha due to the availability of improved varieties. Nigeri today is the largest producer of sweetpotato in Africa wit 3.46 million MT annually. Globally, Nigeria is now th second largest producer after China (FAO 2007).

The research achievements of the NRCRI Sweetpotat Programme include:

a) Development of "2-node cutting" and "groovin techniques" for rapid generation of planting materials, an 4-node cuttings for sweetpotato production.
b) Development of dry season irrigated sweetpotato nurse technique for the conservation of planting materials durin the dry season since most sweetpotato fields dry up in the dr season.
c) Development of cultural packages for the control of sweetpotato weevils, *Cylas* spp. which is a major insect pest of sweetpotato.

d) Development of improved agronomic packages for higher yield per unit area.
e) Development of techniques for the storage of planting materials and storage of sweetpotato root tubers in moist saw dust for about 3-4 months as against the shelf life of 2-4 weeks of harvested roots if not properly stored.
f) Introduction of three (3) forage varieties for livestock farmers.
g) Development of various recipes and blends for different utility purposes.
h) Development of advanced clones for varietal development through open-pollination.
i) Introduction and selection of elite varieties for various ecologies and uses in Nigeria.

On-going Projects

The on-going projects of the Programme tackle five main aspects of sweetpotato systems, thus:

1. Genetic improvement studies which consist of: (a) germplasm collection (in-country and importations); (b) development of new sweetpotato varieties; (c) characterization and evaluation of new sweetpotato germplasm collection; and (d) multi-location trial of sweetpotato for selection of varieties best suited for specific ecologies.

2. Agronomy and soil fertility studies for assessment of: (a) optimum time of application of poultry manure in combination with inorganic fertilizer in sweetpotato production; (b) effect of soil amendment on soil properties and yield of sweetpotato in the Southeastern Nigeria; (c) effect of Nitrogen application on the critical period of weed interference in sweetpotato on an ultisol; and (d) effect of neem-based fertilizers on the productivity of sweetpotato.

3. Pest and Disease management studies on: (a) the use of Neem dust for the control of sweetpotato weevil; (b) the economic threshold and the control of sweetpotato weevil in Umudike, Southeastern Nigeria; and (c) integrated pest management of whitefly-transmitted virus of sweetpotato.
4. Resource Management and Extension studies to carry out cost – benefit analysis for the production of one hectare of sweetpotato at Umudike

5. Value-addition for production of acceptable food forms for different consumers and development of sweetpotato raw materials for agro-processors.

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Status of sweetpotato germplasm in Nigeria: NACGRAB's contributions and prospects

W. T. Odofin (Presented by John Atoyebi)
National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan

What is NACGRAB?

National Centre for Genetic Resources Biotechnology (NACGRAB) was established in 19 the Federal Ministry of Science and Technology (F as the National Centre of Focus in research, data gath and dissemination on genetic resources utilization, ge engineering and biotechnology.

NACGRAB's Objectives

The chief objectives of the Centre hinge on:

a) Conservation and Maintenance of plant, animal microbial genetic resources, for immediate utilizatio posterity;

b) Networking and coordinating activities in the develo of capacities in bio-resources and biotechn applications;

c) Application of tissue culture for plant and a conservation;

d) Servicing of the activities of the National Committ Naming, Registration and Release of Crops, Var Livestock breeds and Fisheries; and

e) Arrest of rapid erosion and loss in the country's cro animal genetic resources.

Activities of the Centre

These include acquisition and conservation germplasm, for posterity and immediate utilizatio well as acquisition, maintenance, exchange and utiliz of microbial cultures and conducting researc conservation and utilization of genetic resources.

Achievements of NACGRAB

NACGRAB has achieved notable strides includin following:

a) Collection and management of over 7,000 accessions o seeds of food crops and forest trees, which have orthod seed behaviour, in short- and long-term gene-banks;

b) Collection of over 1.000 plants, preserved as voucher specimens in the herbarium;

c) In-vitro Propagation for several food/horticultural and economic/timber plant species; and

d) Collection and conservation of several hundreds of indigenous plants, which have significant ethno-botanical, medicinal and economic value on the field gene-bank.

Sweetpotato Production

Sweetpotato is the seventh most produced food crop in the world, surpassed by wheat, rice, corn, potato, barley, and cassava. In 2004, approximately 129,536,275 million tonnes were produced from more than 100 countries. Asia is the world's largest sweetpotato-producing region, with 114 million tonnes of annual production. China supplies about 80% of the world's production, making it the leading supplier of sweetpotato in the world. Nigeria is the second in the world and highest in Africa, cultivating sweetpotato on 954,000 ha. Other notable African countries in sweetpotato production are Uganda (602,000 ha) and Tanzania (500,000 ha).

Economic Importance of Sweetpotato

The growth form of sweetpotato makes it good for soil conservation. The tubers are rich sources of carbohydrate and higher calories than wheat, rice or cassava. Sweetpotato is now being used in Africa to combat a widespread Vitamin A deficiency that causes blindness and death for 250,000-500,000 African children a year.

The tubers are rich in proteins of high biological value, containing many essential amino acids. They are used in industrial production of glucose syrup, alcohol, starch, flour and other pastries. The leaves are rich source of minerals, vitamins and proteins, as well as fodder.

Sweetpotato Conservation

Sweetpotato does not produce seeds easily, thus field conservation is widely used. Field conservation of sweetpotato is threatened by natural disasters, pests, diseases and human factors. In-vitro conservation offers the best and safest method for the conservation of sweetpotato germplasm. NACGRAB conservation efforts on sweetpotato cover the following areas:

a) In-vitro propagation of sweetpotato, using meristem culture to produce over 850 plantlets (Plate 1);

b) Field Management of about 1,500 plantlets established on the field gene-bank, with comparatively higher tuber yield (Plate 2);

c) Through in-vitro propagation, NACGRAB has successfully conserved three varieties of sweetpotato and

d) Sweetpotato cuttings and plantlets are being distributed to interested researchers.

NACGRAB'S Future Work on Sweetpotato

NACGRAB is strongly committed to the UN's CBD on biodiversity conservation; therefore, the centre has recently focused more attention on sweetpotato, and has designed the following programmes:

a) Collaborative exploration and collection of all sweetpotato varieties in Nigeria with NRCRI, Umudike;
b) Genetic and Molecular characterization of sweetpotato germplasm for desirable traits;
c) In-vitro and mass propagation of all the sweetpotato varieties and genotypes in Nigeria;
d) Ex-situ conservation of all sweetpotato varieties in Nigeria in the field gene-bank;
e) Wide distribution of disease-free sweetpotato plantlets to researchers;
f) Training of researchers and other stakeholders on in-vitro propagation of sweetpotato.

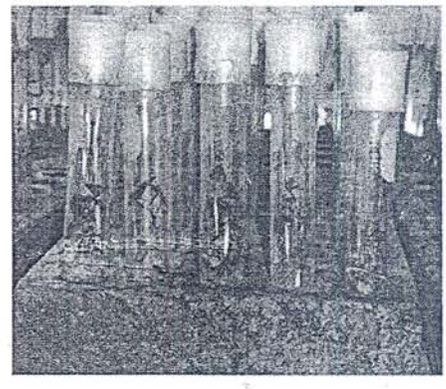

Plate 1. Sweetpotato plantlets in laboratory test-tubes at NACGRAB, Ibadan.

Plate 2. A sweetpotato plant at NACGRAB germplasm field in Ibadan.

Post-harvest Handling, Storage, Processing and Utilization of Sweetpotato in Nigeria: NSPRI's Experience

Dr. A. O. Oyebanji
Officer-In-Charge, NSPRI-Ibadan Outstation

Introduction

I bring greetings from the Executive Director of Nigerian Stored Products Research Institute (NSPRI), Dr. (Mrs.) M.A. Adesida.

NSPRI has the National Mandate for post-harvest handling of all crops as it concerns Research and Development of Technologies, Extension and Training, with a view to preventing deterioration or wastage of crop produce including sweetpotato post-harvest. NSPRI's mission statement is "Increasing Nigeria's agricultural self-reliance through adequate post-harvest loss prevention".

Sweetpotato (*Ipomoea batatas* [L.] Lam work in NSPRI is in the Root and Tuber Programme of the Institute with necessary relationship and inputs from other programmes such as Packaging in the multidisciplinary approach to technology development in the institute.

Some NSPRI Workers and Project Titles

This conference is considered very timely. NSPRI found that the trend production of sweetpotato is on the decline in Offa area of Kwara State, culturally known for the production and consumption of Sweetpotato, there called *anomo*. There is the need to create awareness of the benefits sweetpotato in terms of production, product and utilization. As the production increases the pressure on storage, processing and storage of products would increase. Hence, will be the need to prepare to prevent glut of sweetpotato that is potential in the on-going activity.

In NSPRI, post-harvest work on sweetpotato continues even as there is room for further investigation into the challenges and dissemination of the finding and technologies.

Workers on sweetpotato in NSPRI include:

1. Opadokun, Ikeorah and Ubani. 1985. Preliminary study on the extension of shelf life of sweetpotato by chemical treatment
2. Ibrahim and Ebo. 1984. Rot-causing fungi of sweetpotatoes in storage in Nigeria
3. Adesida *et al.* 2000. Livelihood studies of farmers in Offa area.
4. Adewumi and Afolabi. 2002. Thematic survey of harvest handling of sweetpotato in Ijagbo Communi Kwara State
5. Okonkwo *et al.* 2006. Processing and utilizatio sweetpotato

Other workers on sweetpotato elsewhere include Co and Walker (1961), Okafor (1966), Adeniji (1 Ogundana *et al.* (1971), Kay (1973), Booth (1 Onwueme (1978) and Ryall and Lipton (1979)

Sweetpotato Varieties

Many varieties of sweetpotato are grown in Nigeria. red and yellow skinned types shown below are comm

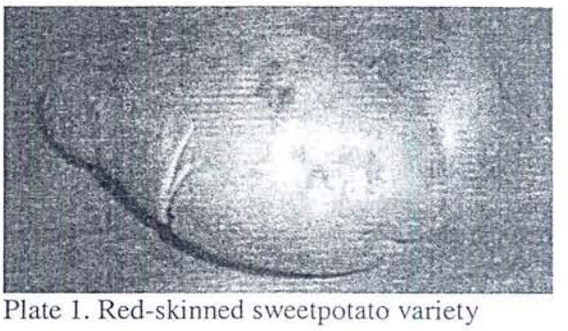

Plate 1. Red-skinned sweetpotato variety

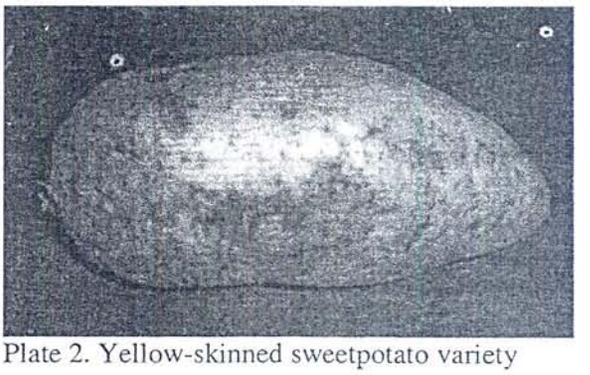

Plate 2. Yellow-skinned sweetpotato variety

Overview of Sweetpotato

Sweetpotato tubers is a nutritious and delicious food grown in the tropics, particularly desired and grow Offa area of Kwara State in Nigeria. Other State Nigeria also produce sweetpotato, especially in many northern states in Nigeria. Sweetpotato production h short growth cycle for up to 3 cycles per year depen on location and possibility for irrigation. The yiel sweetpotato is potentially high and has aggressive gr against weed problem after establishment. Sweetp serves as human food, animal feed and industrial material in the production of sugar syrups, ethanol flour for making confectioneries. However, sweetp tubers deteriorate fast after harvest, with 35% and losses in 4 and 8 weeks, respectively. Declining

fertility and post-harvest losses are some of the reasons for reducing production of sweetpotato.

Utilization / Processing of sweetpotato

Survey studies and investigations have shown that sweetpotato can be:

1. Peeled, chipped, dried and milled into flour for meal like fufu
2. Fresh tubers boiled and pounded into meal like fufu
3. Fresh tubers boiled and eaten with sauce like yam
4. Fresh tubers fried into potato chips like fried yam
5. Fresh tubers roasted and eaten like yam
6. Sweetpotato flour is mixed with cassava flour for meal like fufu

Sweetpotato Post Harvest Loss Indices

Loss indices of sweetpotato post-harvest include:

1. Shrinkage induced by continued physiological activity such respiration and physical impact from dehydration, a function of the relative humidity of the atmosphere
2. Hardening of tuber after a few days of harvest from excessive dehydration
3. Oxidative discolouration in wound areas
4. Sprouting
5. Fungal, bacterial and or heat induced decay or rotting
6. Insect infestation
7. Nematode attack
8. Decrease in carbohydrate content in the consumption activities of pests and spoilage agents

Rot-causing fungi of sweetpotato. Some rot-causing agents of sweetpotato are *Fusarium oxysporium, Rhizopus stolonifer* (Ehr.), *Diplodia theobromae, Aspergillus niger* (V. Tieghen), *Cladosporium* sp. and Bacteria species.

Traditional Storage of Sweetpotato

Traditionally, mature sweetpotato tubers are left in the soil un-harvested to store, believing that sweetpotato tubers cannot be stored post harvest. The resultant delayed harvest manifest in the hardening of tubers. After harvest, sweetpotato tubers are heaped on bare floor, in baskets or bowls (outside often in the sun to display for sale or in doors) to hold until sold or consumed within 1–2 weeks of harvest.

Post-harvest Storage of Sweetpotato

Sweetpotato tubers are ordinarily perishable after harvest, being fleshy by which they are easily susceptible to damage during harvesting, packing, transportation, storage, and marketing. The mechanical and physiological damage and injuries predispose tubers to infection that results in rotting of tuber that becomes unacceptable.

Infection in stock of sweetpotato spread rapidly and as such damaged and infected tubers are required to be removed to avoid spread of infection.

Under ambient tropical conditions, spoilage fungi cause rotting of sweetpotato. As such, cool atmosphere is required to control physiological and spoilage activities as well the storage atmosphere is required to be humid (85-90% relative humidity) to control dehydration.

Furthermore, harvested sweetpotato tubers require pre-storage treatment and storage condition that prevents o limit infection and reduce microbial activity, such a sorting, washing, waxing, wrapping or packaging in perforated polyethylene packs.

Further Information, Development and Recommendation

Of sealed polyethylene, perforated polyethylene and waxing, perforated polyethylene best extends shelf-life o sweetpotato. Other wrappers that have been tried are pape and fresh leaves (*Marantochia* leaves). Partial ventilated shallow packaging in cool humid structures on shelves, a adaptation of the improved yam barn is recommended t optimise the storage of sweetpotato on-farm, at home an during marketing. Sweetpotato tubers have been stored fresh for 3 months in fungicide-treated (thiabendazole moist sawdust and found suitable for the various uses an processing like the fresh tubers.

Pre-storage treatments of sweetpotato in Benlate, CGA a 200ppm, Maleic hydrazide, waxing or wrapping did nc significantly reduce sprouting of sweetpotato tubers.
For processing, sweetpotato tubers are peeled. The peele tubers are maintained in water to limit discoloration or t ferment. Peeled tubers are grated or chipped. The chip can be parboiled, drained and dried hygienically in dryer like NSPRI's solar tray (Plate 3), solar tent (Plate 4 multipurpose dryer and hybrid dryer rather than open sur drying on road side or bare ground. Such inappropriatel dried chips are contaminated with dirt and animal faeces a well as inadequately dried and wetting during rains.

Adequately dried sweetpotato chips are suitable fc prolonged storage (up to 2 years) in hermetic containe (prevent moisture increases, mouldiness and myco-toxi contamination) and can be fumigated with phosphir tablet in envelops in the hermetic containers to contr insect infestation safely.

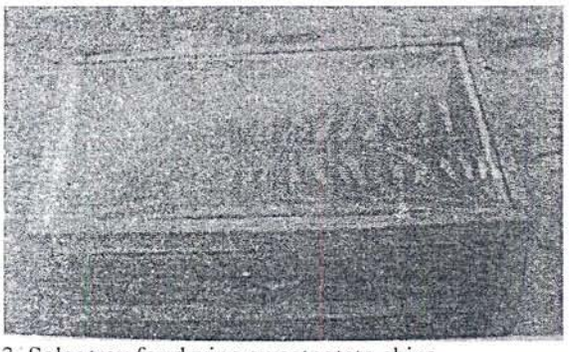

Plate 3. Solar tray for drying sweetpotato chips

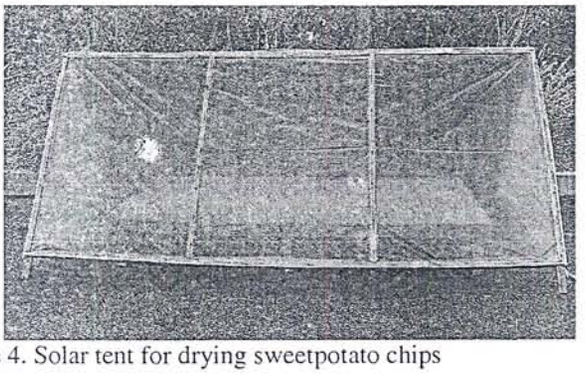

Plate 4. Solar tent for drying sweetpotato chips

Contributions of the Department of Food Technology, Federal Polytechnic, Offa

O.A. Idowu and G.F. Ogundele
Department Of Food Technology, Federal Polytechnic, Offa, Kwara State, Nigeria.

Introduction

The Federal Polytechnic Offa is in a unique position to undertake research into the production, processing and utilization of sweetpotato because of its location in Offa, a town that has historical and cultural affiliation with the crop. Sweetpotato is known and addressed by Offa people as "Anomo" Offa. This provoked our interest in the crop as a way of contributing to the socio-economic development of the town by identifying with sweetpotato, their beloved crop. However, we have been engaged with the processing and utilization of sweetpotato.

Our Contributions

The following are the main contributions from our work over the years:

a) Production of sweetpotato flour (Plate 1).
b) Production of sweetpotato bread using food sweetpotat flour (Plate 2A and B), which is comparable to bread m using only wheat flour (Plate 2C) and mashed sweetpot
c) Production of confectionaries using sweetpotato flour a mashed sweetpotato, the confectionaries include sweetpotato meat pie, sweetpotato doughnut and sweetpotato chin-chin, sweetpotato cake, sweetpotato cookies (Plate 3), sweetpotato rice flakes (Plate 4), sweetpotato egg rolls, etc.
d) Other products produced are (i) ethanol (ii) caramel (ii sugar syrup (iv) sweetpotato wine (v) sweetpotato jam sweetpotato custard (vii) sweetpotato garri.
e) Research work is on-going for the generation of electri using sweetpotato.

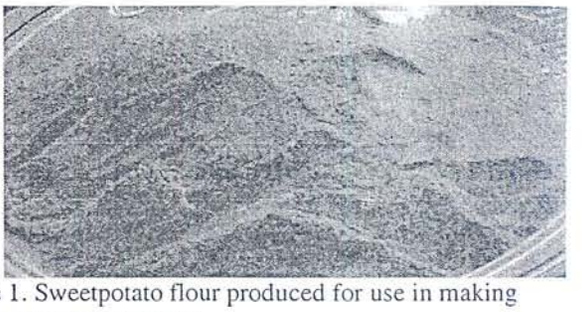

Plate 1. Sweetpotato flour produced for use in making different confectionaries

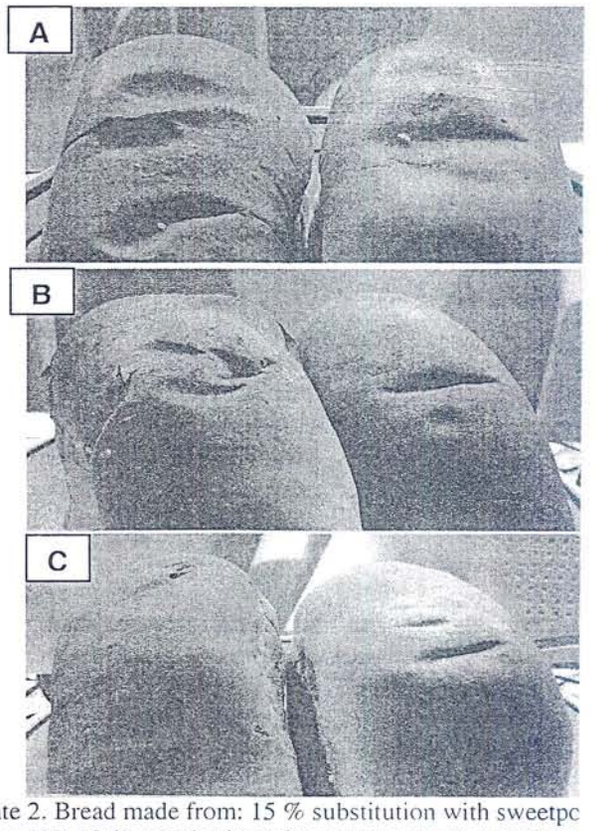

Plate 2. Bread made from: 15 % substitution with sweetpc flour (A); 10 % substitution with sweetpotato flour (B); ar % wheat flour (C)

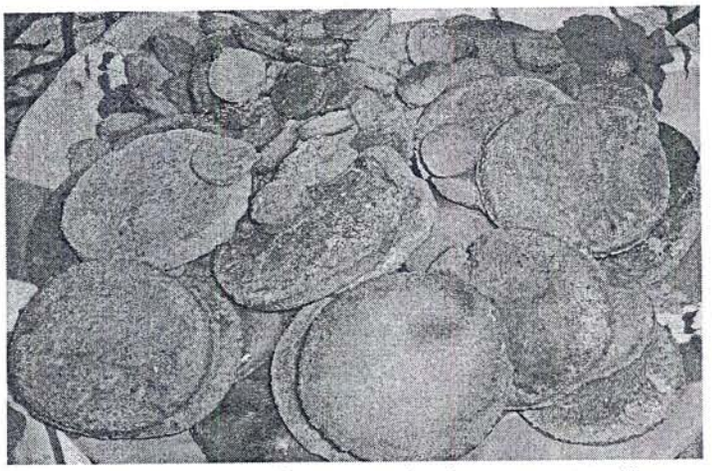

Plate 3: Sweetpotato cookies prepared using sweetpotato flour

Plate 4. Sweetpotato rice flakes prepared using sweetpotato flc

Linkages with Research Institutes

We have made contact officially with a number of research institutes for collaborative studies on processing and utilization of sweetpotato towards food security and poverty alleviation. The under-listed institutes have been contacted:

a) National Root Crops Research Institute (NRCRI) Umudike, Abia State.
b) Federal Industrial Research Institute (FIRO), Oshodi, Lagos State.
c) National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan, Oyo State.

Research on improving the quality of products developec on-going. Furthermore efforts are still geared towa developing more products from sweetpotato. It is our bel that if the necessary support is given to us we would be able make meaningful impact in the development and utilizati of sweetpotato in Nigeria.

Reports of Research and Development Committees

Sweetpotato Research

Chairman: Dr T.N.C Echendu
Rapporteurs: Dr. Jire Dare, Opeyemi Ayanrinola and Yetunde Fawusi

Problems identified and solutions

1. *Poor/marginal soil resulting in low yield.*

Solutions: (a) There is a need to match released varieties with appropriate locations; and (b) Use of suitable cover crops can lead to higher yields in the production system.

2. *Farmer practices (fallow system).* Because of the population pressure on land, the length of fallow period has been reduced. This leads to soil fertility decline and low yield even when inorganic fertilizers are applied.

Solutions: (a) Yield can be improved by leaving the land under cover crops for 2 years. Leguminous cover crops should be used; and (b) The use of organic amendments like 'Vitaplus' can also bring high yield. These organic materials should also be researched to determine there efficiency.

3. *Problem of the introduction of new materials (direct introduction or breeding).* This is also discussed the problem faced with National Agricultural Quarantine Service in bringing in importing plant materials.

Solution: There was a response that NAQS have legalized so many materials and it is easier to import plant material into the country now. NAQS and NACGRAB work together and once NACGRAB approves of the material, there is no delay.

4. *Problems with sweetpotato breeding.*

A) There are few sweetpotato breeders. this is because sweetpotato is an emerging crop and hardly attract funds from donors.

Solution: (a) Academics (lecturers) should put more students on sweetpotato breeding to stir up interest in this crop.

B) The nature of the crop also poses another cha Having to stoop down for several hours to do crossing is tiring and discouraging.

Solution: Not discussed.

C) Low genetic base: Genetic materials availal sweetpotato are not enough. There is need to hav genetic base for sweetpotato breeding

Solutions: (a) Nigerian Agricultural Quarantine S (NAQS) should allow more material to be brought i country; and (b) Response was also made th materials on ground are enough to start research c breeders can liaise with Prof. Akoroda and IITA.

D) Motivational support from institutions is lacking attention is directed towards cassava, leaving cro sweetpotato to suffer.

Solution: Not discussed

E) Lack of adequate information on challenges farmers. Most breeding works are for publication a to tackle farmers' problems. Information is needed challenge faced by farmers.

Solution: Having a survey reaching the farmers grassroots that can provide information need research.

F) Difficulty in crossing of sweetpotato flowers. T high flower abortion (incompatibility problem) sometimes prolongs breeding research on sweetpota

Solution: Compatibility studies using advanced b tools e.g. marker assisted procedure

G) Preference of research institutes to fund research rather than basic research.

Solutions: Not specifically discussed (check Ac Committee Report)

H) Misconception about sweetness of sweetpota research in West Africa, the interest is on sweetpot is bland (taste like yam). Research focus is on the low sweetness.

Solutions: There is need to increase the advoc sweetpotato. It was brought to the fore that swe cures diabetes (Wikipedia). More advocacy on swe will correct many misconceptions.

Some general solutions were proffered to some of the breeding problems

1. Breeding research should delve into genetic and molecular characterization of varieties to address the problem of self incompatibility (flower abortion)
2. Regenerating and characterising some sweetpotato lines can be used to find varieties suitable to a particular region
3. Breeders have to reach out to several organizations in other geopolitical zones and work together.
4. Suggestion also came that breeders should go beyond conventional breeding methods and use transgenic materials.

8. *Dearth of manpower in research.* There are very few scientists/researchers in other fields other than breeders working on sweetpotato. Multidisciplinary action is needed for research on sweetpotato to progress.

9. *Pests and diseases*
a) Nematodes constitute a serious pest of sweetpotato. This problem has hitherto been ignored.

Solutions: Research to address the problem through:
i) Proven crop rotational practices
ii) Identification of resistant genotypes

b) Sweetpotato weevil (*Cylas* spp.). This was identified as a perennial pest of sweetpotato in field and storage. The cultural practice of earthing-up has not solved the problem. Research is therefore needed to urgently find appropriate solutions.

c) Sweetpotato virus diseases. A lot of these diseases complexes have been reported to cause serious yield losses in sweetpotato.

Solutions: (a) Identification of possible resistant lines; (b) Use of thermotherapy to reduce virus effectiveness in infected vines; and (c) Use of tissue culture/biotechnology to clean up infected materials

10. *Stored pests of processed materials* e.g. chips which lead to reduction in quality standard

Solutions: (a) Appropriate packaging and packaging materials; and (b) Use of Phosgene i.e. Phostoxin placed in perforated envelopes (to prevent direct contact with foodstuffs).

11. *Storage of fresh tubers of sweetpotato.*

Solutions: (a) NSPRI has developed a technology for storage of fresh root for a reasonable period by using sawdust. This technology needs to be transferred; and (b) Wrapping in polythene bags will also extend shelf life c sweetpotato.

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Field Production of Sweetpotato

Chairman: M. J. T Adegbete
Rapporteurs: Dr. Ivo Acha and Mr. Olajide Oladejo
Number of Committee participants: 33

Some eight problems were identified and discussed.

1. *Lack of market for sales of produced*

Solutions: (a) Creation of Sweetpotato market informati system at the local, state and federal level; (b) Formation farmer's cooperatives that would be responsible f marketing of produce; and (c) Processing of harvested tub in order to add value guarantee a better price.

2. *Foliar and Root pest problems*

Solutions: (a) Plant vine cuttings early in the season wh rains are steady; (b) Harvest before soils become very d (insect infestation is more severe during dry weather); Mounds should be made around tuberous roots to redu attack by insect pest; and (d) Strict from hygiene should adhered to e.g regular weeding of plots rouging of disea plants.

3. *Consumers' reluctance to accept varieties with sw taste.*
Solution: Grow varieties that meet consur preferences.

4. *Lack of improved varieties and non availability of g quality planting material.*

Solutions: (a) Request for improved varieties fi research institutes and ADPs e.g. NRCRI; (b) P tuberous roots in a nursery to produce vine cuttii Preferably, the nursery should be located near a sou of water; (c) Use one or two- node vine cuttings rapid multiplication; (d) 4-node vine cuttings are best to use for commercial production; and (d) The planting material are cuttings obtained from tip por of the vine.

5. *Tuberous root rot during storage*

Solutions: (a) Avoid wounding tubers at harvest; (b) After harvest, tuberous roots should be spread in a cool dry and well ventilated place and allowed to cure for about 3 days before they are stored; and (c) Only tubers that are free form weevils should be stored.

6. *Excessive vegetative growth with low yield of tuberous roots.*

Solutions: (a) Avoid soils with very high levels of nitrogen; and (b) Avoid excessive use of fertilizer

7. *Weed competition*

Solutions: (a) Ensure that fields are kept weed free during the first 6 weeks of planting; (b) Use pre-emergence herbicide (e.g. Primextra Gold) at a rate of 1.5 kg a.i./ha; (c) Use post-emergence herbicide (e.g. Fusilade) at a rate of 2 kg a.i./ha; and (d) Plant vine cuttings at the recommended spacing of 30cm within the ridge and 100 cm between ridges.

8. *Very poor growth in clayey soil.*

Solution: Sweetpotato thrives best in a well-drained sandy-loam. It does not tolerate water lodging.

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Sweetpotato Extension Outreaches

Chairperson: Mrs Olaniyi
Rapporteurs: Mr. A.O. Ajiboye and Mr. Adegbola

The following challenges were discussed in the Extension Outreaches group:

1. Mobility/Transportation: In the past extension workers were given motorcycles to reach the rural dwellers. At present, the extension workers find it difficult to get to the local people due to mobility problem.
2. Recruitment of extension workers: The number of extension workers is not sufficient to cover the rural dwellers.
3. Farmers are not able to lay their hands on new varieties of sweetpotato developed by researchers.
4. There is also problem of getting labour to work on the farm and also the cost of labour is very high.
5. Land acquisition: Some farmers who are ready to go into sweetpotato farming are finding it difficult to acquire enough land needed for the farming.
6. Land preparation: Government is not providing equipment for tillage/ridging. Farmers therefore find it difficult to go into large scale farming.

Other challenges are in the areas of storage, pro utilization, marketing and value addition.

Achievements

So far, the status of sweetpotato has been enhance following achievements:

1. Sweetpotato can now be used to formulate food for an
2. Soil management: It can be used to check erosion a same time produces root crops for consumption.
3. CENRAD: Centre for Environment, Renewable Resources Management, Research and Development able to use mound compost system for sweetpotato pr in Nigeria.

Recommendations/ Solutions

The following are recommended:

1. Motor cycles should be provided to extension worker access to the rural dwellers.
2. More extension workers should be recruited.
3. Government should provide equipment for land prepa

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Sweetpotato Processing and Utilizati

Chairman: Mr Idowu
Rapporteur: Mr O. Kupoluyi

At present, these are over twenty-five different of food products produced from sweetpotato.

Problems and Challenges of Processing and Utilizing Sweetpotato

The identified problems and challenges facing proc and utilization of sweetpotato include:

1. Ignorance or inadequate knowledge on the various u which sweetpotato could be put.
2. What type of equipments can be used to process sweet
3. Which methods are the best in processing sweetpot the most desirable products?
4. Problems of acceptability of the products of sweetpot
5. Storage, which is the ability to extend the lifesp product, is also a problem which processing ca address.

Proffered Solutions to the Problems stated a

Possible solutions to help tackle the problems identified are as follows:

1. An example was given of the colour of the garri n sweetpotato which has a darker colour than the normal which could put off potential consumers. It was

Solutions: (a) Avoid wounding tubers at harvest; (b) After harvest, tuberous roots should be spread in a cool dry and well ventilated place and allowed to cure for about 3 days before they are stored; and (c) Only tubers that are free form weevils should be stored.

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2. Recruitment of extension workers: The number of extension workers is not sufficient to cover the rural dwellers.
3. Farmers are not able to lay their hands on new varieties of sweetpotato developed by researchers.
4. There is also problem of getting labour to work on the farm and also the cost of labour is very high.
5. Land acquisition: Some farmers who are ready to go into sweetpotato farming are finding it difficult to acquire enough land needed for the farming.
6. Land preparation: Government is not providing equipment for tillage/ridging. Farmers therefore find it difficult to go into large scale farming.

Other challenges are in the areas of storage, proces utilization, marketing and value addition.

Achievements

So far, the status of sweetpotato has been enhanced b following achievements:

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2. Soil management: It can be used to check erosion and same time produces root crops for consumption.
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Recommendations/ Solutions

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The identified problems and challenges facing processir and utilization of sweetpotato include:

1. Ignorance or inadequate knowledge on the various uses t which sweetpotato could be put.
2. What type of equipments can be used to process sweetpotat
3. Which methods are the best in processing sweetpotato t the most desirable products?
4. Problems of acceptability of the products of sweetpotato.
5. Storage, which is the ability to extend the lifespan of product, is also a problem which processing can hel address.

Proffered Solutions to the Problems stated abov

Possible solutions to help tackle the problems identified are as follows:

1. An example was given of the colour of the garri made f sweetpotato which has a darker colour than the normal garri which could put off potential consumers. It was there

agreed that processing should be geared towards making the finished products from sweetpotato acceptable to consumers. Colours associated with similar food products produced from other crops should as much as possible be preserved.

2. Nutritional quality of the products should however not be sacrificed for appearance.
   Without processing, all agreed that the efforts that go into research, breeding and production will be a waste.

Participants expressed concern about the oxidative browning that takes place during the processing of sweet potato tubers especially during peeling. This, most agreed was responsible for the undesirable colours that finished products have. Industrial means exist to take care of this problem. However, solutions at the farm level need to be proffered.

For a coordinated and systematic approach it was agreed that we should take one item at a time. A good starting point is to itemize a list of products that could be made form sweetpotato.

Sweetpotato Products

Currently, the known sweetpotato products include:

1. Sweetpotato Gari;
2. Sweetpotato bread
3. Sweetpotato cake
4. Sweetpotato Biscuits
5. Sweetpotato Cookies
6. Sweetpotato Chips
7. Sweetpotato Flour
8. Sweetpotato Chin Chin
9. Sweetpotato Doughnut
10. Sweetpotato Puff puff
11. Sweetpotato Meatpie
12. Sweetpotato Starch
13. Sweetpotato Juice
14. Sweetpotato Kunnu
15. Sweetpotato Vegetable
16. Microbiological agar
17. Ethanol
18. Bio-fuel

Since flour is the main ingredient in the production of many of the products listed above, the process of flour production is therefore a convenient starting point.

Production of Sweetpotato Flour

Step 1: Obtain good quality sweetpotato tubers. Appropriate tubers should be well formed; medium to large sized, free from bruises and other defects. Two species, whose names are not readily available which are obtainable from NRCRI Umudike, are recommended. One is pink skinned, white fleshed and the other has cream coloured skin and flesh. Both have good flour making qualities. Good orange fleshed varieties (which most of the discussants are not familiar with) are also recommended because of their s high nutritional quality.

Step 2: Clean tubers thoroughly (wash in water) to remove dirt and reduce microbial contamination.

Step 3: Peel off the skin. This will further reduce contamination. The peels can be used to feed animals Care should however be taken to guard against browning (oxidative reaction) at this stage. The browning take place as a result of enzymatic reaction, wher hydroquinone in the tuber reacts with oxygen in th atmosphere. It was suggested form the experience of on of the participants that 1% sodium metabisulphite solutio be added to the water into which sweetpotato chips shoul be soaked. Sweetpotato should be sliced thinly to enhanc quick dying because the longer the drying takes the darke the flour that is produced. The chips should be remove form the water (with sodium metabisulphite) an preferable rinsed in another volume of water free from th sodium metabisulphite. This is to guard against the healt hazard posed by sodium metabisulphite (according t another contributor).

Dry the chips, preferably in a cabinet dryer. Where this not available, this could be done under the sun. It wa cautioned that the orange-fleshed varieties will lose muc of the beta-carotene if dried under the sun due to son light reactions. Sun drying may take 2 to 3 da depending on the weather conditions. Drying with th cabinet dryer will require a temperature of 60–70°C in th dryer. The dryer can be fabricated locally and may n necessarily be expensive.

Suggestions were made to obtain varieties that do not tu brown quickly from research stations like NRCR Umudike.

Step 4: Grind or mill the dried chips into flour.

Step 5: Sieve to remove coarser particles.
The above process is the dry process.

There is also the wet process which is of two types

a. *Steaming method:* This method also prevents t discolouration normally experienced in sweetpot processing.

1. Wash tubers thoroughly in water
2. Peel and slice thinly
3. Chips are placed into a blancher. The blancher is a devic which the chips are steamed. Steam in the blancher

15mins. This stops the oxidation process and prevents discolouration.

b. *The mashing method*
1. Wash tubers in water
2. Peel and cut up as if for boiling to eat
3. Mash the potato
4. Measure the required quantity and mix with wheat flour and bake. The disadvantage of the method is that products made with mashed sweetpotato do not keep for long.

This method is particularly recommended for mothers who do not have the knowledge, skill and equipment to practice the two methods previously highlighted above.

Conclusion
It was concluded that there is need for public enlightenment on the qualities and advantages of consuming sweetpotato to improve acceptability.

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Marketing and Economics of Sweetpotato

Chairperson: Mr. Abioye Akerele
Rapporteurs: Ms. Uzokwe Pauline. A and Mr. O.J. Atoyebi

General Perspective about Sweetpotato
Sweetpotato as a crop helps to combat vitamin A deficiency. It is a very cheap crop but people don't really buy the crop because they feel it can only be fried and boiled and also due to the high sugar content which can cause or might lead to diabetes. The question now is, why are people not willing to buy and how can we make it possible for people to be interested in the crop.

Analysis of the product SWOT of Sweetpotato
Strength: The crop is readily available and abundant for people to buy and quick to produce, it can be grown under any given weather condition and within three months, it is already a known crop all over the world.

Weakness: The preservation is very low in Nigeria, this make it difficult for farmers to harvest and keep for too long, but it is better off in China.

Opportunity: This could also generate income even for the government, if there is government intervention. It also creates employment opportunity.

Threat: Land problem, that is the issue of land, fundi also importance for the purpose of production marketing. Personal effort is also necessary, ge attitude of the people to the farmers of potato.

Marketing of sweetpotato
The processing of sweetpotato very low, this affec marketing of the crop which make it very internal. the red and yellow sweetpotato are good commercialization purpose, we also make use of goc market.

Economics aspect of sweetpotato
Under this consideration a sweetpotato farmer wh one acre (6 plots of land) and is trying to get a loan f bank, he or she is most likely going to be faced wi principle of opportunity cost to other forms of bus This is because production of the crop is not self sust that is it does not have the required value of awaren is now the duty of the stake holders to p sweetpotato in a right perspective, which can be four times in a year (3 months). Benefit cost anal necessary.

Ways of exporting sweetpotato in Nigeria
Certain standards must be followed in exporti sweetpotato in Nigeria e.g. making used of speci cartons for a proper packaging and preservation.

Problems
The general problems facing enhanced marketi sweetpotato are:
1. Poor marketing
2. Bad impression
3. Low preservation
4. Mode of cultivation
5. Lack of awareness
6. Unavailable Attention, Interest, Desire, and Action principle.
7. Lack of marketing education by the farmers
8. Lack of good technology

Solutions
In order to enhance the marketing of sweetpo Nigeria, the following solutions were proffered:

1. Creating a super market

2. Marketing strategies i.e. usage of integrated marketing and communication technique. Examples include: advertising, marketing, public relation, sales promotion, conference, workshop and seminars.

3. Good technology.
4. Government intervention / improved policy.

Recommendation

Every Association of farmers must have a department of marketing and economics unit.

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Sweetpotato Development and Government Policies

Introduction

The appointment of the chairperson and two rapporteurs for the committee was as followed by the listing of the essential components in the development of sweetpotato with reference to government policies and interventions.

It was agreed that government policies on sweetpotato should also take into consideration world trends and economics. In addition government policies should also identify and empower key stakeholders such as farmers, industry commodity crop associations. Government policy should also takes into consideration.

Problems and Suggestions for enhancing Sweetpotato Development through Government Policies

The present state of affairs was considered, with a view to developing sustainable enterprises in sweetpotato development. Therefore the committee agreed on the following components of sweetpotato production and development:

A) Planting materials

B) Land preparation

C) Manuring and agronomic practices

D) Impact of plant pest and diseases

E) Harvesting

F) Storage and transportation

G) Marketing

H) Processing

I) Utilization.

The committee considered the challenges of the above listed components and suggested policy interventions involving the government, private sector, intelligentsia or academic and commodity association of Apex Farmer Association of Nigeria (AFAN).

Planting materials. Committee noted that vines production and supply is a problem to farmers. There is shortage of potato during dry season. The committee recommends that government should establish centres for the supply of plant materials. In addition commodity crop association should be encouraged to establish cine production and government may even guarantee loans for that purpose. Government should direct National Root Crop Research Institute, Umudike to identify, select and develop sweetpotato vines specific for various agronomic ecological zones and uses.

Land preparation. The committee strongly recommends that sweetpotato production should also be treated as a commercial venture. Therefore Commodity Crop Association should liaise with the agricultural researchers, intelligentsia to determine the profitability of small, medium and large scale cultivation of sweetpotato. Since sweetpotato thrives well in open fields and is sensitive to shading, the middle belt of Nigeria such as Benue, Kwara (Offa environs), Oyo and Nassarawa have comparative advantage for establishing of farms size of 5 acres or more.

Manuring and agronomic practices. Since the amount of fertilizer required by sweetpotato is relatively less compared to maize and cassava, it is recommended that it is grown as a second season crop in the south. In order to ensure proper use of fertilizer and other cultural practices, bulletin and agricultural extension manuals and leaflets should be produce for educating sweetpotato farmers using the ADP system.

Impact of plant pests and diseases. Pests such as the sweetpotato weevils *Cylas spp.*, sweetpotato virus, dry and wet rot of tuber were identified by the committee as some of the serious challenges facing sweetpotato development. The committee proposes the publication of extension manuals and leaflets on the management of these plant pests.

Harvesting. The harvesting of sweetpotato was also identified as one of the challenges faced by farmers and impacts negatively on the profitability of the sweetpotato production. The committee recommended that the National

Centre for Agricultural Mechanization should be directed by government to modify existing implements for harvesting Irish potato and make it suitable for harvesting of sweetpotato.

Storage and transportation. The committee noted that pest attack starts from the field and the tuber does not store well. If left for too long, the tubers begin to sprout. Thus, the shelf life cannot extend beyond 2 months.
The availability of ready and reliable market and simple processing methods may address the problem. Governments, commodity crop association and the farmers can adopt the strategy for handling the challenge of storage. Moreover, tubers should not be bruised during transportation. Proper grading and removal of damaged tubers before storage and transportation are recommended.

Marketing. Government should create and promote the awareness on different end-products of sweetpotato and uses as food, feed and industrial uses e.g. starch, syrup, ethanol etc. A Market Information Service (MIS) for sweetpotato should be developed by government similar to other agricultural commodities.

Processing. The committee also noted that marketing of sweetpotato is restricted due to lack of diversification of uses. Since the storage life is short, available machines need not be re-invented but modified to process the crop into various uses, such as flour, feed, ethanol, chips, syrup, alcohol, and starch. The improved and diversified processing method will solve the problem of glut of fresh tubers during harvest periods.

Utilization. The government should adequately fund research on utilization with the view to expanding the multiple uses of sweetpotato. The Sweetpotato Promotion Group (SPG) in association with NRCRI, Umudike should establish strong linkage with countries like China where sweetpotato use has been developed and learn from their methods in order to fast-track or short-circuit the development of the crop in Nigeria. SPG can develop an information centre on sweetpotato for farmers, policy makers and researchers.

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Reports of Zonal Group Discussions

The Zonal Groups were asked to discuss aspects of: Problems, Challenges and Solutions for Sweetpotato Cultivation within their zones.

Osun/Kwara Zone

Chairman: Dr. Oyebanji ; Rapporteur: Arowolo A.D.

A) Planting materials or vines. The major problem is lack of technological know-how on the planting and cultivation of the crop.

Solution: Research and development challenges.

B) Absence of improved varieties

Solutions: Improved varieties of sweetpotato to be obtained from NRCRI, Umudike through the ADPS. The Institute should extend its frontiers to the area/zone. NGOs' intervention will compliment efforts by Government agencies.

C) Sweetpotato weevils

Solutions: No solution yet to the problem in the field but in storage, fumigation is the answer. However, it requires training workshop on the modalities.

D) Poor soil fertility

Solution: Application of fertilizers. This requires prompt and timely application.

E) Marketing

Solutions:(a) There is need for public sensitization and awareness as regards the usefulness/importance of the crop; (b) We need to correct the wrong impression about the high sugar content/sweetness of the crop; (c) Continuous promotion of the uses of the crop; (d) Establishment of cottage industries that will use the crop; (e) Possibility for export; and (f) Diversification to animal and fish meals.

F) Funding and empowerment of sweetpotato stakeholders

Solutions: (a) Proportional inclusion of sweetpotato in the flour used in bread making; and (b) Governmental intervention to secure loans or give direct loans to the farmers.

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Ogbomosho Zone

Members: Mrs Philips, Pastor Seyi Olayinka-Jacs and J. Adegbite

The various challenges to sweetpotato in the Ogbomosho zone were identified as:

1. Lack of awareness
2. Lack of marketing
3. Lack of Nutrition and Health Information for the public and farmers
4. Lack of Researchers as Agencies
5. Lack of sufficient varieties
6. Lack of storage
7. Lack of transportation and roads
8. Lack of finance
9. Lack of accountability
10. Lack of development

Solutions: Zonal and National challenges to the sweetpotato system can be minimized by:

A) Creating awareness to the farmers and through the Farmers Association to the public national and international (seminars, workshops, interactions)

B) Creating a good central marketing place & strategies for distribution/magi show media through the Farmers Association to the farmers.

C) Creating a good health and nutrition information to the farmers through the Farmers Association (like the ability of sweetpotato to combat blindness because it is rich in vitamin C, etc.)

D) Creating a good research awareness, seminar, workshops to the farmers through the Farmers Association on regular basis. Researchers enable development.

E) Creating information dissemination for sufficient varieties of sweetpotato through the Farmers Association to the farmers. Different varieties should be introduced.

F) Creation of transportation and good road to the Farmers Association to get to the farmers.

G) Creating financial incentives for the farmers through the Farmers Association to the farmers.

H) Creation of proper accountability for the farmers through zonal and national seminar, workshop for the farmer through the Farmers Association

I) Creation of good storage and treatment for the farmers through the Farmers Association.

Saki Zone

Chairperson: Mr. Elijah Kayode Jones; Rapporteurs: Mrs. O- Jacs Damilola, Mr. M. Adeniyi and Mr. Akinpelu Wole

Sweetpotato planting is not the major type of crop that is usually planted in the Saki part of Oyo State. However, there are several problems or challenges that the farmers face in the process of farming, harvesting and marketing of the crop.

Sweetpotato is faced with several challenges including:

1) Inadequate supply of vines to the farmers and the vines are not yielding enough due to pests like termites, and others that eat up the plant.
2) Inadequate harvesting system that can encourage the harvesting process of the crop.
3) The crop has a low storage due there are several storage system that can help in the storage of the crop but the lack of understanding and wide training on the storage system that can help the storage.
4) Transportation problem due to bad roads, fuel scarcity and other road challenges, is another major problem facing sweetpotato planting.
5) Marketing of the crop is another problem facing farmers. Adequate marketing of this product is very low due to the low awareness of the benefits of this product.
6) The farmers are not encouraged to produce more of this product due to the stated challenges which eventually head to low production of sweetpotato.

Solutions. In order to improve sweetpotato culture in the zone, and in Nigeria, the following are suggested:

1) Government should supply enough vines for the farmers to plant through the farmer's association at all local levels.
2) Government should provide better machineries for the harvesting.
3) Seminars, lecturing for rural area farmers that will enlighten farmers on several storage systems.
4) Better road maintenance and provision of good transportation system.
5) Government should make available adverts and programmes that will enlighten the populace on t importance and nourishment of this product.

In conclusion, government should see to the fina encouragement of the farmers, because there are who are ready to work but are not encouraged to. capital problems like money, farmland etc.

Oyo Zone

The challenges to the sweetpotato system in the z possible solutions are:

1. Ways of getting sweetpotato vine cuttings is a ma problem. How do we get the vines to plant?
2. Inadequate funding from Federal, State and Local governments constitutes a major problem to the p sweetpotato in Nigeria.
3. Poor availability of tractors for the cultivation of l expanses of land. Many tractor operators plough t and their charges are so exorbitant that most farm afford to pay.
4. Necessary material should be supplied to boost sw production e.g. through farmers association.
5. Bush animals disturb the production and how to e to go to the peasant farmer.
6. Damages by cattle rearers, damage large scale far the peasant farmer should not be left out in any de
7. Large scale farming, where to sell the product is a problem. The state, local should provide open are product.
8. Finally, there should be enlightenment on the radi teievision, newspaper, to enlighten all Nigerians a good aspect of potato-product, instead of caring th everywhere.

Ibadan/ Ibarapa Zone

Sweetpotato is widely cultivated in the Ibadan/Iba Area, however, the following problems are identif

i. Insufficiency of planting materials, especially, impro varieties.

ii. Infestation by pest e.g. grass cutter, termites, crickets, white fly etc.
iii. Lack of funds for land preparation and non-availability of inputs e.g. fertilizers, tractors, agro chemicals etc.

iv. Tubers become inedible if harvesting is delayed i.e. they become fibrous.

v. Inadequate marketing and processing and value addition

vi. Non-formation of co-operative groups

vii. Inadequate research of effective research programmes

viii. Non recognition of Farmers' Associations.

In view of the foregoing, the following solutions and recommendations are being suggested or proffered:
i. Considering the Government's stand on food security there is an urgent need to make the improved varieties available to farmers at highly reduced cost for multiplication and subsequent cultivation.

ii. Provision of pesticides to farmers at low cost. The pesticides should, however, be non-toxic to human and livestock populations. The distribution linkage should be direct to farmers.

iii. Establishment of one-stop inputs store that will be administered by the Farmers Association.

iv. Acquisition of tractorized implements to facilitate mass production and remove drudgery from farm work.

v. Development of a marketing strategy that ensures direct purchase of produce off farmers by the marketing division of the Farmers Association. It is also recommended that potato be preserved and processed to improve shelf life.

vi. Enhancement of profitability through a well-developed feasibility that highlights costs and benefits of potato cultivation to farmers.

vii. Creation of channels through which results of research will be disseminated to the end-users (farmers).
viii. Farmers Association should be given more recognition and farmers made the focus of all agricultural research programmes.

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Ibadan Central Zone

1. Whether sweetpotato can be mass propagated on flat land. Feed grass cutters with sweetpotato tubers processed into pellets and ground into feed. As a researcher a biotech and industrial uses including bio-fuel – Adejare Gabriel.

2. Not much has been done on sweetpotato, challenges on the storage, processing and utilization of potato roots as well as the products – Ndem O.A. (National Food Reserve Agency)

3. Dr. Oyin Olukunle (Wildlife and Fishery Management Department, U.I.) soaked sweetpotato in order to reduce sugar content before feeding it to fishes his ever do not analysis sugar content. 25 % addition has adverse effect so less on the blood of the fisher so less than 25 % of sweetpotato flour addition.

4. Dr. Odebode – less than 2 % mortality rate of fishes fed with sweetpotato flour with normal feed as control.

5. Dr. Taiwo – detect pathological changes in the blood, enzymes of animals fed with sweetpotato.

6. Use of tissue culture to eliminate diseases associated with sweetpotato in fields, and produces a pure culture.

7. Animal nutritionist — sweetpotato does not cause diabetes. The sugar in its tuber is different from normal sugar taken which function straight away in the blood stream as glucose (100 %) sugar in sweetpotato has to undergo digestion which will be reduced to about 30 %. There is worry about the analysis of blood samples conducted by Dr. Taiwo.

Constituting sweetpotato in feed controls sweetpotato tuber sweetness.

Dr. Odebode said sugar in sweetpotato reduces as it undergoes different processes citing example of cake baked and that there is non-sweet variety of sweetpotato

8. NACGRAB talked about neglect of sweetpotato cultivation by farmers with preference to yam and cassava. Also, the problem of marketing, as well as, scarcity of vines for planting during planting season and as such NACGRAB has so much concern about germplasm production which one may get on request.

Solutions.
A) Marketing. Sensitize Nigerians inform of public awareness, mass media (TV), banner, radio) ADPS fully involved, farmers must be ready and willing about the marketing of sweetpotato farmers grouped together for setting of

B) Vines to be readily available. NACGRAB is working seriously on vines preservation using tissue culture. NACGRAB said funding is important for vine multiplication more networking and collaboration is needed in this case, in order to help farmers. PCU carry information to ADPS and link up with NACGRAB to make sure.

C) National germplasm collection should be well informed of the new varieties of Sp available.

D) Scientists can also bring germplasm to NACGRAB preserve.

E) Research should not end up in the lab but must be disseminated to the farmers through the right channels.

F) Contact experts when there is a problem encountered during research (forming Sweetpotato Promotion Group of Nigeria).

G) Problems for storage and processing. The three main aspects of sweetpotato that are a problem are: (i) perish-ability; (ii) discolouration of the products e.g. sparri; and (iii) problem of drying.

Solutions:

- Rapid drying to reduce moisture content and as such reduce contamination.
- Dr. Stella noted that there is browning discolouration during oven drying of sweetpotato.
- Harvesting without bruising.
- Use in Potato dextrose agar for cultivation of micro-organism

Sweetpotato Planting Conservation Experiences

1. Mr. G.A. Adejare who recently retired from Nigerian Agricultural Quarantine Service (NAQS), uses sweetpotato to feed grass cutters and rabbits. He stated that he prefers taking fried sweetpotato, and does not know whether it can be cultivated on flat-land. Also, he uses it as a cover crop in palm oil plantation. Only few growing sweetpotato except the Agatus, control weed in oil palm, saves feed, and reduces cost. A biotechnologist. Low awareness IITA how material which may be available to researchers. It can also be gotten from Prof. Akoroda.

2. O.A. Ndem — NISPRI has the national mandate for processing and storage of the crop. Sweetpotato conservation has not been given preference. There is need to know how to process and store, as we to utilize sweetpotato.

3. Dr. Oyin Olukunle — When fish feed was con from sweetpotato, there was less mortality at Fish have been found to be inactive to hig Tubers were soaked in water to reduce sugar Need for varieties that contain less sugar 25 % level to add sweetpotato that will not be det to the growth of fish. There is low mortality sweetpotato with fish.

4. V.O. Taiwo — Pathologist (subtle changes in e Animals are also susceptible to diabetes. Ve Odebunmi comments that taboos are a miscor borne out of illiteracy. Sugar from sweetpo different from the sugar we take because straight into the blood. The sugar in swee passes through metabolism. Total sugar avail the sugar we take is 100 % rice bran substitut potato is not good, rather maize for sweetpotato.

5. Mr. Dabisi Alamu (NACGRAB): Pres sweetpotato germplasm and marketing is a p for farmers. They do not respond to cult sweetpotato due to difficulties in getting vines some seasons. Information on getting planting m is also a problem. The possible solution to marl according to Odebunmi, is to sensitize Nigeri themes on awareness in television, radio, exte officers, farmers to avail themselves the opportu germplasm without virus can be avai Sweetpotato multiplication for vines (is prese NACGRAB). The non-availability of less sweetpotato germplasm. Scientists are urge disseminate information discrimination networking on sweetpotato (Potato expert or task of Nigeria). Dr. Odebode informed that non-s varieties are available in the germplasm held a Department of Agronomy, University of Ibadan.

6. Odebunmi mentioned the problem of high pe ability, discolouration for storage and proces What could be done to combat the problem? Dr. Taiwo suggested immediate drying after harvest dehydration when not due for eating since mi organisms thrive in moist environment.

7. Odebode — drying affects weight and coloration les Sugar variety may reduce discolouration cabinet drying preferable because vitamin A escapes during sun-drying at 60–70^{0}C.

8. O.A. Ndem — Is it possible to harvest sweetpotato roots without bruising the peel? Cheap production of sweetpotato agar medium for growing micro-organisms such as mushroom is possible (Dr. Oyin Olukunle).

The resultant level of sugar affects processing

Top 12 sweetpotato clones selected at the University of Ibadan are to be duplicated at NACGRAB in collaboration with NAQS, NACCRAB, and PCU in order to make their on-farm trial and eventual cultivation easier.

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Lagos/Ogun Zone

By: Chief A.A. Oshoniyi RTEP Ijebu-Ife - Chairman, Mr. M. O. Aiyembo RTEP Ijebu-Ife, Mr. A. A. Fetuga UNAAB, and Mrs G. O. Fetuga UNAAB - Secretary

Sweetpotato is an emerging crop for household food security and industrial uses in Lagos and Ogun Zones.

Challenges

1. Production

a. Non-availability of improved varieties
b. Lack of multiplication centres
c. Creating awareness among farmers
d. Non-availability of inputs (fertilizers, pesticides, etc.)

2. Utilization

a. Creating awareness for domestic and industrial uses (Recipes and stable products such as chips, flour, starch)
b. Linking processors to farmers

3. Training on production and utilization options
4. Inadequate funding
5. Lack of government policy support

Solutions: RTEP and UNAAB could be made centres for the following activities:

i. Identification, collection and multiplication of all available varieties (white, cream and orange-fleshed) RTEP presently has only 3 varieties (TIS 87/0087, TIS 2532 OP. 1.13 and TIS 8164)
ii. Creating awareness and extension of improved cultivation technologies among farmers.
iii. Government (State and Federal) should make available necessary inputs for farmers.
iv. Each centre i.e. RTEP and UNAAB to carry out sensitization campaigns through their extension arms/departments ADP and AMRFC respectively on the utilization (domestic and processing into stable forms su as chips, flour and starch) within their catchment areas.
v. Funding of research at the department of food science a technology of UNAAB to characterize the varieties a match them with specific end uses.
vi. The two centres to organise training for farmers, process and other users.
vii. Quality Control Unit of RTEP should also be invited fr time to time to check sweetpotato fields for management pests and diseases.

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Abia/Cross River Zone

Problems

1. Most farmers have shifted their attention from produc sweetpotato to cassava and other crops.
2. Farmers are ignorant of the benefits of the crops. There also misconceptions and misgivings about the c especially its sweetness.
3. Unavailability of improved planting materials.
4. The wetlands around the Obubra area of Cross River S do not support the crop.
5. Poor extension infrastructure does not facilitate the adopt of research by farmers.
6. Pest problems
7. Storage problems and post-harvest losses
8. There is no market for the crop.

Solutions

1. Farmers need awareness and a rekindling of interest.

2. There is need for research to develop varieties adapte the different locations in the region.

3. To achieve [2] above, there is need to identify response available varieties to management practices.

4. Weed problems can be solved culturally and by chem means (cultural weed control). Manual weeding shoulc done in the first six weeks as needed and required in the week, by then weeding will no longer be required. Chem weed control with Primextra gold applied as pre-emerge herbicide at the rate of 1.5 kg a.i./ha and Fusilade fort the rate of 2.0 kg a.i./ha as post-emergence herbicide.

5. Depending on the weather conditions of the area i important that farmers plant at the correct time. Some need to plant early and some later in the season.

6. There is need to create market for the crops. This ca done through improved processing, packaging and b awareness on the value of the crop.

7. Post-harvest and storage techniques to reduce losses need to be communicated to the farmers through appropriate agricultural extension channels.

Nassarawa/FCT Abuja/Plateau/Bauchi Zone

The areas in which major challenges to sweetpotato culture are faced in this zone are:

Production

1. Mostly small-scale producers

Solution: Encourage farmers to increase production.

2. Lack of information on varieties available in the zone.

Solution: Relevant agencies (NRCRI, Umudike) should make an inventory of varieties grown in the zone

3. Lack of planting materials of improved varieties, especially orange-fleshed varieties.

Solution: Make more improved varieties available to farmers.

4. Only one crop is produced during the rainy season.

Solution: Encourage all-year-round production by providing adequate irrigation facilities.

Research

1. In adequate in formation on sweetpotato research and development.

Solutions: (a) Intensify research on varieties adapted to the zone; (b) Disseminate findings through extension institutions (ADPs, NGOs) and scientific publications; (c) Conduct on-farm trials and demonstrations; and (d) Formation of Sweetpotato Promotion Group in State.

Marketing and Economics

1. Lack of proper marketing channels.
2. Low prices because tuberous roots do not store well, there is limited knowledge of value-added products, and sweetpotato is considered an inferior crop.

Solutions: (a) Need for adequate market information;
(b) Educate the populace on nutritional value of the crop (especially its high Vitamin A content); and
(c) Create awareness on the value-added products.

Development of Government Policies

1. Low emphasis on the crop by government.

Solutions: (a) Promote initiatives, programmes and projects on the crop; (b) Government should encourage the use of sweetpotato as a source of Vitamin A; (c) Encourage public/private partnerships in the promotion of the crop; and (d) Government should increase budgetary allocation for agriculture.

Extension Outreaches

1. Inadequate extension services.
2. Low number of agents.
3. Extension bulletins not available and inadequate.
4. Lack of mobility.

Sweetpotato Status in States of Nigeria

Nassarawa State

J. Jonathan
Nassarawa ADP, Lafia, Nassarawa State, Nigeria.

Introduction

Nassarawa State has a great potential for sweetpotato production. The crop been one of the major crops grown in the state ranked sixth in order of priority. Yield varies with farming system, variety, and management practices.

Varieties grown. The major sweetpotato varieties grown in the state are: TIS 87/0087, TIS 2489, Dam china and Jan Dankali. These varieties are all grown across the state. The highest production of 47 % comes from the southern zone, 33 % from the western zone and 20 % from the central zone.

Farming system. Farmers in the state plant sweetpotato on ridges and heaps. Some plant it sole while others intercrop mainly with maize, and sometimes with yam.

Root yields. Although the yield of the crop is still considered low by farmers, the production figures had been progressive for the past three years in the state. The annual production figures of the state from 2005 to 2007 are: 119,093 tonnes (2005); 120,123 tonnes (2006) and 190,830 tonnes (2007). The state average yield was 6.62 t/ha in 2007, compared to less than 5.0 t/ha been experienced in many production areas in the country.

Marketing. In realization of the potential of this crop in the state, the State Government in partnership with the Federal Government established an Export Reconditioning Centre in Keffi for yam and sweetpotato export. Already, the State Government has entered an agreement with First Produce—a procuring agency in the UK for export of both crops. This arrangement has increased farmers' interest in producing both sweetpotato and yam in the state.

Problems

The problems being faced presently are:

- Low yielding varieties of the crop
- Poor storability
- Pest and diseases (especially root)
- Lack of access to processing technologies
- Low prices in the market

Conclusion

Nassarawa State is already positioned to fully exploit sweetpotato potential. We request the researchers and all stakeholders in this crop to assist us to achieve our desires.

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Federal Capital Territory, Abuja

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Abstract. The paper focuses on the production, marketing and economics of sweetpotato in Federal Capital Territory The production level is low as farm sizes are small marketing is through retail outlets with prices varying across locations in the city. High prices in the centre of the city with low prices outside the city record remarkable differences between on- and off-harvesting season observed. Problems of low demand, abundant supply, and poor preservation lead to low prices, thereby making the crop attractive for low-income buyers.

Introduction

Sweetpotato (*Ipomoea batatas* [L.] Lam), a perennial roo crop, is grown as an annual crop in Federal Capita Territory of Nigeria. The crop, which is commonl propagated by the use of vines and roots, is usuall intercropped with major food crops such as yam, cassav maize, etc. Anyaegbunam *et al.* (2006). The chief aim i using the crop to check weed growth and as supplementary crop in the farm. The scale of production small and mostly pocket-scale due to low economic valu in terms of price mostly during the harvesting period alon with other tuber and root crops.

Economic importance. The tubers are eaten boiled, frie and as sweeteners in the preparation of "Kunu" ar "burukutu" two locally brewed drinks. The leaves are use in feeding livestock like rabbit mostly.

Varieties. The commonly cultivated varieties a identified by their skin colour: yellow, pink, white, ar orange varieties. Thus, there is little awareness on oth characteristics for differentiating varieties besides skin ar flesh colour.

Cultivation. Sweetpotato is planted on mounds, ridges well as tilled and untilled soil using cuttings of vin (Onwueme 1978). The planting time is mostly June wh rain sets in for the annual planting season. Apparent farmers do not apply fertilizer to this crop except what

applied for the major crop; which gives a resultant fertility effect on the crop. This shows the low emphasis farmers give in the cultural practices. However, the late planting period of October is scarcely done by only few farmers and it is a further utilization of the already planted plot for the year.

Marketing. The supply of sweetpotato tuberous roots is high during the harvesting season. It competes with other tuber crops (yam) and this lowers its price. The late planting yield is low but price is high as the low supply of yam the competing crop with high price will necessitate people to divert and patronize sweetpotato during the off-season for yam harvest.

Generally, price per heap varies based on the location within the city and suburb depending on the cosmopolitan level of the location. Table 1 shows comparative seasonal price differences by location within the Federal Capital Territory. A commercial food vendor makes more money as the fried form attracts high consumers and patronage from the urban poor and lower income earners.

Economics. The demand and supply of sweetpotato roots fluctuates based on the harvesting season and this changes the price even more. The storage problem makes the price to be flexible mostly during the off-season. The profit for the sweetpotato production is low and most farmers do not keep records of their farming activities. The lower pricing gives low profit along with generally low awareness of the potentials of the crop. Thus, the low interest classifies the crop as a crop for low-income consumers particularly by the urban poor.

Problems and Solutions

The outstanding challenges in the production of this crop are lack of knowledge in the potential and low patronage for consumption, which reduces supply; thus causing low profits. More so, the storage problem is peculiar. This is so because of consumers' lack of awareness on the multiple uses when processed.

Creating awareness, extension of the research findings and government emphasizing efforts on the potentials of this crop will attract farmers' interests. This would draw the attention of consumers to the benefits associated to the health issue of vitamin A to solving deficiency levels among children and adults.

Table 1: Observed prices (₦/average heap) for swee the Federal Capital Territory, Abuja, Nigeria

Location (Area Council)	Harvesting seas	
	On-season	Off-se
1a. AMAC (Wuse, Gariki, Maitama)	180–200	250–3
b. (Jabi, Utako, Nnyanya)	120–180	200–2
2. Bwari (Kubwa and Dutse)	100–150	150–2
3. Gwagwalada	100–120	120–1
4. Kuje	80–100	100–1
5. Kwali	60–80	100–1
6. Abagi	50–70	80–12

Source: Field Observation. AMAC: Abuja Municipal Area Co

Conclusion

In as much as the crop holds high potentials, the inc population of the urban dwellers in the city give opportunity for expansion of farm size so as to i outputs. This should increase farmers' incor improved livelihoods.

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Kwara State

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Introduction

Sweetpotato (*Ipomoea batatas* [L.] Lam) origina Tropical America and thus belongs to the group of tr crops. It is properly grown in the tropics and i adapted to the warm temperate countries. The production of the crop is put at about 111 million t About 90 % of the world production of sweetpot grown in Asia, particularly in the eastern part c continent (FAO 1985).

In developing countries, sweetpotato is mainly us food supplement. In Kwara State, sweetpotato is g throughout the State, but mostly utilized among the It Sweetpotato in Kwara State is associated with two I (Offa and Oyun) because the crop is widely utiliz these LGAs. Other parts of the State, however, use food supplements. The yield of sweetpotato could b high as 30–40 t/ha, but in Kwara State, the yield of 6 is still common.

Agronomic Practices

In Nigeria in general, and Kwara State in particular, sweetpotato is grown in very diverse environmental and agroecological zones. It is grown in the whole of Kwara State. For high productivity, the crop requires soil of light texture, good drainage and sufficient moisture during the vegetative growth period. A common plant spacing of 100 cm x 25 cm giving about 40,000 plants is good, but present farmers' spacing in the State is 120 cm x 60 cm, which needs further improvement.

In growing sweetpotato, most farmers in Kwara State usually do not apply any fertilizer, or just put a small amount of urea. This may be one of the reasons why yields obtained by farmers are still lower than the potential yield. Fertilizer application of about 45 kg/ha Nitrogen and 60 kg/ha Potassium was found adequate for increasing sweetpotato tuber yield. This is to say that 200 kg/ha of NPK 15:15:15 is required for good root yield of sweetpotato in Kwara State.

In the growing period, availability of improved vines is necessary to increase yields, as the use of the local variety by farmers reduces the yield. The optimum harvesting time is between 120–130 days in Kwara State. Innovative training approaches are used in teaching farmers new crop production techniques. Also used is the MTP and demonstrations. These demonstrations and management training pots are not adequate to train all the farmers due to fund limitation. In Kwara State, sweetpotato is grown as monoculture or intercropped with other crops. According to Djatiwaluyo (2000) intercropping of sweetpotato is dependent on varieties. However, in Kwara State, especially in Offa and its environment, sweetpotato is mostly intercropped with maize, guinea corn, etc. This, however, leads to a lower yield of the crop. It can be interesting to note that major agronomic pest is of less importance to sweetpotato in Kwara State. This is not to say that it does not occur, but it has less negative consequence on the crop when found in the field as compared to other root crops. Among the agronomic problems faced in Kwara State is the inability to plant the improved variety that is high yielding.

Processing

Sweetpotato is normally processed into many products and all used as food for consumption, especially in Offa and its environment. It is normally processed into four for making "amola" or mixed with cassava four. At times, it is boiled and eaten as refreshment like yam. It is often added with yam to make pounded yam and many other local food varieties. It should be noted that the Extension Department of the ADP has been able to process sweetpotato i confectioneries such as adding it to wheat (10–20 inclusion) to make bread, biscuits, even in the baking chin-chin. It is sometimes processed into chips, etc. Th have gone a long way through extension method to people in the State not only in Offa and its environs.

From the above, the areas of interventions include:

1. Getting improved vines of sweetpotato varieties ensuring its availability at the right time of planting.
2. Market information as to the sale.
3. Utilization and processing of sweetpotato.
4. Intervention in the area of demonstration, manage training plots, farmers' meetings, etc. to improve produ and productivity.
5. Enhancing extension network in such a way to popu sweetpotato production through publicity.

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Enugu State

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Introduction

Sweetpotato (*Ipomoea batatas*) is a tropical crop gro over Enugu State. The crop is adapted to well draine loam and has a short maturity period of 3–4 month an average yield of 5.8–7.0 t/ha. In Enugu sweetpotato is widely grown in the following locatio

1. Awgu LGA (Ogbaku, etc)
2. Enugu East LGA (Ugwuogo, Nike, etc)
3. Isi Uzo LGA (Eha Amufu, etc)
4. Aninri LGA (Nenwe, etc)
5. Uzo-Uwani LGA (Umuluokpa, etc)
6. Nsukka LGA
7. Igbo-Etiti LGA

Varieties. The production of sweetpotato is still o holder level. An average farm size measures 0.3–1. farmer. Many varieties are grown by farmers. these varieties, the most preferred include white- red-skinned and yellow-skinned varieties. Few improved varieties are in use.

Production and uses. Sweetpotato production in is carried out manually using local hoes. This p slow and a lot of tubers are lost before harv

production data (area and productivity) of sweetpotato from 2002 to 2007 in Enugu State is as shown in Table 1. The bulk of the crop is consumed either boiled or fried while the production of confectionaries like bread and biscuit from sweetpotato flour has started. The leaves of some varieties are fed to livestock by farmers in the State. However in Uzo-Uwani LGA, sweetpotato is pounded and eaten as fufu. The annual average prices of sweetpotato in the State are ₦31.38/kg, ₦40.07/kg, ₦44.13/kg, ₦65.81/kg, ₦68.81/kg, and ₦62.83/kg for 2002, 2003, 2004, 2005, 2006 and 2007 respectively.

Production Limitations

Sweetpotato production in the State is faced with a lot of constraints. These include:

1. Inadequate supply of improved planting materials (vines) at the onset of planting season. The vines usually dry up after harvest and regeneration of new vines awaits the next rains which come in April or May the following year.
2. Poor storability of the sweetpotato tubers after harvest.
3. The traditional concept in Enugu State that sweetpotato production is meant for lazy farmers who cannot embark on yam production.
4. The crop is also prone to several pests and diseases. These create a lot of problem in the field and also in the storage chambers.

Future of the Crop in the State

The consumption of sweetpotato and its products is gaining a wider ground among the people. There is, therefore, need to increase production to meet with the increasing demand for the crop. Efforts should be made towards finding solutions to the numerous problems militating against the production of the crop in the State.

Table 1: Area and production of sweetpotato in Enugu State from 2002–2007

Year	Area (ha)	Production (tonnes)
2002	5,480	41,210
2003	5,640	42,640
2004	7,860	43,920
2005	8,060	46,990
2006	8,620	50,350
2007	9,130	53,370

Kogi State

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Introduction

Sweetpotato, an inexpensive source of energy, is succulent tuberous root of *Ipomoea batatas*. It cor high energy, vitamins, proteins and minerals. The cr produced at subsistence level by peasant farmers as a crop, and sometimes in mixtures with maize, sorghum okra. Its production is highly limited by difficult preserving planting material.

Sweetpotato production in Kogi State

Kogi State produces 44,020 tonnes of sweetpotato 5,270 ha. Land is prepared with hoes into ridges 1.0–1 apart and in-row spacing of 30cm. Vines of 3–5 node planted. Most farmers plant in July/August, and harve December/January.

Area of production. Although sweetpotato is produce over the state, the following LGAs are noted fo production; Kogi/Koton Karfi, Lokoja, Okehi, Ac Ajaokuta, Olamaboro, Ankpa and Idah .

Sweetpotato improvement programme in Kogi St Sweetpotato began to receive required attention f government with the start of the Root and Tu Expansion Programme in 2001. Pre-RTEP activ included the diagnostic survey of sweetpotato and follow-up activities of adaptive research and extension.

Local varieties. Available local varieties are known various names, with one type having several names fi one location to another. Root yields range from 2 to 3 due to poor agronomic practices, and their poor gen potentials. In view of the dietary importance of this c there is need to improve its production through vari selection and improved agronomic practices.

Adaptive research on sweetpotato

In a 2003 experiment to evaluate the performance sweetpotato varieties for yield and adoption, f improved varieties (TIS 87/0087, Ex-Igbariam, TIS 2 OP 1.13, TIS 8164) were tested against farmer's varie across the State. Vines of each variety measuring about cm were planted on 4m x 5m plots. Significant differen in the yield of different varieties were observed, with 87/0087 giving the highest mean yield of 9.05 t/ha profit of ₦133,250/ha, respectively. This was followed Ex-Igbariam with a yield of 9.00 t/ha and profit

₦132,250/ha. Farmers variety gave the lowest mean yield of 2.66 t/ha and profit of ₦5,450 across locations.

Table 1a. Sweetpotato tuber yield in Kogi State t/ha)

Treatment	Locations				Total Yield (t/ha)	Mean yield (t/ ha)
	1	2	3	4		
TIS 87/0087	10.10	7.75	8.75	9.60	36.20	9.05a
Ex-Igbariam	8.50	9.60	8.80	9.10	36.00	9.00a
TIS 2532 OP 1.13	8.40	8.20	7.80	8.60	33.00	8.25a
TIS 8164	5.80	4.60	4.20	5.20	19.80	4.95b
Local (Dukwaba)	2.40	2.75	3.00	2.50	10.65	2.66c
$LSD_{0.05}$						
CV (%)	9					

Means followed by the same letter along columns are not significantly different at 5% level of significance.

Table 1b. Economic analysis of mean tuber yield (t/ha) in sweetpotato varietal trials

Treatment	Production Cost (₦/ha)	Mean yield (t/ha)	Gross value of output (₦ / ha)	Profit (₦)
TIS 87/0087	47,750	9.05	181,000	133,250
Ex Igbariam	47,750	9.00	180,000	132,250
TIS 2532 OP 1.13	47,750	8.25	165,000	117,250
TIS 8164	47,750	4.95	99,000	51,250
Local (Dukwaba)	47,750	2.66	53,200	5,450

1kg of sweetpotato tubers = ₦20 in Lokoja market as of 19 March 2003

Extension activities involving sweetpotato. The On-Farm-Adaptive Research (OFAR) to evaluate different varieties of sweetpotato was conducted for 3 years with TIS 87/0087 as the most preferred variety. This variety was passed to extension for adoption. Between 2003 and 2006, about 2.0 ha of TIS 87/0087 was planted by out-growers, from where about 545 farmers collected vines for planting. In 2008, four out-growers have planted 2.0 ha sweetpotato. These farms will provide plantings materials to other farmers in 2009.

Utilization of sweetpotato. In Kogi State, sweetpotato is used as food — boiled or fried and eaten with stew. The fresh tuber is used as sweetener in the preparation of local corn drink. It can be processed into chips by dehydration of fresh and pre-cooked sweetpotato tubers and sun-dry. Both white and coloured varieties are suitable for sun drying. The roots are cut in 2–3 mm slices, and submerged into boiling water for minutes and sun dried to moisture level of about 60 %. These slices can be ground into flour.

Constraints to sweetpotato production

The major constraints to sweetpotato production in Kogi State include:

1. Inability of farmers to preserve vines during the fairly long dry season, leading to scarcity of planting materials of both improved and local varieties.
2. High level of weevil attack on tubers while in store
3. Black root which causes blackening of the tuber and underground stems.

Ogun State

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Introduction

Sweetpotato (*Ipomoea batatas*), of the Family Convolvulaceae, is considered as one of the important staples in some countries in Africa. (Rwanda, Burundi, Uganda and parts of Democratic Republic of Congo). In West Africa, it is important in Liberia, and Sierra-Leone and parts of a number of countries. In Nigeria, it is important in the derived savannah of Oyo, Kwara, Kogi, Osun and Ogun States.

It has a role to play in sub-Saharan Africa where there is increasing human population and low levels of increase in food production. Its attributes include high yield in short period of time, requires low input , low level of resources, resistant/tolerant to drought and grows under a wide range of environmental conditions (altitude from 0–2300 m.a.s.l.) and between 30°N and 30°S of the equator to which Ogun State, South West of Nigeria belongs to the region.

Status of sweetpotato production in Ogun State

The crop is one of the four crops targeted for promotion in Ogun state by Root and Tuber Expansion Project (RTEP). RTEP's overall objective is to increase small holders' production/preservation through processing and marketing of cassava, yam, potato and cocoyam. The project covers 26 States inclusive of Federal Capital Territory (FCT). The program is expected to embrace 5.2 million farming households in the roots and tubers growing belt with the bulk of them being either very poor (20 %) or poor (65 %) households.

Root yields. Currently the efforts of Ogun State in promoting the crop are captured in Table 1. The output in

tonnes has been on the increase between 1996 and 2007. The output was between 5,927 tonnes and 13,583 tonnes in the respective periods, under review. Also within the same period the area cropped increased from 1,240–2,338 ha.

Table 1: Estimated hectarage, output and yield data of sweetpotato in Ogun State from 1996–2007

Year	Area (ha)	Output (tonnes)	Yield (t/ha)
1996	1,240	5,927	4.78
1997	1,341	6,409	4.78
1998	1,233	5,930	4.81
1999	1,478	7,242	4.90
2000	1,674	8,537	5.10
2001	1,701	9,125	5.24
2002	1,741	9,125	5.24
2003	1,604	8,341	5.19
2004	1,682	8,674	5.16
2005	1,783	9,460	5.31
2006	2,032	10,871	5.35
2007	2,338	13,583	5.81

Source: OGADEP 2007 Crop, Area and Yield Survey (CAYS) 1996–2006 Agricultural Production Survey (APS)

Constraints and suggested solutions

The yields in metric t/ha have been fairly constant, reason being that there have not been any known improved varieties available for farmers' use in the State. Also, the cost of other inputs and services such as fertilizer, agro chemicals and land preparation has been high, almost beyond the reach of the ordinary resource poor farmers. This area needs to be looked into in order to boost the production in the state. Furthermore, National Agricultural Research Institutes should come up with diversification of utilization options which will stimulate increased production.

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Sweetpotato Productio

Situation Report on Sweetpotato Agronomy in National Root Crops Research Institute, Umudike

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Introduction

Sweetpotato (*Ipomoea batatas* (L.) Lam) is an imp plant in many parts of the world. It is cultivated ir than 100 countries (Woolfe 1992). Globally, sweet ranks third among root and tuber crops after potat million tonnes) and cassava (164 million tonnes), production of about 122 million tonnes (FAO 1996). accounts for the highest proportion of the w production, followed by Uganda and Nigeria in that (FAO 2004). In Nigeria, it is one of the four majo and tuber crops coming after cassava, yam and coc (APMEU 1996). These crops play important roles ir social and economic development of the country.

Sweetpotato is widely adapted to most regions of Ni with low input requirement, and shorter growing peri 6 months). High root yields can be obtained espe under fertile soil conditions than other root crops (Ko *al.* 1996). Sweetpotato produces more edible en protein and dry matter in a per hectare per day basis any other crop (Horton *et al.* 1986). It contains vita particularly vitamin A, and minerals comparable to va fruits (Truong 1989). The storage roots and shoot consumed directly (as fresh or processed food) indirectly (as animal feed). The potentials of this crop major source of raw material for industrial purp (Kozai *et al.* 1996; Woolfe 1992) have increase importance. FAO (1989, 1991 and 2004) indicated tha production increased from 260,000 to 2.2 million tonn Nigeria under a period of 15 years. However, yields still low in farmer's fields (8 t/ha). Yields of more tha t/ha have been recorded in various parts of the cou (Njoku 2000). The yield potential of sweetpotato ma further increased by introducing new technologies production methods.

The establishment of National Root Crops Rese Institute, Umudike and subsequent establishment of sweetpotato programme was to ensure research focu developing improved sweetpotato varieties with desir characteristics such as high root yield, resistance to p

ıd diseases, acceptable culinary and industrial qualities, s well as the development and improvement of agronomic ackages for sustained and enhanced productivity and ɔroduction of sweetpotato. These intervention measures ıave helped to address production constraints of sweetpotato in Nigeria and the South-Eastern zone in particular. The constraints include high degeneration rate of planting materials, lack of quality planting materials, inadequate planting material, poor maintenance of resource base (soil) with the attendant low soil native nutrient, susceptibility to pests and diseases, and narrow genetic base (diversity) of the crop, among others. These production constraints are being tackled under different disciplines in the programme.

Experiences with sweetpotato production

A number of agronomic studies have been carried out, and the highlights of results are as follows:

a) A study carried out in an ultisol with marginal organic matter and nitrogen and moderate potassium at Umudike research farm using popular sweetpotato variety TIS 87/0087 showed that for optimum marketable tuber yields, nitrogen applied at 40 kg N/ha combined with potassium at 150 kg K/ha would be recommended (Njoku *et al*. 2001).

b) The effect of nitrogen and potassium on dry matter accumulation of sweetpotato was examined and results indicated that the highest dry matter yield was obtained with a fertilizer combination of 80 kg N/ha and 100 kg K/ha on the average (Njoku *et al*. 2004).

c) The use of leguminous crop cover to stabilize and improve impoverished soil at Umudike resulted in yield increases in sweetpotato from *Mucuna pruriens* maintained for two years over natural grass cover, but compared favourably with inorganic fertilizer (Njoku *et al*. 2003).

d) A 3-year fallow trial with herbaceous cover legumes indicated that the soil was improved and that *Mucuna veracruz*, *Centrosema pascurum*, *Centrosema brasilianum* or natural cover infested with the leguminous weed *Mimosa invisa* was as efficient as NPK fertilizer application for sweetpotato production in Nigeria (Ikeorgu *et al*. 2008).

e) The responses of two sweetpotato varieties (TIS 87/0087 and TIS 8164) on four green manure sources and inorganic fertilizer presented an interesting result. *Mucuna pruriens* produced more biomass and soil nitrogen compared to Centrosema, Pueraria and natural cover, which placed it at an advantage of increasing the root yield of sweetpotato varieties more than other legumes. Sweetpotato yield was also higher in two years more than one year which, compared with the yield obtained from application of inorganic fertilizer (Okpara *et al*. 2004).

f) The incorporation of two species (*Mucuna pruriens* and *Crotolaria* spp.) of leguminous crop cover and natural cover after the growth of three months as green manure and rates of compound fertilizer NPK (15: 15: 15) on sweetpotato production was examined. The results showed that the yield under inorganic fertilizer rate of 400 kg/ha irrespective of the source of green manure was superior to other treatments. This indicated that the legumes incorporated after three months of growth did not build enough biomass or soil nitrogen to support sweetpotato production. However, the leguminous species tended to suppress weeds in subsequent cropping (Njoku *et al*. 2006; NRCRI Annual Report).

g) The agronomic performance of introduced genotypes of orange- and white-fleshed sweetpotato across two agro-ecological zones for adaptation and generation of necessary data needed for their registration was conducted. There were marked location effects on the performance of the genotypes, where those that had higher yields in one location (Ebonyi) performed poorly at the second location (Benue). However, most of the genotypes had good acceptability (Njoku *et al*. 2006; NRCRI Annual Report).

h) Among the introduced CIP sweetpotato clones, 199024.1 and SPK 004 (both orange-fleshed), with high total carotenoid content and moderate yields are adaptable to rain forest and derived savannah belts of Nigeria. They are, therefore, recommended for adoption to increase the vitamin A level in the diet of an average farm family (Njoku *et al*. 2007; NRCRI Annual Report).

i) The need to solve the problem of inadequate planting material at the onset of the planting season by resorting to the use of smaller plant sizes and subsequent incorporation into existing farming systems was examined holistically. The results showed that sweetpotato planting materials can be reduced to 2-node vine cuttings planted at a narrow spacing of 20 cm to provide more plantable vine pieces, and also produces significantly more sellable roots and total storage root yield. To improve the establishment of smaller plant sizes, 2-node cuttings remarkably improved field establishment and yield when kept for not more than 4 days before planting.

j) There are yield advantages of intercropping sweetpotato plant sizes and soybeans. On the basis of land equivalent ratio (LER) and net returns, the highest yield advantages and economic returns were obtained with 3-node cuttings of sweetpotato (Njoku 2008).

Conclusion

The way forward would include the following steps:

a) There is need to improve on the ability of leguminous cover crops to persist in farms after establishment. This will make the practice more acceptable to the farmers instead of the more costly option of yearly re-establishment of the species.

b) There is need to set up a well-organized structure for multiplication of cuttings of improved sweetpotato varieties. The ADPs can be empowered to carry out this function in designated agroecological zones of the country, in liaison with the research institute.

c) Sweetpotato cuttings have low multiplication ratio (l: 30), which may slow down rapid expansion of sweetpotato production. The possibility of rapid multiplication of vines through the tissues culture mechanism should be explored.

d) The orange-fleshed sweetpotato is becoming popular among households, but has the problem of low root yield and vine production, susceptibility to weevil and rodent attacks, as well as endemic sweetpotato virus disease. There is the need

to go on with further breeding work backed with good cultural operations.

e) Sweetpotato weevil (*Cylas puncticollis*) attack on sweetpotato storage roots is still a big problem that has not been properly addressed. We should look beyond the conventional breeding procedures and apply the use of biotechnology. The use of transgenic materials has been successful in transferring resistance to pests and diseases in other crops.

f) An aggressive sweetpotato production campaign should be mounted to attract the attention of the government so that the crop can be included among those with presidential initiatives.

g) Market information should include local demand and utilization of storage roots. Also, for commercial sweetpotato production, prospective growers need to target a market, and understand monthly market trends even before commencing planting.

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Sweetpotato Production in South-Eas Nigeria

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Introduction

Sweetpotato has high nutritional value and is mostly for its edible storage roots. With the excep protein and niacin, sweetpotato provides over 90% nutrient per calorie required by most people (Wa Merill, 1975). It is a good source of calcium, vita and β-carotene. The yellow to orange-fleshed cu contain particularly high levels of carotenoids, ar equalled only by carrot as a source of pro-vitar (Woolfe, 1992). It is used as a staple food veg (fleshy roots, tender leaves and petioles), snack animal feed, as well as for industrial starch extractic fermentation, and for various processed pr (Bouwkamp, 1985).

Sweetpotato in the Cropping System

The increasing potential of sweetpotato in poverty alleviation and food security due to its high productivity per unit area and time makes it an important crop for poor farmers in Nigeria (NRCRI 2003). The common practice is to grow the crop in marginal soils, resulting in poor yields of 3 to 8 t/ha in farmers' fields (NRCRI 1988). However, under improved management conditions, storage root yields of 15–30 t/ha have been reported in south-eastern Nigeria (Okpara *et al.* 2008; Okpara *et al.* 2004; Njoku *et al.* 2001). Being a planophile, the crop is well suited as an under-storey crop in intercropping and in the control of weeds (Njoku *et al.* 2007). Studies conducted in south-eastern Nigeria, showed significant response of sweetpotato to 40–80 kg N/ha and 100–150 kg K_20/ha, depending on initial or background soil fertility (Njoku *et al.* 2001; Njoku *et al.* 2004; Okpara *et al.* 2008). There is no disadvantage in the use of suitable cover-crops in improving storage root yields compared to inorganic fertilizers in the region (Okpara *et al.* 2004).

Way Forward in Sweetpotato Research

Sweetpotato is heterozygous in nature and exhibits a wide variability of morphological traits and nutritional quality (Nwinyi 1991). This confers genetic diversity on the crop (Afuape *et al.* 2006). Sweetpotato cultivars differ from one another in the colour of the tuber skin, colour of tuber flesh, shape of tuber, shape of leaves, rooting depth, time of maturity, resistance to disease and other vegetative characteristics (Onwueme 1978). The recent introduction of white and orange-fleshed clones of sweetpotato require a study to match varieties with locations in Nigeria.

Efforts should be intensified to produce and disseminate improved quality planting materials as the fundamental basis for high yields of high quality produce. The response of varieties to management practices is required to identify high and low response cultivars. For example, studies carried out in the south-eastern agro-ecology have shown TIS 87/0087 and Ex Igbariam as high nitrogen-response varieties and TIS 8164 as a low nitrogen-response variety (Okpara *et al.* 2008). Storage root yield in the low nitrogen-response variety was not enhanced beyond 40 kg N/ha. Murata (1969) reported that high response varieties accumulated under heavy nitrogen supply, more carbohydrates than low response varieties. Tanaka *et al.* (1964) indicated that even low-response varieties can produce a high yield, if grown in an environment where nitrogen supply is restricted.

There is need to obtain information on growth analysis in relation to dry matter accumulation and partitioning especially to the storage root sink. Such data are necess for management intervention for optimization of tuber root yields. There is also need for greater extension eff both on the nutritional importance and utilization patte on the field production advisory package of sweetpotatc

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Sweetpotato as a Root Crop

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Introduction

Sweetpotato (*Ipomoea batatas* [L] Lam) is an important root crop grown in Nigeria, usually matured in about 90 days. The crop serves as a cover crop, which prevents soil run-off and also a source of carbohydrate that is used as supplementary diet to yam and cassava (Jassens 2001). The fresh tuber of sweetpotato and leaves can be fed to livestock (Onwueme *et al.* 1991). The crop could be regarded as poverty reduction crop as it requires little inputs to establish in a fragile soil. In Nigeria, many farmers today do not make conscious efforts to conserve the soil. This may not be unconnected with the thinking and attitude that farmland is exhaustible (Nnabube 1999). The crop can be planted in erosion prone area to protect the farmland at the same time provides income to farmers. It can also be planted in ridge, bed, and mound or even in zero or flat land and in rice field after rice has been harvested at a small cost. Sweetpotato production as a measure of soil conservation has been reported as one of the solution in farmland management for poverty reduction (Asawalam and Chukwu 2000). Evidence show that applying the concept of agro diversity to indigenous soil conservation farming practices is a way of spreading risk and supporting food security in resource poor farming systems (Tengberg *et al.* 1998).

Origin and distribution. Sweetpotato is a creeper of the Convolvulaceae Family. It is believed to be originated from either Central America or within the tropical region of the North Western parts of the Central America (Onwueme 1978; Hahn and Hozyo 1984). Sweetpotato was brought to Nigeria by Spanish and Portuguese explorers (Agbo and Ene 1994). The cultivation of the crop started in 3000Bc and is now grows throughout the tropics, subtropics and warm temperate zones of both hemispheres. It grows well in high altitudes up to 2300 meters above sea level and between 30^0 North and 30^0 South (Hahn and Hozyo 1984).

Agronomy of Sweetpotato

Sweetpotato is cultivated with vines. The slips or vines of 30cm in length are planted (Islam *et al.* 2002). Collins (1995) reported the use of 25cm vine cuttings and National Root Crops Research Institute Umudike developed 4-node cuttings (Agbo and Ene 1994). Two-node cutting technique has been researched on by the National Root Crops Research Institute Umudike (Mbanaso *et al.* 2005).

Fertilizer requirement. Fertilizer requirement depen the soil nutrient status. Fertilizer rates of 60kgN/h also a normal fertilizer range of 60kg N/ha to 120 was applied to sweetpotato crop in Research Ins Umudike which gave a high yield (Korieocha *et al.* 2C

Water requirement. Sweetpotato water requireme put at 4500mm/ha distributed at seven day inte (Collins 1995). The distribution of water ranges fron 20mm/week in early season and 40-45mm/week at season when roots are rapidly tuberized is essentia good yield.

Maturity. The crop matures 3 to 4 months after plan Maturity signs include yellowing of mature leaves, senescing and cracking of the soil surface.

Harvesting. Harvesting can be done mechanicall manually with digging fork and hoe.

Production status. Sweetpotato is a member of morning glory or bind weed family, the Convolvulac It is the only member of the genus Ipomoea whose r are edible and is undeniably one of the world's n important food crops due to its high nutritive value. It been moved up from the minor crop status it usec occupy to an enviable position. It rank fourth amongst most important root and tuber crop in Nigeria a cassava, yam and cocoyam in that order, and the si most cultivated crop in a few restricted areas by farn for their own consumption. Currently Nigeria is rank f as largest producer of sweetpotato in Africa with ann output of 3.46 million tonnes (FAO 2008). Globa Nigeria is second largest producer of sweetpotato, w China leading.

Tuberous root composition. Sweetpotato is a rich c that contains proteins of high nutritive value (Eka 199 It is high in carbohydrates and vitamin A and c produced more edible energy per hectare per day th wheat, rice or cassava. It has the highest carotene conte and the five leading root and tuber crops, such as cassa yam, cocoyam, sweetpotato and potato. Sweetpotato noted for its richness in minerals such as Ca, Mg, K, I Zn, and Na. Sugar syrup from sweetpotato starch hac dextrose equivalent of 28:30, and has the potential f producing sugar syrup of 32:34 digestible energy.

Utilization and economic importance. Sweetpotato roc can be boiled, roasted and eaten as good. The foliage al serves as feedstuff for animal. Fried chips and crisps a made from the roots. About 15–30% of sweetpotato flo can be blended with wheat flour for baking brea

Industrial starch can be produced from sweetpotato, as it contains high percentage of starch. Japan derived about 60% of its industrial starch from sweetpotato (Agbo and Ene 1994). Industrial starch is used in the paper and textile industries. Alcohol (ethanol) is produced from it through fermentation. It is used as a sweetener in Northern Nigeria in place of sugar. The roots are rich in vitamin such as ascorbic acid (Vitamin C) and total carotenoids make it a good raw material for pharmaceutical industries. Forms of food produced from sweetpotato include sweetpotato meat pie, flakes and drinks like "kunnu".

Production Constraints

Weeds. Weeds are a problem in sweetpotato production. Failure to remove weeds during the first six weeks of crop growth causes reduction in yield (Korieocha *et al.* 2006). Also, herbicides such as Primextra Gold 660SC at 1.5kg a.i./ha applied pre-emergence and Fusilade Forte (fluazipobutyl) at 2.0kg a.i./ha applied post-emergence effectively controlled weeds (Korieocha *et al.* 2007).

Production of planting materials. Availability of planting materials is a major constraint in expanding sweetpotato production as most vines are lost during the dry month of the year. Using vines slips and draws as planting materials may solve this problem. Also leaf buds can give up to 60% sprouting with regular watering.

Pests and diseases. The most important insect pest of sweetpotato is the sweetpotato weevil (*Cylas puncticollis*). It attacks mostly the tubers and the leaves. *Chrysometidae* and *Coccinellidae* are known to eat up leaf in this part of Nigeria. They attack the foliage and roots. Others are beetles, termites and sweetpotato weevil. The most damaging insect pest is *Lasiadiplodia theobramae* which transmits virus diseases, sweetpotato root rot, chlorosis, vein banding, stunted and mosaic or mottle diseases.

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Spatial distribution of sweetpotato cultivation in Nigeria

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Introduction

Sweetpotato is presently accepted as a minor root crop in Nigeria despite its high agronomic and utilization potentials. Sweetpotato surpasses any other root crop in terms of its agronomic potentials. It is, therefore, a promising crop for ensuring food security and also a promising industrial crop if backed up with the necessary national policy on food security in Nigeria. The cultivation of sweetpotato in Nigeria has transcended the hitherto traditional areas.

Pilot survey

A pilot survey was carried out using primary and secondary data sources. Questionnaires were administered by a one-to-one contact in Oyan, Osun State. Secondary data was obtained from the libraries of the University of Ibadan, Institute of Tropical Agriculture (IITA), Ibadan, Nigerian Institute for Social and Economic Research (NISER) Ibadan, National Root Crop Research Institute (NRCRI) Umudike, Ahmadu Bello University, Zaria, National Horticultural Research Institute, (NIHORT) Ibadan, Institute of Agricultural Research and Training, (IAR&T) Moor Plantation, Ibadan and eight River Basin Development Authorities in Nigeria.

The country was divided into five zones: Zone A is North-Western Zone comprising Sokoto and Kaduna States; Zone B is North-Eastern Zone comprising Bauchi and Borno States; Zone C is Central Zone comprising Niger, Kwara, Plateau and Benue States; Zone D is South-Western Zone comprising Osun, Lagos and Oyo States; and Zone E is South-Eastern Zone comprising Abia, Anambra, Cross River, Enugu, Imo, and Rivers States.

Results and Discussion

Sweetpotato production in the North-Western Zone. This zone consisted of Kano, Sokoto, Kebbi, Kaduna, and Jigawa States. These States lie between latitudes 09° to 14° N and longitudes 30` to 12° E. The total land area is approximately 200,000 sq km which is about 20 % of the country's total land area. The grassland ecology is distinguishable into the Southern and Northern Guinea savannah, the Sudan Savannah. Sweetpotato is cultivated particularly along the river basins, irrigation schemes, and lowland fadama areas of the zone. Sweetpotato is produced in Wuno, Talata Mafara, Shinkafi, Sabirin LGAs of Sokoto State. Talata Mafara is co the highest producer of sweetpotato in the State, well organized irrigation system. Sweetpotato i mostly in southern part of Kaduna State and the f LGAs (arranged in increasing order) were identifi major sweetpotato producing areas in Kadun Kaura, Zango Kataf, Jemaa, Igabi, Kauru an Statistics by the Kaduna State ADP showed tha 450,170 farming households in Kaduna State i 73.58 % owned an average cropping area of 0.8 sweetpotato indicating that sweetpotato crop Kaduna State is largely subsistent and t contributes to food security of the farming family.

Sweetpotato production in the North-Eastern This zone lies within latitude 6°–14° N and lc 10°–14° E. The total land area is approximately 25(about 25 % of the total land area of the count major sweetpotato producing LGAs in Bauchi S Toro, Tafawa Balewa, Balanga, Bauchi and Das LGA is considered the largest producer of sweetp Bauchi State. The major sweetpotato producing L Borno State are Kukawa, Marte, Marbar, Mongo Ngala. All these areas take advantage of the shore Lake Chad to grow sweetpotato during the dry Other sweetpotato producing LGAs are Gwosa, Uba and Biu. All these LGAs are located in the s part of Borno State.

Sweetpotato production in the Central Zon Central zone covers six States namely; Niger, Kogi, Plateau, Benue and Taraba. It occupies ab million has. About 75 % of the arable area is not cul due to low population density and this offers th scope for expansion of cultivated area in the fut Kwara States Oke-Ode, Iludun, Agbamu, Omido, A Eleyoko, Gaa Ogbe, Koko, Igosun, Igbonna, Offa Ile, Ilemona and Ira as the major sweetpotato pro areas of the State. Offa which comprises Igbosun, Ig Offa, Erin-Ile, Ilemona and Ira, is the largest produ sweetpotato in the State. Most farmers cultivate b 0.5–1.0 ha of farm land on sweetpotato.

The status of sweetpotato is secondary in Plateau relative to Irish potato. The major sweetpotato pro areas in the State are Bokkos, Barakin Ladi, Mang South, Pankshin, Bassai, Wuse, Kanam, Langtan Shendam. Bokkos is considered the largest sweet producing area in Plateau State. Most of the sweet producing areas in Plateau State are found in the No part of the State and are on the plateau. One of the determinants of the cropping system is the netw

rivers and the topography of these areas. Farmers cultivate between 1.0–3.0 ha of farm land per head.

The major sweetpotato producing LGAs of Benue State in decreasing magnitude are Vandeikya, Konohisha, Kwande, Oturkpo and Makurdi.

Sweetpotato production in the South-Western Zone. This area consists of seven States namely; Delta, Edo, Lagos, Ogun, Ondo, Osun and Oyo. They collectively cover about 120 sq km which is approximately 12% of the Nigerian's total land area. In Osun State the major sweetpotato growing areas include; Ashi, Asaba, Oshogbo, Iree, Ijabe, Okuku, Inisha, Iba, Ikirun, Ila-Odo, Igbaje, Ekoende, Akipata and Oyan. Oyan is considered the largest sweetpotato producing area in the State. Results conducted in Oyan showed that nearly every household cultivated sweetpotato and the average farm size was 0.4 ha per farmer. About 90 % of the farmers were men while the remaining 10 % consists of women and children.

Cultivation of sweetpotato is limited to the following areas of Lagos State; Aragan farm settlement, Iraye, Iganke, Oke-Oso (all in Epe division), Ikorodu area, Ojo and Ipaja areas of the State. In Oyo State, sweetpotato is mostly grown in Ogbomoso zone, Ibadan, Saki, Iseyin, and Oyo areas.

Sweetpotato production in the South-Eastern Zone. The South-Eastern zone consists of seven States namely; Abia, Akwa Ibom, Anambra, Cross Rivers, Enugu, Imo and Rivers. All except Akwa Ibom State are identified as sweetpotato growing areas of the zone. The zone occupies a land area of about 80,000 sq km which represents about 8 % of the total area of Nigeria. In Abia State the following are the major sweetpotato producing areas Afikpo, Arochukwu, Bende, Ohafia and Ukwa LGAs. In Anambra State Oyi, Anambra, Ogbaku and Ihiala LGAs are noted for producing substantial sweetpotato. In Cross River State, Ogoja, Yala, Ikom, Obudu and Obubra LGAs are the main sweetpotato producing areas. In Rivers State Port Harcourt, Onne, Oyigbo, Egbema and Odu are considered the main sweetpotato producing LGAs.

Outlook

The areas of sweetpotato cultivation in Nigeria have expanded beyond the projected national figures of 40,000 tonnes on 5,000 ha (FAO, 1994) as showed by Crop Average Yield Surveys reported by the State Agricultural Development Programmes.

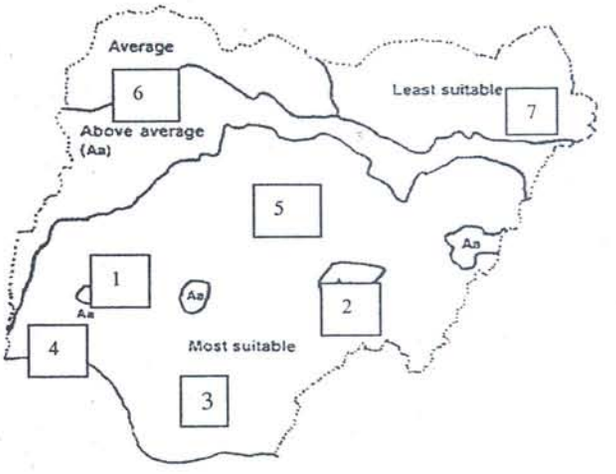

Figure 1: Major sweetpotato growing areas in Nigeria
Area 1= Offa and Oyan (Kwara State); 2= Benue State; 3= Afikpo (Ebonyi State), Egbema (Rivers State) and Bende (Abi State); 4= Ikorodu (Lagos State); 5= Bokkos, Jos (Plateau Stat 6= Talata Mafara (Sokoto State); and 7= Lake Chad Region, Toro LGA (Borno State).

Missing Stands in Sweetpotato Field Trials

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Abstract. Sweetpotato is grown across a wide ran agroecological zones. In Nigeria, tuber yields obtain farmers' fields differ considerably across agroecol zones and even from farmer-to-farmer. This wide variat tuber yields is a matter of concern because it means output of the crop is lower than it should be. In order to understand the variations in sweetpotato tuber yi different locations and seasons, results from 13 sweet field trials in different environments were examine factors that could lead to missing stands in such field also identified. It is recommended that care is tak sweetpotato growers to address the identified factors s increase productivity of their sweetpotato fields.

Key words: Sweetpotato; tuber yields; missing s

Introduction

Sweetpotato (*Ipomoea batatas*) is grown using 20– vine portions called slips or cuttings. The usual spa sweetpotato planting to produce ware tubers is 1 m giving 33,333 plants per hectare. To get that number as surviving on the date of harvest is rare.

stands are lost due to varied factors from the day vines are cut till the day the mature plant is harvested. The aim is to reduce the percentage of missing plants if we better understand the factors controlling the death of plants throughout the season. This should thus enable us better manage sweetpotato field production process.

Materials and Methods

Studies and observation of the process of cutting vine slips from fields, their packaging and transportation were taken on several occasions. The overall counts of missing stands were taken from several trials and these were used to compute the percentage of missing stands. The yields of the crop in different farm circumstances were then used to draw a correlation between the percentage of missing stand and their tuberous root yields obtained. Conditions during the trials varied and could partly account for the different degrees of missing stands among the sweetpotato clones studied. These are summarized in Table 1.

Description of cases. Generally, there was wet weather for most of the crop in cases 1-6, but wet to dry weather for cases 7-13. That is, cases 1-6 had rain falling for most of the time during the cropping season from plating to harvesting, while for cases 7-13, rain fell only during the first half of the crops growing period. Soils were relatively fertile, and no fertilizer was applied, only for case 7, where 200 kg/ha NPK 15:15:15 and 495kg/ha OMF was added. Mature tubers were harvested with hoes or digging fork pressed into the side of the ridge and upturned. Every root was retrieved in all the cases studied. Field was protected by 15 mm wire mesh for case 3 and 4 only. Flooding was observed in case 2. Livestock (cattle) or rodent attack was experienced in all but case 12. In the case of livestock attack, the damage included trampling, chewing of leaves and vines, as well as uprooting of whole plants. Rodents attacked freshly-planted vine slips, dug-up plants, and also ate all or parts of maturing/mature tubers.

Results

The overall average percent missing stands was 28.56%. This was for 13 experimental trials where the level of field care was considered to be moderate to high. The 13 cases considered helped in the estimation of good and bad field conditions as shown in the description of the cases presented in Table 2. Of the 13 field trials studied, only one was considered as having bad field conditions, based on the very high percent missing stands (71.92%). The mean available water in each of the trial locations calculated by subtracting the mean evapo-transpiration from the mean annual rainfall is depicted in Figure 1.

The factors associated with high level of missi were more common around those detailed in Extreme care was taken, while establis sweetpotato fields, to ensure only good quality 2 slips from top to middle portions of mother pl used. Handling, packaging, storage and trans were done so as to minimize possible damag planting materials. This means that disease pressure in the field location; weather conditior establishment of planted vines; planting date in re the length of the rainy season were largely respon the higher percentage missing stands; and livestoc attack observed in cases 3, 4, 8, 9, 10 and 13.

Discussion

Care should be taken to address each of the identified in this study. The 28.56 % average for stands in the experiments indicates that the situatio be expected to be worse on-farm. All 13 tria experiments in which all recommended field op were carried out properly and in a timely manne though vine slips were prepared, packaged, transported, and planted according to recommen field conditions in each location led to varying le missing stands. By far the greatest contributor missing stands was available water. Locations w little (Iburu) or too much (Onne) could have swee plants with less than adequate growth to give reas yields.

Another important factor is disease pressure. In Um the high level of available water (and thus r humidity) leads to high levels of sweetpotato virus d (SPVD) incidence. This affected plant growth and the highest recorded percent missing stands across field trials. A study carried out by Gruneberg *et al.* (showed that the highest mean sweetpotato tuber were obtained in a location with 600mm rainfall i growing season. On the other hand, lowest tuber were in locations with very high rainfall and very rainfall in the growing season. The location in v sweetpotato plots were irrigated also gave relatively tuber yields with not much variation in mean yields a the tested clones. Since sweetpotato requires 500m rainfall during the growing season, locations with enough or too much rainfall for sweetpotato will re high percent missing stands. Similarly, Andrade and 2000 had the lowest yields and stand count in locations which had high pathogen infestation. rainfall being twice or more than the amount require sweetpotato.

Table 1. Descriptions for 13 cases of sweetpotato field trials from 2006 to 2009 under different locations and field conditions in Nigeria

Case number	Field trial	Location	Ridge preparation	Planting date-Harvest date	Crop growth (days)	Fertilizer applied	No. of weedings	Virus status (score)	Harvesting implement used	Livestock (L) or rodent (R) attack
1	Germplasm 2006	Ibadan	manual	2 May – 30 Sep	150	no	3	low (2)	small hoe	R
2	Germplasm 2006	Onne	manual	19 Jun – 8 Nov	150	no	3	medium (3)	small hoe	R
3	Germplasm 2007	Ibadan	manual	14 Mar –13 Aug	150	no	3	medium (3)	small hoe	R; L
4	Germplasm 2008	Ibadan	manual	6 Jun – 10 Oct	126	no	3	high (4)	small hoe	R
5	Multi-site trial 2006	Ibadan	manual	1 Jul – 4 Nov	125	no	3	very low (1)	small hoe	R
6	Multi-site trial 2006	Umudike	tractor	18 Jul – 21 Nov	126	no	2	medium (3)	digging fork	R
7	Vine trial 2006	Ibadan	manual	15 Sep – 8 Dec	84	yes	2	very low (1)	small hoe	R
8	PYT 2007	Ibadan	manual	27 Aug – 1 Dec	126	no	2	medium (3)	small hoe	R
9	PYT 2007	Iburu	manual	11 Jul – 18 Nov	128	no	1	very low (1)	small hoe	L
10	PYT 2007	Umudike	tractor	27 Jul – 1 Dec	126	no	2	very high (5)	digging fork	R
11	UYT 2008	Ibadan	manual	23 Jul – 8 Dec	138	no	3	medium (3)	small hoe	R
12	UYT 2008	Kuru	tractor	22 Aug – 8 Jan	138	no	2	medium (3)	small hoe	-
13	UYT 2008	Umudike	tractor	10 Sep – 27 Jan	139	no	2	high (4)	digging fork	R

PYT: Preliminary yield trial; UYT: Uniform yield trial

Table 2. Description of the 13 cases studied for percent missing stands in sweetpotato fields, 2006–2008 in Nigeria.

Case number	Field Trial	Location of field	No. of replications	Plants/ plot	Clones planted	Expected plants	Harvested plants	Missing plants (%)	FCA*
1	Germplasm 2006	Ibadan	1	10	125	1250	1200	4.00	good
3	Germplasm 2007	Ibadan	1	10	125	1250	607	51.44	fair
4	Germplasm 2008	Ibadan	1	5	125	625	276	55.84	fair
5	Multi-site trial 2006	Ibadan	3	10	25	750	693	7.60	good
7	Vine trial 2006	Ibadan	3	10	25	1500	1349	10.07	good
8	PYT 2007	Ibadan	3	10	40	1200	769	35.92	fair
11	UYT 2008	Ibadan	2	85	15	2550	2203	13.61	good
	Sum		*14*	*140*	*480*	*9125*	*7097*	*22.22*	
6	Multi-site trial 2006	Umudike	3	10	25	750	729	2.80	good
10	PYT 2007	Umudike	3	10	40	1200	337	71.92	bad
13	UYT 2008	Umudike	2	85	15	2550	1248	51.06	fair
	Sum		*8*	*105*	*80*	*4500*	*2314*	*48.58*	
9	PYT 2007 Kaduna	Iburu	3	10	40	1200	575	52.08	fair
12	UYT 2008 Plateau	Kuru	2	85	15	2550	2314	9.25	good
2	Germplasm 2006	Onne	1	30	90	2700	2042	24.37	good
	Overall		***28***	***-***	***125***	***20075***	***14342***	***28.56***	

*FCA: Field conditions assessment based on percent missing stands at each location compared to the average across all locations, where <30% = good, 30-59% = fair and >60% = bad.

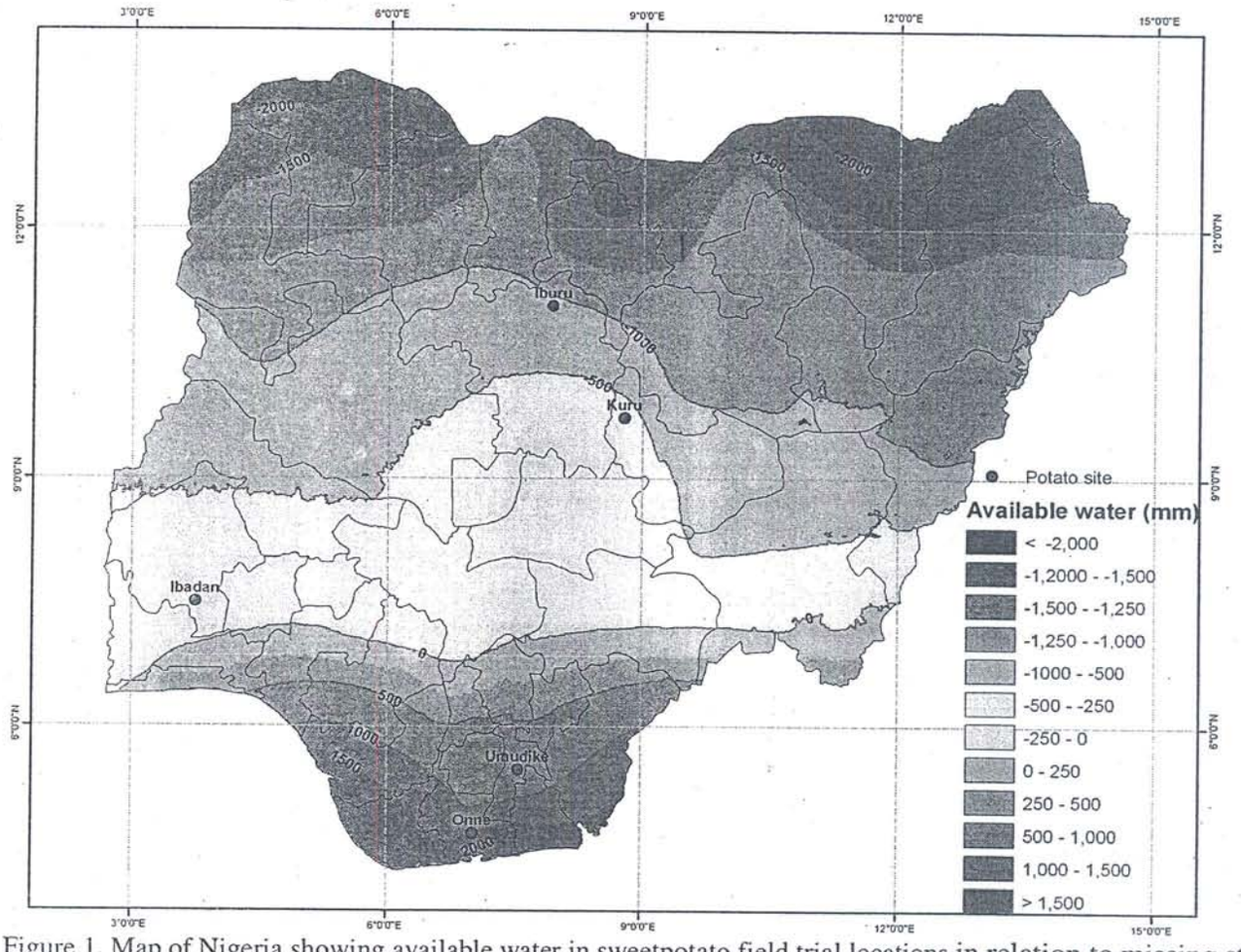

Figure 1. Map of Nigeria showing available water in sweetpotato field trial locations in relation to missing stands i Ibadan (22.2%); Umudike (48.6 %); Iburu (52.1 %); Kuru (9.3 %); and Onne (24.4 %) from 2006 to 2009

Table 3. Causes of missing stands in sweetpotato fields

	Factor
1.	Position of the vine away from the terminal tip
2.	Age of the vine
3.	Variety characteristics
4.	Substandard cuttings as regard: length, number of nodes, health
5.	Hours after severance of the vine from the plant
6.	Storage conditions from cutting of vine to its planting
7.	Packing of the vines after cutting and their exposure to sunlight
8.	Transportation conditions and duration
9.	Planting operations (depth, vine orientation,)
10.	Type of vine (area of leaves retained or without leaf)
11.	Disease and pest pressure of the vine
12.	Weather conditions before establishment of planted vine (1–4 WAP)
13.	Planting date in relation to the length of rainy season at the location

Conclusion

To enhance sweetpotato production, we need t understanding of factors leading to missing stands. thus lower tuber yields. Effective field management consider all aspects ranging from sweetpotato selection to vine preparation, handling and planting. these are taken care of, tuber yields will certainly incr even without the addition of external inputs like ferti or even improved varieties. This study highlights the that environment has a large role to play in the expre of plant characteristics and economic yield.

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Sweetpotato Crop Health

Varietal Evaluation under Different Tillage Methods for the Control of Sweetpotato Weevil (*Cylas puncticollis* [Boh.]) Infesting Sweetpotato (a proposal)

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Introduction

Sweetpotato (*Ipomoea batatas* (L.) Lam) is a major food and industrial crop in Nigeria. Though farmers' yields have remained low at 6.8 t/ha (Tewe *et al.*2003); NRCRI (1985); Chinaka (1983); and Nwinyi (1987) reported yields of 20–30 t/ha for improved varieties under experiments. Nigeria ranks second in Africa after Uganda with production level of 2.5 million metric tonnes (FAO 2005). Sweetpotato is generally planted at the onset of rains. It may be planted on mounds, ridges, beds, or on the flat, but performs best on mounds and least on the flat (Kimber 1970). Ridge planting is the most common method of growing sweetpotato. The higher the ridge, the greater the yield, up to a height of 36cm (Edmond *et al.* 1950).The flexibility of the harvest time makes sweetpotato an important food security crop at times of adverse conditions. It is now consumed mainly for its nutrients rather than for energy (Jack *et al.*1992).The crop has a higher β-carotene content than any other root and tuber crop (Suda *et al.*1999; Janssen 2001). Orange-fleshed sweetpotato is very rich in vitamin A (Jack *et al.*1992). The root could be boiled and/ or soaked overnight to remove sugar and then boiled. It could also be processed into animal feed, and even used in alcohol production. The plant has fast spreading foliage which could serve as a protective ground cover. Sweetpotato has even been identified as an important crop for controlled environmental life support system (CELSS) for manned space missions (Hill *et. al.* 1984).

Short shelf-life and weevil infestation of roots are both major constraints in sweetpotato production (Bashaasha *et al.* 1995, Kapinga *et al.*1995).Sweetpotato weevil *Cylas puncticollis* (Boh.) constitutes a major constraint to sweetpotato production and utilization world-wide (Villareal 1982; Southerland 1986; Chalfant *et al.*1990; Lenne 1991). In Nigeria, yield reduction of sweetpotato attributed to the pest is as high as 40–80 % (Nwana 1978). Ho (1970); Subrananian *et al.* (1977); Mullen (1984); Jansson *et a/.* (1987); Smit (1997) reported that losses of marketable yield can reach as high as 60–97 %. Candidate cultivars are new and their selection was based on their yield potentials. The combination of management techniques revealed in the study will enhance sweetpotato production in the study area. The technique neither requires high level knowledge nor capital.

Objective

The objective of the study is to identify the best combination of variety and tillage methods for management of *Cylas puncticollis* infesting sweetpotato.

Materials and Methods

Six sweetpotato varieties: TIS 87/0087, TIS 2532 OP.1.1 TIS 8441, TIS 86/0356, TIS 440168, and Ex Igbaria shall be obtained from the germplasm collection NRCRI, Umudike. The trial will be carried out at Kuru Plateau State sub-station of NRCRI. All varieties shall tried on three distinct tillage methods (flat, mound a ridge). After harvesting, each tuber will be dissected usi dissecting set. The following parameters will be recorde

(1) Number of adults, larvae and pupae
(2) Percentage infestation
(3) Percentage damage
(4) Tuber size (width and length)
(5) Tunnel length

Agronomic practices would include: planting depth of cm; plot size of 3 m x 2 m ($6m^2$); spacing (intra- and in row) 1 m x 30 cm and 1 m; weeding at 4 weeks a planting (WAP) ; rouging at 8–10 WAP; and applica of N.P.K 15: 15: 15 fertilizer at a rate of 240 g/plot.

Experimental design and data analysis. The experir shall be arranged in a Randomized Complete B Design (RCBD), and each treatment replicated thrice. collected will be subjected to analysis of vari (ANOVA), using Genstat software version 5 releas (Lawes Agricultural Trust 1995) or SAS (1990) at 9 level of significance. Significant means will be sepa using LSD at 0.05 error limit.

Expected Output

The study is expected to generate information o appropriate strategy or combination of strategies to pr or mitigate damage/losses caused by this wee sweetpotato growing areas in this agro-ecology. overall impact will be to increase its production (output) in view of its role in our environment and as saver' in this region and Nigeria by extension.

Advancing Sweetpotato Culture in Nigeria

Some suggestions for the advancement of sweetpota cultivation in Nigeria are:

1. Improve the nutrient content (especially protein content) of sweetpotato. The crop should be consumed mainly for nutrient rather than for energy (Jack *et al.* 1992)
2. Value addition: Its flavour, visual appeal and texture is related to its acceptability e.g fufu texture can be improved by blenditl9 with cassava starch.
3. Provision/equipping to state-of-the-art biotechnology laboratories in tertiary institutions in Nigeria for micro-propagation of sweetpotato.
4. Technology transfer/dissemination. Research scientist, lecturers and extension agents to diffuse knowledge on production and utilization of sweetpotato.
5. Adoption of IPM approach in sweetpotato pest containment.

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Evaluation of Fusilade Forte and Primextra Gold Herbicides for Weed Control in Sweetpotato Production

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Introduction

Sweetpotato *(Ipomoea batatas* [L.] Lam) is the sev most important crop in the world (Jansson and Ra 1991). It is used as food, as feed, and as an industrial c and more recently has come to be appreciated as a h fibre food and green vegetable. The constraints sweetpotato production include weed competition, soil management, and low yields (Unamma *et al.* 19 Sweetpotato is a planophile, which does not dev sufficient vines and foliage before 30–40 days planting, during which period weeds would

established. Manual weeding is laborious and wastes time. This constraint could be addressed through timely herbicides application to remove the emergent weeds. The objectives of this study were to determine the effects of herbicides and their rates for weed control and their economic implications in sweetpotato production.

Materials and methods

The trials were conducted at the research farm of the National Root Crops Research Institute, Umudike, Nigeria (5° 29'N, 7° 33'E and 122 m above sea level) in 2006 and 2007 cropping seasons. Four-node cuttings of sweetpotato cultivar TIS 87/0087 were planted on the crest of the ridges. A plot size of 5 m x 6 m in a randomized complete block design with three replications, at a spacing of 1.0 m x 0.3 m for a plant population of 33,333 plants/ha was used. Treatments consisted of three herbicides, namely: Fusilade forte at rates 1.0 kg a.i./ha, 1.5 kg a.i./ha and 2.0 kg a.i./ha; Primextra Gold at rates 1.5 kg a.i./ha, 2.5 kg a.i./ha and 3.5kg a.i./ha; a mixture of Fusilade + Primextra Gold at 1.0 kg a.i./ha + 1.75 kg a.i./ha; and farmers' practice of manual weeding 4 + 8 WAP, with unweeded plots as control. Fertilizer NPK 15:15:15 was basally applied at a rate of 400 kg/ha. The crop was harvested at 4 MAP. Data collected were subjected to analysis of variance using the GLM procedure of SAS and significant differences among means were tested using Fisher's least significant difference (LSD) at 5 % level of probability.

Results and Discussion

The effect of herbicides on weed types (Table 1) showed that plots treated with Fusilade Forte at rate 1.5 kg a.i./ha reduced weed density and controlled grass weeds in both 2006 and 2007 when applied post-emergence. The plots treated with the mixture of Fusilade Forte and Primextra Gold at rate 1.0 kg a.i./ha + Primextra 1. 75 kg a.i./ha controlled broad leaf weeds effectively in both years. The effects of weed control methods on yield and yield component of sweetpotato in 2006 and 2007 at Umudike are summarized in Table 2. Total root yield (t/h higher in plots treated with Primextra Gold at rate a.i./ha (7.9 t/ha). This represents an increase of 2 over manual weeding and over other treatments in 2 2007, a similar trend was observed, with Primextr 1.5 kg a.i./ha giving yield of 21.1 t/ha, which repres increase of 122.1 % over manual weeding and treatments. The unweeded plots gave a yield reduc 49 % in 2006 and 17.9 % in 2007. Sellable root yiel was high in plots treated with Primextra Gold at r kg a.i./ha in both years.

The economic analysis of chemical weed control an weeding based on labour productivity of sweetpc 2006 and 2007 is summarized in Table 3. The table that among the rates and types of herbicide Primextra Gold at 1.5 kg a.i./ha gave the highest ret naira investment (₦ 1.87) and labour productivity t/man-days, as well as the lowest labour cost per ou ₦ 3193.1/tonne/ha.

Conclusion

Results showed that Fusilade Forte at rate 1.5kg a.i. the lowest weed density compared to other treatm both years and controlled grass weeds effectively. the herbicide rates and types used, Primextra Gold kg a.i./ha gave the highest yield (t/ha), and also g highest return per naira investment (₦ 1.87), and productivity of 0.17 t/ha/man-days, as well as the labour cost per output ₦ 3193.10 per t/ha.

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Table 1. Effect of weed control methods on weed types and weed density in 2006 and 2007 at Umudike

Weed control treatments	Rate (kg a.i./ha)	Weed density No./m^2		Grasses		Broad leaves		Sedges	
		2006	2007	2006	2007	2006	2007	2006	2007
Primextra Gold	1.50	8.50	7.50	2.08	8.00	5.50	7.00	0.92	0.00
Primextra Gold	2.50	10.00	12.67	4.00	15.00	5.58	9.00	0.42	1.30
Primextra Gold	3.50	11.91	12.33	6.83	13.00	4.43	11.33	0.75	0.33
Fusilade Forte + Primextra Gold	1.00 + 1.75	7.42	7.33	2.50	5.67	4.33	6.33	0.58	0.66
Fusilade Forte	1.00	8.67	17.33	1.75	11.67	6.58	21.00	0.33	2.00
Fusilade Forte	1.50	7.17	6.07	0.92	4.67	5.92	27.33	0.33	2.33
Fusilade Forte	2.00	9.42	23.33	2.25	15.67	6.62	76.67	0.25	4.33
Weeding 4 + 8 WAP	-	10.02	8.00	2.00	9.00	7.00	11.02	0.27	1.00
No weeding	-	20.30	69.17	10.00	55.66	12.95	62.33	1.00	20.00
LSD 0.05		7.45	12.29	3.09	16.74	4.95	11.52	0.86	3.89

Table 2. Effect of weed control methods on yield and yield components of sweetpotato in 2006 and 2007 at Umudike

Weed control treatments	Rate (kg a.i./ha)	Stand count/ha		Root yield (t/ha)	% yield loss	Root yield (t/ha)	% yield loss	Sellable root yield (t/ha)		Total root No.		Sellable root No.	
		2006	2007	2006	2006	2007	2007	2006	2007	2006	2007	2006	20
P. Gold	1.5	23560	80670	7.9	25.4	21.1	122.1	7.1	17.6	31780	78330	21000	52
P. Gold	2.5	25670	74000	5.2	-17.5	8.9	-6.3	4.6	7.0	28990	72000	20000	34
P. Gold	3.5	27000	64670	5.8	-7.9	10.8	13.7	5.3	9.1	27000	66330	18440	37
F. Forte + P. Gold	1.0 + 1.75	21560	79670	6.5	3.2	12.2	28.4	6.1	10.1	28890	94000	22330	51
F. Forte	1.0	29110	74000	7.6	20.6	14.1	48.4	6.4	12.3	33220	89670	20330	56
F. Forte	1.5	28110	70330	6.2	-1.6	12.4	30.5	5.5	10.3	34220	101670	23110	54
F. Forte	2.0	27000	81330	7.8	23.8	12.8	34. 0	6.8	10.6	37440	95670	25110	53
Weeding 4+8 WAP	-	28550	64670	6.3	-	9.5	-	5.5	8.5	36440	61330	23890	38
No weeding	-	20890	69330	3.2	-49.2	7.8	-17.9	2.4	6.1	20560	76670	10890	31
LSD 0.05		7000	20350	3.4		4.6		3.4	4.2	12120	35390	11030	224

P.: Primextra; F.: Fusilade

Table 3. Summary of economics of chemical weed control and hand weeding based on labour productivity in sweetpotato production in 2006 and 2007 at Umudike

Particulars	Yield	Gross Return (₦)	Total Cost (₦/ha)	Return (₦)	Return/ ₦ Investment	Labour Productivity (t/manday)	Labour cost/output (₦/t/ha)
Primextra Gold 1.5 kg a.i./ha	14.50	203000	108549.6	94450.4	1.87	0.17	3193.10
Primextra Gold 2.5 kg a.i./ha	7.10	99400	110009.6	-10609.6	-1.10	0.08	6515.50
Primextra Gold 3.5 kg a.i./ha	8.30	116200	111549.6	4650.4	1.04	0.10	5578.31
Fusilade Forte 1.0 + Primextra Gold 1.75 kg a.i./ha	9.40	131600	112384.6	19215.4	1.17	0.11	4921.28
Fusilade Forte 1.0 kg a.i./ha	10.90	152600	109799.6	42800.4	1.39	0.13	4247.71
Fusilade Forte 1.5 kg a.i./ha	9.30	130200	111609.6	18690.4	1.17	0.11	4974.19
Fusilade Forte 2.0 kg a.i./ha	10.30	144200	113259.6	30940.4	1.27	0.12	4491.26
Weeding 4 + 8 WAP	7.90	110600	106339.6	-25739.6	-1.19	0.05	9541.77
No weeding	5.50	77000	105299.6	-28299.6	-1.27	0.07	8236.36

Preliminary Comparison of Effectiveness and Economics of Cultural and Chemical Weed Control in Sweetpotato Production in Rain Forest Zone

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Introduction

Sweetpotato *(Ipomoea batatas* [L.] Lam) is an important root crop, which is extensively cultivated in tropical and sub-tropical zones (Islam *et al.* 2002). It is the only member of the genus *Ipomoea* whose roots are edible and is undeniably one of the world's most important food crops due to its high yield and nutritive value (Data and Eronico 1987). The constraints of sweetpotato cultivation include weed competition, poor soil management, and low yield (Unamma *et al.* 1984) and these could be addressed through timely herbicide application to remove weeds. The study was conducted to assess the effectiveness and economics of manual and chemical weed control measures in sweetpotato production.

Materials and Methods

Field experiments were conducted at the farms of the National Root Crops Research, Institute Umudike, Nigeria (5° 29'N, 7 ° 33'E and 122 m above sea level), in the 2007 cropping season. The experiment was set up in a randomized complete block design with three replicalions. The treatments consisted of 11 herbicides, namely: Gramoxone 1.5 kg a.i./ha, Galex 2.0 kg a.i./ha, Diuron 3.0 kg a.i./ha, Dual Gold 2.0 kg ai/ha, Paraeforce 2.5 kg a.i./ha, Touch Down 2.0 kg a.i./ha, Fusilade 2.0 kg a.i./ha, Xtrazine 1.5 kg a.i./ha, G + Galex 0.75 + 1.0 kg a.i./ha, 1 gram Combi 1.5 kg a.i./ha, Codal 2.5 kg a.i./ha and manual weeding for 3 + 4 + 8 weeks after planting (WAP), and weedy throughout. Weed control ratings in the plots were taken at 8 W AP on a scale of 0–10, where "0" meant that all the plots were covered with weeds and "10" meant that the plot was weed free. The plot size was 6 m x 5 m. Sweetpotato variety TIS 87/0087 was planted at a spacing of 1 m between and 30 cm within the rows. The crop was harvested at 4 months after planting (MAP). Data collected were subjected to analysis of variance using GLM procedure of SAS and significant differences among means of variables were tested using Fisher's least significant differences (LSD) at 5 % level of probability.

Results and Discussion

The dominant grass weeds in the experimental sites were *Cynodon dactylon pers., Digitaria horizontalis* wild *Eleusine indica* Gaerth, *and Panicum maximum* J broadleaf weeds were *Calapogonium muc Chlomolaena odorata, Ipomoea involucrata* P. Th were *Mariscus allerifolius, Fimbritylis hiltoralis.*

The effect of herbicides on weeds and weed contr at Umudike (Table 1) was satisfactory with Para 2.5 kg a.i./ha, which had the lowest weed density controlled broad leaves, while Dual Gold c grasses. Manual weeding for 3 + 4 + 8 WAP ga weed control than all other treatments except Pa Weed control at 8 WAP was satisfactory with Gr 1.5 kg a.i./ha giving the highest efficacy, followe 1 gram Combi 1.5 kg a.i./ha and Paraeforce 2.5 kg

Table 1. Effect of herbicides on weeds and weed contr at 8 WAP in 2007 at Umudike, Nigeria

Weed control treatment	Hr	Wd	Broad leaf	Gras-ses	Sed-ges
Codal	2.50	8.17	10.00	6.33	0.0
Diuron	3.00	8.20	11.00	7.67	0.0
Dual	2.00	5.83	9.00	1.67	0.0
Fusilade	2.00	7.00	10.67	2.67	0.0
G + Galex	0.75 +1.0	7.33	9.67	5.00	0.0
Galex	2.00	8.00	11.00	5.00	0.0
1 gram Combi	1.50	5.83	7.67	4.00	0.3
Paraeforce	2.50	5.50	7.00	4.00	0.0
Touch Down	2.00	6.83	8.00	5.33	0.3
Xtrazine	1.50	6.33	8.33	4.33	0.0
Gramoxone	1.50	8.00	10.67	5.32	0.0
Weeding 3+ 4 + 8 WAP		0.10	1.00	0.20	0.0
Unweeded		45.2	45.00	27.00	8.3
LSD 0.05		5.46	5.77	6.88	1.2

Hr: Herbicide rate (kg a.i./ha); Wd: Weed density (No./m^2)
Wc8: Weed control rating at 8 WAP

The effect of herbicides on yield and yield com sweetpotato in 2007, at Umudike (Table 2) sho at 2.0 kg a.i./ha gave the highest total root y t/ha), or an increase of 10.2 % over hand-w other treatments; while use of Dual Gold herbi highest total root yield of 29 % followed b unweeded plots. Unweeded plots had the highe number/ha, compared to weed-free for 3 + 4 + other treatments. Plots treated with Paraefor highest sellable root weight (t/ha). Plots treated herbicide had the lowest sellable root weight. plots had the highest sellable root number/ha, plots treated with Fusillade 2.0 kg a.i./ha.

Comparative labour analysis of chemical weed control and manual weeding in sweetpotato production is shown in Table 3. Fusilade 2.0 kg a.i./ha gave the highest return per naira investment (₦1.49), as well as the highest productivity index of 0.14 t/ha with the lowest labc of ₦ 3822.70/t/ha.

Table 2. Effect of herbicides on yield and yield components of sweetpotato in 2007 at Umudike, Abia State, Nigeria

Weed control treatment	Rate (kg a.i. /ha)	Stand count (x 10^3/ha)	Total yield (t/ha)	% yield loss	Total root No./ha	Sellable root weight (t/ha)	Sellable root No./ha	Unsellable root weight (t/ha)	Unsellable root No./ha	Cyl No.
Codal	2.50	72.00	11.95	9.10	62.00	9.00	47.50	0.90	14.50	2.0(
Diuron	3.00	72.00	11.60	5.90	89.33	9.57	55.33	1.03	34.00	1.3:
Dual	2.00	59.00	7.77	-29.0	86.33	6.93	44.33	1.00	42.00	0.0(
Fusilade	2.00	77.67	12.07	10.20	91.33	9.17	60.33	0.97	31.00	0.0(
G	0.75	55.67	9.63	-12.10	84.33	8.90	39.33	1.67	45.00	2.6
+ Galex	+ 1.0									
Galex	2.00	73.33	8.73	-20.30	67.67	6.50	38.00	1.80	29.67	1.0(
1 gram Combi	1.50	81.67	10.53	-3.80	85.67	7.40	50.00	1.90	35.67	1.0(
Paraeforce	2.50	82.33	11.03	0.70	94.00	12.37	47.00	1.77	47.00	0.3:
Touch Down	2.00	79.67	10.43	-4.70	95.67	9.83	43.33	1.90	52.33	1.0(
Xtrazine	1.50	60.00	9.47	-13.50	72.67	8.57	53.33	0.63	19.67	1.0(
Gramoxone	1.50	65.33	9.60	-12.30	65.67	8.43	36.67	1.17	29.00	1.3:
Weeding 3+ 4+ 8 WAP		72.50	10.95	-	72.50	9.25	41.50	2.20	31.00	1.5(
Unweeded		47.00	8.90	-18.70	111.00	8.00	93.00	0.90	18.00	4.0(
LSD 0.05		22.85	6.67	-	38.98	5.16	27.74	1.27	23.12	0.1(

Table 3. Comparative labour analysis of chemical weed control and manual weeding in sweetpotato production in 2007

Particular	Gross return (₦:k)	Total cost (₦:k)	Root yield (t/ha)	Return (₦:k)	Labour productivity (₦:k/t/ha)	Labour cost/output (₦:k/t/ha)	Return/ Naira investmen
Codal 2.5 kg a.i./ha	167300.00	114969.60	11.95	52330.40	0.138	3867.78	1.46
Diuron 3 kg a.i./ha	162400.00	114619.60	11.60	47780.40	0.134	3984.48	1.42
Dual Gold 2 kg a.i./ha	108780.00	111819.60	7.77	-3039.60	0.090	5948.52	-1.03
Fusilade 2 kg a.i./ha	168980.00	113139.60	12.07	55840.40	0.140	3822.70	1.49
G + Galex 0.75 + 1.0 kg a.i./ha	134820.00	110764.60	9.63	24055.40	0.120	4791.28	1.21
Galex 2 kg a.i./ha	122220.00	113259.60	8.73	8690.40	0.101	5298.97	1.08
1 gram Combi 1.5 kg a.i./ha	147420.00	110459.60	10.53	36960.40	0.122	4393.16	1.33
Paraeforce 2.5 kg a.i./ha	154420.00	112389.60	11.03	42030.40	0.128	4183.14	1.37
Touch Down 2 kg a.i./ha	146020.00	109139.60	10.43	36880.40	0.121	4423.78	1.34
Weeding	124600.00	108299.60	8.90	16300.40	0.097	5426.97	1.15
Weeding	153300.00	135659.60	10.95	17640.40	0.068	6909.59	1.13
Xtrazine 1.5 kg a.i./ha	132500.00	109969.60	9.47	22530.40	0.110	4884.90	1.20
Gramoxone 1.5 kg a.i./ha	134400.00	108389.60	9.60	26010.40	0.111	4806.25	1.24

Sweetpotato Post-harvest

Utilization of Sweetpotato for Food Production and other Industrial Products

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Introduction

Sweetpotato (*Ipomoea batatas*), a trailing perennial plant of the family Convolvulaceae (*morning glory family*), is native to the New World tropics and was cultivated from ancient times by the Aztecs for its edible tubers. It was introduced into Europe in the 16th Century and later spread to Asia. The crop is now the most important of tropical root crops and many varieties are grown (differentiated by their leaf shapes).

There are many varieties of sweetpotato, but the two that are widely grown commercially are the pale sweetpotato and the dark-skinned variety Americans erroneously call yam (the true yam is not botanically related to the sweetpotato). The pale sweetpotato has thin, light yellow skin and a pale yellow flesh. Its flavour is not sweet and after being cooked, the pale sweetpotato is dry and crumbly, much like a white baking potato. The darker variety has a thicker, dark orange skin and a vivid orange, sweet flesh that cooks to a much moister texture.

The edible root is long and tapered with a smooth skin. Its flesh ranges from white to yellow, orange or purple depending on variety. All varieties are more-or-less sweet flavoured. The storage root is not actually a tuber even though it looks like one, since it develops from root tissue rather than stem tissue as true tubers do. Some botanists describe it as tuberous root. The sweetpotato is a crop plant whose large, starchy, sweet-tasting tuberous roots are important as vegetable. They are rich in dietary fibre, vitamin C and B_6. In some tropical areas, they are a staple food crop. The storage roots, leaves and shoots are all edible. The tubers are most frequently boiled, fried, and baked. All parts of the plant are used for animal feeds (Wikipedia 2005). Sweetpotato is an important source of human food and animal feeds. In Sichuan Province, China, it is popularly referred to as "the green golden mine" that should be fully developed (Jiang *et al.* 2005)

Sweetpotato Productivity per Hectare per Day

Sweetpotato is a high yielding crop with a wide adaptation and high resistance to drought. However, the natu range from 16–17 t/ha, which is only 40 % of the new varieties. Thus, there is significant pot increase production (Jiang *et al.* 2005). It h reported that one of the general advantages of tuber crops particularly in areas where land is their high productivity per unit of area and Sweetpotato is a short season fast growing crop the list in terms of potential dry matter and edibl per hectare per day. Market values vary accordin prices, but sweetpotato provides a flexible sourc during the extended harvest period.

In addition to these efficiencies of time, sweetpc produces food with a minimum of labour input, t flexible timing of cultural operations, and yield poor soils with little or no purchased inputs. advantage of the crop is that it can be planted t year in the middle belt and southern part of Nig also amenable to irrigation; therefore, it could be the dry season. Nigeria is blessed with a vast arab is a known fact that the greater percentage of c land is under-utilized. Therefore, sweetpotatc cultivated on a large scale. Sweetpotato is a sh crop which reliably provides food on marg degraded soil with little labour and few or no in outside the farm. The crop is efficient in the proc carbohydrates, protein, vitamins and cash incom of land and time.

Production Statistics

About 98 % of annual sweetpotato production developing countries. In 1994, China alone mad of the harvest, producing about 10.5 million ton million ha (FAO 1995). Based on earlier record (1989), China accounted for 86 % of total world the mid 1980s, just over 6 million tonnes of sv was grown in 1.2 million ha in Africa or about total for developing countries of the world. Thi is expected to have improved after 20 years. W Saharan African, sweetpotato is the third most root and tuber crop after cassava and yam. Nearl the total output has been reported to come fro and Southern Africa. Sweetpotato is grown wi small scale in West Africa for the leaves as a ve well as for the storage roots, but total output i countries with more than 15,000 ha are Cameroc and Burkina Faso.

The Sichuan Province in China alone account than 1.33 million ha. The total production contri % of sweetpotato production in the world. This than the total production of all countries in

except China. Research and development of sweetpotato in Sichuan is very important. Though sweetpotato production in the USA is miniscule compared to the world total, it is important regionally. The Southern States of the U.S. are a traditional sweetpotato producing area.

Utilization of Sweetpotato

a. Food production. In Nigeria, sweetpotato is produced for food. The tubers are mostly boiled, roasted, and fried. They are also cooked together with cowpea and other foods. In some parts of Kwara State, Nigeria, sweetpotato is pounded with yam. It is also sliced, dried and later milled into flour, which is then prepared like "amala", a local staple food. This limited number of uses to which sweetpotato has been put in Nigeria may be due in part to our low production output and availability of other alternative food crops. In other countries, sweetpotato has a number of culinary uses [baked, steamed, glazed, and fried], as well as sweetpotato pie, sweetpotato cobbler, stuffed sweetpotato, scalloped sweetpotato and sweetpotato muffin. How about sweetpotato bread? Sweetpotato is also processed into flour and used for bread production and other confectioneries.

Sweetpotato is grown in over 100 tropical, sub-tropical and temperate countries. It is used as a major food staple in a few countries, as an alternative staple in many countries, and as an incidental or luxury addition to diet in many countries. It is one of only seven world food crops with an annual production exceeding 100 million metric tonnes per year, ranking 13th globally in production value among agricultural commodities (Collins 2005). The tender tips and young leaves of sweetpotato vines are commonly eaten as vegetable in Asia, West Africa and in South Africa (Villareal *et al.* 1985). Sweetpotato is used as food for man and for livestock. Vines are high in protein and vitamins while tubers are rich in carbohydrates.

b. Industrial uses. Sweetpotato has a great potential as an industrial raw material for developing a number of products on a commercial scale.

i. Sweetpotato flour. This is one of the major products of sweetpotato. Appropriate technologies have been developed for the production of sweetpotato flour. The product has been used as a wheat flour substitute for the production of bread and other confectioneries. Wheat flour substitution of between 1–10 % has been found acceptable for the production of bread. However, for other confectionaries, different ranges of substitution of between 10–50 % have been found acceptable, based on the type of product. This is of great interest in most developing countries, including Nigeria, that rely on imported wheat for the production of bread and confectioneries. This substitution would reduce the a of wheat consumed and consequently conserve foreign exchange. Examples of these confecti include biscuits, meat pie, doughnut, muffins, c puff-puff and chin-chin.

ii. Production of sweetpotato starch. Different m have been developed for producing sweetpotato based on existing and improved technologies. The p is used in some industries such as food, pharmace confectioneries, and paper industries. China and Asian countries are now using sweetpotato starch ba an improved process for the production of noodl other products. This has helped to reduce the depen on wheat for the production of noodles.

iii. Production for fruity-food products. In an atter increase the economic value of sweetpotato, the s roots have been processed into fruity-food product formulated fruity-sweetpotato has similar tastes nutrient contents but has higher vitamin A levels compared with other processed fruits and veg products. The different fruity products include sweet-sour sweetpotato, sweetpotato cod sup, sweet jam, sweetpotato beverage and sweetpotato leather.

iv. Other industrial potentials. Other industrial pote of sweetpotato could be exploited. These include i for producing ethanol, sugar syrup, caramel, and sta good chance to be used as a source of renewable er Based on existing technologies, this is possible.

Conclusion

Utilizing sweetpotato for bread making is a re approach towards reducing demand for wheat flour. will conserve foreign exchange since Nigeria depen imported wheat for its needs. Furthermore, a numb industrial products would be produced from sweetp Bearing in mind the level of poverty and unemployme Nigeria, jobs will be created and poverty alleviated sweetpotato, an industrial raw material, is fully exploi

Recommendations

In order to realise the full post-harvest potential of sweetpotato, the following are recommended:

a. Farmers should be educated on the potentials of sweetp as a food and export crop.
b. Farmers should be encouraged and supported to different varieties of sweetpotato. The crop is mostly n cropped in Nigeria, however, it could be inter and r cropped with cassava, maize, sorghum and other crops.
c. Efforts should be geared towards organizing tra

workshops and seminars on processing and utilization of sweetpotato with the active participation of all tiers of government and NGOs.

d. Research Institutions involved in aspects of the production, processing and utilization of sweetpotato should be well-funded and their activities well-coordinated.

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Towards Sustainable Sweetpotato Production and Consumption: The Role of Confectioneries

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Abstract. The economic, nutrition and food security potentials of sweetpotato cannot be overemphasized, hence the need for consumption diversification and sustainability of production. However, the bulkiness and perishable nature of the roots are major constraints on the marketing and availability of the crop. Unacceptability of only one form of preparation as food has reduced the cons level. However, one way of tackling these const through processing of the fresh sweetpotato rc different forms. This process is carried out to trans raw root into value added products that are more p less bulky, less perishable and less sugar. Th exposed the fact that sweetpotato is suitable a: flour for cake, biscuit, juice, tea, soup and granules. This innovation should be promoted to women, not only to create variety, increased con: of vitamin A but also enhance income generatic will invariably attract the farmers to gro sweetpotato.

Keywords: Diversification, transformation, sw vitamin A, income-generation.

Introduction

Alleviation of poverty through suitable ag production and productivity is a major co government as a way of achieving food securit Saharan Africa (Brader 1994). This region is with high level of cassava and yam cultivati 1994; 2000). This shows that sweetpotato *batatas* L.) has very low relative importance in t Also the level of technology utilization for sweetpotato production is very low (Table 1).

Sweetpotato yields are 4–7 t/ha on average, dep cultivation practices and variety. If well-man improved technologies, yields could be as high Table 2 shows sweetpotato production in West 1997 as compared with Asia that produced ove the world's production. Sweetpotato is produ countries out of the 16 countries that are in A crop is often cultivated in small patches either in with cassava, maize, sorghum and vegetables c crops in small farm holdings in Nigeria. This c reason why sweetpotato yield is low when com other crops among farmers utilizing Root Expansion Program (RTEP) Technology (Table

Table 1: Level of Utilization of Root and Tube Programme Technologies

	Level of use	
	Regularly	Seldom
Cassava: TMS 30572	58.8	32.7
Yam: Akosu	53.8	9.5
Cocoyam	57.3	6.5
Sweetpotato:		
TIS 8164	36.7	13.6
TIS 87/0087	11.6	26.1
TIS 25320	3.0	31.7

Source: Adapted from Yusuf 2005

Table 2. Sweetpotato production in West Africa in 1997

Country	Area cultivated (100 ha)	Yield (kg/ha)	Production (1000 MT)
Benin	11	5909	65
Burkina Faso	4	5000	20
Chad	22	2609	60
Cote d'Ivoire	12	3000	36
Guinea	22	6136	135
Liberia	2	1000	17
Mali	3	5333	16
Mauritania	2	1000	2
Niger	5	7000	35
Nigeria	5	8000	40
Senegal	1	6667	4
Sierra Leone	17	2647	45
Togo	1	5000	10

Source: Adapted from FAO 1997

Table 3. Crop percentage yield (kg) among farmers utilizing RTEP training

Crops	0–250,000	251,000–500,000	501,000–750,000	751,000 and above
Cassava	80.0	9.5	2.5	8.0
Cocoyam	92.5	3.0	3.5	1.0
Yam	64.8	12.6	10.0	12.6
Sweetpotato	91.0	2.0	2.5	4.5

Source: Adapted from Yusuf 2005.

Cultural preferences and taste seem to be the primary determinant of the level of production. Lack of awareness on processing into intermediate products that could be stored for a long period of time is a secondary factor in constraining production of sweetpotato. Lack of knowledge on how the sugar content can be reduced has also reduced its acceptability (Talekar 1982). However, this has been taken care of by Meludu, Ajala and Akoroda in 2003 and Meludu 2008 subjected the toasted granules to sugar content analysis and revealed that sweetpotato toasted granules have reduced sugar. The vitamin A content in sweetpotato is yet to be appreciated by consumers and farmers. Sweetpotato is an important drought resistant crop with a high potential to serve as a major staple like cassava, yam and others. It is a short season crop, which reliably provides food on marginal and degraded land with little labour and few or no input outside the farm. Sweetpotato was introduced almost 100 years after cassava it is just been recently promoted in Nigeria to serve as a supplement or accompaniment or an alternative to cassava garri (toasted granules) often consumed through drinking after it has been soaked in cold water Meludu *et al.* 2003. The improvement of sweetpotato in Nigeria has been under the supervision of the National Root Crops Research Institute at Umudike in Abia State. Akoroda *et al.* (2000) revealed that this institute has done a lot of crossing and generation superior types along line selection of characterist Unfortunately much research has not been done on status of sweetpotato in Nigeria.

Sweetpotato is a rich source of Vitamin A and li amount of other Vitamins such as Vitamins B and (Ndolo *et al.* 2001). It produces more edible ener protein and dry matter basis than any other crop (Hortor *al.* 1989; Edwell and Mutuvra 1991). It is often a sou of starch used in industries to manufacture adhesiv dextrin, paper and also cosmetics. It is also a source Mg, K and other mineral (Lu *et al.* 1989). Sweetpotatc also used industrially to produce glucose syrup, noodl and alcohol. Its flour often acts as dough conditioner bread manufacture and functions also as a stabilizer in cream. It can also be used as animal feed or infant fc (Ambe 1997; Oyeniyi *et al.*2004; Meludu *et al.* 2004).

Large quantities of sweetpotato, mainly culls are used some countries as a high carbohydrate feeding stuff cattle, pigs and poultry (Otoo *et al.* 2001). They occasionally used as food for Tilapia in ponds (Kay 197 The foliage has the potential for use as vegetable and eaten in parts of Africa and the Philippines (Alvai 1987). Bacterial and fungicidal substances have be isolated from both the tubers and the vines of sweetpot and used in a number of countries for various medici purposes (Kay 1973).

Sweetpotato in Africa is mainly a women's crop fr planting to harvesting, processing and utilization washing, boiling, frying or roasting for hum consumption (Nungo *et al.* 2000). Due to hi perishability of the crop after harvesting, farmers ha been confined to home consumption and minimal amou are sold to neighbours or immediate communities. T variety grown in Nigeria is mostly the white-fleshed typ with pockets of orange-fleshed varieties in few places a still on trial in research institutes. Unfortunately, farme and consumers do not utilize diverse processing a utilization methods. This study highlights select processing and utilization methods that have be developed and need to be transferred to farmers a consumers. This will enable the establishment a functioning of cottage industries, as proposed by Melu in 2006. Sweetpotato was cultivated and harvested by final year student of Agronomy Department University Ibadan in 2003. Root samples of 11 varieties we transformed into toasted granules. The toasted granul were made into "speba" (eba) (Meludu *et al.* 2003).

In 2004, sweetpotato tubers were purchased from a local market in Ibadan Oyo State and were transformed into toasted granule. Some roots were dried and milled into flour and the flour was used for baking cookies and queen cakes. In 2005, the leaves were dried and processed into tea and also in cooking soup. In 2006 some sweetpotato roots were purchased from a local market in Abagana, Anambra State and were transformed into toasted granules, and also milled into flour.

Materials needed. Sweetpotato products and materials needed for each are as follows:

1. Toasted granules: sweetpotato roots, knife, basin, grater, empty rice bag, sieve, dewatering press, fuel wood, fireplace, steel pan, and spatula.
2. Flour: sweetpotato roots, knife and basin.
3. Cake: sweetpotato flour, margarine, eggs, baking powder, fruits and flavourings.
4. Cookies: sweetpotato flour, margarine, baking powder and flavourings.
5. Juice: sweetpotato roots, water and syrup (optional)
6. Tea: dried sweetpotato leaves
7. Soup: fresh sweetpotato leaves
8. "Kunu" drink: sweetpotato, guinea corn and millet
9. Pottage: sweetpotato roots, palm oil, salt
10. Fries: sweetpotato roots, vegetable oil

Results

Some areas were identified in Anambra State as the major sweetpotato producing localities, such as in villages in Anambra East and Anambra West with the following variety names: Ije agwo, Agric, White, butter and Abakiliki butter (white- and orange-fleshed varieties respectively).

Recipes using sweetpotato roots and leaves

Recipe 1: Sweetpotato toasted granules

Ingredients:

5 kg of Sweetpotato roots

Method:

1. Sweetpotato roots are peeled manually (peels should be consumed by livestock)
2. Wash the peeled roots and sent for grating
3. After grating, put into an empty washed feed bag
4. Put the bag under the jack press to press out water whish could be allowed to settle and starch will be collected
5. Depending on the taste one wants to have (for sour taste, put in a bag and allow to stay for 1–3 days or fry the same day for sugary taste)
6. Sieve out chaff before toasting (sifted particles should be consumed by livestock)
7. Toast the sifted granules

Recipe 2: Sweetpotato flour

Ingredients:

5 kg sweetpotato roots

Method:

1. Sweetpotato roots are peeled manually (peels should t consumed by livestock).
2. Wash the peeled roots.
3. Cut into chunks and dry under the sun for 2–5 da depending on the weather.
4. Mill into flour.
5. Sweetpotato flour could be used for confectionaries and f making fufu like "amala"

Recipe 3: Sweetpotato Cake

Ingredients:

500 g sweetpotato flour — 100 g margarine
3 eggs — Fruits and flavourings
3 teaspoons baking powder

Method

1. Sieve flour and add baking powder.
2. Rubbing the margarine and mix in the egg with wood spatula.
3. Add flavourings and fruit and scoop into small baking tin
4. Bake for 15–25 minutes.

Wheat flour (50 %) could be added to the quantity sweetpotato that will be used and about half or the sa quantity of sugar to margarine could also be used.

Recipe 4: Sweetpotato Cookies

Ingredients:

500 g sweetpotato flour — 150 g margarine
1 egg — Flavourings
1 teaspoons baking powder

Method

1. Sieve flour and add baking powder.
2. Rubbing the margarine and mix in the egg with wo spatula.
3. Add flavourings and cut with biscuit cutters and plac baking pan.
4. Bake for 15–20 minutes.

Recipe 5: Sweetpotato Juice

Ingredients:

1 kg sweetpotato root — 3 litres of water
10 ml vinegar as preservative

Method

1. Peel, wash and boil sweetpotato roots

2. Mashed and add water, strain and boil
3. Cool and add vinegar
4. Pour the juice in an air tight bottle and chill before serving

Recipe 6: Sweetpotato Tea

Ingredients:

Fresh sweetpotato leaves

Method

1. Wash the leaves and dry under a very intense sun or in a very low oven
2. Grind the dry leaves into powder
3. Put some in boiled water and serve as tea.

Recipe 7: Sweetpotato Soup

Sweetpotato fresh leaves are used in cooking soups of different kind. Most preferred is egusi soup. Wash and cut the sweetpotato leaves and add to the soup just 10 minutes before the soup is done. Serve with "speba", eba and any type of fufu.

Recipe 8: Sweetpotato Pottage

Ingredients:

10 roots of sweetpotato	salt to taste
2 tablespoon palm oil	Pepper to taste
½ cup crayfish	1 onion
Fresh tomatoes (optional)	250g meat or fish (optional)

Method

1. Wash, peel and wash the sweetpotato.
2. Cut into pieces.
3. Put water on fire and add fish or meat, ground crayfish, sliced onions, ground pepper, salt and oil.
4. Allow to boil, add sweetpotato and turn to mix up the ingredients.
5. Allow to boil for about 20–30 minutes.
6. Addition of vegetable like `Efirin' or `Chuanwu' (scent leaves) is optional.
7. Serve warm.

Recipe 9: Sweetpotato "Kunu"

Ingredients:

10 cups of Guinea corn	10 cups of Millet
10 sweetpotato roots	10 litres of water
5 roots of ginger (optional)	

Method:

1. Pick out stones and pebbles from the grains and soak for 2-3 days.
2. Grind into fine paste with the ginger and the sweetpotato.
3. Sieve with muslin cloth (use for sifting pap)
4. Boil three quarter of the liquid for 5 minutes and add to the un-boiled one-quarter and mix very well cover.
5. Cover for about 20 minutes, chill and serve as a refreshing drink

Recipe 10: Sweetpotato fries

Ingredients:

Sweetpotato roots Vegetable oil for deep frying

Method

1. Wash sweetpotato roots.
2. Peel and wash again
3. Cut into thin sliced pieces
4. Fry in deep oil and serve hot with drinks, sauté vege stew

Conclusion

The crux of the matter in this study is that the m consume sweetpotato the less deficient you are in A. The study has exposed the different suitable f preparing sweetpotato. Though the colour of the p is not very palatable, the consumers will invariably to them. After all, the colour of chocolate is not c from some of processed products of sweetpotat transformation is the role the confectioneries could reduce post harvest losses and bulkiness of fres improve nutrition towards sustainable swee production and consumption.

Recommendations

There is the need for participatory training on swee processing and utilization technology that will i demonstration, person-to-person discussion farmers' field day. Also the display of already pr products and testing of prepared products w necessary. Sweetpotato multiplication centres sho established in every state.

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Sensory Evaluation of Bread Produced with Composite Flour of Wheat and Sweetpotato

Paper submitted to FIIRO/ RMDC/ AFAN and Cassava Growers Association of Nigeria

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Abstract. Bread samples were produced using wheat and sweetpotato flours in composite flours. The loaves of bread were formulated using the approved bread recipe, substituting sweetpotato flour with wheat flour at 5 %, 10 %, 15 %, 20 %, 25 %, and 30 %, respectively. Sensory evaluation of the bread samples were determined using 9-point Hedonic Scale of preference with 9 = like extremely and 1 = dislike extremely. The sensory parameters tested included: taste, texture, aroma, and overall acceptability of the product. The result of the sensory evaluation indicates that bread samples made from 100 % whole wheat flour (WWF) were rated higher in all parameters tested. However, significant differences were not found for bread samples with up to 10 % sweetpotato flour, while *acceptable* bread samples were produced from 15–20 % sweetpotato and wheat flours. The least acceptable of all the bread samples were those with higher level of substitution of wheat flour, at 25% and 30 % in the composite flour. The results indicate that comparat bread could be produced from sweetpotato flour with up 20 % substitution without adversely affecting the quali parameters of the bread.

Introduction

Sweetpotato *(Ipomoea batatas)* is an important staple cr in Africa, and it plays a major role as a food and cash cr (Bashaasha 1995; Ewell 1993). It belongs to the botani family Convolvulaceae, and is a creeping annual crop. T stems are twiny or vines, thin, dark green to brown colour and contain latex. The tubers vary greatly in si shape, colour, and quality or taste, depending on varie Tubers contain starch, some sugar, protein, and Sweetpotato is rich in vitamins A, B, and C. Ihekoroi (1985) reported that wheat could not grow in the hur tropical areas of the world, especially Africa. Therefo there is need to also use non-wheat flour in baked fo products. Several bread formulations have been develo from non-wheat flour mixed with oats, potato flo cassava, peanut meal, sorghum flour and rice flour (De *et al.* 1970; Eggleston 1992; FIIRO 2004). There is m sense in using indigenous and local crops like sweetpo in bread production, because it will save Nigeria a g deal of foreign exchange spent on the importatior wheat. Thus, the objective of this study was to deterr the sensory quality of bread produced from the use of u 30 % substitution of sweetpotato flour with subst wheat flour.

Materials and Methods

The sweetpotato tubers used were obtained from Ov Market in Offa; other ingredients were obtained fron Department of Food Technology, Federal Polytec Offa, Kwara State Nigeria.

Production of sweetpotato flour. The metho Bashaasha (1995) was used to produce wheat flour. cleaned sweetpotato tubers were washed and sliced i a 10 % solution of sodium meta-bisulphite, and allow remain there until they were removed and draine drying. The drained tubers were put in a pre-heated ca dryer at low temperature of 70°C and dried. The sweetpotato tubers were ground in the attrition followed by sieving. The flours obtained were kept i tight containers for further use. Figure 1 shows the st producing sweetpotato flour.

Sweetpotato tubers —>Washed —>Peeled —>Sliced —>Drying —>Milling —>Sieving—>Sweetpotato flou

Figure 1: Flow Chart for Processing of Sweetpotato flour Source: Bashaasha (1995).

Method of bread production. Bread samples were produced from composite flour at various percentages of inclusion of sweetpotato flour (0 %, 5 %, 10 %, 15 %, 20 %, 25 %, and 30 %), while whole wheat flour was used as the control. The recipe of Ihekoronye (1985) was used, with modification. The percentage of sugar and quantity of water were increased. The bread samples were baked using straight dough method as described by Chuahan *et al.* (1992).

Sensory evaluation. A set of 25 members of staff and students of the Polytechnic community were served the seven loaves of bread for sensory evaluation using a 9-point Hedonic scale of preference, where 9 indicates "like extremely" and 1 is "dislike extremely". The parameters tested include colour, texture, aroma, taste, and overall acceptability. The data obtained were subjected to statistical analysis.

Results and Discussion

Table 1 shows the result of the sensory evaluation. The bread produced from 100 % whole-wheat flour (control) was rated best for all attributes tested. Bread samples containing 5 and 10 % sweetpotato flour were rated closer to the control. The taste panellists were unable to record significant differences among the attributes tested, except for taste and overall acceptability. This may be due to the familiarization of the panellists with the whole-wheat bread. Bread samples with 15 and 20 % sweetpotato flour (SPF) had lower mean scores when compared to the control. However, the products containing 15 and 20 % were quite acceptable, and compared favourably with control samples, and those with lower levels of sweetpotato flour. This shows that adding sweetpotato flour up to 20 % has no negative impact on the quality of bread, in terms of all parameters tested. This is in line with the findings of Dendy *et al.* 1970; and Ihekoronye 1985. Bread samples with 25 and 30 % sweetpotato flour had the lowest mean scores. Most of the panellists complained that the bread had poor colour quality, aroma, and taste. The taste of the sweetpotato became more pronounced at higher levels of inclusion in the composite flour.

Conclusion

In conclusion, bread samples with sweetpotato flour substitution, up to 20 % could be used to produce bread without affecting its quality negatively. Wheat flour substitution above 25–30 % would adversely affect bread quality (colour, taste, and aroma). The results of this study indicate the optimum level of sweetpotato that could be added to wheat flour, without negatively impacting on the quality of bread produced. This will help the F Government to save foreign exchange.

Table 1: Mean scores of sensory evaluation of bread fror with different levels of sweetpotato in mixture with wheat

Bread quality attributes	% sweetpotato in composite flour					
	0	5	10	15	20	25
Crust	7.6a	7.4a	7.2a	6.9a	6.8a	6.7b
Colour	7.1a	7.0a	6.9b	6.7b	6.3bc	4.7f
Texture	7.3a	7.2a	6.7b	6.6bc	6.3bc	5.0e
Aroma	7.3a	7.1a	7.0a	6.6bc	6.5bc	5.8d
Taste	7.4a	6.9b	6.1bc	5.6d	5.0e	4.8f
Overall accepta-bility	7.5a	6.9b	6.9b	5.8d	5.6d	5.0e

Mean scores with the same letters along the rows are not signil different ($P < 0.05$)

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The Role of Sweetpotato in Livestock Farming in Nigeria

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Introduction

The uncertainty surrounding the escalating cost of cereals as traditional sources of energy for livestock feeding makes it imperative to seek alternative sources. The potential and wide ecological adaptability of sweetpotato makes it a likely suitable alternative. Sweetpotato is an import crop in the feeding of humans and livestock in developing economies.

In Africa, only 3 % of the total production estimate is believed to be utilized for animal feed, while over 20 % is reported to be wasted (Calpe 1991). This suggests improved processing techniques and greater awareness of sweetpotato's potential will lead to its greater use in livestock feeds. Oboh (1987) cited the following potential attributes of sweetpotato in livestock feeding:

1. Sweetpotato competes favourably with or far outstrips some well-known root and tubers in terms of nutrient content.
2. No serious competition for its uses as staple in Nigeria
3. The Irish potato, an alternative to sweetpotato, is preferred by humans
4. Sweetpotato produces more dry matter and has a greater feeding value per acre than even maize
5. The peels and vines can be utilized for animal feeding thereby reducing wastes.
6. Research has shown that as much as 40 % sweetpotato can be used in broiler ration without detrimental effect on the performance of broilers.
7. Sweetpotato contains low toxic factor no adverse effect on production when the root is used, compared to cassava.

Status of sweetpotato in livestock feeding at the Department of Animal Science, University of Ibadan

The Department of Animal Science has conducted research on the feeding value of sweetpotato as a replace for maize in the diets of rabbits, cockerels and broiler chickens. Sweetpotato leaves have also been fed as forage to small and large ruminants. Encouraging results have been obtained in terms of body weight gains, semen quality and milk yield.

Potentials of sweetpotato as livestock feed

Many workers have considered the suitability of sweetpotato (roots and tops) in feeding livestock. Most of these studies attempted to replace maize either wholly or partially with sweetpotato as an energy source. Inclusion of uncooked sweetpotato at 250–300 g/kg diet for pi lead to slower growth and a lower protein efficiency rat but popping improved starch availability and al eliminated trypsin inhibition completely. Earlier work have reported reduce back fat thickness of yearling cat when corn was replaced with dehydrated sweetpot roots. Furthermore, milk yield was also improv Sweetpotato leaves supply enough carotene needed colouring egg yolk.

Limitations of sweetpotato as animal feed

Poor starch digestibility has been recognised as a ma constraints in the utilization of raw sweetpotato livestock feeding. Previous studies have shown that sweetpotato starch is less susceptible to a-amy hydrolysis than in cooked cereal starches. Heating therefore, essential for better use of sweetpotato sta Trypsin inhibitor found in sweetpotato affects prc utilization and for this reason inhibition caused by try should be removed by adequate processing methods.

Conclusion

Sweetpotato is widely grown in all agro-ecologie Nigeria. In the face of the unprecedented rise in the cc maize in livestock feed, sweetpotato has a compar advantage as a substitute in feeding livestock.

Nigerian Scientists working on use of sweetpotat livestock feeding at Department of Animal Sci University of Ibadan are: Professor O. O. Tewe, Prof A. D. Ologhobo, Professor E. A. Iyayi, Professor Oluyemi, Professor G. N. Egbunike, and Dr. O. A. Professor S. O. Oboh has done work at Departme Animal Science, Ambrose Alli University, Ekpoma State, while Dr. O. A., Olorunisomo is of the Depar of Animal Production and Health Science, Univers Ado-Ekiti, Ado-Ekiti, Ekiti State.

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Cost Implications of Feeding *Clarias gariepinus* (Burchell) Processed Sweetpotato (*Ipomoea batatas*)

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Abstract. Maize is an expensive energy source feedstuff in fish management especially during the c season, hence the need to source and utilize other chea and non-conventional energy sources. This stu investigated the growth performance of *Clarias gariepi* fry fed processed sweetpotato meal as an energy sou and its effect on the haematological and economic valu Three experimental diets were compounded such t maize was 100% energy source in Diet 1 (Control). Diets 2 and 3, maize was replaced with sweetpotato tu (SPT) and sweetpotato peel (SPP), respectively at 25 inclusion level. The diets were fed at 5 % body weight the *C. gariepinus* fry (0.21 ±0.03 g) in polystyrene cages suspended in 3 concrete tanks (2 x 3 x 1.2 m^3) for days in triplicates. Growth, nutrient utilizati haematological parameters were measured and c evaluations were calculated. The mean weight g (MWG) of the fry fed the maize-based diet (1.96) v significantly higher ($P< 0.05$) than the fry fed SPT (1.: and SPP (1.27) respectively. The MWG of fry fed Diet and 3 were not significantly different from each other. T feed conversion ratio (FCR) of the control and the SF based diets were not significantly different from each otl but both were significantly different ($P<0.05$) from f fed the SPP diet. The Growth Efficiency Feed Conversi

(GEFC) values of the 3 diets were 0.50, 0.51, and 0.40 respectively and were not significantly different from each other. However, the protein efficiency ratio (PER) and the survival rates were significantly better in fry fed the SPT-based diet (0.51; 95 %) than in fry fed the maize-based diet (0.50; 92 %) and the SPP-based diet (0.40; 82 %) respectively. The haematology results showed that the fry fed the control diet had the lowest MCV and WBC counts while the fry fed sweetpotato-based diets manifested moderately severe normocyctic normochromic anaemia and leucocytosis, which means that the maize diet showed better haematological indices. The economic evaluation revealed the need to produce SPT and SPP at low costs value to reduce the overall fry production cost. This study showed that sweetpotato-based diets have potential as substitute replacement for maize. In addition, it is recommended that sweetpotato replaces maize at less than 25% inclusion for maximum growth, economic and haematological performance in catfish diets.

Key-words: Growth performance; nutrient utilization; processed sweetpotato; *Clarias gariepinus*; haematology.

Introduction

The processing and utilization of sweetpotato (*Ipomoea batatas*) has been the focus of several researches in Nigeria (Oyenuga 1968; Tewe *et al.* 2000; Ojeniyi and Tewe 2001) and outside Nigeria (Woolfe 1992). These works have demonstrated the agronomic potentials of sweetpotato, in the humid zone of Africa, its nutritional value, the processing and utilization of sweetpotato in human cuisine, livestock feed and its industrial usage.

In Nigeria, sweetpotato is regarded agriculturally as a minor root crop but it is classified as a major crop in the developing world (Woolfe 1992). It does not feature as a main food in Nigerian dishes quite unlike yam and rice. Most farmers in humid Africa grow sweetpotato for their family's consumption (Odebode 2004). Moreover, in Nigeria, very little processing of sweetpotato is being done; it is usually added to yam, cassava or millet to prepare different Nigerian dishes (Odebode 2004). Other sweetpotato products such as chips, starch, puff-puff, chin-chin, buns, bread, jam and crisps (Table 1), when introduced into the food industry will enhance the demand for new sweetpotato varieties (Odebode 2004). However, very limited use of sweetpotato, if any, has been reported in fish diet. Since it is not a major food crop in Nigeria, there will be limited competition for its usage in human food if found appropriate for fish. Its cultivation should be encouraged on a larger scale. Hence, the objective of this study was to determine the nutrient utilization of *C. gariepinus* fry fed sweetpotato meal and peel as a cheaper source of energy and its effect on some haematological parameters.

Table 1. Product types, processing steps and utilization o sweetpotato

Product Type: Sun-dried chips (milled into flour).
Product name: a) Sweetpotato Cake
Processing steps: Fresh roots, peeling, chipping, sun-dryin (2days), and milling
Description: Sun-drying chips, milled, product is usually whit in colour, and can store for 3-6months
Utilization: Serve as snack, use dish to entertain visitors.
Product name: b) Other products: Puff-puff, Buns, Bread, ar Chin-chin
Utilization: Served as snack, used to entertain visitors, and u for income generation
Product Type: Sweetpotato leaves
Processing steps: Wither fresh leaves in the sun to get soft, b for 20-30minutes, and squeeze to drain water.
Description: For making soup. Narrow leaves are preferred broad leaves.
Utilization: Vegetable soup. Serve with pounded yam, eba amala
Product Type: Sweetpotato toasted granules ("sparri")
Product name: "Sparri"
Processing steps: Peeling, grating, de-watering, sieving, toasting
Description: Can store for more than 6 months. Vulnerabl storage pests, so put in refrigerator
Utilization: Soak in water, add groundnuts, and drink as a sn or stir into boiled water and serve with soup
Product Type: Boiled sweet sweetpotato tuber
Product name: Sweetpotato Ketchup
Processing steps: Boil sweetpotato tuber, chop and mix tomato, sugar, onions, vinegar, salt and water
Description: Put in refrigerator
Utilization: Serve with bread as breakfast
Product Type: Sun-dried chips
Product name: Sweetpotato chips
Processing steps: Peel, trim, chip, and deep fry
Description: Shed and deep fry. It is better to avoid breakag
Utilization: Serve as a snack
Product Type: Sweetpotato tuber
Product name: Sweetpotato Jam
Processing steps: Peel (450g) tuber, simmer for 20minute 3 lemons + 3 oranges and boil in 750 ml water + 6 g Citric and cook for 25minutes at 92^0C till mixture is thickened.
Description: Put in refrigerator
Utilization: Serve with bread as breakfast

Source: Odebode 2004.

Problem description. The pressure on the utilization of maize for energy in human food and for livestock causes the price of maize to fluctuate especially during the off-season. This phenomenal increase affects the cost of fish feed, which represents over 60 % of the cost of inputs on a fish farm. Sweetpotato is a minor crop in Nigeria and the pressure for its use in human food and livestock feed is not as great as that for maize. In addition, there is a dearth of research on the utilization of sweetpotato tubers or peels.

Sweetpotato, especially the peels, are products for the waste-bin because research has not highlighted the potential for their utilization in livestock feed. In the tropics, sweetpotato has a 5-month growth cycle, which implies that it can be grown twice a year. In calorie deficient diets, Woolfe (1992) reported two significant advantages of sweetpotato over most staple crops. As a crop, it has the highest useful energy production rate among the major tropical food crops (e.g., sweetpotato 194 MJ ha^{-1} day^{-1} ; rice 149; maize 145; cassava 138; banana 113; sorghum 101; yam 94; millet 82). Hence, sweetpotato can provide significantly more calories on a given unit of land per unit of time. It is a nutritious food, providing a good supply of Vitamin C, calcium and iron and can be an excellent source of pro-vitamin A (Tsou and Hong 1992). Many Asian countries such as China are utilizing sweetpotato as an industrial starter product for manufacturing starch and alcohol and as a replacement for conventional energy crops, which constitute major energy sources for humans, such as maize, Irish potato and rice (Woolfe 1992). The usage of the sweetpotato peels needs to be encouraged to reduce the pressure on conventional sources of energy food like maize for livestock feed, especially for fish, if research highlights its potentials. The carotene content in the orange variety of sweetpotato and its influence on the pigmentation of catfish fry will be another potential point for the utilization of sweetpotato in its nursery management.

Materials and Methods

Preparation of SPT and SPP flours. Mature tubers (11.0 kg) of white-fleshed sweetpotato variety were harvested from 4 rows (4.0 x 1.0 m^2) of a homestead garden. The tubers were peeled and immediately the peels were soaked for 1 hour to reduce the concentration of sugar. Finally, the peels were drained and dried. The peeled sweetpotato tubers (SPT) were sliced and soaked for 1 hour and sun-dried to constant weight within 3 days with at least 5 hours daily. The dried slices of SPP and SPT were ground to flour separately and incorporated in experimental diets as source of energy to partially replace maize in Diets 2 and 3, while Diet 1 had maize as the main source of energy.

Experimental diets. Three experimental diets formulated as follows: Diet 1 is the control and ha sweetpotato inclusion; Diets 2 and 3 had 25 % replaced by SPP and SPT respectively (Jackson 1982; Olukunle 1996; Olukunle and Agboola 2005) dietary energy content of the feed was calculated by the conversion factors of 4, 9, and 4 for p carbohydrate and lipids, respectively. The crude p level of the diets was a mean of 46.9 $\pm$ 0.57 %. Pr research recommended between 45 % and 50 % p inclusions in the diet of fry/fingerling stages of c (Viveen and Huisman 1985; Adekoya *et al.* 2004) three diets were iso-calorific (3.47 kcal/100 g). experimental ingredients were weighed, thoroughly n moistened, pelleted, sun-dried for 6 hours and sto polythene bags until used.

Experimental tanks. Three concrete tanks dimensions 2.0 x 3.0 x 1.5 m^3 were used as experin tanks. Three net-cages were suspended on bamboo st with each tank representing each treatment. The were impounded with tap water to a depth of 1.2 m the tanks and allowed to fallow for 14 days. Subsequ fresh water was supplied from connected municipal t 0.25 ml/min to replace water loss by evaporation. water quality parameters such as temperature, diss oxygen, pH, and alkalinity were weekly taken and t samples were monitored at the initial, mid-way (weeks) and at the end (6 weeks) of the experiment u standard methods (Boyd 1982).

Experimental fish. A batch of 100 advanced fry o *gariepinus* with mean weight of 0.21$\pm$ 0.03 g were all per cage, and were fed 5 % of total body weight per da 10.00 hr, 14.00 hr, and 18.00 hr daily. Biweekly weig was done and the quantity of feed fed to the fish adjusted relative to the weight gained. The experin lasted 42 days. The diets and carcasses were analyzed proximate composition using Standard Analytical Meth (AOAC 1991). At 21 days, and at the end of experiment, blood samples were taken from the ca peduncle of randomly selected fingerlings pooled f each treatment for haematological studies according Falaye *et al.* (1999) and Olukunle *et al.* (2002).

The data obtained were analyzed using the analysis variance (ANOVA) and standard error was used estimate the probability of significant differences am the treatments.

Results and Discussion

Table 2 shows the composition of the ingredients used the formulation of the experimental diets. The variation

the dry matter composition of processed sweetpotato in this study and those of other researchers like Oyenuga (1968), Ashida (1982) may be due to differences in variety, time of harvest, and/or length of storage. The sweetpotato used in this study was processed immediately after harvest. Table 3 shows the gross composition of the experimental diets used.

Premix composition (per kg). The composition of the premix used in this study was: Vitamin A 12,500,000 IU; Vitamin D_3 2,500,000 IU; Vitamin E 40,000 mg; Vitamin K_3 2,000 mg; Vitamin B, 3,000 mg; Niacin 5,500 mg; Calcium Panthothenate 55,000 mg; Vitamin B_6 11,500 mg; Vitamin B_{12} 25 mg; Chloride 500,000 mg; Folic Acid 1,000 mg; Biotin 80 mg; Mn 120,000 mg; Fe 100,000; Zn 80,000 mg; Cu 8,500 mg; 1_2 1,500 mg; Co 300 mg; Se 120 mg; Antioxidant 120,000 mg.

Tables 3 and 4 show the gross composition and the proximate composition of the experimental diets. The mean crude protein in the diets ranged from 45.58 % in Diet 2 to 48.13 % in the Control while the dietary energy values have a mean value of 3.47±0.16 mg/l and were not significantly different from each other. The mean crude protein of the experimental diets ranged from 45–50 %, that is within the range recommended by Viveen and Hisman 1985; Adekoya *et al.* 2004.

Water quality. The water quality analysis for the experimental tanks is shown in Table 5. Temperature variations were limited in all the tanks to 27±1.12^{0}C. All the parameters were within acceptable ranges as recommended by Boyd 1982 and Viveen *et al.* 1983.

The food conversion ratio (FCR) of the diets ranged from 1.97–2.5 (Table 6), which is an indication of the acceptability and good conversion of the diets by the experimental fish. The FCR of the SPT diet (1.97) and the control (2.0) were not significantly different from each other while that of the SPP (2.5) was higher and significantly different ($P < 0.05$) from the control. There were no significant differences ($P \leq 0.05$) within the values of GECF among the treatments. The PER values were however significantly different ($P \leq 0.05$) within the treatments. The PER values explain the fact that the crude protein in the SPT diet was better utilized than the SPP and the maize based diets. The higher fibre content of the SPT diet probably aided faster digestion of Diet 2. The MWG was highest in the maize-based diet (control), and it was significantly different ($P < 0.05$) from the two sweetpotato diets. However, the MWG of the sweetpotato-based diets were not significantly different from each other. A treatment using whole sweetpotato (tuber plus peels) flour would probably make little difference. However, using peels while utilizing the tuber for human consumption be a better economic option. Peels are products mean the garbage heap so finding use for them will environmentally friendly. The maize-based diet (con elicited a significantly ($P < 0.05$) better gr performance and utilization than the sweetpotato-b diets. The SPT-based diet was not much different i MWG and GEFC values from the SPP statistically b the other parameters the SPT fed fish performed b than the fish fed the SPP diet.

The haematological result (Table 7) indicated that the blood parameters analyzed, the fry fed the contro were significantly different ($P < 0.05$) from fry sweetpotato diets. This observation is similar to reported by Olukunle *et al.* (2002) and Taiwo *et al.* (in the examination of the nutritional values of cow meal and grasscutter faeces in the diets of hybrid c and *C. gariepinus* bloodstock, respectively. Howeve sweetpotato-based diets were not significantly dif from each other, except in the WBC counts and the N values. The high WBC counts in the sweetpotato-diets may be an indication of a defence reaction l experimental fry in Diets 2 and 3 which were compo with 25 % sweetpotato replacement. The 25 % inc level may not elicit the optimal performance level experimental fish. Similar observations were repor Olukunle (1996); Falaye and Oloruntuyi (1998) high concentrations of sesame seed cake (SSC plantain peel meal respectively suppressed fish gro *Clarias* fingerlings. The latter authors made the sug that further research should be made to obtain the c inclusion levels of SSC and plantain peel meal in th of *C. gariepinus* fingerlings.

Tables 8 and 9 show the cost analysis of th ingredients used in the experiment. The average the energy inclusion is highest in the SPT-bas (244.1), while that of the SPP diet was lowest (2 There are three assumptions: (1) a fry diet should in protein component. This explains the low l maize (E) inclusion and the protein component; size of the diet should be as small as the mouth siz fry, hence, the attempt to reduce the fibre (whe rather than the already small maize (E) inclusion utilization of SPT and SPP; and (3) the sweetpotat cost the farmer next to nothing since it is expect used as a cover crop but an arbitrary cost ha assigned for the sake of cost analysis. If a nil valu to do the analysis the cost of sweetpotato-based c be cheaper than the maize based diet.

Table 2. Proximate composition (per 100 g) and gross energy content of ingredients fed to *Clarias gariepinus*

	Maize[1]	SPP[1]	SPP[2]	SPT[1]	SP[1] whole	SP[2] whole
Dry matter	90.38	28.72	30.00 (25.45)[3]	11.70 (36.36)[3]	28.08	86.80
% Crude Protein	10.65 (9.00)[4]	5.24	1.50	6.33	5.36	3.30
% Crude Fibre	0.06	0.41	0.40	0.34	0.33	N.A.
Lipid	4.09	0.46	0.30	1.34	0.54	0.60
% Ash	2.13	2.96	N.A.	4.18	3.21	2.70
% NFE	83.20	91.49	78.30	87.44	90.56	79.20
Gross Energy (Kcal/100 g)	409.65	391.06	111.00	N.A.	N.A.	337.00

Sources: (1) Oyenuga (1968); (2) Ashida (1982) p. 48; (3) Present work; and (4) FAO (1983).
SP: sweetpotato; SPP: sweetpotato peels; SPT: sweetpotato tuber; NFE = Non-fat extract

Table 3. Gross composition of experimental diets for *Clarias* fry

Ingredients	Treatments		
	Maize	SPT	SPP
Fish meal	50.86	51.26	49.43
Soya bean meal	33.90	34.17	32.95
Maize	3.00	3.00	3.00
Wheat offal	3.24	0.23	1.42
SPT	-	2.34	-
SPP	-	-	4.20
Palm oil	3.00	3.00	3.00
Premix (growers)	2.00	2.00	2.00
Lysine	1.00	1.00	1.00
Methionine	1.00	1.00	1.00
$Ca_3(PO_4)_2$	1.00	1.00	1.00
Salt	1.00	1.00	1.00
Total	100.00	100.00	100.00

Table 4: Proximate composition of experimental diets for *Clarias* fry

Diets	Treatments			Mean
	1	2	3	
% Moisture	10.03	8.83	9.84	9.57±1.03
% Crude protein	48.13	45.58	46.32	46.67±1.21
% Crude lipid	6.78	9.28	7.57	7.88±1.42
% Crude ash	8.64	9.33	9.33	9.10±0.41
% Crude fibre	3.81	4.87	3.98	4.22±0.23
% NFE	21.32	22.80	22.36	22.16±0.11
Dietary energy (kcal/100g)	3.57[a]	3.57[a]	3.42[a]	3.47±0.16

Table 5: Water quality parameters during the study at mean temperature of 27 °C

	Alkalinity (mg/l)	Dissolved oxygen (mg/l)	pH
Initial	10	6.2	7.2
Tank 1	10	7.4	7.4
Tank 2	7	8.4	7.2
Tank 3	5	9.2	7.1
Tank 4	10	7.0	6.9

Table 6: Growth performance and nutrient utilization of *C .gariepinus* fed processed SPT and SPP

Growth parameters	Treatments			Mean
	1	2	3	
Total No. of fish stocked	100	100	100	100
Mean initial weight (g)	0.23a	0.23a	0.19a	0.21 ±0.05
Mean final weight (g) (MFW)	2.19a	1.59b	1.46b	1.75 ±0.15
Mean weight gained (g) (MWG)	1.96a	1.37b	1.27b	1.53 ±0.14
Mean daily weight gain (g/day)	0.05a	0.04a	0.03a	0.04 ±2.02
Total percent weight gained (%)	852a	623c	668b	714.3 ±2.97
Specific growth rate (g/day)	0.70a	0.33b	0.25c	0.45 ±0.07
Total feed intake SGR (g)	362.2	256.8	264.4	294.5 ±0.18
Mean feed intake/fish (g)	3.94	2.70	3.22	2.55 ±1.91
Average No. of survivals	92.0a	95.0a	82.0c	90 ±1.05
Feed conversion ratio (FCR)	2.0a	1.97a	2.5b	2.2 ±0.16
Gross efficiency feed conversion (GEFC)	0.50a	0.51a	0.40a	0.45 ±0.7
Daily protein intake (g/day)	8.62a	6.11b	6.30b	7.01 ±0.29
Protein efficiency ratio (PER)	0.50b	0.59a	0.39c	0.49 ±0.07

Numbers along the same row followed by the same letter are not significantly different ($P < 0.05$)

Table 7. Haematology of *Clarias gariepinus* fingerlings fed the experimental diets

Parameters	Treatment		
	Maize (1)	SPT (2)	SPP (3)
PCV (%)	31.8 ± 0.3a	28.3 ± 0.3b	28.3 ± 0.5b
HbC (mg/dl)	10.0 ± 0.1a	8.7 ± 0.2b	8.5 ±0.3b
RBC counts ($x10^6$/ml)	2.6 ± 0.1a	2.3 ± 0.2b	2.2 ±0.2b
WBC counts ($x10^3$/ml)	17.8 ±2.4b	23.2 ± 0.8a	24.1± 1.5a
MCV (fl)	122.3 ±2.2b	123.2 ± 3.2b	128.6 ±3.1a
MCHC (%)	31.4 ± 0.6a	30.7 ±3.1b	30.1±2.2b

HbC: Hb concentration; Numbers along the same row followed by the same letter are not significantly different ($P < 0.05$)

Table 8: Cost analysis of feed ingredients (₦ : K)

Diets Feed Ingredients	Maize	SPT	SPP
Maize inclusion (₦ : K)	50.86 (15.77)	51.26 (15.87)	49.40 (15.31)
Plant Protein Inclusions			
Soybean meal (₦ : K)	33.90 (4.07)	34.17 (4.00)	32.95 (3.98)
Average Cost of Protein Inclusion (₦ : K)	19.84	19.99	19.26
Feed ingredients			
% Energy inclusion			
- Maize (₦ : K)	3.00 (195.00)	3.00 (195.00)	3.00 (195.00)
- Wheat offal (₦ : K)	3.24 (32.40)	0.23 (2.30)	1.42 (14.2)
- SPT (₦ : K)	- -	2.34 (40.80)	- -
- SPP (₦ : K)	- -	- -	4.20 (42.00)
Average cost of Energy	217.40	244.1	213.40

Conclusions

This study highlighted the potential of sweetpotato-based diets in fattening catfish fry in its nursery management. However, the haematological analysis does not appear to support using sweetpotato processed products at above 20 % level, probably due to microbial contamination. More hygienic preparation and less of sweetpotato tuber or peels in diets of catfish fry may be more beneficial and will reduce cost of diet and profit index. Other modes of processing sweetpotato are suggested, such as applying dry or moist heat to kill pathogens so as to elicit better growth and utilization comparable to maize-based diets for the catfish fry. Hence, there may be need to include the SPP and SPT at lower levels (e.g. 5−20 %) to obtain optimal performance in the diet of advanced fry of *Clarias gariepinus*.

Table 9: Economic evaluation of three *Clarias* fry diets

Index of evaluation	Diets			Me
	Maize (1)	SPT (2)	SPP (3)	
Incidence of Cost	217.40 1.96 110.92a	244.1 1.37 178.18c	213.40 1.24 168.03b	152 ±1.
Profit Index	1.96x8.52 217.40c 0.077a	1.37x8.69 244.1b 0.049b	1.27x8.76 213.40 0.050b ± 8.061	
Productive Protein Value	0.05 8.62	0.04 6.11	0.03 6.30	
Protein intake (g)	0.0058 $5.8x10^3$	0.0065 $6.5x10^3$	0.00496 $4.76x10^3$	
Dietary energy (Kcal/ 100g)	3.57a	3.57a	3.40b	3.5 ±0.

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Utilization of Sweetpotato *(Ipomoea batatas)* for Bread and other Confectionery Products

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Preamble

Federal Government efforts to the utilization of ro tuber crops for the producing composite flour fo making are highly commendable. When this pro becomes fully implemented, it would reduce the importing wheat and save Nigeria's foreign exchang been recommended that the composite flour produce contain 10 % cassava flour, thus reducing the qua wheat flour consumed. Besides conserving exchange, it will create employment opportuniti promote indigenous technology.

Sweetpotato *(Ipomoea batatas)* is a root crop that fin in much the same way as cassava and other carbohydr crops. It is grown in most parts of the world, especiall tropics where the bulk of the crop is cultivated and con The crop is very popular in certain parts of Nigeria, es Kwara State, and particularly Offa Local Governme (LGA). The people of this area have historical, trac and cultural affiliation with the crop. Its popularity ha Offa town to be associated with the crop and it has l their 'logo'. In local parlance it is called "anomo Despite its popularity in the LGA and among othe groups in Nigeria, the potential of this crop has not be exploited in the area of utilization.

Justification

Sweetpotato belongs to family Convolvulaceae or n glory family. It is classified as *Ipomoea batatas*, a indigenous to South America from where it has across the tropics and sub-tropics. It has large starch tuberous roots and it is an important crop. The young and shoots are used as vegetables. In parts of the States, it is often called yam; however, swee is different from the Irish potato and at the same time d from yam of the *Dioscorea* species. Swee tubers are often boiled or fried in oil; its leaves are vegetables in soup. The tubers, especially the yellow-type, are rich sources of vitamin A and C. It high calorific value supplying the body with 21 kiloj energy. The texture of the tuber, sweetness, siz Shape varies with different varieties. It does not con dreaded hydro-cyanide found in cassava. The crop

cultivated twice a year in certain parts of the country and it can be easily adapted to mechanized farming. They are mostly propagated by stem or root cuttings or by adventitious sprouts called slips that grow out from the tuberous roots during storage. True seeds are used for breeding only.

Cultivation and Yield

It has been documented that sweetpotato grows best where the mean temperature is about 25°C with high sunshine and rainfall of at least 300 mm over the growing period of about 4 months. It performs best in well-drained loamy soil that is very rich in humus. Therefore, it can be cultivated in most parts of the country. The planting materials that are normally used consist of stem cuttings of about 30–40 cm long from tips of the grown, mature plants. The bottom leaves of each cutting are removed and the lower half of the cutting sown. Sweetpotato could be planted on ridges or mounds. The ridges are usually 100 cm apart and up to 50 cm high. Yields of up to 40 t/ha may be obtained, but an average of 15–20 t/ha are normal. Sweetpotato can be cultivated twice in a year during rainy season.

Harvest and Storage of Sweetpotato

Sweetpotato tubers are usually harvested one time (in Offa area) by uprooting the tuber from the soil. The tubers loose much of their moisture during prolonged storage, but still have good nutritive value. Harvesting of tubers should be done promptly to minimize losses due to spoilage.

Composite flour production

It has been documented that several carbohydrate-rich plants could be used to produce composite flour used for making bread and other confectioneries. Available records show that wheat cannot grow in humid tropical areas of the world, especially Africa. Therefore, there is the need to use composite flour for baked food products. Bread formulations have been developed using wheat flour mixed with flours of oat, potato, cassava, sorghum, rice, etc. Therefore, it is wise and profitable to use locally produced crops like cassava and sweetpotato to bake bread. The problem with bread from composite flour is that the resulting bread is not identical with bread from 100 % wheat flour. The level of flour from other carbohydrate sources added to wheat that can be used for baking products ranges from 5 % to 50 %, and depends on the type of baked products. The use of composite flour in the bakery industries offers some advantages among which are: the provision of employment opportunities for those who produce non-wheat crops, reduction in the importation of wheat, and the utilization of locally produced crops. Finally, it introduces diversity into the ra of products in terms of texture, colour, and taste; thus mal it more competitive in the market.

Efforts of the Department of Food Technology, Federal Polytechnic Offa

Sweetpotato research has been highly emphasized in Department for producing many food products such as bi chin-chin, puff-puff, doughnut, garri, tapioca, cake, coo coconut cake, Scottish shortbread and noodles.

Sweetpotato and Malnutrition

Over the years, one of the major problems facing Africa deficiency of protein, vitamins, and mineral in most o foods, especially among children. Sweetpotato snacks be used to alleviate this problem if such snacks are fort The Department of Food Technology, Federal Polyte Offa has intensified efforts in the fortification of sweetpotato snacks with proteins, vitamins, and mineral Department has concluded work on sweetpotato co fortified with protein, sweetpotato garri fortified with pr vitamins, and minerals as well as sweetpotato chin-chi doughnuts fortified with protein, sweetpotato chips for with minerals.

Sweetpotato and Power supply

The Departments of Food Technology, Physics Electr and Electrical Electronics of the Federal Polytechnic, O at present in a collaborative study on the use of sweetpo generate electricity. Promising results have been ob from the aspect that deals with food technology.

Limitations

One of the problems with new products is th acceptability. We believe our efforts backed with enlightenment would help people understand the adva offered by these new products.

Conclusion

It is our belief that, if sweetpotato research and develc were given the necessary financial support, it would provide food for Nigerians. Furthermore, it would l alleviating poverty through the creation of empl opportunities for our youths and jobless graduates wh to grow and use the crop.

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Sweetpotato Leaves: My Experience as a Consumer

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Introduction

Please, imagine with me if you will, a delicacy within arm's length, nourishing and satisfying. No matter how hungry you are, you are willing to wait because you know it is worth the wait. That describes sweetpotato leaves. Like most vegetables, it is rich in minerals and high in protein, but unlike others, it stands out with a unique taste. In some other parts of the world, we share this same view, but to the typical Nigerian, the leaves are not even considered to be edible, which justifies why it is not found on sale in markets. Unlike my mother who for many years grew sweetpotato on her father's farm without tasting the leaves, I had the opportunity of growing up in Sierra Leone and enjoyed this leafy vegetable.

I fell in love with sweetpotato leaves as a child. In Sierra Leone, sweetpotato is a very popular and most important vegetable — one of the staple food items. Both the leaves and the tubers are consumed and can be easily purchased in markets. We grew it in our backyard garden, and due to its perennial and spreading nature, it was always available for use. We would simply go out and pluck just enough leaves to prepare the soup and cook as we desired. Even after relocating from Sierra Leone to Nigeria, we planted the vines again and they thrived. I recall times when it was freely prepared and other times when it was a life-saver when finances were low or when I could not just make the trip to the market. Definitely, eating solely sweetpotato everyday would become tiring, so it was not our practice to do so. We enjoy other vegetables also, but whenever sweetpotato leaves were prepared, it was a welcome treat.

When sweetpotato vines are available, they can easily be planted at an angle with buds facing up, each vine cutting being about 25–30 cm long. About two months after planting, one can start picking the leaves. Fresh leaves are randomly plucked off the vines, along with the petioles, which are eaten with the leaf laminae. After this time, one can pick the leaves daily for as long as one desires. Sweetpotato is a hardy plant that can survive during the dry season. Even if the plant dries a bit, by the time the rains begin, it springs back to life — flourishing. One of its advantages is that it is not appealing to goats and sheep, so one can confidently cultivate it in ones backyard. More so, it regenerates itself, unlike other vegetables that must be planted every growing season. It should be noted that when sweetpotato is grown mainly for leaf vegetable, t tuber size would definitely reduce. In Sierra Leone, only real competitor crop is cassava leaf, which is equa as great, but the advantage of sweetpotato leaf is that takes less time to prepare.

Rice is a main staple food in Sierra Leone and it is eat with most vegetables. Sweetpotato leaves are also be eat with morsel-type foods like eba or amala. In fa sweetpotato leaves are prepared like any other cook vegetable: amaranthus or celosia. The recipes given belc are thus the Nigerian recipe and the Sierra Leonean recip

Ingredients

40 sweetpotato leaves
2 chilli peppers (rodo)
½ cup of water
1 "Maggi" cube
1 tablespoon of locust bean
2 wraps of dry fish or fresh fish
4 medium ripe tomatoes
2 medium onions
1½ cup palm oil/ oil
4 pieces of meat
Salt
3 tablespoons of ground groundnut/ peanut butter
*4 medium red bell peppers (tatase) and 1 garden egg (S. Leon

Nigerian recipe

Instructions. Purée the tomatoes, bell peppers, chil pepper, and onions. Thoroughly wash the sweetpota leaves and cut thinly, along with the petioles. Ensure the are no sand grains. Season the meat as desired and bo until tender. Pour the puréed ingredients, along with th fish, locust beans, boiled meat, salt, "Maggi" cube, wate and oil in a pot and allow to cook at medium heat for abo 15 minutes, to make the sauce. If it is dry fish that is use it should be washed and void of bones. Next, add shredde leaves, stir with the sauces in pot and let it cook another 1 minutes. More salt could be added to one's desired taste.

Sierra Leonean recipe

Instructions. Follow the same procedure as for th Nigerian recipe, except that the garden egg is sliced int the puréed ingredients to make the sauce. Raw tomatoe need not be added to the puréed ingredients. Then, afte the vegetable is half-cooked, add the ground groundnut a the last in gradient. As the leaves themselves contai water, so the half-cup of water will be sufficient. The o can be reduced, depending on one's desired taste. Th vegetable does not purge, but aids in bowel movement.

Conclusion

Sweetpotato is a crop that is still waiting for its ful potential to be exploited. The tubers and the leaves presen several opportunities for research. I hope you enjo exploring it as much as my family has done over the years

Sweetpotato Crop Improvement

Sweetpotato Breeding Program at NRCRI, Umudike, Abia State, Nigeria

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Mandate

The mandates of the NRCRI, Umudike which include the research into the production, processing, storage, utilization and marketing of root and tuber crops of economic importance (sweetpotato, cassava, yam, potato, cocoyam, ginger etc), has as its main research focus the research into the genetic improvement of these crops.

Sweetpotato Breeding Activities

Attempts at developing new sweetpotato cultivars for the production system in Nigeria started in 1975 and could be described in two phases: (i) Phase I: 1975–1989, and (ii) Phase II: 1990 till date.

Phase I (1975–1989). This phase was characterised by local sweetpotato germplasm collection and collection of elite genotypes from the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria, conservation of the genetic materials, and evaluation of the germplasm collections. Traits screened for included fresh root yield, pests (*Acrae acerata, Cylas* spp) resistance, dry matter content, starch content, flour content and reducing sugars. IITA as the regional backstopping centre was responsible for the development of new segregating populations which were distributed to NARIs. These were the sources for the bulk of the genotypes that were worked upon during this era.

Phase II (1990 till date). This phase started with the employment of a breeder, and so started the establishment of crossing blocks, and the beginning of the development of segregating population in the Institute. The first part of this phase (1990–1992) was short-lived as a result of the retirement of the breeder on the crop in 1992. For about a decade, no breeder was available for sweetpotato and other root crops as a result of the general embargo on staff employment by the then military government, and the difficulty in recruiting a breeder that was ready to work on root and tuber crops on a temporary basis.

The second part of this phase started in late 2002 with tl employment of a Breeder (Solomon Afuape) ai subsequent posting to the Sweetpotato Programme.

Sweetpotato breeding activities from 2003. The breedi cycle officially approved by the Government for t development of new varieties is as follows:

CROSSING —> SEEDLING EVALUATION (visual scree ing for virus symptoms) —> CLONAL EVALUATION (no replicated, 10–20 stands on a single row, 1yr) —> PYT (rep cated trial, 1yr, 1–2 locations) —> AYT (replicated, 1–2 y 2 locations) —> UYT (replicated, 2yrs, 2–4 locations, on-fa evaluation) —> MET /NCRP (replicated trials, 8–10 St ADPs, 2yrs)

The traits of interest for the breeding scheme include: high fresh root yield, (2) bland taste, (3) pest (*Cylas* s and disease (viruses) resistance/tolerance, (4) root size, high dry matter content, (6) high starch content, (7) h flour content, (8) adaptability to the environment, (9) l oil absorption, and (10) early maturity.

Summary of Breeding Activities So Far

1. Development of new populations and the selection desirable genotypes

(a) **2003:** Germplasm evaluation for fresh root yield, rc size, virus symptoms resistance, dry matter and star content. Parents were selected for crossing.

(b) **2004:** Development of sexual seeds through the polycross technique. About 5,000 seeds were collected.

(c) **2005:** Seedling development and seedling visual screening for virus symptoms. This was also follow by clone evaluation for root yield potential.

(d) **2006:** Preliminary yield trial (PYT) of 51 clones selected in 2005 in two locations.

(e) **2007:** Advanced yield trial (AYT) evaluating 17 clones in two agro-ecologies.

(f) **2008:** Uniform yield trial (UYT) evaluating 11 selected lines in three locations.

2007 cycle. In 2007, about 10,000 seeds were develop two locations (low and high altitude areas). These being raised into seedlings presently (2008) in the nu (Plate 1). The seedlings will be transferred to the fie September for virus and *Cylas* spp. screening, preliminary clones evaluation for root yield pote

SPVD, *Cylas* spp. root infestation, root size, drought resistance.

In 2009, some 100-200 clones will be evaluated in at least three locations representing the rainforest, savannah and high altitude ecologies.
Selected farmers will be involved at harvesting to aid in clone selection.

2. Germplasm Collection and Maintenance

(a) Between 1990 and 2000, there was a breakdown of the Tissue Culture Laboratory equipment for in-vitro germplasm conservation, and a serious fire incidence which led to the genetic erosion of the sweetpotato in vivo germplasm conservation field.
(b) By 2002, only nine genotypes were in the sweetpotato germplasm.
(c) In 2004, about 30 local cultivars were collected.
(d) In 2005, clones of 53 genotypes including OFSP were collected from CIP, Uganda of which 10 died due to viral pressure.
(e) In 2007, local germplasm collection yielded 54 genotypes (these are being characterized to determine the duplicate genotypes among them).
(f) Altogether, tentatively, above 100 genotypes are conserved in the sweetpotato germplasm with the Sweetpotato Programme, as well as the Germplasm Resources Unit (GRU).
(g) Work has also started to back up the in vivo conservation with in vitro in the Tissue Culture laboratory.

Progress to Date

Progress made by the Sweetpotato Programme, NRCRI, Umudike is as follows:

(a) In the last 10 yrs, three varieties have been officially released to farmers. The materials have wide adaptation to various agro-ecologies.
(b) Some 11 breeding lines with yield in the range of 20–25 t/ha, dry matter of up to 40 %, and starch of up to 27 % are at the tail end of the breeding cycle.
(c) In 2008, though still grossly inadequate, about 100 genotypes are being conserved and maintained in the sweetpotato germplasm from a paltry 9 genotypes in 2002.
(d) About 8,000 seedlings are being raised now in the screen house for a new selection cycle.
(e) Planting materials of the released varieties have been extended to five State Agricultural Development Programmes and students from 9 higher institutions across Nigeria. The five out-stations of the Institute which cut across the country also serve as points through which new varieties reach out to rural farmers.

Reinforcements

In order to facilitate further progress, the following are suggested:

(a) The renovation and the present operational status of th Tissue Culture Laboratory, with the newly constructed fiv screen houses will give the required support in germplasr maintenance (power is available 24 hours a day), propagul and line multiplication, as well as the raising of clea planting materials for farmers.
(b) Rapid multiplication capacity of the Tissue Cultu Laboratory is now enhanced.
(c) The functional status of the CIAT/NRCRI Molecul Biology lab has opened the door for the application of MA in sweetpotato breeding program.
(d) The top priority being accorded crop improveme programs by the Institute which led to the renovation laboratories and the construction of screen-houses can on improve our efficiency.

Constraints

The major constraints faced by the Sweetpotato programme include:

(a) Technical deficiency in the use of molecular markers sweetpotato breeding has limited our success rate a efficiency. Training is needed in this aspect.
(b) Technical deficiency in ELISA technique in detecti viruses, as well as thermo/chemotherapy in cleani materials with viruses is a problem. Training is need for this aspect.
(c) Operational vehicle for sweetpotato plant breedi program is needed for effectiveness and timeliness operations.

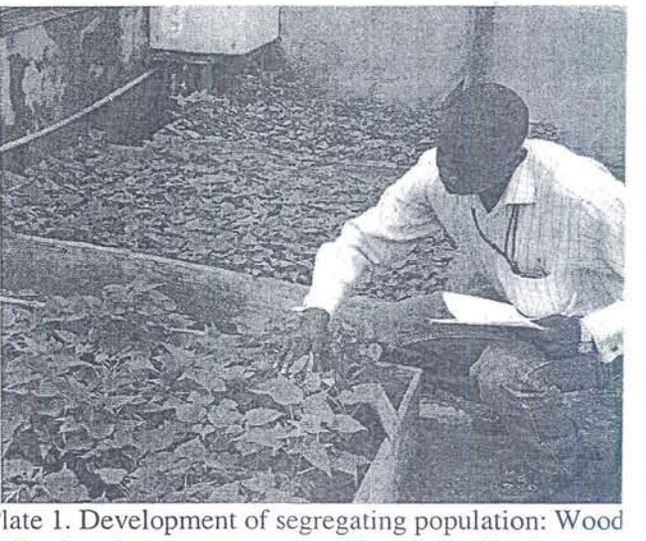

Plate 1. Development of segregating population: Wood slabs showing sweetpotato seedlings raised in the scree house from our 2007 sexual seeds.

Field Screening of Sweetpotato Germplasm at Umudike for Resistance to Root Knot Nematodes *Meloidogyne* spp.

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Abstract. This study was undertaken in 2003 to screen the available sweetpotato germplasm for resistance to root knot nematodes at Umudike. The results showed that there was significant varietal difference in root knot damage index and in tuber yield. CIP Wagabolige showed the least susceptibility to *Meloidogyne* spp., while Ex Igbariam had the highest susceptibility.

Introduction

The root knot nematodes *Meloidogyne* spp. are still major obstacles to the production of adequate supplies of food in the world (Taylor and Sasser 1978). Reports of susceptibility of sweetpotato to these nematodes have been much obtained from some sweetpotato areas like Puerto Rico. Evaluation of pest resistance forms the bedrock of integrated crop protecting and breeding schemes. In addition, sources of resistance have been identified for several crops but not much yet for sweetpotato. The objective of the screening trial was, therefore, to evaluate the reaction of al the varieties in the germplasm to natural populations of root knot nematodes in the field.

Materials and Methods

All the nine available varieties in the sweetpotato germplasm were planted in the National Root Crops Research Institute farm fields at Umudike in a randomized complete block design comprising five replicates and all other agronomic inputs and maintenance were applied as at when due. Three samples per plot were harvested at maturity and the following growth parameters and damage symptoms (foliage weight, number of tubers, tuber yield, and root knot index {0—5}) according to Caveness (1967) were measured and the collected data were analyzed.

Results and Discussion

The results of the varietal screening for resistance to root knot nematodes *Meloidogyne* spp. are shown on Table 1. There was significant damage between the varieties, and the varieties that showed levels of resistance were CIP Wagabolige, CIP 440168, and CIP Tanzania. However, it is these same varieties that had high foliage weight but significantly low tuber yields. It is interesting to note that the varieties with highest tuber yields were also significantly susceptible to the root knot nematodes. These results are those of the first year and second year data still being collected.

Table 1. Effect of natural populations of *Meloidogyne* spp on sweetpotato in 2003 at Umudike

Variety	Foliage weight (g)	Tuber yield (g)	Tuber no./plant	Ro knc ind
TIS 8441	245.30 b	300.60 bc	1.87 a	2.3
Ex Igbariam	233.22 b	221.42 c	2.55 a	3.1
CIP Tanzania	484.32 ab	143.94 c	1.54 a	1.2
TIS 86/0356	269.98 b	273.64 bc	2.52 a	3.(
CIP Wagabolige	268.13 b	115.46 c	2.05 a	0.9
TIS 2532 OP.1.13	174.56 b	554.99 a	1.59 a	2.:
TIS 87/0087	224.32 b	477.16 ab	1.84 a	3.(
TIS 8164	175.32 b	620.32 a	2.26 a	2.:
CIP 440168	705.30 a	111.82 c	1.98 a	1.

Means along the column with the same letter are not significantly different according to DMRT.

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Growth and Tuber Variability in Four Varieti Sweetpotato (*Ipomoea batatas*) in Ogbon Southern Guinea Savannah

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Abstract. A field experiment was conducted Teaching and Research Farm of Ladoke A University of Technology, Ogbomoso, Nigeria to the growth and tuber variability of four varie sweetpotato. The four varieties tested were those fc be adapted to Osogbo-Erinile agricultural zone o State. They were named as Erin 1 (V1), Erin 2 (V2). (V3), and Erin 4 (V4). Vines were collected fron Osun, Orolu Local Government Area, Osun State were cut into length of 20 cm and treated with I against sweetpotato weevil. The experiment was l

followed randomized complete block design with four replicates. Growth parameters assessed were vine length, number of leaves and leaf area at 4, 6, 8, 10 and 12 weeks after planting while tuber characteristics evaluated are number of tubers/plant, tuber length, diameter, cracking index and nematode infestation. The phytonutrient contents of the tubers such as Ca, Mg, P, Fe, moisture content, crude protein, fat, ash, total sugar, dietary fibre, vitamins A, B, and C were also assessed. Significant variability was observed among the four varieties of sweetpotato tested. The tuber yield was highest in Erin 3 while Erin 2 had the lowest. Despite this, tuber cracking index was highest (74 %) with Erin 3 variety. The sugar content varied from 22.88 % in Erin 2 to 26.84 % in Erin 4 while carotene/vitamin A content was highest in Erin 4 but least in Erin 2. Erin 4 was observed to be the most promising one among the tested varieties in Ogbomoso agro-ecological zone. This is because it is the most nutritious and produced medium sized tubers that are least prone to cracking.

Key words: Sweetpotato, tuber yield, phytonutrients, variety, growth parameters.

Introduction

Sweetpotato (*Ipomoea batatas*) is a staple food belonging to the tuber and root agricultural crop group and the Convolvulaceae Family. The crop is a critical essential food in developing countries claiming fourth place after rice, wheat and corn. The amount produced is similar to, or slightly higher than that of cassava. It is widely cultivated both in small home gardens and farm in the tropics. Sweetpotato is well known to contain high starch like other root crops like yam, but unlike any other root and tuber crop, is very rich in carotene and Vitamin A. Carotenes are antioxidant and play a vital role in preventing cancer and many other diseases. Vitamin A is also essential for children health. It is a fat-free food containing protein, vitamins and minerals. Though commonly consumed fresh, the tuber is quite versatile and may be used frozen, fried or dehydrated (flakes) among other derived foods. Further, new applications are extending sweetpotato for agro industrial usage. In addition, sweetpotato tubers are used for seed and animal feed. Recently, sweetpotato has exhibited great potential and versatility as an export item. Flakes, starch, flours and frozen sweetpotato products now join traditional fresh sweetpotato consumption and seed for import/export.

From season to season there are strong variations in sweetpotato prices and volumes. Processing allows the possibility to add value to fresh sweetpotato. This is particularly important in times of abundance, when the tuber price is lowest. Processing allows part of the ha to be retired from the market, thus introducing ce price stabilization. It also prolongs tuber shelf life sweetpotato, flour), employs below standard varieties direct consumption (bitter potato) and sweetpotato of l commercial value (very big, very small, unsigh Sweetpotato is highly adaptable crop and is able to gro a wide range of different agro-ecological zo Preliminary survey of the major area of sweetpo production in Nigeria revealed that the crop has fo favour with people in eastern part of the country an Offa (Kwara State) and Erin Osun/ Ilobu (Osun Sta Despite the nutritional importance and industrial poten of the crop it is less cultivated in Ogbomoso, South Gui savannah of Oyo State. The objective of the study wa assess four varieties of potato with the hope of introduc the most promising of them (in terms of tuber yield a nutritional composition) to farmers for cultivation.

Materials and Methods

Experimental site. The study was conducted at t Teaching and Research Farm, Ladoke Akintola Univers of Technology, Ogbomosho, Oyo State in 2007. Lado Akintola University of Technology Ogbomoso is locat on latitude 8^0 10'N and longitude 4^0 10'N and the altitu is about 420 m above sea level. Ogbomoso lies in t transitional zone between forest and guinea savannah. has a bimodal rainfall pattern with peaks in July a September, with a short rainfall break in August. Ear rains usually from late March/ early April to end of Ju while late rain usually starts in early September and en in Ogbomoso in late October/early November. The d season lasts from November to March. The experiment site has been under cassava, cropping for 2 years befo cleared for use. The bimodal rainfall of the area between, 150–1250 mm of rainfall.

Experimental design and treatments. A field experimer was conducted to assess the growth and tuber variability c four varieties of sweetpotato. The four varieties teste were those found to be adapted to Osogbo/ Erinil agricultural zone of Osun State. They were named as Eri 1 (V1); Erin 2 (V2), Erin 3 (V3) and Erin 4 (V4). The cro vines four all the varieties were collected from Erin-Osun Orolu Local Government Area, Osun State. They were cu into 20 cm lengths and treated with Furadan agains sweetpotato weevil. The experiment was laid out in a randomized complete block design with four replicates Each replicate contained all the 4 treatments. The crop wa spaced out on ridges at 1.0 m x 1.0 m apart. A plo measured 10 m x 10 m (100 m^2) and contained eleven

rows of crop and each row had 11 plant stands making 36 plants per plot. A replicate was 46 m x 10 m (460 m^2) in dimension and adjacent replicates were separated by walk-ways of 2 m.

Data collection. Growth parameters assessment was done on eight crop stands randomly selected per plot. The were assessed for vine length, number of leaves and leaf area at 4, 6, 8, 10 and 12 weeks after planting. At maturity another 12 plants per plot were randomly selected for determination of tuber characteristics such as number of tubers/plant, mean tuber length, diameter, cracking index and nematode infestation. For determination of tuber phytonutrient contents, at ripening eight tubers representing the various size ranges were randomly selected per plot and analysed for Ca, Mg, P, Fe, total soluble solids (TSS), moisture content, crude protein, fat, ash, total sugar, dietary fibre and vitamins A, B and C. Proximate compositions were determined using AOAC (1984) method. The tuber total N was determined by a semi micro-kjeldahl procedure (Bremner 1965; Ulger *et al.* 1997) and tuber protein calculated from the Kjeldahl nitrogen using the conversion factor 6.25. Ether extract was estimated by exhaustively extracting a known weight of sample with petroleum ether (BP 60^0 C) using a Tecator Soxhlet apparatus. The Total Soluble Solids (TSS) was determined by using the hand refractometer and vitamins content was determined by using the method of Jagdish *et al.* (2007). Mineral elements were estimated using the AOAC (1984) method. The atomic absorption spectrometer was used to determine Ca, Mg and Fe. Phosphorus (P) was determined using the colorimetric molybdenum-blue procedure (Murphy and Riley 1962).

Statistical analysis. The analysis of variance was performed on the data following procedure of Gomez and Gomez (1991) and significant means were compared using Duncan's Multiple range test ($P \leq 0.05$).

Results and Discussion

Sweetpotato tuberous root nutritional contents varied significantly among the four varieties tested (Table 1). The tuber Ca contents varied from 0.12 in Erin 4 to 0.38 g/100 g in Erin 3. Also, the rubber Fe content ranged from 8.6 in Erin 2 to 62.1 g/100g in Erin 1. The Fe content of Erin 1 was 45.1 %, 76.7 %, and 86.2 % higher than that of Erin 4, Erin 3 and Erin 2, respectively. Tuber total sugar and starch contents showed similar variability across the four varieties. The two parameters were at highest with Erin 3. It is worth noting that the values of these two parameters in Erin 3 and Erin 4 were similar. Figure 1 shows the root tuber yield of the tested sweetpotato. The order of tuber yields were Erin 3 > Erin 4 > Erin 1 > Erin 1. The tuber yield of Erin 3 was not statistically different from that of Erin 4, while that of Erin 4 was similar to that of Erin 1.

Plates 1 to 8 show the shoot and root tuber variability of the four varieties of sweetpotato used in this study. The Erin 1 variety is characterized by light green vines with large leaves and terminal flowers. The leaf area of Erin 2 was the smallest but with deep green leaves. The tuber colour varies from red in Erin 1 to creamy in Erin 4. In terms of tuber length, Erin 4 had the longest tubers, while the least was observed with Erin 3. However, the tubers of Erin 3 had the widest diameter, followed by Erin 1and Erin 4, with Erin 2 being the least.

Table 1. Variation in nutritional contents of varieties of sweetpotato tubers assessed in 2007 at Ogbomoso, Oyo State

Variety	Calcium	Iron	Total sugar	Total starch	Vitamin A*
Erin 1	0.32 a	62.10 a	4.25 a	26.12 a	212.4 0 a
Erin 2	0.30 b	8.60 c	3.18 b	22.88 b	189.30 b
Erin 3	0.38 a	14.50 c	4.34 a	26.84 a	217.50 a
Erin 4	0.12 c	34.10 b	4.39 a	26.79 a	224.90 a

Means with the same letter along the same column are not significantly different (DMRT 5 %); *: mg/ 100g dry tuber weight

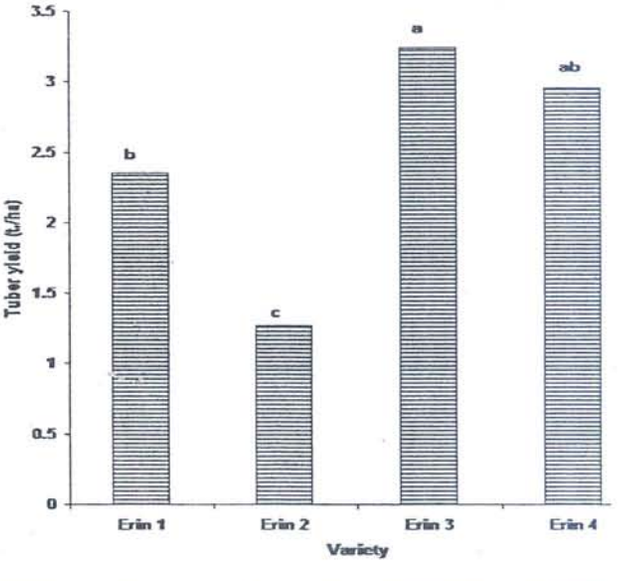

Figure 1. Tuber yield of four sweetpotato varieties Ogbomoso, Oyo State in 2007

Alphabets on the bars represent Duncan ranking at 5 % probability level. Bars with the same alphabet are not significantly different from each other.

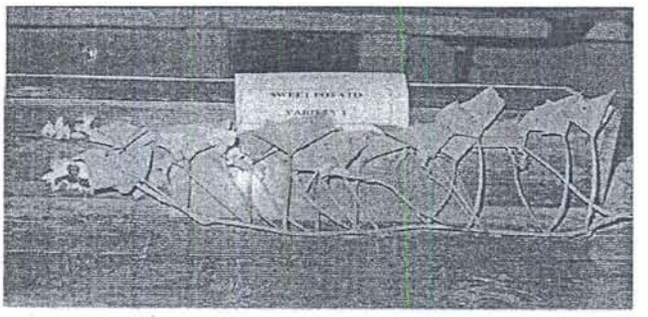

Plate 1. Vine and leaf shape of Erin 1

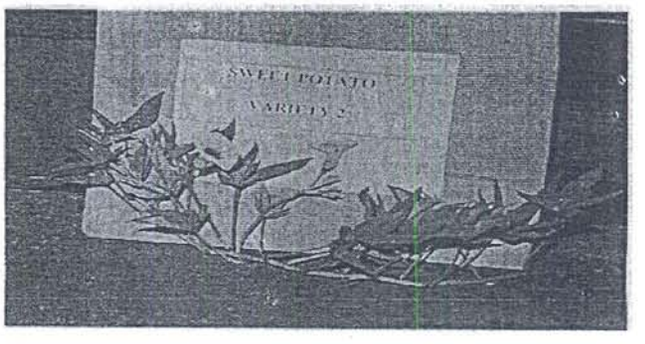

Plate 2. Vine and leaf shape of Erin 2

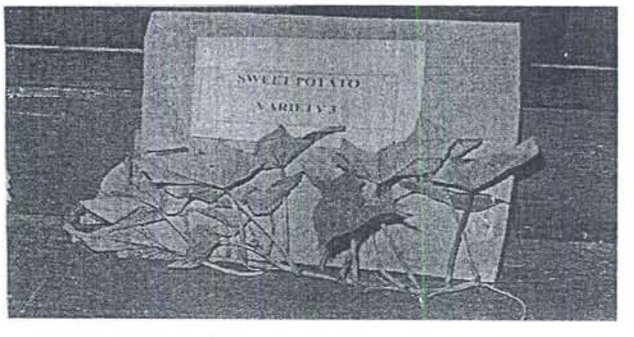

Plate 3. Vine and leaf shape of Erin 3

Plate 4. Vine and leaf shape of Erin 4

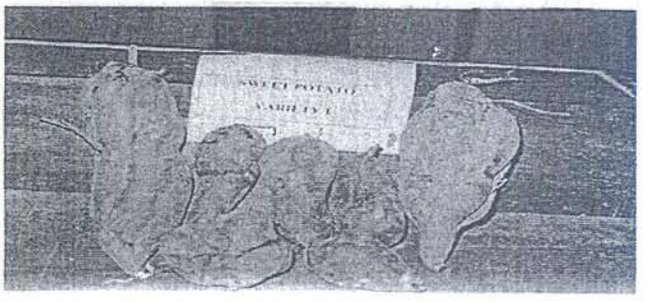

Plate 5. Tuber size and shape of Erin 1

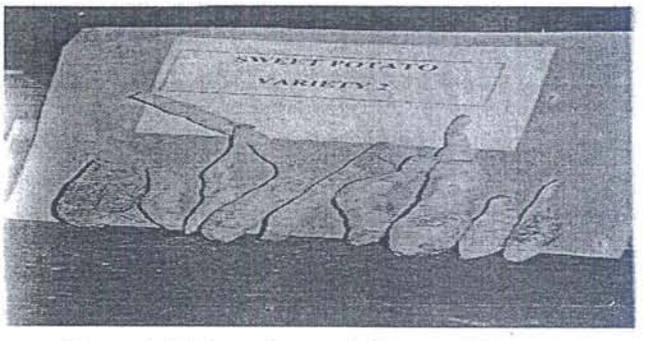

Plate 6: Tuber size and shape of Erin 2

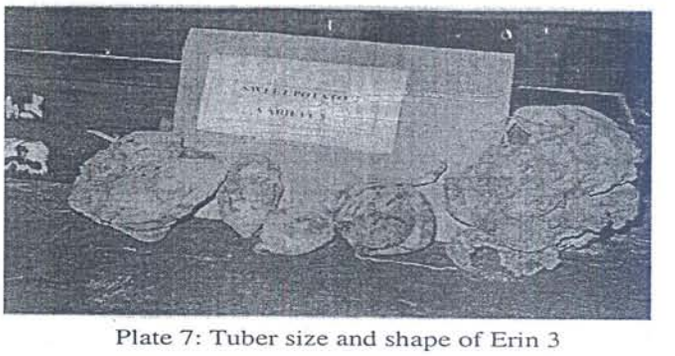

Plate 7: Tuber size and shape of Erin 3

Fig. 8: Tuber size and shape of variety 4

Summary and Conclusion

This study shows that economic tuber production of sweetpotato is possible in Ogbomoso. This is because the tuber yields obtained with Erin 1, Erin 3 and Erin 4 varieties compared favourably with what has been reported in sweetpotato-growing zones in Nigeria. Among the tested sweetpotato varieties, Erin 3 had the highest tuber yield. However, high cracking and nematode infestation associated with it may not make it a variety of choice for farmers. It was concluded that Erin 4 variety seems to be most promising because it produced medium-sized tubers which were highly nutritious and less prone to cracking and pest infestation.

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Assemblage, characterization and germplasm management of sweetpot clones at Ibadan, Nigeria

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Abstract. Sweetpotato is gaining importance i countries of the world, as a food crop with diverse use in Nigeria is mainly limited to boiling, fryi roasting, due to the short storage life of fresh t roots. Introduction of improved clones witl consumer acceptability can enhance food secu farmers' incomes in the country. Their wi cultivation and processing into value-added prod help. A total of 125 clones were collected October 2005 and March 2007, from locations w outside Nigeria. Characterization and evaluation from June 2007 to November 2008 at Ibadan to distinguishing traits for better identification, and selections for multi-locational trials. Am sweetpotato germplasm, there were 37 white-, 61 and 27 orange-fleshed clones with large variation traits. Of particular interest is the number of tut which is a determinant of yield; and boiled tube sensory preference, which indicates suitability end-uses in Nigeria. White-fleshed clones were more preferable (CV= 31.95 %), than yellc clones (CV= 42.50 %). The orange-fleshed clo were mostly moist to soft after boiling, were the (CV= 48.24 %). Efforts were made to ma germplasm collection from season-to-seaso University of Ibadan from March 2007 till date. cuttings of each clone were planted in plastic shade during the dry season, transferred to a multiplication in the early rainy season and star were planting out in a field when the rains had This germplasm maintenance cycle is effective is no outbreak of sweetpotato virus disease. M of germplasm should be de-centralized, includ back-ups to avoid total loss.

Key-words: Sweetpotato, germplasm, characte food security, Nigeria

Introduction

Root and tuber crops, including sweetpotato, are well-distributed, provide relatively cheap food, are a source of cash income, and supply food in times of scarcity in many African communities. They continually feature in the region's economic development (Quin 1998). This raises issues of competitiveness and efficiency in production, processing and marketing. In Nigeria, the main root and tuber crops are cassava, yam, cocoyam and sweetpotato. Production of cassava and yam has steadily increased in Nigeria in the last two decades. These two crops are firmly established in the diets of many Nigerians. Growth in sweetpotato production needs to be enhanced, due to its advantage of being a short-season crop that can be grown even in the Northern zones with short rainy season, as well as in most farming systems practiced in Nigeria. Also of importance is its superiority to cassava and yam in terms of nutrient content (Woolfe 1992), versatility of usage and usefulness of all plant parts. With tuber production of 3.49 million tonnes in 2007 (FAO 2009), Nigeria is the second highest producer of the crop in the world, after China's 102.24 million tonnes. This position was attained more by increase in area cultivated rather than increases in yields from farmers' farms. Nigerian research has a large role to play in enhancing sweetpotato production by increasing average yields, since farmland cannot be increased.

Sweetpotato (*Ipomoea batatas* [L.] Lam) originated in Central America and the North-Western parts of South America and has been cultivated probably from 300 B.C. Today, the crop remains one of the three most important root crops in the world, following the potato (*Solanum tuberosum*) and cassava (*Manihot esculenta).* The use of sweetpotato in Nigeria dates back to the 1594–1698 period when Portuguese traders introduced it. There are more varieties of sweetpotato in existence, than the number available for yams, cassava or cocoyam. Many of these have developed through breeding efforts, as well as natural hybridization and mutations. A lot of variability exists in sweetpotato as follows: (1) most varieties are trailing types; (2) enormous variability in leaf shape, size, and orientation; (3) leaf lamina is variously lobed or simple with petiole of varying length and degree of erectness; (4) there is a great variation in tuber number and yield; (5) tubers vary in size, shape and colour (usually cream, yellow, brown, pink or reddish-purple skin colour), while tuber skin ranges from smooth to ridged; (6) tuber flesh shows gradation of white, cream, yellow, orange, and purple, depending upon the amount of carotenoid pigments present and availability of anthocyanins (Onwueme and Charles 1994).

Little is known of the origins or characteristics of loca sweetpotato varieties in Nigeria, most of which can b assumed to be derived from varieties introduced b Europeans several centuries ago. Generally, one to tw varieties of sweetpotato are cultivated in farmers' field except in few areas where improved varieties have bee introduced (Tewe *et al.* 2001). This is one of the reason why poor yields are recorded. Increased production of th crop is desired, particularly as more emphasis is graduall being placed on agriculture. Local varieties cannot mee the demand of end-users for different utilization purpose This brings about the need to increase the genetic base o the crop in the country. Evaluation of phenotypic diversit usually reveals important traits of interest to plant breeder (Singh 1989), and this makes crop improvement possibl through the use of appropriate selection methods (Adebi *et al.* 2001).Crop variety is the main variable in the syster that farmers often manipulate to raise yields. For thi reason, sweetpotato varieties that are higher yielding tha the available local clones need to be identified an released after a good multiplication programme. Unt some effort is put in this regard, sweetpotato farmers wi continue to use the low-yielding varieties. Presently, th average yield of sweetpotato in Nigeria is 5t/ha. Thes yields result, in most cases, from the use of local varietie which are not genetically superior. Thus, farmers becom discouraged because the efforts they put into sweetpotat production is not commensurate with the yields obtained.

Justification

Recently in Nigeria, more attention is being given t sweetpotato by researchers and farmers alike because c the role it has to play in improving the food security an income-earning capacities of rural and urban household The advantages of increased sweetpotato production in th country have been highlighted by several authors (Eluag *et al.* 1986; Tewe at al. 2001; Egeonu 2004; Fawole 200 Akoroda 2009) What remains is a more concerted effort encouraging both increased production and consumptio of sweetpotato tubers. Varieties suited to the needs c various end-users already exist outside the countr Improvement of the crop will also entail introducing thes "exotic" varieties and subsequent release of those adapte to the different agroecologies in Nigeria. This study is contribution to efforts to improve the diversity c sweetpotato varieties available in Nigeria.

Materials and Methods

Sweetpotato germplasm collection. A set of 1 sweetpotato clones from a germplasm collection at th Department of Agronomy, University of Ibadan, wer originally from International Institute for Tropic

Agriculture (IITA), Ibadan. A minimum of 10 cuttings of Nigerian landraces were collected from 12 States (October 2005 to March 2007), and assembled at Ibadan. The States are: Ebonyi (October 2005), Abia (November 2005), Oyo (February 2006), Kwara (March 2006), Bayelsa (June 2006), Rivers (June 2006), Delta (June 2006) Akwa Ibom (July 2006), Cross River (July 2006), Benue (December 2006), Plateau (March 2007), and Kaduna (March 2007). The Nigerian collection locations are indicated in Figure 1. A total of 66 introduced sweetpotato clones were added to the collection from different sources, including the International Potato Centre (CIP), Kenya.

Sweetpotato germplasm characterization. The 125 sweetpotato clones were characterized in a field at Ibadan from June to November 2007, and June to November 2008. Ridges were made manually using hoes, after land clearing and removal of debris.

Planting of 25cm long vine cuttings was done on the crest of each ridge after light rains on 14 June 2007, and 10 June 2008. Each vine cutting was inserted at a slant, with two-thirds buried below the soil surface at a spacing of 30 cm along the ridge and 1 m between the crest of one ridge and another. The plot size used was 6m x 1m in two rows. This gave a total of 20 plants per clone. Weeding was done 4, and 8 weeks after planting, using small hoes, to keep the plots and walk-ways between plots free of weeds. No fertilizer was applied to the sweetpotato plants. The field plot was fenced round with chicken wire mesh during the cropping season in both years to keep out large pests like rodents and goats. A total of three botanic and seven agronomic plant characteristics were assessed from planting till harvest, and in storage up to 4 weeks after harvesting. The mature tuberous roots were harvested 4.5 months after planting using small hoes.

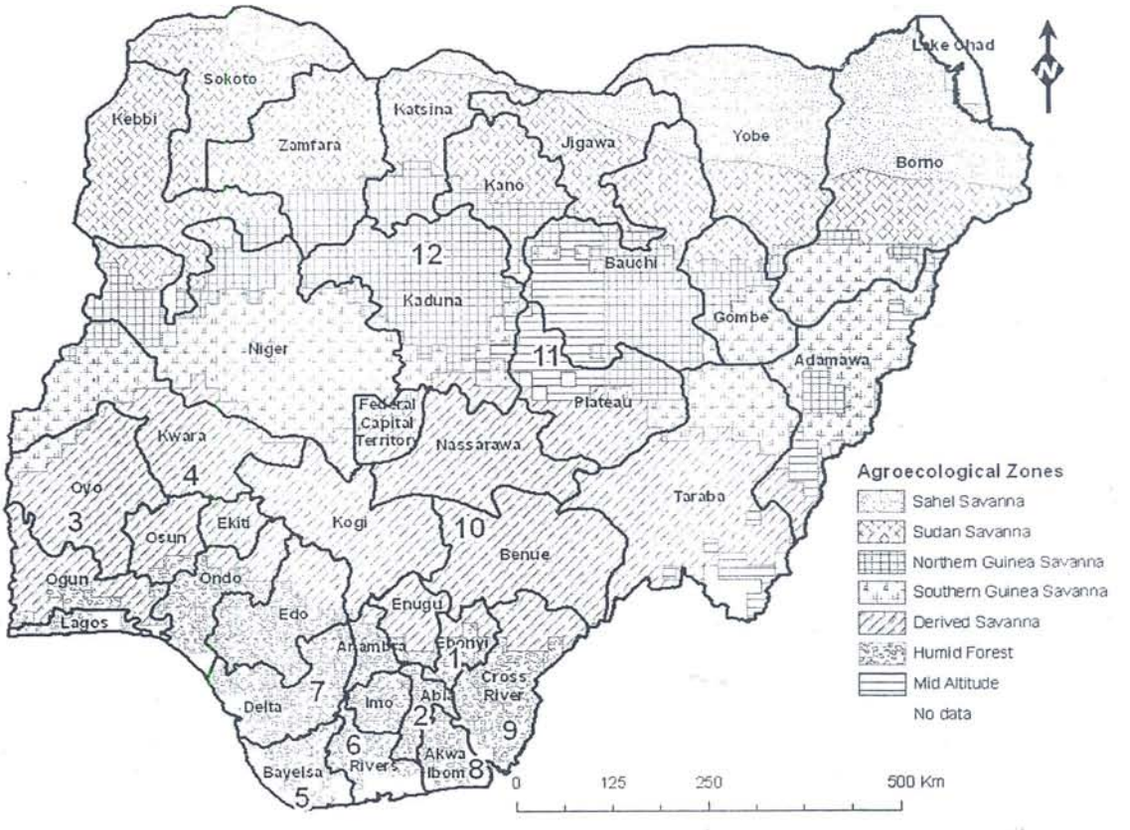


Figure 1. Locations for the sweetpotato germplasm collection in Nigeria from October 2005 to March 2007

(1) Ebonyi State: Abakaliki, Isielu, and Anuabe LGAs; (2) Abia State: Bende, Ikwuano and Umuahia North LGAs;
(3) Oyo State: Akinyele, Iseyin and Ibadan Central LGAs; (4) Kwara State: Offa, Oyun and Irepodun LGAs;
(5) Bayelsa State: Yenagoa, Sagbama and Ogbia LGAs; (6) Rivers State: Eleme, Egbema and Ahoada LGAs;
(7) Delta State: Udu, Isoko North and Ndokwa East LGAs; (8) Akwa Ibom State: Uyo, Ikot Ekpene and Etinam LGAs;
(9) Cross River State: Ogoja and Obubra LGAs; (10) Benue State: Makurdi LGA;
(11) Plateau State: Bokkos and Jos South LGAs; and (12) Kaduna State: Kajuru and Igabi LGAs

Botanic characteristics assessed for identification purposes are: (1) growth habit (90 days after planting), where the length of the main vine for each plant was measured, and a score assigned based on this. (2) mature leaf shape (90 days after planting), where the general outline of five mature leaves from five different plants were observed; and (3) tuberous root skin colour, where mature tuberous roots were washed in clean water and dried before observing the predominant skin colour and assigning scores.

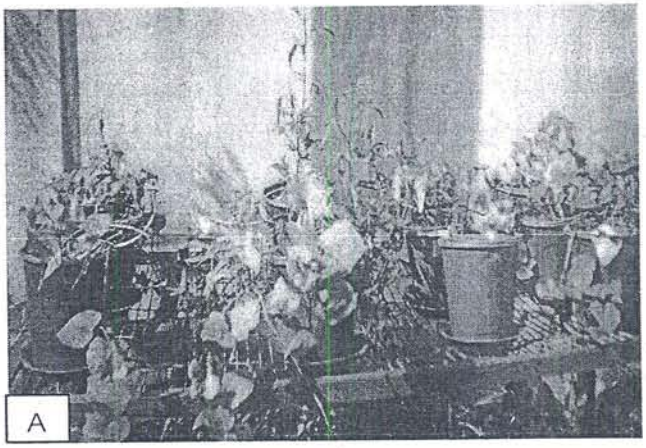
Agronomic characteristics assessed are: (1) number of tubers/plant (immediately after harvest); (2) weight of tuberous roots/plant (immediately after harvest); (3) tuber density (immediately after harvest); (4) weevil sc (immediately after harvest); (5) sensory preference (%) boiled tuberous roots, calculated based on scores assig for consistency, texture, sweetness and acceptability b taste panel (one day after harvest); (6) sprouting score weeks after harvest), where scores were assigned presence of sprouting of 10 tubers stored at ro temperature on a flat surface; and (7) tuberous root score 4 weeks after harvest where scores were assigned extent of rotting of 10 tubers stored at room temperat on a flat surface. Sweetpotato plant characteristics a their method, unit and time of assessment for the furtl characterization and evaluation of 125 sweetpotato clo at Ibadan in 2007 and 2008 are shown in Table 1.

Table 1: Sweetpotato plant characteristics and their method, unit and time of assessment for the further characterization and evaluation of 125 sweetpotato clones at Ibadan in 2007 and 2008

Characteristic	Method of Assessment	Unit of Measurement	Period of assessment
A. *Leaf*			
Mature leaf shape	Visual inspection	category	12 WAP
B. *Vine*			
Growth habit	Visual inspection, and classification based on length of main vine	category	12 WAP
C. *Tuber*			
Tuber skin colour	Visual inspection of whole tuberous roots after cleaning sample tubers free of soil	colour	16 WAP
Tuber flesh colour	Visual inspection of clean tuberous roots cut into equal halves	colour	
Fresh tuber weight	Measuring within an hour after harvesting and cleaning all tubers free of soil	kg	16 WAP
Tuberous root shape	Visual inspection	category	16 WAP
Number of tubers/plant	Counting of all tuberous roots from each plant	number	16 WAP
Taste evaluation	Boiling samples of fresh tuberous roots and presenting to a taste panel to eat and assess	Scoring for consistency, texture, sweetness, and appearance acceptability based on a scale indicated below	1 day after harvest
Sprouting of mature tubers	Visual observation and scoring of 10 mature tubers kept on a flat surface in a shaded, ventilated room for 4 weeks after harvest	category	4 weeks after harves
Weevil damage on mature tubers	Visual observation and scoring of 10 mature tubers kept on a flat surface in a shaded, ventilated room for 4 weeks	category	4 weeks after harves

Boiled tuber consistency: 1=watery; 2=extremely soft; 3=very soft; 4=soft; 5=slightly hard; 6=moderately hard; 7=hard; 8=very hard; 9=very hard and non-cooked;
Boiled tuber texture: 1=dry; 3=somewhat dry; 5=intermediate; 7=moist; 9=very moist;
Boiled tuber sweetness: 1=slightly bitter; 2=not at all sweet; 3=slightly sweet; 4=moderately sweet; 5=sweet; 6=very sweet;
Boiled tuber appearance acceptability: 1=very bad; 2=bad; 3=fair; 4=good; 5=very good

Sweetpotato germplasm management. In order to maintain the germplasm from season to season, a cycle of planting in plastic pots, nursery and field plots was used (Plate 1a-d). This began from short vine cuttings (10cm) planted in plastic pots, in March 2007. The soil in the pots was moistened three times a week until the rains began in mid-April 2007. Cuttings (15cm long) June obtained from these plants at the beginning of the rainy season and planted out on small beds in a small nursery for multiplication. They were allowed to grow for two months (April to June 2007). On 14 June 2007, 25cm vine cuttings of all clones were planted out on ridges in two-row plots in a field located at the Parry Road Experimental Field of the Department of Agronomy, University of Ibadan can The field was fenced round with 15mm chicke mesh to keep out rodents and goats. Plants were left months; tubers were harvested manually using smal Three small whole and healthy tubers were selec each clone in November 2007, and planted in plas placed on raised surfaces in a shaded enclosure. from these tubers were watered three times a week beginning of the rainy season in 2008. This c germplasm maintenance in plastic pots, then nurse field plot, was continued in 2008, to maintain the till 2009. Unfortunately, clones that were susceptible to sweetpotato virus disease (SPVD) di



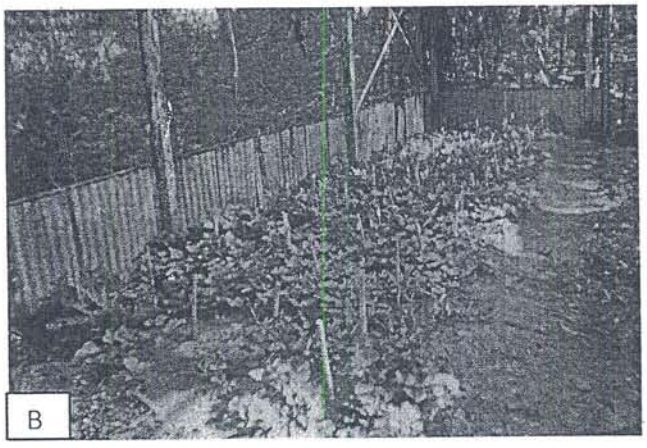


Plate 1. Sweetpotato clones in (A) plastic pots (late dry season); (B) a nursery during the early rainy season;

Plate 1 (C) a field plot during the rainy season; (from harvested tubers in pots in the next dry seas

Results and Discussion

Botanic characteristics. The collection origin and selected botanic characteristics of the sweetpotato clones assembled and characterized at Ibadan in 2007 and 2008 are shown in Tables 2–4.

In the germplasm collection, there were 37 v yellow- and 27 orange-fleshed sweetpotat Spreading growth habit was the most common clones). This makes it easier for multiplicatior since only 14 had erect growth habits. Only (Caroline Lee) had a hastate leaf shape, while the

remaining clones were almost equally distributed among cordate (40), lobed (41) and triangular (41) mature leaf shapes. As many as 33 clones had purple tuberous root skin, 39 had cream skin, and only two had dark purple skin. This makes the identification of clones based on skin colour alone, as practiced by sweetpotato marketers interviewed during the germplasm collection, quite unreliable. A better approach is to combine the growth habit, mature leaf shape, and tuberous root skin and flesh colour for more reliable identification.

Agronomic characteristics. There was a lot of variability in terms of number of tubers/plant, tuber weight/plant, sprouting score, weevil score, mean density, rot score and sensory preference for the 125 sweetpotato clones characterized at Ibadan in 2007 and 2008 (Table 4). For number of tubers/plant, the highest variation existed among white-fleshed clones (CV= 88.4%), followed by orange-fleshed clones (CV= 53.97%) and yellow-fleshed clones (CV= 48.13%). White-fleshed clones were generally more preferable (CV= 31.95), next were the yellow-fleshed clones (CV= 42.50%). The orange-fleshed clones, which were mostly moist to soft after boiling, were the least preferred (CV= 48.24%).

New cultivars with stable and high yield acceptable for local consumption are the main priority for sweetpotato crop improvement in developing countries Fuglie (2007). This applies in Nigeria because farmers still rely on traditional landraces. The wide variation in the germplasm collection shows the tremendous potential for improvement through breeding efforts.

Summary and Conclusions

The assessment has shown that sweetpotato grouped by flesh colour can respond to consumer demands. Consequently, the best of each colour group can be selected after further field evaluation at different localities for local suitability in terms of soil adaptation, disease/pest tolerance and culinary and sensory preferences. Taste panels with local people will help in this regard. Botanical traits for identification of these accessions are indicated and will be useful for separating them when in cultivation. The assemblage is an on-going event so also their characterization across locations of diverse agro-ecological environment s and seasons. Maintenance of germplasm should be de-centralized to avoid total loss due to in-situ degradation of environment, fire, livestock damage, theft and other hazards that would adversely affect the number and composition of the germplasm collection. Support for these activities may come from government and private sector as well as stakeholders in the sweetpotato commodity chain. This may include research institutes, medium to big farmers, independent researche marketers, processors and traditional authorities where t crop is a major staple.

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Table 2. Botanic and agronomic characteristics of 37 white-fleshed sweetpotato clones at Ibadan in 2007 and 2008

Clone No./Name	Origin	Growth habit	Mature leaf shape	Tuber skin main colour	No. of tubers/ plant	Tuber weight/ plant (g)	Fresh tuber yield (t/ha)	Percent Sensory preference
KB Wide	Japan	S	T	P	0	0.00	0.00	52.5
400004	CIP Kenya	SE	L	Y	0	0.00	0.00	0.0
Onne I	Rivers State	S	T	P	0	0.00	0.00	42.9
TIS 86/0356	IITA, Ibadan	S	T	P	1	7.00	0.23	49.2
TIS 87/0087	IITA, Ibadan	ES	C	P	2	104.00	3.47	54.2
Kalama Pink	Bayelsa State	ES	C	P	2	104.00	3.47	54.2
Zarama Market II	Bayelsa State	ES	C	P	2	104.00	3.47	54.2
Yibama I	Bayelsa State	ES	C	P	2	104.00	3.47	54.2
UMU I	Umudike, Abia State	S	C	P	2	166.67	5.56	53.3
Brondal	CIP Kenya	E	C	Y	2	18.00	0.60	40.2
AK Wide	Professor Akoroda	ES	T	PR	2	119.09	3.97	52.4
Famgbe II	Bayelsa State	ES	T	PR	2	119.09	3.97	52.4
Zarama Nyambiri II	Bayelsa State	ES	T	PR	2	119.09	3.97	52.
Yenaka II	Bayelsa State	S	L	P	2	223.33	7.44	41.
Ogoja	IITA, Ibadan	SE	T	PR	2	199.71	6.66	48.
Alphonso	IITA, Ibadan	ES	C	P	3	384.75	12.82	43.
NASPOT 2(2)	NARI Uganda	SE	C	P	3	122.25	4.07	32.
440288	CIP Kenya	SE	T	R	3	161.40	5.38	32.
440168	CIP Kenya	SE	L	PR	3	176.73	5.89	37
420005	CIP Kenya	SE	L	O	3	268.33	8.94	69
199005.1	CIP Kenya	S	C	C	3	703.33	23.44	37
AOB 25	IITA, Ibadan	SE	L	R	3	233.20	7.77	50
TIS 2532	IITA, Ibadan	S	T	P	3	438.75	14.62	74
ABK 2	Ebonyi State	SE	C	C	3	448.33	14.94	57
KB Lobed	Japan	S	L	C	3	242.83	8.09	61
TIS 8441	IITA, Ibadan	S	T	P	4	256.50	8.55	61
440163	CIP Kenya	S	T	DP	4	153.25	5.11	4
Coconut	Agronomy Dept., U.I.	S	C	P	4	86.50	2.88	5
Benue	Oyo State	ES	T	P	4	374.50	12.48	5
TIS 8164	IITA, Ibadan	SE	T	P	5	169.25	5.64	4
TIS 8250	IITA, Ibadan	ES	C	O	5	454.33	15.14	4
18801.2	CIP Kenya	E	L	PR	5	149.67	4.99	3
199026.1	CIP Kenya	E	T	C	6	355.80	11.86	
440170	CIP Kenya	ES	T	PR	12	839.55	27.98	3
Arrowtip	Oyo State	ES	T	P	13	1170.83	39.03	4
Sagbama II	Bayelsa State	ES	T	P	13	1170.83	39.03	4
Caroline Lee	IITA, Ibadan	S	H	C	4	1650.50	55.02	6
Mean					3	308	10	
Std					3.07	364.28	12.14	1
CV (%)					88.40	118.24	118.24	3

Growth habit: E – erect; SE – semi-erect; S – spreading; ES – extremely spreading; Mature leaf shape: R – reniform; C – co – triangular; H – hastate; L – lobed; Tuber skin main colour: C – cream; Y – yellow; O – orange; BO – brownish orange; P R – red; PR – purple-red; DP – dark purple; Percent sensory preference calculated from mean scores for boiled tuber consistency, texture sweetness, and appearance acceptability.

Table 3. Botanic and agronomic characteristics of 27 orange-fleshed sweetpotato clones at Ibadan in 2007 and 20

Clone No./Name	Collection Origin	Growth habit	Mature leaf shape	Tuber skin main colour	No. of tubers/ plant	Tuber weight/ plant (g)	Fresh tuber yield (t/ha)	Percen Sensor prefere
440037	CIP Kenya	S	C	BO	1	0.00	0.00	
Congo 2	D.R. Congo	E	C	O	1	0.00	0.00	
440443	CIP Kenya	S	T	P	2	955.20	31.84	
440031	CIP Kenya	S	T	Y	2	23.00	0.77	
Congo 1	D.R. Congo	E	C	O	2	103.00	3.43	3
440016	CIP Kenya	E	L	P	2	94.60	3.15	4
SPK 004	CIP Kenya	ES	L	P	3	718.00	23.93	4
440185	CIP Kenya	ES	C	O	3	577.50	19.25	4
187016.2	CIP Kenya	SE	L	PR	4	54.67	1.82	3
440140	CIP Kenya	SE	T	BO	4	119.71	3.99	4
440141	CIP Kenya	SE	L	C	4	933.33	31.11	5
199034.1	CIP Kenya	S	L	O	4	1696.60	56.55	5
440041	CIP Kenya	E	L	O	4	1187.57	39.58	2
566638	CIP Kenya	E	T	O	5	265.25	8.84	3
199004.2	CIP Kenya	SE	T	O	5	179.83	5.99	3
440293	CIP Kenya	SE	C	O	5	840.60	28.02	3
440001	CIP Kenya	SE	R	O	6	251.00	8.37	5
Dogoyaro	Uganda	S	R	O	6	533.43	17.78	4
Blesbok	CIP Kenya	S	L	R	6	157.67	5.26	3
Ex Oyunga	Uganda	S	R	O	7	477.00	15.90	4
440112	CIP Kenya	E	L	PR	7	313.17	10.44	4
400001	CIP Kenya	SE	R	O	7	289.86	9.66	3
440060	CIP Kenya	E	L	O	9	418.50	13.95	2
440216	CIP Kenya	S	C	O	10	181.20	6.04	3
Resisto	CIP Kenya	SE	T	P	1	18.00	0.60	5
199024.2	CIP Kenya	S	L	P	4	937.71	31.25	4
440034	CIP Kenya	S	L	C	4	712.80	23.76	4
Mean					4	445.90	14.86	
Std					2.30	428.66	14.29	16.
CV (%)					53.97	96.13	96.13	48.

Growth habit: E — erect; SE — semi-erect; S — spreading; ES — extremely spreading; Mature leaf shape: R — reniform; C — cord
T — triangular; H — hastate; L — lobed; Tuber skin main colour: C — cream; Y — yellow; O — orange; BO — brownish orange;
P — pink; R — red; PR — purple-red; DP — dark purple; Percent sensory preference calculated from mean scores for boiled tuber consistency, texture sweetness, and appearance acceptability.

Table 4. Botanic and agronomic characteristics of 61 yellow-fleshed sweetpotato clones at Ibadan in 2007 and 2008

Clone No./Name	Origin	Growth habit	Mature leaf shape	Tuber skin colour	No. of tubers/ plant	Tuber weight/ plant (g)	Fresh tuber yield (t/ha)	Percent Sensory preference
W-151	CIP Kenya	SE	R	DP	0	0.00	0.00	37.3
440203	CIP Kenya	S	T	O	0	0.00	0.00	0.0
NASPOT 3	NARI Uganda	SE	L	O	0	0.00	0.00	0.0
NASPOT 6(1)	NARI Uganda	SE	L	O	0	0.00	0.00	41.5
440166	CIP Kenya	E	T	O	0	0.00	0.00	0.0
NASPOT 4	NARI Uganda	SE	L	C	1	122.50	4.08	0.0
CIP Wagaboliga	CIP Kenya	ES	T	Y	1	143.40	4.78	47.9
NASPOT 2(1)	NARI Uganda	SE	L	R	2	69.25	2.31	40.2
TIS 70357	IITA, Ibadan	S	L	P	2	685.60	22.85	54.2
Yenaka I	Bayelsa State	S	L	BO	2	430.33	14.34	41.7
Santo-Amaro	CIP Kenya	SE	C	P	2	125.00	4.17	32.3
199062.1	CIP Kenya	ES	R	C	2	675.29	22.51	47.1
Zarama Market I	Bayelsa State	S	T	P	2	170.00	5.67	54.2
420068	CIP Kenya	ES	C	BO	2	77.75	2.59	34.4
Ex Igbariam	Abia State	ES	T	C	2	421.40	14.05	54.6
NASPOT 5	NARI Uganda	E	L	P	2	180.17	6.01	41.5
199024.1	CIP Kenya	E	T	C	2	442.60	14.75	0.0
ABK 1	Ebonyi State	S	C	C	2	649.25	21.64	41.7
Kayode	Oyo State	ES	T	C	2	452.25	15.07	73.9
199027.3	CIP Kenya	S	C	BO	2	167.25	5.57	0.0
ABK 4	Nkalagu, Ebonyi State	SE	T	C	2	139.27	4.64	52.5
K 118 (RST)	CIP Kenya	SE	L	Y	2	385.80	12.86	53.1
CIP Tanzania	Tanzania	SE	L	C	2	502.80	16.76	54.2
440027	CIP Kenya	E	L	P	2	128.00	4.27	0.0
Kaduna I	Kaduna State	ES	T	C	3	335.50	11.18	47.5
Sauti	Tanzania	SE	L	C	3	261.80	8.73	58.1
187017.1	CIP Kenya	ES	T	C	3	12.00	0.40	0.0
Zarama Nyambiri I	Bayelsa State	S	T	P	3	153.40	5.11	54.2
440167	CIP Kenya	ES	T	C	3	127.67	4.26	60.0
Odhiolugboji	Rivers State	ES	T	C	3	548.00	18.26	47.5
Carrot-C (EJM)	CIP Kenya	SE	L	O	3	82.80	2.76	36.5
K 134 (MGO)	CIP Kenya	SE	L	P	3	782.60	26.08	43.9
NASPOT 6(2)	NARI Uganda	SE	L	R	3	192.57	6.42	43.8
NASPOT 1	NARI Uganda	SE	L	Y	3	341.17	11.37	51.3
Shaba	Oyo State	ES	T	C	4	627.40	20.91	46.3
Yibama II	Bayelsa State	ES	T	C	4	627.40	20.91	46.3
Barth	Oyo State	S	L	Y	4	342.33	11.41	53.3
Ogu I	Bayelsa State	ES	L	C	4	442.14	14.74	49.2
Zarama Epie	Bayelsa State	ES	L	C	4	442.14	14.74	49.2
Imiringi	Bayelsa State	ES	L	C	4	442.14	14.74	49.2
440102	CIP Kenya	S	T	PR	4	135.75	4.52	39.2
ABK 3	Ebonyi State	SE	C	PR	4	323.60	10.79	53.3
199015.14	CIP Kenya	S	C	C	4	613.75	20.46	52.5
EBSU I	Ebonyi State	SE	C	C	4	260.67	8.69	41.7

Table 4 continued. Botanic and agronomic characteristics of 61 yellow-fleshed sweetpotato clones at Ibadan in 2007 and 2

Clone No./Name	Origin	Growth habit	Mature leaf shape	Tuber skin colour	No. of tubers/ plant	Tuber weight/ plant (g)	Fresh tuber yield (t/ha)	Percen Sensor prefere
GR 3 25	IITA, Ibadan	SE	T	P	5	313.00	10.43	4
440215	CIP Kenya	ES	L	C	5	346.00	11.53	4
OP-1-1-30	NRCRI, Abia State	S	T	O	6	571.50	19.05	4
IJ Noble	Ijeoma Egeonu	SE	C	O	3	256.83	8.56	5
Otuasega I	Bayelsa State	S	C	C	4	141.25	4.71	5
Ishiayi Red	Bayelsa State	S	C	C	4	141.25	4.71	5
Kalama White	Bayelsa State	S	C	C	4	141.25	4.71	5
Akinima	Bayelsa State	S	C	C	4	141.25	4.71	5
Anyamabele-Okordia	Bayelsa State	S	C	C	4	141.25	4.71	5
Zarama Nyambiri III	Bayelsa State	S	C	C	4	141.25	4.71	5
Kalama Red	Bayelsa State	S	C	C	4	141.25	4.71	5
Kaiama	Bayelsa State	S	C	C	4	141.25	4.71	5
Sagbama I	Bayelsa State	S	C	C	4	141.25	4.71	5
TIS 4400-2	IITA, Ibadan,	ES	L	C	4	1072.60	35.75	5
De Virousky	IITA Ibadan	S	L	C	5	119.00	3.97	5
Famgbe I	Bayelsa State	S	C	P	5	260.00	8.67	4
TIS 80/0140	IITA Ibadan	ES	L	DP	4	314.33	10.48	6
Mean					3	288	10	
Std					1.42	227.40	7.58	18.
CV (%)					48.13	78.87	78.87	42.

Growth habit: E—erect; SE—semi-erect; S—spreading; ES—extremely spreading; Mature leaf shape: R—reniform; C—cordate; T—triangular; H—hastate; L—lobed; Tuber skin colour: C—cream; Y—yellow; O—orange; BO—brownish orange; P—pink; R—red; PR—purple-red; DP—dark purple; Percent sensory preference calculated from mean scores for boiled tuberous root consistency, texture sweetness, and appearance acceptability.

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Orange-fleshed Sweetpotato Selection and Duplication Efforts in Southern Nigeria

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Abstract. Sweetpotato is fast gaining importance as a food security crop in the world, including Nigeria. Orange-fleshed sweetpotato clones, in particular, are valuable for their higher beta-carotene content which is useful in reducing the effects of vitamin A deficiency. As a contribution to efforts in promoting orange-fleshed sweetpotato in the diets of Nigerians, this study sought to select the best clones in a germplasm collection at the Department of Agronomy, University of Ibadan, Oyo State, Nigeria. Traits used for the selection process in 2009 were root yield, number of tuberous roots/plant, scores for sweetpotato virus disease and weevil intensity, as well as sensory acceptability of boiled tuberous roots. Values for each trait were standardized and summed-up to get a coefficient for selection. The top five clones selected based on higher selection coefficients were, in descending order: Ex Oyunga, 199024.2, 440141, 199034.1 and 440034. These five clones are recommended for further on-farm trials and eventual release to farmers. It is hoped that they will contribute to bio-diverse diets of Nigerians to help improve nutrition and food security status of consumers. A total of 809 healthy vine cuttings (25cm) were distributed to 18 collaborators across South-Western Nigeria for further increase of planting materials and assessment of field, kitchen and table suitabilities from July 2008 to September 2009.

Key words: Orange-fleshed sweetpotato; selection; bio-diverse diets; Nigeria

Introduction

Sweetpotato improvement efforts at the University of Ibadan entails the importation of clones through tissue culture materials which are locally grown and selected in field plots at sites representing major sweetpotato growing agroecologies. With low funding base and few workers, only small experimental trial plots have been adopted in field screening and assessments. Selection using data gathered by the Ibadan Group does not stop other workers from engaging in selections at other sites. For this reason, elite clones were also distributed to collaborators to evaluate locally so as to capture clones best suited to their needs in their environments. Thus, the five OFSP clones judged most suitable on the basis of ten environments for which we have data is a step forward but not the end of the selection process. As more entries are tried in more locations we hopefully would recommend more clones that better respond to the end-uses and preferences of consumers, as well as growers and processors.

The aim of sweetpotato selection is to produce more quantity of useful materials for feeding humans in a specified area. Thus, the genotypes will differ according to the preferences of consumers and end-users in each community with a demand for sweetpotato. So, selection closely relates to local tastes and tuber sizes that are locally marketable. Sensory acceptance is as important as the quantity (yield) of tuber fresh weight generated from production systems (IITA 1971; Tomlins *et al.* 2004). This paper is a first attempt after a decade (2000–2009) of germplasm collection, assessment, multi-site studies to statistically integrate all available information and data on 125 genotypes held at University of Ibadan, Nigeria.

Materials and Methods

A collection of 125 clones of sweetpotato at the Department of Agronomy were planted and evaluated in various field trials from 2006–2009. The data collected was pooled in 2009 to select the top clones for multiplication and transfer for on-farm trials.

The selection of elite orange-fleshed sweetpotato (OFSP) clones from the germplasm collection at the Department of Agronomy, University of Ibadan was to facilitate the multiplication and dissemination to farmers of clones with traits such as: (1) root yield; (2) number of tuberous roots/plant; (3) sweetpotato virus disease intensity score (SPVD score); (4) sweetpotato weevil score; and (5) sensory acceptability after selection as shown below:

1) *Tuber yield (RY).* Clones with data for at least 4 seasons of cropping were advanced for selection based on sum of standardized root yields taken across 4–8 seasons. This left 11 clones out of 23 OFSP clones for further selection.

2) *Number of tubers/plant (NoT).* Data for number of tuberous roots/plant were standardized and summed-up across all surviving plants for each clone thus:

Standardized NoT = $\frac{\text{NoT}}{\text{Standard deviation}}$

3) *Sweetpotato virus disease intensity score (SPVD score).* Data for SPVD score were standardized for each clone thus:
Standardized SPVD score = $\frac{\text{Standard deviation}}{\text{SPVD score}}$

4) *Sweetpotato weevil intensity score (WS).* Data for WS were standardized for each clone thus:
Standardized WS = $\frac{\text{Standard deviation}}{\text{WS}}$

5) *Sensory acceptability (SA).* SA has four components given below. Mean scores for boiled tuber consistency (BTC), texture (BTT), sweetness (BTS), and acceptable appearance (BTA) were used to calculate preference score for each clone thus:

BTC: 5 is best, therefore, preferred score = BTC/5 if < 5 or 5/BTC if >5
BTT: 1 is best, therefore, preferred score = 1/ BTT
BTS: 1 is best, therefore, preferred score = 1/ BTS
BTA: 5 is best, therefore, preferred score = 5/ BTA

Preference score was standardized by dividing each value by the standard deviation. The standardized preference scores were then summed-up.

6) Mean standardized values for root yield, number of tuberous roots/plant, SPVD score, weevil score and sensory acceptability were divided by the maximum values, so that the best is unity. This was to remove the influence of the different magnitudes of values.

7) Consequently, RY, SPVD, NoT, WS, and SA were assumed to be of equal contribution to the selection. The coefficients created were summed by clone and divided by the maximum summed coefficient, such that the clone with the highest summed coefficient assumed a score of 100 and all other clones assumed values less than 100. The percentage of the minimum was then used to rank the 11 OFSP clones.

Distribution of OFSP clones

Given the limited resources, personnel and land area for sweetpotato at the University of Ibadan, the policy adopted for collaborative distribution for further multiplication and testing was based usually on five healthy cuttings (25cm long) for each clone per collaborator.

Results and Discussion

Selection efforts. Selected traits of 23 OFSP clones in the germplasm collection of the Department of Agronomy, University of Ibadan are shown in Table 1. The top five OFSP clones were: Ex Oyunga, 199024.2, 440141, 199034.1 and 440034, based on coefficients for selection and ranking of 11 out of 23 OFSP clones (Table 2). These OSFP clones, having been evaluated in 10 environments across three seasons (2006–2009) are suitable for furthe assessments in on-farm trials, and subsequent release fo commercial cultivation.

The five selected OFSP clones contain good levels of zinc iron and total carotenoids from which vitamin A can b synthesized eventually in the human body (Table 3) Consequently, small amounts (100–200g) consumed dail by children and adults would meet daily requirement without need to swallow tablets that are often out o supply or expensive to purchase by many people.

Duplication efforts. About 809 healthy 25 cm vine cutting of 19 OFSP clones were distributed to 18 collaborators o the basis of five cuttings/clone to enable them furthe multiply and assess using their preferred characteristic on-farm, in kitchen, and on the dining table (Tables 4 an 5). We expect feedbacks to help us better understand th performances of OFSP in different parts of South-Wes Nigeria. In all, 76.4 % of the 809 cuttings distributed wer from the five elite clones selected at the end of this cycle Consequently, only 5 of 125 clones originally assemble were suitable OFSP clones. Our efforts in future would b to increase the proportion of OFSP in our collection, whil also seeking to identify clones superior to these five.

Conclusion

To bio-diversify diets in Nigeria, and combat vitamin A deficiency sustainably, OFSP clones: Ex Oyunga 199024.2, 440141, 199034.1 and 440034 ar recommended for further on-farm trials and eventua release to farmers. Recommended supplementation witl Vitamin A capsules is not sufficient. Promoting the use o easy-to-cultivate pro-Vitamin A rich OFSP as supplement in food of children and adults in small quantities fron home-grown tubers is advised. According to Low *et al* (2008), 100g of sweetpotato can provide enough beta carotene to produce from 0 to 100% of the suggested dail vitamin A requirement (350ug) per day for infants an young children. In most rural communities in Nigeria such capsules are scarce, and unaffordable. Also, it may b difficult giving them to children, especially the under fives, on a regular basis. Orange-fleshed sweetpotat tubers, on the other hand, are tasty, nutritious, and easy t cook. If grown in the country on a widespread commercia scale, they will be readily available for all to include i traditional recipes, thus improving household food securit and nutrition. Clones were given to collaborating farmer or researchers and development agencies on demand base on characteristics that they wanted. Most requests wer with regard to tuber flesh colour, and limited germplasn planting materials for duplication efforts.

Table 1. Characteristics of 23 OFSP clones in 10 environments from 2006/2007 to 2008/2009 seasons used for selection

Clone	Tuber yield (t/ha) (n= 40)	No. of tubers/ plant (n= 40)	Sweet-potato virus disease score (3 MAP)	Weevil score (4.5 MAP)	Boiled tuber consistency (1–9; 5 is best)	Boiled tuber texture (1–9; 1 is best)	Boiled tuber sweetness (1–6; 1 is best)	Boiled tube appearance (1–5; 5 is best)
187016.2	1.82	3.67	-	1.00	4	3	2	3
199004.2	2.36	2.03	6.00	4.50	3	7	4	3
199024.2	9.82	3.84	3.00	1.50	3	7	4	3
199026.1	11.85	5.80	-	2.00	5	3	3	3
199034.1	10.09	3.65	3.60	4.00	7	3	3	2
400001	9.65	7.29	-	1.00	5	3	3	2
440001	3.75	3.99	4.50	3.33	4	7	4	3
440027	4.26	2.40	-	3.00	5	5	4	3
440034	5.00	2.69	3.50	3.06	4	5	2	4
440041	18.30	2.76	5.00	3.50	3	5	4	2
440060	13.94	8.75	-	1.00	6	3	3	2
440112	2.98	2.64	5.50	4.67	2	5	4	2
440140	2.63	3.69	6.00	4.67	5	6	3	4
440141	7.46	3.36	3.25	2.00	4	5	4	1
440185	19.23	3.00	-	5.00	5	3	3	3
440216	6.03	10.00	-	1.00	2	7	4	3
440293	9.23	2.93	4.00	2.50	4	6	3	2
440443	16.13	1.67	6.00	4.00	4	3	3	4
Blesbok	5.25	5.67	-	2.00	4	7	5	3
Congo 1	3.43	2.00	-	1.00	5	5	3	4
Ex Oyunga	6.38	4.65	2.75	1.53	4	5	4	3
Resisto	0.17	1.00	4.00	5.00	5	1	3	3
SPK 004	6.53	1.93	3.00	4.00	4	7	6	4
Total	176.29	89.41	60.10	65.25	97.00	111.00	81.00	66.0(
Mean	7.66	3.89	4.29	2.84	4.22	4.83	3.52	2.87
Std	5.31	2.26	1.20	1.45	1.17	1.77	0.90	0.81
CV (%)	69.34	58.23	28.04	51.09	27.65	36.78	25.50	28.4(

- no visible symptoms

Table 2. Coefficients for selection and ranking of 11 out of 23 orange-fleshed sweetpotato (OFSP) clones as in Table 1

Clone	NoT	NoT coef	RY	RY coef	SPVD score	SPVD coef	WS score	WS coef	Sens Accp	Sens Accp coef	sum coef of five factors	ratio to min sum coef	% of min coef	F c c
Ex Oyunga	2.12	0.64	1.56	0.82	0.46	1.90	2.52	7.36	12.31	0.74	11.46	3.01	300.8	
199024.2	3.17	0.96	1.90	1.00	0.38	1.56	1.66	4.84	10.89	0.65	9.02	2.37	236.6	
440141	2.77	0.84	1.58	0.83	0.45	1.82	1.10	3.21	9.86	0.59	7.30	1.92	191.6	
440034	2.20	0.67	1.48	0.78	0.35	1.43	0.82	2.39	16.66	1.00	6.28	1.65	164.7	
199034.1	2.98	0.91	1.74	0.92	0.36	1.45	0.65	1.89	12.40	0.74	5.92	1.55	155.2	
440001	3.29	1.00	1.16	0.61	0.32	1.31	0.62	1.80	11.99	0.72	5.44	1.43	142.7	
440041	2.18	0.66	2.55	1.35	0.27	1.12	0.57	1.66	9.98	0.60	5.39	1.41	141.5	
440293	3.20	0.97	1.89	1.00	0.34	1.40	0.36	1.05	11.94	0.72	5.14	1.35	134.8	
SPK 004	0.94	0.28	2.13	1.12	0.46	1.87	0.37	1.08	12.18	0.73	5.09	1.34	133.5	
440140	3.62	1.10	1.41	0.75	0.22	0.91	0.34	1.00	15.49	0.93	4.69	1.23	122.9	
440112	2.80	0.85	0.81	0.43	0.24	1.00	0.34	1.00	8.89	0.53	3.81	1.00	100.0	

Mean % of minimum coefficient 165.9, Standard deviation 57.7, C.V. (%) 34.8

NoT: standardized (std) mean no. of tubers/plant; NoT coef: coefficient for std. mean no. of tubers/plant; RY: std mean tuber yield; RY coef: for std mean tuber yield; SPVD: std mean SPVD intensity score; SPVD coef: coef. for std mean SPVD intensity score; WS: std sweetpotato v intensity score; WS coef: coef. for std mean sweetpotato weevil intensity score; Sens Accp: std sensory acceptability of boiled tuberous root coef: coef. for std sensory acceptability of boiled tuberous roots.

Table 3: Nutritional content of five elite sweetpotato clones selected at Ibadan in 2006

Clone	Total Carotenoid content (μg/g)	Fe content (ppm)	Zn content (ppm)
Ex Oyunga	91.26	59.13	14.16
199024.2	113.57	59.01	9.83
199034.1	46.52	56.72	10.85
440034	96.34	59.47	10.31
440141	92.29	66.41	11.16

Table 4. Distribution of sweetpotato clones by vine cuttings from the University of Ibadan (July 2008–August 2009)

S/ No.	Clone	Cases																		
		1	2	4	5	6	7	8	9	10	12	15	17	18	19	20	21	22	23	Total
		Number of cuttings																		
1	566638	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
2	Congo 1	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
3	Dogoyaro	-	-	-	5	-	-	-	-	-	-	5	-	-	-	-	-	-	-	10
4	199024.2	-	-	-	5	-	-	10	20	-	-	5	-	-	-	5	-	12	5	62
5	187016.2	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
6	440001	-	-	-	5	-	-	-	-	-	-	5	-	-	-	-	-	-	-	10
7	440034	-	-	-	-	-	-	10	-	-	-	5	-	-	-	5	-	10	-	30
8	Tega (Ejumula)	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	5
9	Ex Oyunga	77		12	5	5	-	10	20	-	150	5	30	5	10	-	20	10	5	364
10	440027	-	3	12	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
11	440140	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
12	Resisto	-	3	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
13	440041	-	3		5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
14	440216	-	3	12	5	-	-	-	-	-	-	5	-	-	-	5	-	-	-	30
15	SPK 004	-	3	12	5	-	-	-	-	-	-	5	-	5	-	-	-	-	5	35
16	440141 (Ejumula)	-	3	12	5	-	15	10	20	10	-	5	-	5	10	-	-	10	5	110
17	Blesbok	-	3	12	5	-	-	-	-	-	-	5	-	-	-	-	-	-	-	35
18	400001	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	5
19	199034.1	-	-	12	5	-	-	10	-	-	-	5	-	-	-	5	-	10	5	52
	Total	77	24	96	70	10	15	50	60	10	150	55	30	15	30	20	20	52	25	809

Table 5. Transfer date, person, organization and location where sweetpotato clones were transferred to from July 2008–August 2009

Case	Transfer date	Name of person transferred to	Organization	Location
1	27.06.08	Mr. Adejare	NAQS	Ibadan, Oyo State
2	22.07.08	Mr. Adejare	NAQS	Ibadan, Oyo State
3	28.07.08	Rev. Adeleye	RTEP	Ijebu-Ife, Ogun State
4	14.08.08	Seun Adesanya, c/o Dr. Akintobi	Dept of Plant Breeding and Seed Tech., UNAAB	Abeokuta, Ogun State
5	12.09.09	Mrs. Fetuga	Dept of Food Tech., UNAAB	Abeokuta, Ogun State
6	03.10.08	Mrs. F. Fagbuyi	PYTP	Ibadan, Oyo State
7	06.11.09	Anifat	Dept of Agronomy, U.I.	Ibadan, Oyo State
8	13.02.09	Dr. Stella Odebode	Dept of Agric. Extn and Rural Devt, U.I.	Ibadan, Oyo State
9	21.02.09	Dr. Stella Odebode	Dept of Agric. Extn and Rural Devt, U.I.	Ibadan, Oyo State
10	22.02.09	Mrs. Folake	IAR&T	Ibadan, Oyo State
11	09.04.09	Victoria Odii	Dept of Agronomy, U.I.	Ibadan, Oyo State
12	14.04.09	Mrs. Biola	Dept of Agronomy, U.I.	Ibadan, Oyo State

Table 5 continued. Transfer date, person, organization and location where sweetpotato clones were transferred to from July 2008–August 2009

Case	Transfer date	Name of person transferred to	Organization	Location
13	08.05.09	Dr. Oyin Olukunle	Dept of Wildlife and Fisheries Management, U.I.	Ibadan, Oyo State
14	13.05.09	Dr. Oyin Olukunle	Dept of Wildlife and Fisheries Management, U.I.	Ibadan, Oyo State
15	13.05.09	Mrs. Phillips	POGPMAN	Eruwa, Oyo State
16	13.05.09	Phillip	Dept of Agronomy, U.I.	Ibadan, Oyo State
17	20.05.09	Prof. Aiyelaagbe	UNAAB	Abeokuta, Ogun State
18	12.06.09	Prof. Aiyelaagbe	UNAAB	Abeokuta, Ogun State
19	16.06.09	Mr. Idowu	Dept of Food Tech., Polytechnic Offa	Offa, Kwara State
20	08.07.09	Prof. Aiyelaagbe	UNAAB	Abeokuta, Ogun State
21	10.07.09	Rev. James Edivri	AGN, Mokola	Ibadan, Oyo State
22	12.08.09	Mr. Aiyembo	RTEP	Ijebu-Ife, Ogun State
23	09.09.09	Mr. Friday Emmanuel	Kogi State Univ., Anyingba	Anyingba, Kogi State

NAQS: Nigerian Agricultural Quarantine Service; RTEP: Root and Tuber Expansion Programme;
PYTP: Practical Year Training Programme, Faculty of Agriculture and Forestry, U.I.;
IAR&T: Institute for Agricultural Research and Training, Moor Plantation, Ibadan;
POGPMAN: Potato Growers, Processors and Marketers Association of Nigeria, Oyo State Chapter;
UNAAB: University of Agriculture, Abeokuta, Ogun State; AGN: Assemblies of God Church;

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Sweetpotato Economics

Analysis of Acceleration, Deceleration and Stagnation in Output, Land area, and Yield of Sweetpotato [*Ipomoea batatas* (L.) Lam] in Nigeria, 1961–2007

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Abstract. This study investigated trends in production, yield, and land area devoted to sweetpotato, the fourth-ranking root and tuber crop in Nigeria from 1961 to 2007. It also estimated the compound growth rates and tested the hypotheses of existence of acceleration or deceleration or stagnation in growth of the variables. Secondary data collected from the FAO Statistical database were used for the study. Data were analyzed using descriptive tools and regression of trend equations in time variables. Also, annual compound growths were calculated while existence of acceleration, deceleration or stagnation was verified by estimating quadratic equations in time trend variables. Results revealed that while the trends in both output and area devoted to sweetpotato were increasing, that of yield was decreasing. Significant positive association ($r = 0.99$; $p < 0.01$) was found between output and area, while statistically significant negative associations existed between output and yield ($r = -0.71$; $p < 0.01$), and area and yield ($r = -0.72$; $p < 0.01$). Estimated trend equations for the 1961–2007 aggregate data revealed statistically significant increases or growths for output and area, but statistically significant decrease for yield. Compound growth rates for the aggregate data were calculated to be 7.86 % for output, 11.52 % for land area, and -3.28 % for yield. When acceleration, deceleration or stagnation were assessed, results also revealed significant acceleration for output ($p < 0.01$) and land area ($p < 0.01$), but deceleration for yield ($p < 0.05$). The conclusion from the study is that growth in output in the study period was accounted for by increase in land area than by increase in sweetpotato yield. Conscious investments in innovations, funding of research for development and dissemination of appropriate technologies, development of rural infrastructures, and guaranteed access to production inputs and appropriate marketing channels for farmers would also be needed to promote yield and production of sweetpotato in Nigeria.

Key-words: *Ipomoea batatas* (L.), production, land area, yield, acceleration, deceleration, stagnation, growth, Nigeria

Introduction

Sweetpotato [*Ipomoea batatas* (L.) Lam] is an importa food security crop that feeds millions of people in t developing world. The crop is popular among farmers wi limited resources and produces more biomass and nutrier per hectare than any other food crop in the world (Praka 1994). It is also high in nutritional energy and its leav can be consumed as vegetables (Fawole 2007; Chukv 1999). Furthermore, it has been reported that sweetpota is a good source of vitamins A, C, and E, dietary fibr potassium, and iron and is low in fat and cholester (http://www.answers.com/topic/sweet-potato, retrieve October 2, 2008).

In Nigeria, sweetpotato ranks fourth among major root ar tuber crops produced (Tewe *et al.* 2003), after cassav (*Manihot esculenta*), yams (*Dioscorea* spp.), and cocoya (*Xanthosoma* spp.), or taro (*Colocasia* spp.). Amon factors accounting for its increasing importance in th nation's farming and food systems are its relative ease c cultivation, short-maturing, and has enormous industri and economic potentials (Fawole 2007). Also, Ogbonna *al.* (2007) found sweetpotato can be profitably used t conserve farmland soils, and recommended that farmers b encouraged to grow sweetpotato.

There tends to be gross inefficiency in the allocation c resources in sweetpotato production, though it ha importance and potentials as a food security crop an potential foreign exchange earner for Nigeria. Takin available land resources as a test case, there seems to be a inverse relationship between production and yield (Figur 1). Whereas quantity produced and area cultivated tend t increase with time — suggesting a positive associatio between them — the yield tends to show a decreasin trend. There is need to analyze trends in production, yiel or productivity and land area devoted to sweetpotato i Nigeria. The specific objectives are to determine if th output, area and yield have grown or retarded over time, t calculate the growth rates, and determine if there had bee acceleration or deceleration or stagnation in growth o these variables. Consequently the hypotheses to be teste are that there was significant acceleration in growth of: a output of sweetpotato; b) area devoted to sweetpotato; an c) yield of sweetpotato, each against the null hypothese that there was either deceleration or stagnation at differen periods during 1961–2007.

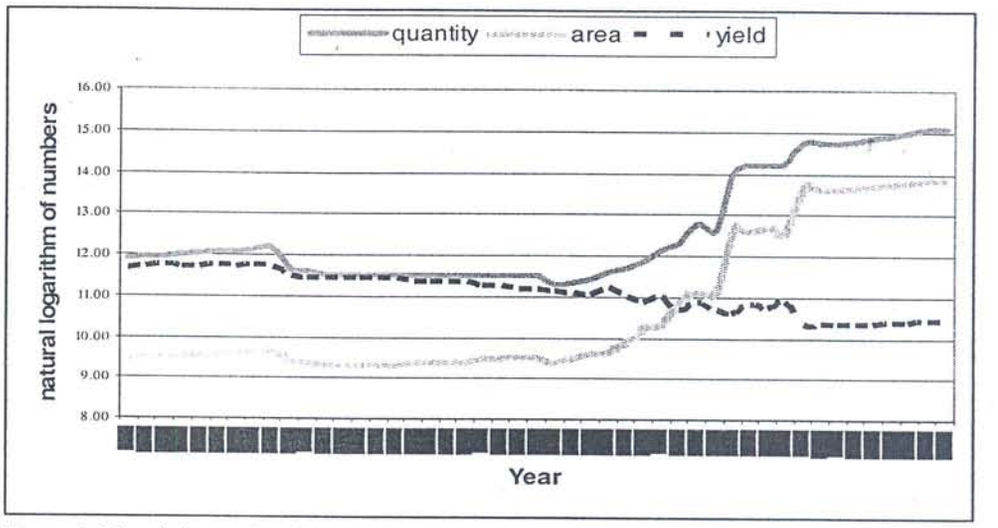

Figure 1: Trends in production quantity (Q), area (A), and yield (Y) of sweetpotato in Nigeria from 1961–20

Results of the study are expected to assist researchers, policy makers and relevant government agencies in their planning, research, development, and use of sweetpotato towards attaining food security.

Materials and Methods

Data source. Secondary data were used for the study. Time series data covering 1961–2007, were collected from the Statistics Division of the Food and Agriculture Organization (FAO 2008). The national series data, such as those from the Central Bank of Nigeria (CBN) could alternatively have been used. However, it is common to find differences in such data series from different sources (Manyong and Nokoe 2003), but data from such sources do not cover the 1961–2007 period. This explains the reliance on the FAO data.

Modelling trends for analysis of growth rate in sweetpotato. The exponential, also called the log-linear trend or left-side semi-log analysis (Studenmund 2001), was used to model the growth trends in sweetpotato production in Nigeria. This follows Diebold (2007), as has been variously applied (Udom 2006; Onyenweaku and Okoye 2005; Ojiako *et al.* 2007; Ojiako *et al.* 2008).
The exponential trend equation for output, yield and area devoted to sweetpotato is specified as:

$$Q_{SP_i} = \exp(\beta_0 + \beta_1 t_i + \xi_i) \ldots\ldots\ldots\ldots\ldots (1)$$

where Q_{SP_i} is either the volume of production, or area of land, or yield of sweetpotato at year i measured in metric tonnes for output, tonnes per hectare for yield, and hectares for land area; t_i is the time trend measured in years; β_0 is the intercept or constant of the trend equation; β_1 is the slope or trend coefficient; and ξ_t is the term. If linearized by taking the natural logarithm of sides, equation (1) becomes:

$$\ln Q_{SP_i} = \beta_0 + \beta_1 t_i + \xi_i \ldots\ldots\ldots\ldots\ldots (2)$$

where $\ln Q_{SP_i}$ is the natural logarithm of the rele variables; and all other variables are as previously defi

From equation (2), the annual exponential growth rat of sweetpotato output, area or yield when t increase one year can be expressed following Onyenweaku Okoye (2005) and Ojiako and Olayode (2008), as:

$$g = (e^{\beta_1} - 1) * 100\% \ldots\ldots\ldots\ldots\ldots (3)$$

where g = growth rate, and $e = 2.71828$ is the Euler' exponential constant (Sawant 1983)

To ascertain growth pattern, and consequently tes hypothesis of whether there was acceleration or stagn or deceleration in growth of sweetpotato production, and yield, the quadratic equations in the time variables were fitted to the data for the periods cover the analysis. The quadratic equation is specified as:

$$\ln Q_{SP_i} = \beta_0 + \beta_1 t_i + \beta_2 t_i^2 + e_i \ldots\ldots\ldots\ldots\ldots$$

where the variables $\ln Q_{SP}$ and t are as previously def and β_0, β_1 and β_2 are unknown parameters to be estima

In the specification of expression (4), the linear quadratic time variables indicate the circular path i dependent variable (Q_{SP}) while the quadratic term allows for the possibility of acceleration or deceleratio stagnation in growth during the period under (Sawant 1983; Onyenweaku and Okoye 2005). In te the specified hypotheses, the major interest is o

coefficient of t^2 (β_2), which is a measure of the pattern of growth. If β_2 is positive and statistically significant there is acceleration in growth; if β_2 is negative and statistically significant there is deceleration in growth; if β_2 is positive or negative but not statistically significant there is stagnation in the growth process (Onyenweaku and Okoye 2005; Anyaegbunam *et al.* 2006).

For this study, five different periods were considered to enable comparison of the influence of the various economic and political development policies on growth trends of sweetpotato: the first decade following political independence (1961–1970) during which the nation survived a 30-month Civil War; the second decade following independence (1971–1980), which was the post-Civil War era of recovery, reconciliation and reconstruction; the third decade of political independence (1981–1990) during which the nation had a failed Second Republic and experimented different measures of economic restructuring, including the Austerity Measures introduced in April 1982 and the Structural Adjustment Programme (SAP) introduced in July 1986 respectively; the fourth decade following political independence (1991–2000) that witnessed the highest level of social, economic and political instability but which later culminated in the enthronement of democratic rule in May 1999; and the 2001–2007 era of democratic rule and full liberalization. Finally, the aggregated data for 1961–2007 periods were analyzed to get the general trend. All analyses were done using Standard E-views Software.

Results and Discussion

Descriptive statistics of output, area, and yield of sweetpotato. The mean and standard deviation of the production output, cultivated land area, and yield of sweetpotato for the periods covered by this study are presented in Table 1. For output, the average level was 0.164 million metric tonnes during the 1961–1970 period. This dropped by 38.3 % to 0.101 million metric tonnes during the 1971–1980 period. The recorded average out for the 1981–1990 period was 0.102 million metric tonr or a decrease of 37.1 % over the 1961–1970 peri Output increased substantially to an average of 1 million metric tonnes during the 1991–2000 periods. T represented increases of 614.2 % and 1035.5 respectively, over the 1961–1970 and 1981–1990 perio The average output recorded for 2001–2007 represen increases of 1738.7 % and 157.5 % respectively, over t average for the 1961–1970 and 1991–2000 periods. T average annual output of sweetpotato for the ent 1961–2007 period was calculated as 0.75 million met tonnes, which is 485.6 % higher than the average record in the first two decades (1961–1980), but 45.7 % low than the 1.4 million metric tonnes annual average record in the following 27 years (1981–2007).

Table 1 also shows that aside from the initial 17.3 decrease in average area cultivated during the 1971–19 over the base 1961–1970 period, continuous increases 12.9 %, 2112.4 %, and 6672.9 % were recorded in t 1981–1990, 1991–2000, and 2001–2007 respectivel over the base period. The average cultivated area for t 1961–2007 aggregate data was 214, 387 hectares. In t case of yield, the annual averages, given as 11.73 t/l during 1961–1970, fell continuously to 8.79 t/ha 1971–1980, 6.74 t/ha in 1981–1990, 4.47 t/ha 1991–2000 and 3.18 t/ha in the 2001–2007 periods. The reflect average decreases of 25.0 %, 42.6 %, 61.9 % ar 72.9 % respectively over the annual average for t 1961–1970 periods. Thus, it follows that while the trend in both output and area of sweetpotato were increasin that of yield was decreasing. This finding wa corroborated further by the correlation matrix presented i Table 2. Output and area cultivated are positivel associated (r = 0.99), while negative associations wer calculated for output and yield (r = -0.71); and area an yield (r = -0.72). All correlation coefficients are highl significant ($p<0.01$).

Table 1: Descriptive statistics of quantity produced, land area and yield of sweetpotato

Variable	1961–70 (n=10)	1971–80 (n=10)	1981–1990 (n=10)	1991–2000 (n=10)	2001–2007 (n=7)	1961–2007 (n=47)
Quantity (metric tonnes)	163600.0 (22152.00)	101000.0 (3162.278)	102900.0 (18266.24)	1168400. (879487.4)	3008143. (397704.0)	774808.5 (1114842.0)
Area (hectares)	13900.00 (1197.219)	11500.00 (527.0463)	15700.00 (4854.551)	307520.0 (294909.5)	941428.6 (78202.42)	214387.2 (355542.3)
Yield (t/ha)	11.731 (0.864)	8.795 (0.398)	6.736 (0.825)	4.466 (0.982)	3.184 (0.163)	7.225 (3.106)

Values in parentheses are the standard deviations

Table 2: Correlation matrix for quantity produced, land area and yield of sweetpotato, 1961–2007

Variable	Quantity	Area	Yield
Quantity	1.000000	-	-
Area	0.991631***	1.000000	-
Yield	-0.712379***	-0.716379***	1.000000

***= significant at 1 %; **= significant at 5 %

Analysis of trend equations for output, land area and yield of sweetpotato. The estimated trend equations for sweetpotato output are presented in Table 3 for the different time periods under consideration. The results show that the coefficients of the time trend were positive for all periods, except for 1971–1980, when the coefficient was negative. The slope coefficients were not statistically significant for the 1961–1970, 1971–1980, and 1981–1990 periods. This implies that sweetpotato production remained the same during the periods. However, the coefficients were statistically significant (p <0.01) for 1991–2000 and 2001–2007 periods as well as for the aggregated data (1961–2007) signifying incr production. The regression equations also had g with $r^2 = 0.592$ and F = 65.18 for 1961–2007, $r^2 = 0$ = 74.62 for 1991–2007, and $r^2 = 0.985$ and F = 367 2001–2007. Since the slope coefficients were posit these periods, it means that significant increases or were recorded during those periods. The trend eq for land area devoted to sweetpotato are shown in T

The results reveal similar trend as was the case for The equations have good fit for the 1981–1990 (r^2 = p <0.05), 1991–2000 ($r^2 = 0.91$; p<0.01), 2001–20C 0.97; p <0.01) and the aggregate data of 1961–200 0.72; p <0.01). The slope coefficients were positi statistically significant, implying that significant in or growths were achieved during those periods. conclusion could not be drawn for the 1961–19 1971–1980 periods when the area cultivated remair same.

Table 3: Estimated trend equations for Nigeria's sweetpotato output, 1961-2007

Period	Estimated parameters		r^2	F-value	Sig.	D-W
	β_0	β_1				
1961–1970 (n=10)	11.99482***	0.000185	0.000014	0.001	0.976	1.355
	(111.1329)	(0.010608)				
1971–1980 (n=10)	11.55105***	-0.005199	0.272727	3.000	0.122	1.402
	(620.2316)	(-1.732051)				
1981–1990 (n=10)	11.36855***	0.029036	0.269925	3.139	0.114	0.618
	(108.5221)	(1.719821)				
1991–2000 (n=10)	11.83685***	0.319091***	0.903216	74.616	0.000	1.795
	(51.65699)	(8.640481)				
2001–2007 (n=10)	14.66389***	0.061338***	0.985337	367.427	0.000	2.155
	(979.8784)	(18.33024)				
1961–2007 (n=47)	10.7523***	0.075702***	0.591814	65.179	0.000	0.077
	(41.61582)	(8.077367)				

***=significant at 1%; **=significant at 5%; t-values are in parentheses.

Table 4: Estimated trend equations for area cultivated of sweetpotato in Nigeria's, 1961-2007

Period	Estimated parameters		r^2	F-value	Sig.	D-W
	β_0	β_1				
1961–1970 (n=10)	9.481131***	0.010034	0.124923	1.16	0.312	1.713437
	(162.7454)	(1.068670)				
1971–1980 (n=10)	9.305651***	0.007910	0.272727	3.000	0.122	1.409
	(328.3928)	(1.732051)				
1981–1990 (n=10)	9.276187***	0.063956**	0.570412	10.719	0.011	0.750696
	(76.18510)	(3.259216)				
1991–2000 (n=10)	10.09556***	0.367871***	0.913558	84.453	0.000	2.331059
	(40.66813)	(9.194964)				
2001–2007 (n=10)	13.59881***	0.038334***	0.967155	171.602	0.000	1.769321
	(962.4862)	(12.13381)				
1961–2007 (n=47)	8.077251***	0.109004***	0.725870	119.08	0.000	0.093861
	(29.34068)	(10.91584)				

***=significant at 1%; **=significant at 5%; t-values are in parentheses.

The estimated yield trend equations are shown in Table 5. Like the case for output and area grown, yield did not change significantly during the 1961–1970 periods. However, significant decreases were observed during 1971–1980, 1981–1990 and 1991–2000, as depicted by the negative signs of the slope coefficients. Significant growth was only achieved during the last seven years (2001–2007). The estimated equation for the aggregate data for 1961–2007 also produced a statistically significant negative sign for the slope coefficient, implying significant decrease in yield. All the estimated yield trend equations have good fit, except in 1961–1970.

Growth rate of output. The computed annual compound growth rates in sweetpotato output, land area and yield are shown in Table 6. The output grew at a compound rate of 0.0 2% during the first decade of political independence (1961–1970). It slumped to an annual rate of -0.52 % during the second decade (1971–1980), but picked up again during the third decade (1981–1990) when annual compound growth rate of 2.95 % was recorded. None of these growth rates was statistically significant. However, statistically significant annual compound growth rates were achieved during the fourth decade (1991–2000), and the last seven years of political independence, 2001–2007 when 37.6 % and 6.3 % respectively were attained Statistically significant annual compound growth rate o 7.9 % was attained in the aggregate data for 1961–2007 For the cultivated land area, the growth rates were calculated as 1.0 % for 1961–1970, 0.8 % for 1971–1980 6.6 % for 1981–1990, 44.5 % for 1991–2000, and 3.9 % for 2001–2007. For the aggregate 1961–2007 period, the compound growth rate was calculated as 11.5 %. Positive growth was realized for each period. A comparison with calculated growth rates for output shows that, although the two follow similar trends, higher growths were recorded for land area in all the studied periods, except for 2001–2007, when growth rate in output was 6.3 %, as against 3.9 % for land area. A more severe case is observed in yield. The growth rate dropped persistently from -0.9 % in 1961–1970 to -1.3 % in 1971–1980, -3.4 % in 1981–1990, and further to -4.8 % in 1991–2000. The aggregate data for 1961–2007 produced an annual compound growth rate calculated as -3.3 %. Although the rate for 2001–2007 periods is significant and positive, this could be temporary and deceptive as to reflect the true situation.

Table 5: Estimated trend equations for yield of sweetpotato in Nigeria, 1961–2007

Period	Estimated parameters		r^2	F-value	Sig.	D-W
	β_0	β_1				
1961–1970 (n=10)	11.72402***	-0.009849	0.138698	1.347	0.279	1.221514
	(217.7464)	(-1.13502)				
1971–1980 (n=10)	11.45574***	-0.01311***	0.753675	25.000	0.001	1.443410
	(696.7987)	(-4.94747)				
1981–1990 (n=10)	11.30270***	-0.03492***	0.676504	17.352	0.003	1.865930
	(213.3652)	(-4.09021)				
1991–2000 (n=10)	10.95162***	-0.048781**	0.400534	5.298	0.050	2.113704
	(83.65311)	(-2.311969)				
2001–2007 (n=7)	10.27542***	0.023001***	0.945571	80.000	0.000	2.816718
	(931.0079)	(9.320065)				
1961–2007 (n=47)	11.88537***	-0.03330***	0.934141	640.743	0.000	1.256023
	(327.0583)	(-25.26408)				

***=significant at 1%; **=significant at 5%; t-values are in parentheses.

Table 6: Exponential growth rates in sweetpotato output, area, and yield for Nigeria from 1961–2007

Period	Output		Land area		Yield	
	Parameter (β_1)	Exponential Growth	Parameter (β_1)	Exponential Growth	Parameter (β_1)	Exponential Growth
1961–1970 (n=10)	0.000185	0.018502	0.01003	1.008	-0.00985	-0.980
1971–1980 (n=10)	-0.005199	-0.51855	0.00791	0.794	-0.01311***	-1.302
1981–1990 (n=10)	0.029036	2.946165	0.06396**	6.605	-0.03492***	-3.432
1991–2000 (n=10)	0.319091***	37.58765	0.36787***	44.466	-0.04878**	-4.761
2001–2007 (n=7)	0.061338***	6.325823	0.03833***	3.908	0.02300***	2.327
1961–2007 9n=47)	0.075702***	7.864109	0.10900***	11.517	-0.0333***	-3.275

***=significant at 1%; **=significant at 5%

Confirmation of Acceleration, Deceleration, or Stagnation in Output growth

The existence or otherwise of acceleration, stagnation or deceleration in growth of sweetpotato output, land area and yield was ascertained using the quadratic equations in the time trend variables earlier expressed in equation (4). The results for output are shown in Table 7. Besides the output equation for 1961–1970 all other equations have good fit as shown by the r^2 and significance of F-values. The slope coefficients for t^2 are negative for 1961–1970, 1991–2000 and 2001–2007, and positive for 1971–1980, 1981–1990 and 1961–2007. However, the coefficients were only significant for 1981–1990 and 1961–2007 periods. The significant positive values of the coefficient of t^2 for 1981–1990 and 1961–2007 are confirmation of statistically significant acceleration during the two periods. None of the investigated periods confirmed significant deceleration; rather stagnation in output was recorded for sweetpotato during 1961–1970, 1971–1980, 1991 and 2001–2007.

The results for cultivated land area are shown in Ta Like in the case of output, all equations have go except for 1961–1970. Also, existence of statis significant acceleration was confirmed for 1981–19 1961–2007, and stagnation was confirmed for the i the investigated periods.

The estimated quadratic equations for yield of sweet (Table 9) have good fit for all time periods, exce 1991–2000. Statistically significant negative values calculated for the coefficients of t^2 for the aggregat (1961–2007) as well as for 1961–1970. The resul confirming existence of significant deceleration in growth during the periods. The rest of the invest time periods confirmed existence of stagnation in growth.

Table 7: Estimated quadratic equations in time variables for Nigeria's output of sweetpotato, 1970–2007

Period	Estimated parameters			r^2	F-value	Sig.	D-W
	β_0	β_1	β_2				
1961–1970 (n=10)	11.71558***	0.139804	-0.012693	0.425957	2.789	0.129	1.757
	(77.83618)	(2.223996)	(-2.279042)				
1971–1980 (n=10)	11.59870***	-0.029026**	0.002166	0.575758	4.750	0.050	1.776
	(443.0242)	(-2.654637)	(2.236068)				
1981–1990 (n=10)	11.72447***	-0.148921***	0.016178***	0.806206	15.105	0.003	1.492
	(118.0221)	(-3.589411)	(4.401236)				
1991–2000 (n=10)	11.40067***	0.537183**	-0.019827	0.925533	43.690	0.000	2.283
	(30.81675)	(3.476761)	(-1.448386)				
2001–2007 (n=7)	14.63597***	0.079951***	-0.002327	0.989590	199.895	0.000	2.387
	(563.0398)	(5.366862)	(-1.278388)				
1961–2007 (n=47)	12.53273***	-0.142313***	0.004542***	0.904983	209.905	0.000	0.317
	(64.50314)	(-7.621563)	(12.04248)				

***=significant at 1%; **=significant at 5%; t-values are in parentheses.

Table 8: Estimated quadratic equations in time variables for area of land devoted to sweetpotato in Nigeria, 1970–2007

Period	Estimated parameters			r^2	F-value	Sig.	D-W
	β_0	β_1	β_2				
1961–1970 (n=10)	9.360084***	0.070557	-0.005502	0.365337	2.185	0.183	1.994163
	(102.5000)	(1.850048)	(-1.628386)				
1971–1980 (n=10)	9.378160***	-0.028345	0.003296	0.575758	4.750	0.050	1.566234
	(235.4237)	(-1.703722)	(2.236068)				
1981–1990 (n=10)	9.685890***	-0.140895**	0.018623***	0.879937	25.000	0.001	1.462665
	(81.75345)	(-2.847466)	(4.248084)				
1991–2000 (n=10)	9.805799***	0.512750**	-0.013171	0.921052	40.814	0.000	2.520354
	(22.45662)	(2.811660)	(-0.815182)				
2001–2007 (n=7)	13.56084***	0.063647***	-0.003164	0.986922	136.832	0.000	2.734317
	(737.8216)	(6.042584)	(-2.45885)				
1961–2007 (n=47)	9.964464***	-0.12208***	0.004814***	0.934011	311.637	0.000	0.376830
	(47.33157)	(-6.034171)	(11.78064)				

***=significant at 1%; **=significant at 5%; t-values are in parentheses.

Table 9: Estimated quadratic equations in time variables for yield of sweetpotato in Nigeria, 1970-2007

Period	Estimated parameters			r^2	F-value	Sig.	D-W
	β_0	β_1	β_2				
1961–1970 (n=10)	11.56583***	0.069247**	-0.007191**	0.611827	5.732	0.034	1.739102
	(173.8443)	(2.492185)	(-2.920966)				
1971–1980 (n=10)	11.43088***	-0.000680	-0.001130	0.789512	13.266	0.004	1.705087
	(408.6473)	(-0.058180)	(-1.091697)				
1981–1990 (n=10)	11.24892***	-0.008027	-0.00245	0.697726	8.390	0.014	1.887704
	(119.3520)	(-0.203936)	(-0.701032)				
1991–2000 (n=10)	10.80520***	0.024431	-0.006656	0.448254	2.817	0.127	2.302919
	(46.74047)	(0.253048)	(-0.778091)				
2001–2007 (n=7)	10.28549***	0.016291	0.000839	0.949344	35.091	0.003	3.012157
	(468.5791)	(1.295008)	(0.545814)				
1961–2007 (n=47)	11.77860***	-0.02023***	-0.00027**	0.943326	368.642	0.000	1.459661
	(224.1661)	(-4.006108)	(-2.67038)				

***=significant at 1%; **=significant at 5%; t-values are in parentheses.

Summary and Conclusion

We have examined the trends in output, land area, and yield or productivity of sweetpotato in Nigeria since the nation's political independence with a view to determining the existence of acceleration, deceleration or stagnation in growth of the variables overtime. The results reveal that there was a strong positive association between sweetpotato production and land area devoted to the crop. Also revealed was a strong negative association between outputs and yield, on the one hand, and yield and area, on the other. When the entire 1961–2007 time period was considered, it was found that the output of sweetpotato increased substantially. However, the growth recorded in output within the period was mainly accounted for by increase in land area cultivated, rather than increase in yield of the crop.

However, investigation of the different time periods showed that they were characterized by either stagnation or deceleration in productivity even as both output and area might have increased. Similar findings were reported by Onyenweaku and Okoye (2005) in their investigation of trends in cassava, another important food security crop in Nigeria. Even at that, growth in area devoted to sweetpotato production at different periods of time exceeded the growth in output, implying that there has been high level of inefficiency in the use of land resources. Specifically, the yield per hectare showed significant and persistent decrease within the three decades between 1971 and 2000, resulting to decrease in the aggregate productivity performance.

The study showed further that significant acceleration in growth of output and area cultivated was only achieved during 1981–1990, when the Structural Adjustment Programme (SAP) was initiated and implemented in Nigeria. This is in disagreement with the observed significant deceleration in output reported by Ojiako *et al.* (2008) in the case of livestock during the SAP era in Nigeria. The observed acceleration in growth observed for sweetpotato during the SAP era could be attributed to the price incentives provided to farmers under the liberalization policy adopted at the time. It is regrettable though that the gains could not be sustained due largely to political instability and associated policy distortion, lack of political will, infrastructural decay and adequate funding of research for development of the crops sector.

The implication of the foregoing findings is that the effort to achieve the desired expansion of sweetpotato should be directed towards improvement in productivity rather than mere expansion in production. This would require conscious investments in chemical, mechanical as well as organic or biological innovations, which would be beneficial to sweetpotato as a crop. Appropriate political will is required towards developing our rural infrastructures and funding of research to ensure the development of appropriate technologies, including use of improved sweetpotato varieties, productive agronomic practices, optimal post-harvest utilization options, and appropriate extension services that would ensure timely dissemination of such technologies and relevant information to farmers. Also there is need to guarantee improvement in the farmers' access to production inputs like land, credit, fertilizer, irrigation facilities as well as appropriate marketing channels for their products.

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Analysis of Drifts in Prices of Sweetpo (*Ipomoea batatas*) in Nigeria, 2001–200

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Abstract. This study recognized the importanc price in marketing analysis of agricultural product investigated the behaviour of the retail price sweetpotato roots in Nigeria using the monthly r retail prices. Data were obtained from the publica of the National Bureau of Statistics for 2001–2 Data were analyzed using descriptive statistics simple regression model that considered only the variable. Results revealed that there were increa growth trends in prices of sweetpotato over the period, but when compared with the immediate periods, cyclical fluctuating growth trends observed. Higher retail prices were recorded fo year-beginning month of January relative to the en year month of December in greater part of the p investigated. The average retail price of N38.70/k the entire 2001–2006, which ranged from N24.98/ 2001 to N54.46/kg in 2006, was the lowest compared to average prices per kilogram of common staple food products in Nigerian markets study revealed further that minimum prices sweetpotato were realized around January/Feb while the maximum prices occurred ar July/August and November/December per suggesting a bi-modal price structure. The linear gr trend equations revealed that time explained over of variations in prices during the period. To enhanc contribution of sweetpotato in promoting house food security, rural income, and poverty allevi there is need to ensure increase in root yield throug of improved high-yielding varieties, as wel increase in the net returns the crop was capab generating to farmers. The crop's industrial should be explored to enhance its marketa and competitiveness. Factories that have potentia use of sweetpotato as basic raw mate Should be sited at appropriate locat

in the zones of the country. Sustained industrial demand and use of farmers' sweetpotato output would eventually result to increase in prices and improve farmers' income.

Key-words: Trends, retail prices, *Ipomoea batatas*, growth, Nigeria

Introduction

Sweetpotato (*Ipomoea batatas*) ranks fourth among root and tuber crops produced in Nigeria (Tewe et al. 2003), after cassava (*Manihot esculenta*), yam (*Dioscorea* spp.), and cocoyam (*Xanthosoma* spp.), or taro (*Colocasia* sp.). The crop possesses high nutritional energy qualities and its leaves can be consumed as vegetables (Fawole 2007; Chukwu 1999). Among the benefits of sweetpotato is that it produces more biomass and nutrients per hectare than any other food crop in the world (Prakash 1994). It could also be a good source of vitamins A, C, and E, dietary fibre, potassium, and iron while being low in fat and cholesterol (Answers.com 2008). In Nigeria, Tewe *et al.* (2003) reported that variety, yield, labour rates, and market prices affect profitability of sweetpotato production. Their estimation of the costs of production inputs, yield, selling price, net revenues, and gross margins of sweetpotato per hectare in the North-Central, South-Western and South-Eastern zones of Nigeria in 1995 is presented in Table 1.

The Table shows that production cost, yield, and sales revenue were highest for the South-Eastern relative to the North-Central and South-Western zones. One of the reasons accounting for this trend is the early exposure of farmers in the South-Eastern Zone to the use of improved

Table 1: Sweetpotato production inputs, costs and net revenues (per ha) in North-Central, South-Western and South-Eastern zones of Nigeria in 1995

Description	NC zone (Benue State)	SW zone (Oyo State)	SE zone (7 states)*	Average (3 zones)
Total production cost (₦/ha)	25950.00	28300.00	40300.00	31500.00
Root yield (t/ha)	4.50	4.00	7.00	5.17
Selling price (₦/kg)	7.00	8.00	7.00	7.33
Revenue (₦/ha)	31500.00	32000.00	49000.00	37500.00
Gross Margin (₦/ha)	5550.00	3700.00	8700.00	6000.00

NC: North- Central; SW: South-Western; SE: South-Eastern; * The zone consists of Abia, Akwa Ibom, Anambra, Cross Rivers, Enugu, Imo, and Rivers States

Source: Compiled from Tewe *et al.* (2003)

sweetpotato production technology courtesy of the resear works of the National Root Crops Research Institu (NRCRI), Umudike, Abia State domiciled in the zone. Wi respect to national yield, available records from FAO (FA 2007) reveal that the average yield dropped substantial from 11.73 t/ha in 1961–1970 period to 8.79 t/ha 1971–1980, 6.74 t/ha in 1981–1990, 4.47 t/ha in 1991–200 and 3.18 t/ha in 2001–2007 periods. The calculated yie values for the post-1970 periods represent decreases of 25 %, 42.5 %, 61.9 % and 72.9 % respectively over tl 1961–1970 era. Table 1 shows further that although tl selling price was highest in the South-Western zone, return c investment was also highest in the South-Eastern zone with gross margin of N8700.00 being 36.2 % and 57.5 % high than what was realized in the other two zones, respectivel The gross marketing margin is a broader aspect of tl marketing margin that represents the difference between tl price received by producers and the price paid by consume (Chopak 1998). The price paid by consumers of sweetpotat is the commodity's retail price, which is basis of th investigation.

Importance of price in market analysis

Price is an important variable in market analysis. Although has been argued that some non-price factors, like produ attributes, could be equally relevant, relationships betwee prices are imperative in explaining market equilibriur (Asche *et al.* 2005). In a theoretical deregulated system, th equilibrium price and output are determined by th interaction of demand and supply forces. The importance c price in market analysis is further substantiated in the variou pricing practices used by the market operators to achieve th profit-making goal of their enterprises. One of these is th *mark-up pricing*, which involves setting prices to cover th average cost and the desired margin of profit. Firms can eithe mark-up on cost or on price: the former entails setting pric for profit as a percentage of average cost of production and th latter involves setting the price for profit as a percentage o price. The second pricing practice is using an *optimal pric* that is described as the price that makes maximum profit b considering demand and cost. The optimal price (P^*) i expressed as a function of price elasticity of demand an marginal cost of producing a product, that is:

$$P^* = [\in_p /(1+ \in_p)] * MC$$

where $\in_p$ is the price elasticity of demand and MC is the marginal cost of production. The use of optimal pric guarantees that neither the higher nor the lower price settin produces the maximum profit for the enterprise.

The third pricing practice often used under an imperfect system is *price discrimination* described as setting the same kind of product (usually from the same factory) at different prices in different markets in order to get maximum profit. Suppose we assume a hypothetical seller of a good (G) that has no close substitutes but who sells in three different markets (M_1, M_2 and M_3). To achieve maximum profit using the price discrimination tool, the seller adjusts price and quantity of the good until equality is attained among the marginal revenue (MR) of the product at the three markets and the marginal cost of production (MC). Whether price discrimination is of first-degree (charging different prices to different customers) or second-degree (charging different prices based on quantities purchased) or third-degree (charging different prices to each customer class) the goal is the same. The fourth pricing practice is the *odd number pricing*, under which the sellers attempt to lure the buyers by making them think that the product's price is just "₦99 instead of ₦100". Usually, sellers would quote the product price as "₦9.99 instead of ₦10.00" or "₦99.99 instead of ₦100.00" believing that the buyer has the tendency of rounding up to ₦9.00 or ₦99.00, which is a whole ₦1.00 below the round number ₦10.00 or ₦100.00 as the case may be. However, clever buyers would always know that the odd number pricing is a mere marketing trick to "persuade the fools".

In agricultural marketing, defined as the set of economic and behavioural activities involved in coordinating the various stages of economic activity from production to consumption of agricultural products (Purcell 1979), products' prices are also at the centre of discussion because, among other things, prices determine the revenue and by extension the profitability of a farm enterprise. As Marr and Gast (1995) succinctly argued, there was probably no single aspect of selling in a farmers' market that causes more discussion, and often more problems, than prices and selling strategies. Among other functions, prices help to express the values of agricultural products, explain their levels of supply and demand in the market, explain how people trading on them perceive their future demand and supply, and act either as an incentive or a disincentive for trade, and production (Chopak 1998).

It is in recognition of the centrality of price in market analysis that this study on the behaviour of retail prices of sweetpotato was conceived. The specific objectives are to examine the trends, estimate growth rate, and time trend equation for sweetpotato prices. Understanding the behaviour of an agricultural product price will serve as a useful guide to the farmers, marketing agents, research scientist, and relevant government agents charged v responsibility of formulating policies on food security.

Methodology

Price data. The price data used for this analysis w obtained from the publications of the National Bureau Statistics of the Federal Government of Nigeria (N 2007). The agency has been documenting the urban re prices of selected items, including agricultural products both the national level and for the six geopolitical zone Nigeria since 1997. Among the available data series the monthly prices of staple food items, including ma millet, plantain, yam, rice, guinea corn, be sweetpotato, Irish potato, and *garri*, a granul processed cassava product that often comes in yellow white colours. For this study, the behavioural trend in national urban retail prices per kilogram of sweetpo was investigated. The available data covered a perio 72 months, from January 2001 to December 2(However, proper examination revealed existence outliers (excessive high values) in the documented series for almost all products in the months of Noven and December 2003. To remove these outliers the data the affected months were adjusted to reflect the mean p values for the particular month across the entire pe under investigation. The data were analyzed using sir descriptive statistics, graphs, and linear time t equation.

Trend analysis. Trend analysis can be viewed as introduction and consequent consideration of the influ of time variable on the data series considered as dependent variable. Koutsoyiannis (1977) observed researchers could often introduce time as an explan variable in a model, meaning that the dependent vari experiences an autonomous trend. The analysis of series consists of a description, generally mathematica component movements present (Spiegel 1972). W introduced, time, often measured by the numbe observation periods from a starting year onwards, produce a coefficient that can be interpreted as a mea of autonomous growth (Koutsoyiannis 1977).

Growth in prices. The growth rate in agricultural pro prices is calculated as:

$$g_p = \left(\frac{P_t - P_{t-1}}{P_{t-1}} \right) * 100\% \quad \ldots\ldots\ldots(1)$$

where g_p = index of growth in product price; P_t = pri product at current period (t); and P_{t-1} = price of prod the immediate past period (t-1). If $g > 0$ it means th

a rise in product price at the current period relative to the immediate past period. Otherwise, that is if $g < 0$, there is a relative fall in the product price.

Results and Discussion

Graphical trends. The graphical trend in the national sweetpotato average monthly prices is presented in Figure 1. It shows that from ₦23.21/kg in 1st month, January 2001, the price rose by 8.3% to ₦25.26 in 12th month, December 2001. The average price recorded for the 13th month, January 2002, was ₦24.22, which reflected a drop by 4.1% over the December 2001 year-ending price. The year-ending (December) prices for 2002, 2003, 2004, 2005, and 2006 were reported as ₦24.70, ₦44.61, ₦37.39, ₦58.68, and ₦49.00/kg, respectively. It follows that in absolute terms there has been steady increases in the commodity prices over the period of time under review.

The curve of the growth in sweetpotato prices during the period is presented in Figure 2. It considers the growth in prices at current period relative to the immediate past period. It shows no systematic growth pattern within the period. Cyclical growth trends were observed instead reflecting, perhaps, the effect of seasons. Aside from January 2003 (25th month), November 2003 (35th month), and December 2005 (60th month) when positive growth rates of 35.8 %, 22.3 % and 22.5 % respectively were achieved, and January 2004 (37th month) when a compensating negative growth rate of 22.1 % was achieved, the growth index (g) was fluctuating between plus and minus 20.0 % throughout the period.

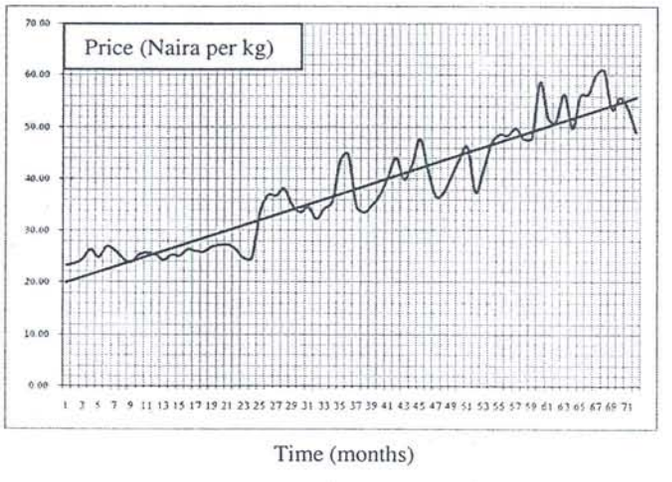

Figure 1: Trends in monthly mean prices per kilogram of sweetpotato roots, January 2001–December 2006
(Regression line $y_1 = 19.56 + 0.502\,x + e_1$; $R^2 = 0.888$)
Source: Compiled from National Bureau of Statistics' 2007data

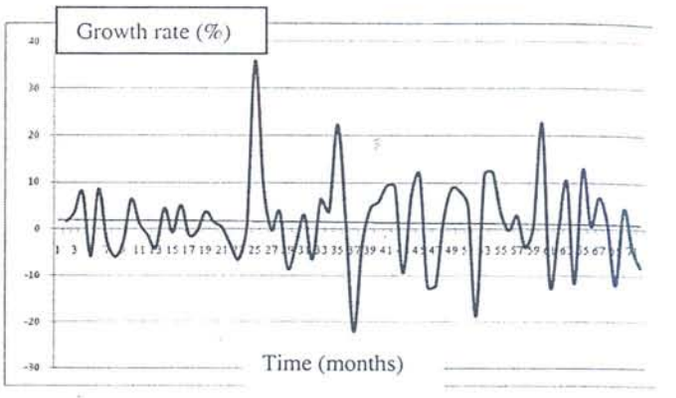

Figure 2: Growth rate in mean monthly prices of sweetpotato roots relative to immediate past period, 2001–2006
(Regression line $y_1 = 1.945 - 0.013\,x + e_1$; $R^2 = 0.001$)
Source: Compiled using data from the National Bureau of Statistics, 2007

Figure 3 presents the growth in sweetpotato prices at th current period relative to the base period (January 2001 Its trend is similar to that shown in Figure 1 for raw price: Between February 2001 (2nd month) and December 200 (24th month) increases, which ranged from 1.6% to 17. % were recorded for retail prices every month. The rat increased sharply from 6.4 % in December 2002 to 44.6 % in January 2003. Throughout 2003 growth in price relative to the base period remained high at more than 4 % for each month. The same trend was maintained i 2004, up to May 2005. By June 2005 however, the pric relative to the base period had more than doubled resultin in rate of 101.9 % at that month. Between July 2005 an December 2006 the growth rate had remained high, with range of 105.4 % to 162.0 %.

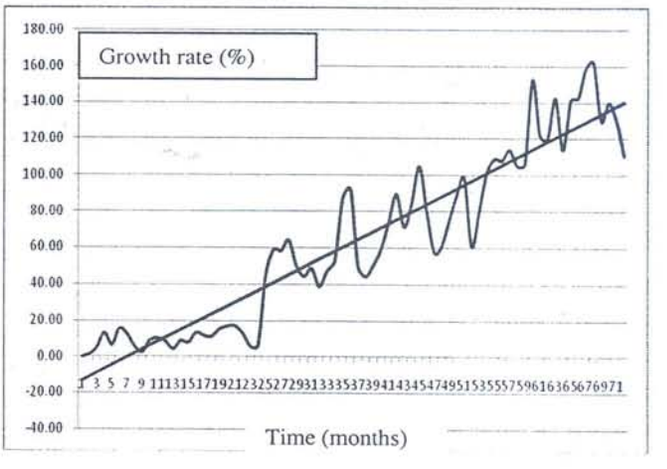

Figure 3: Growth rate in mean monthly prices of sweetpotato roots relative to base period, 2001–2006
(Regression line $y_1 = -15.71 + 2.164\,x + e_1$; $R^2 = 0.888$)
Source: Compiled from National Bureau of Statistics' 2007 data

Changes in beginning and end-of-year prices. The relative changes in the prices of sweetpotato recorded for the beginning and end of the years are shown in Table 2. Apart from 2006, there have been relative increases in the recorded prices for the end-of-year month of December compared to the beginning of the year prices recorded for the month of January. The growth rates have been calculated as 1.9 %, 32.9 %, 7.6 %, and 44.4 %, respectively for 2002, 2003, 2004, and 2005. In 2006, however, there was a 4.9 % fall in price between January and December. The observed relative higher prices for January could have resulted from general inflation that follows the Christmas and New Year festivities nationwide, resulting mostly from increases in households' demand of foodstuff and instability in the economy leading to rising costs of business, such as rising cost of transportation resulting from either scarcity of petroleum products (artificial or genuine) or announcement of increase in pump prices of fuel. It could also have resulted from expectations of announcement of the Federal and State Governments' Appropriation Bills for the New Year.

Descriptive statistics of sweetpotato prices. The mean, standard deviation, and minimum and maximum prices per kilogram of sweetpotato roots for the respective years is shown in Table 3. Average prices per kilogram had risen by 3.2 % between 2001 and 2002, 41.7 % between 2002 and 2003 and 7.3 % between 2003 and 2004. Further increases of 18.5 % and 17.2 % respectively were observed for 2005 over 2004 and 2006 over 2005 prices. Table 3 also shows that the standard deviation was highest in 2005 (5.14) when compared with 2001 (1.09), 2002 (0.97), 2003 (3.71), 2004 (4.09), and 2006 (3.62). The coefficient of variation, calculated as the ratio of the standard deviation to the mean, was also highest for 2005 and follows similar pattern as the standard deviation for the entire periods. The differences in standard deviations and coefficients of variation were caused by the high variations in the observed maximum and minimum prices. The range of the observed prices of sweetpotato roots was highest for 2005 (21.30), followed by 2004 (14.12) and 2003 (12.37). It was lowest for 2002 (2.99).

For the entire 2001–2006 period, the average price of sweetpotato roots was ₦37.74/kg. This ranged from a minimum price of ₦23.21/kg in January 2001 to a maximum price of ₦60.82/kg in August 2006. When compared with some common staple food items in the Nigerian markets (Table 4), sweetpotato had the lowest price. For example, yam was sold for an average price of ₦56.11/kg, Irish potato ₦67.90/kg, rice (foreign – ₦94.34/kg, local – ₦70.61/kg), cowpea (brown ₦77.65/kg, white – ₦67.32/kg), maize (white ₦44.52/kg, yellow – ₦45.61/kg), guinea corn (₦46.46/k and millet (₦46.26/kg). Data were not available cassava tubers, however, cassava by-products, nam white and yellow *garri* sold for average prices ₦58.07/kg and ₦63.55/kg respectively.

Minimum, average, and maximum prices for vario months. The month-by-month highest, average and low prices per kilogram of sweetpotato are presented in Figu 2. It can be inferred that minimum prices of sweetpot are achieved about the months of January/February wh the maximum prices are attained about July/August a November/December of every year. The average pric per kilogram were ₦35.18 during January/Februa ₦39.33 during July/August and ₦44.05 duri November/December periods. This tends to suggest a l modal price structure for the crop.

Table 2: Relative changes in sweetpotato root prices for the beginning and closing of years, 2001–2006

Year	January (₦/kg)	December (₦/kg)	Change (%)
2001	23.21	25.26	8.83
2002	24.22	24.70	1.98
2003	33.55	44.61	32.96
2004	34.74	37.39	7.63
2005	40.64	58.68	44.39
2006	51.55	49.00	-4.95
2006	51.55	49.00	-4.95

Source: Computed from data of National Bureau of Statistics, 2007

Table 3: Statistics of sweetpotato root prices, 2001–2006

Year	Mean (₦/kg)	Std. Dev.	Maxi-mum (₦/kg)	Mini-mum (₦/kg)	Relative dispersion (CV %)
2001	24.98	1.09	26.84	23.21	4.36
2002	25.78	0.97	27.21	24.22	3.77
2003	35.57	3.71	44.61	32.24	10.16
2004	39.21	4.09	47.63	33.51	10.42
2005	46.46	5.14	58.68	37.38	11.05
2006	54.46	3.62	60.82	49.00	6.66

Source: Computed from data of National Bureau of Statistics, 2007

Table 4: Average monthly prices of selected crops, 2001–2006

Type	Product	2001	2002	2003	2004	2005	2006	Mean (₦/kg)	Std. Dev.	CV (%)
Tuber crops	**Sweetpotato**	**24.98**	**25.78**	**35.57**	**39.21**	**46.46**	**54.46**	**37.74**	**11.56**	**30.63**
	Yam	39.48	49.94	54.68	54.94	66.22	71.41	56.11	11.44	20.39
	Irish Potato	49.53	56.27	59.78	70.99	81.07	89.75	67.90	15.49	22.81
Cereals crops	Rice (foreign)	64.49	68.49	85.14	104.71	118.90	124.31	94.34	25.50	27.03
	Rice (local)	50.60	53.21	62.54	75.49	90.07	91.76	70.61	17.99	25.47
	Maize (yellow)	37.48	41.95	38.20	40.40	59.88	55.77	45.61	9.68	21.22
	Maize (white)	36.57	42.17	37.05	39.74	57.73	53.88	44.52	9.05	20.32
	Millet	36.97	41.51	39.11	40.82	61.84	57.30	46.26	10.53	22.76
	Guinea corn	36.84	41.65	37.98	41.27	63.18	57.83	46.46	11.17	24.04
Legume crops	Beans (brown)	62.48	67.03	68.94	77.31	102.40	87.74	77.65	15.05	19.39
	Beans (white)	54.57	57.11	59.33	66.23	92.08	74.58	67.32	14.13	20.99
Cassava product	*Gari* (white)	54.79	61.20	43.62	48.46	70.86	69.51	58.07	11.10	19.12
	Gari (yellow)	57.11	64.81	53.10	53.40	75.54	76.15	63.35	10.56	16.67
	Mean (₦/kg)	46.61	51.62	51.93	57.92	75.86	74.19	--	--	--
	Std. Dev.	12.00	12.57	15.10	19.98	20.36	20.36	--	--	--
	CV (%)	25.75	24.36	29.08	34.49	26.83	27.44	--	--	--

CV=Coefficient of variation expressed as (Std. dev./Mean)
Source: Computed from data of National Bureau of Statistics, 2007

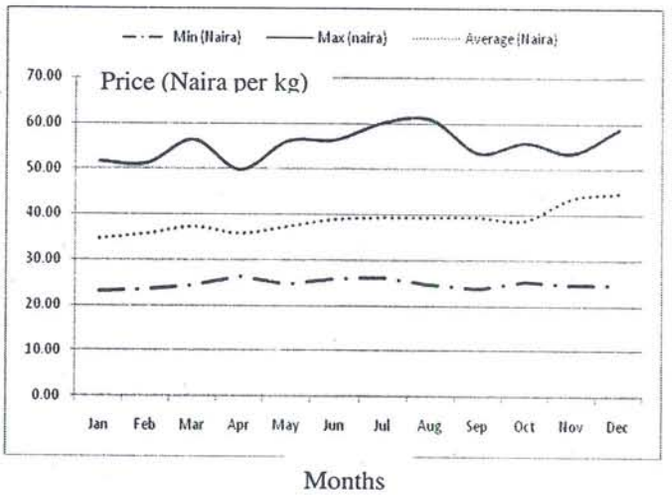

Figure 2: Monthly maximum, minimum and average prices per kilogram, 2001–2006
Source: Charted from data of National Bureau of Statistics, 2007

Price-time trend equation. The linear trend equation earlier presented in Figure 1 is estimated as:

$$y_i = 19.562 + 0.502x + e_i$$
$$(21.83)^{***}\ (23.55)^{***} \quad \text{.....(2)}$$

where y = average price per kilogram of sweetpotato, x = time trend; and e = error term; the values in parentheses are the t-values both of which point out that the paramete estimates are highly significant ($p < 0.01$).

The regression has good fit. It has the associate coefficient of correlation calculated as $R^2 = 0.886$ and th F-value = 554.81 ($p<0.01$). It shows that time accounte for 88.6 % of the changes in sweetpotato prices during th period under review. The slope of the linear function i given as positive 0.502, implying that a unit change in th time variable would result to a 0.502 (that is 50.1 % ove 100 %) increase in average price of sweetpotato. It is measure of the effect of time on sweetpotato prices.

Growth equations. The growth equation over th immediate past period is shown in Figure 2 as:

$$y_i = 1.945 - 0.013x + e_i$$
$$(0.862)^{ns}\ (-0.246)^{ns} \quad \text{.....(3)}$$

where y = an index of growth over the immediate pas period; x = time trend; e = error term; values i parentheses are the t-values, both of which indicate tha the parameter estimates are not significant in this case; n = not significant. The regression presented in equation (3 has associated $R^2 = 0.001$ and not significant F-value : 0.061, meaning that it does not have good fit. Th implication is that time is not a relevant variabl explaining growth of prices over the immediate pas period.

The case of growth over the base period is shown in the following equation (4).

$$y_i = -16.515 + 2.181x + e_i \quad \text{.....(4)}$$
$$(-4.153)^{***} \quad (23.198)^{***}$$

where y = an index of growth over the base year period, x = time trend; e = error term; and values in parentheses are the t-values. The regression has good fit and like the price-time trend model of equation (1) has the associated $R^2 = 0.886$ and the F-value = 538:15 that is highly significant ($p < 0.01$). In other words, time is a relevant factor and has explained 66.9 % of the variations in growth during the period. The slope coefficient given as positive 2.181 implies that a unit increase in time would result to 218.1 % over 100 % increases in mean sweetpotato prices.

The trends shown in Figures 1 and 2 and further explained by the positive slope coefficients are a suggestion of prevailing inflationary trends in the economy. Among the major causes of inflation in Nigeria are rising cost of production and general socio-economic instability, like increase in pump price of petroleum products and exchange rate of the local currency (the Naira). Usually, the purchasing power of money is reduced under inflation with the greater negative impact falling on the fixed income (salary) earners. The non-fixed income earners would usually adjust the prices of their products or services to counterbalance the rising cost of production, processing and distribution while maintaining sufficient margin to enable them remain in business. There is need for constant review of salaries and remunerations of the fixed income earners in line with the inflationary trends in the economy.

Conclusion

The following salient points emerge from this study:

1. In absolute terms, increases were observed in the national average retail prices of sweetpotato over the base period during the 2001–2006 period investigated.
2. Relative to the immediate past period, however, the growth rate fluctuated in a cyclic manner.
3. Comparison of the January and December prices shows that relative higher prices were observed for January, which could be attributed first, to general inflation that follows the seasonal festivities nationwide, often resulting from economic instability and second, to the general expectation of announcement of federal and state New Year budgets.
4. Compared with other common food security crops in the market, the price of sweetpotato was lowest during the 2001–2006 period under investigation; this low pricing has constituted a major problem in the quest to promoting production of the crop to achieve household food security.
5. Peak prices were realized during the July/August an November/December periods suggesting a bi-modal pric structure for sweetpotato in Nigeria.
6. Estimated trends equations corroborate the relevance c time in explaining variations in sweetpotato prices durin the period.

In conclusion, this study upholds that for sweetpotato t become more relevant in the quest to promoting househol food security, rural income, and alleviating the poverty c the Nigerian farmer, there is need to ensure increase in it root yield per hectare as well as the net returns it is capabl of generating to farmers by way of competitive pricin and/or cost reduction. It is also desirable to explore th crop's industrial usage to enhance its marketability an competitiveness. While research and extension activitie should be intensified to ensure further development ar dissemination of improved high-yielding and diseas resistant cultivars, especially for the areas where loc varieties are still very much in use, massive campaig should be embarked upon to promote the processing sweetpotato into different food recipes. Factories th could use sweetpotato as basic raw materials for chip alcohol, and livestock feed-making factories, should l sited at appropriate locations in the zones of the count that have potentials for sweetpotato production. Under th arrangement both the factories and the farmers sta chances of benefiting. For instance, sourcing their bas input directly from farmers would drastically minimize tl production costs for the factories while the farmers, l having steady markets would reduce certain postharve losses, especially those associated wi preservation/storage and marketing. Sustained industr demand and use for the farmers' output would eventual result to increase in prices and improve farmers' income.

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Gender, Extension and Policy Issues

Gender and age gap acceptance of sweetpotato foods in Apata, Ibadan

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Abstract. A survey assessed the gender and age gap acceptance of sweetpotato foods in Apata, Ibadan. Fifty questionnaires were administered, and 48 people responded (25 females and 23 males). Most male respondents were youth and children. Five of the 23 males do not like sweetpotato, while 10 out of 25 females do not like sweetpotato as food, the major reason being its high sugar content. More children and youth liked sweetpota than adults, while gender gap is inconclusive. Th preliminary survey shows that more males could pref sweetpotato than do females.

Introduction

Sweetpotato (*Ipomoea batatas*) is a starchy food containi vitamins (much vitamin A), and minerals comparable those of fruits (Truong 1989). This was the basis f development of fruity products namely: dried sweet-sc sweetpotato, sweetpotato beverage, catsup, jam, and leath to raise its economic value. Processing sweetpotato ir products with similar taste and appearance as processed fr items has been proven to be cost-effective in making it competitive as fruits (Truong 1991). These products occur the Philippines. Why are such products or variants not fou in Nigeria?

Large-scale production of such products will benefit farm who will get better markets for sweetpotato; tub processors who will take advantage of the relative cheapn and non-seasonal production of sweetpotato compared fruits, and being nutrient-rich item; consumers to be offe low-priced and nutritious products (Truong 1991); and j seekers to be employed.

Development of products outlined by Truong 1991are:

1. Dried sweet-sour sweetpotato. The product has a sweet : sour taste of dried fruits. Cooked sweetpotato slices soal in 60° Brix syrup having 00:8 % citric acid produced the m acceptable product.

2. Sweetpotato catsup. A formula consisting of 32.2 % (w sweetpotato, 42 % water, 2.9 % vinegar, 11.3 % sugar, salt, 0.3 % spices, and food colours was develop Sweetpotato cultivars with cooked flesh yellow to ora colour and 'moist' texture can be used.

3. Sweetpotato jam. A formula with 20.7% (w/w) sw potato, 45.0% sugar, 34.0% water, and 0.3% citric acid, most acceptable to the taste panel. Due to higher sta content of sweetpotato compared to fruits, the ratic sweetpotato to sugar differed from the standard of 45% fruits and 55% in fruit jams (Gross 1974). Jams of nat light yellow, orange, and purple colours can be made.

4. Sweetpotato beverage. Processing involves wash peeling, trimming to remove damaged parts, steam extracting, and formulating with 12 % (w/v) sugar, 0. (w/v) citric acid, and 232 mg/l ascorbic acid as vitami fortification (Troung and Fementira 1989). The bever was bottled in 150 ml vials and pasteurized at 90−95°C.

Sweetpotato leather. Processed from steamed sweetpo chunks were blended with water, sugar, salt, citric acid, with artificial flavours. The slurry was then spread as thin la on plastic sheets and mechanically dried until

desired moisture content and texture were obtained. A loading density of 4 kg/ m^2 slurry produced the sweetpotato leather which was rated with high scores for thickness, texture and general acceptability.

Gender is a concept used in social science to look at the roles and activities of men and women. The focus of gender analysis is not so much on biological differences between men and women but rather on their experiences as members of the society. The age gap also determines the soft spot for different dishes. The survey concentrated on the gender and age gap in the way people accept various forms of sweetpotato foods found in Apata, Ibadan, Nigeria.

Materials and Methods

A survey was carried out at Apata, Ibadan, Oyo State using questionnaires to sample different people's opinions. Some people that could read filled the questionnaires by themselves while those who were illiterates were helped to fill the questionnaires. Fifty questionnaires were administered because of the time constraints. The questionnaires were comprehensive and were tailored to ensure accurate answers were given. The questions were clarified to, as much as possible, avoid evasive answers.

Results and Discussion

Out of 50 questionnaires administered, only 48 people responded. This was a small sample size. The gender and ages of the respondents are shown in Table 1. Two out of 23 (8.7 %) male respondents, had never eaten sweetpotato; their age groups were 36–40 and 41–50 respectively, while (4.0 %) of females from the 36–40 years' age group had never eaten sweetpotato. Thus, 91.3 % of male and 96.0 % of females had at one time or the other eaten sweetpotato, or about 93.7 % of all respondents. Some 40 % of female respondents do not like sweetpotato food, whereas 20 % of females who do not like sweetpotato (or 8 % of all female respondents) claimed that they do not have satisfaction of having eaten enough food when they eat sweetpotato.

Table 1. Gender and age analysis of the respondents

Age	Female	Male	Total
9–12	3	1	4
13–18	1	9	10
19–25	7	5	12
26–35	6	2	8
36–40	4	4	8
41–45	3	2	5
46–50	1	0	1
Total	25	23	48

Some of the reasons for dislike for sweetpotato foo include: (1) It is too sugary (8 of 10 respondents); (2 Sweetpotato is not readily available (3 of 10); (3) It expensive (8 of 10). But 1 of 10 wants sweetpotato to b included in the diet of secondary school students living i the boarding house. These ten people who dislik sweetpotato food also claimed that they have at one tim or the other eaten sweetpotato in form of: (10 frie sweetpotato chips (4 of 10); (2) pottage (1 of 10); (3 boiled and eaten with stew or oil (3 of 10); (4) boiled an eaten as such (2 of 10); and (5) roasted (1 of 10).

Table 2 shows the age analysis of female respondents i the study. Some 15 of 25 female respondents of thei claimed they like sweetpotato (60 %). That is impressiv This information can be harnessed in poverty alleviatio programmes by encouraging small-scale businesses in th production and sale of various types of sweetpotato food such as sweetpotato chips. This is also a mark opportunity for large scale businesses. Some of thes people claimed they have at one time or the other eate sweetpotato in form of boiled tuber eaten with stew or oi boiled with cowpea and eaten as pottage; fried as chip roasted over fire; or eaten as pottage. These peop constitute 31.3 % of all respondents or 60 % of the fema respondents. Out of these, one was in the 9–12 years ag group or 100 % of female respondents in that age grou while three were in the age group of 13–18 years, or 1(% of that age group. Also, three out of seven were in th 19–25 years age range (42.9 %), three out of six in age 26–35 (50 %). Likewise, two out of four were of age 36–40 years (50 %) and three out of three in ages 41–4 years (100 %). No doubt, sweetpotato has a wid acceptability among different age groups. Some of th adult respondents also claim that their children lik sweetpotato like Indomie noodles (a food popular amon children in Nigeria).

The analysis of ages of male respondents in the study is shown in Table 3. Five out of the 23 male respondents do not like sweetpotato (21.7 %).

Table 2. Age analysis of female respondents to sweetpotato

Age	Like sweetpotato	Do not like sweetpotato	Total
9–12	1	0	1
13–18	3	0	3
19–25	3	4	7
26–35	3	3	6
36–40	2	2	4
41–45	3	0	3
46–50	0	1	1
Total	15	10	25

Table 3. Age analysis of male respondents to sweetpotato

Age	Like sweetpotato	Do not like sweetpotato	Total
9–12	1	0	1
13–18	7	1	8
19–25	4	2	6
26–35	2	0	2
36–40	3	1	4
41–45	1	1	2
46–50	0	0	0
Total	18	5	25

The five males are in the following age groups: one in the age group of 13–18 years or 12.5 % of respondents in that age group; two in the age group of 19–25 years or 40 %; one in the age group of 36–40 years or 25 % of that age group; one in the age group of 41–45 years or 50 % of that age group. The reason for a higher percentage of male respondents who like sweetpotato is probably due to the fact that majority of the male respondents were young. Young people tend to like sweetpotato more than adults because sweetpotato contains sugar which adult tends to avoid since it is linked to diabetes. Sweetpotato breeders should, therefore, respond by releasing sweetpotato varieties that are less sweet. Up to 73.8 % of the males who liked sweetpotato were mostly youth and children. These constitute a potential market for small- and large-scale businesses. About 38.9 % of male respondents who liked sweetpotato claim they have at one time or the other eaten sweetpotato fried chips. This implies that there is a market for fried sweetpotato chips.

Conclusion

In all, 33 out of 48 respondents like sweetpotato food (68.8 % of all respondents). This would be a large market for sweetpotato. Large-scale businesses can exploit sweetpotato food markets in Nigeria, especially with appropriate patent rights; they can venture into the production of dried sweet–sour sweetpotato, sweetpotato catsup, sweetpotato jam, sweetpotato beverage and sweetpotato leather, in addition to sweetpotato fried chips. It is obvious that children like sweetpotato, while that of gender gap is not conclusive because of the small number and age groups of the respondents. With over 22.4 million children in Nigeria, there should be a big market for sweetpotato food products for children in Nigeria. However, the survey shows that males like sweetpotato

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General Perception of Sweetpotato as food: a case study of Apata, Ibadan, South-Western Nigeria

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Abstract. "Potatoes" (*Ipomoea batatas and Solanur tuberosum*) are common food crops in Nigeria Sweetpotato can produce more food per hectare than ric and requires fewer inputs and less management Sweetpotato is, therefore, an important crop to exploit in world of rising population and fixed area for foo production. A survey was conducted to get the genera view of people concerning potato as food in a loca community of Apata in Ibadan, Nigeria. Though th sample size was small, much information was obtaine from respondents. Out of 50 questionnaires, 49 response were obtained. Some 51 % of the respondents claim the can eat sweetpotato regularly like other Nigeria staple foo such as rice, yams, cowpea, etc. Also, 63.3 % of th respondents are ready to substitute other Nigeria staple foods with sweetpotato. Likewise, currently about 51 % o the respondents see sweetpotato as snack or refreshment while 42.9 % see sweetpotato as normal food. In all, sweetpotato has wide acceptability and should be exploited in the country's drive towards food sufficiency.

Introduction

Available "potato" in Nigeria includes sweetpotato and Irish potato. Sweetpotato (*Ipomoea batatas*) belongs to the Family Convolvulaceae. It is an annual herbaceous plant

with white and blue flowers. It is an ideal plant for covering soil to prevent soil degradation. Sweetpotato can produce more food per hectare than rice and requires fewer inputs and less management. Thus, it is an important crop to exploit in a world of rising population and fixed area for food production (AVRDC 1976). Sweetpotato is popular in Papua New Guinea where people eat an average of 1.0 kg daily. In the U.S., sweetpotato served as candied yams is a popular dish (AVRDC 1976). Sweetpotato grows with vigour under a wide range of adverse environments and their durability may be their greatest agronomic asset but also result in lower esteem for the crop (AVRDC 1976).

Ibadan in South-Western, Nigeria, is the largest city in West Africa and third in Africa after Cairo and Johannesburg. Apata is a small community along Abeokuta Road, (Abeokuta is the capital of Ogun State, Nigeria). The main staple foods in Nigeria are maize, yams, cowpea, garri (processed cassava), cocoyam, sorghum and pearl millet. The essence of the survey was to get views on how sweetpotato compares with staple foods such as maize, yams, cowpea, garri, cocoyam, sorghum and pearl millet. Sweetpotato contains far more proteins than cassava, and should therefore be given priority. Orange-fleshed sweetpotato tubers and leaves provide Vitamin A and help to prevent blindness, especially in children, because they are rich in beta carotene. The leaves are edible when cooked, containing Vitamin C and iron, effective in combating anaemia (Hans-Martin and M'Pia 2008).

Materials and Methods

A total of 50 questionnaires were administered in Apata community in Ibadan, to get views of sweetpotato as a staple energy food in Nigeria. The people were allowed to express themselves freely, though only forty nine people responded. The questionnaire was designed in such a way that people would not give evasive answers. It was also designed in such a way so as to get as accurate information as possible.

Results and Discussion

Table 1 shows that 25 out of 49 respondents, or 51 %, claim they can eat potato as regularly as they eat other Nigeria staple foods such as yams, beans, garri, rice, yam flour, cassava flour, cocoyam, sorghum, maize and millet. The reasons some respondents gave for not eating sweetpotato as regularly as they do other Nigerian foods include being too sweet or sugary; expensive; a food to be eaten once in a while; the sweetness may cause sickness if taken regularly; that some people claim it can cause diabetes; it is not easy to include in traditional recipes; and

Table 1. General perception of sweetpotato among 49 respondents at Apata, Ibadan, Oyo State

Respondents	Yes	No	Not decided
Can take sweetpotato as regularly as other Nigerian staple foods	25	17	7
Can substitute sweetpotato for other Nigerian staple foods	31	16	2
See sweetpotato as snacks (refreshment)	25	21	3
Like potato for sweetness	36	13	0
Will buy potato in large quantity if available and cheap	39	10	0

that it contains only carbohydrates. From the respond it is clear that sweetpotato is widely accepted and ca promoted by both government and Agricultural Exte agents as a staple food in Nigeria. Also, sweetp breeders need to work on sweetpotato to produce le not sweet types. Agricultural Extension agents also ne correct misgivings of the people on the food conte sweetpotato. Sweetpotato contains more protein cassava. Orange-fleshed sweetpotato, which is rich ir carotene, should be promoted as food for chil especially in the Northern Nigeria where the proble blindness is severe.

However, an overwhelming 63.3 % of respondents willing to complement and/ or substitute other Nig staple foods such as yams, beans, garri, yam flour, r sorghum, cocoyam, etc. with sweetpotato, but 36.7 % not ready to do so. Also, 51 % of people surveye sweetpotato as snacks or refreshments. About 42 people see potato as normal food and not refreshm snack. Similarly, 73.5 % of respondents like the swe of sweetpotato. This is a challenge to sweetpotato br on the need to breed varieties of the crop that ar sweet. Some people do not like the sweetne sweetpotato because of fears of consuming too much that could result in diabetes.

Likewise, 79.6 % of the respondents are willi purchase sweetpotato in large quantities if availab cheap, while other respondents will not. The reason: who will not purchase gave include: sweetpotato will spoil, and it is too sweet. This is equally a cha for the crop protection specialists to work on the b affordable indigenous methods of storing sweetpot 1982, Nigeria Stored Products Research Institute (N estimated that the loss of grains in storage was ab million tonnes of cereal grains and grain legun

monetary terms, this was estimated to be between ₦ 300–400 million. However, NSPRI noted that with root and tuber crops (sweetpotato inclusive), the problem is more severe (Agboola 1982).

Some 32.7 % of the respondents said they do not have satisfaction of having eaten enough food when they eat sweetpotato, while 67.3 % normally have satisfaction of having eaten food when they eat sweetpotato. Likewise, 59.2 % of respondents preferred sweetpotato, but 22.4 % had no preference, for either sweetpotato or Irish potato. To them, potato is potato, while 18.4 % preferred Irish potato to sweetpotato. Many of the respondents want government to boost production of sweetpotato by providing appropriate incentives for farmers to put more effort and resources into sweetpotato production.

Conclusion

Nigeria has land and agro-ecologies suitable for sweetpotato production. Large-scale production could further enhance food sufficiency in Nigeria, and trigger economic revitalization and alleviation of poverty as the benefits trickle down from farmer to middlemen to large-scale or small-scale business owners down to consumers.

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Sweetpotato: Role in Food Security, Creation of Employment Opportunities and Poverty Alleviation

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Introduction

There are but few, if any, of our staple farm crops receiving more attention than the sweetpotato, and indeed rightfully so. The splendid service it rendered during the great World War in the saving of wheat flour will not soon be forgotten. The 118 different and attractive products (to date) made from it are sufficient to convince the mo sceptical that we are just beginning to discover the re value and marvellous possibilities of this splend vegetable (Carver, 1937). Saleh and Hartojo (200 reported that in Indonesia, sweetpotato is considered a important food crop. Among the tuber crops grown Indonesia, sweetpotato is the second most important aft cassava. Sweetpotato roots are mostly used as food whi the surplus is used as feed and raw materials for industrie Efforts are geared towards the improvement of the ro yield and overall production level.

There are many varieties of sweetpotato, but the two th are widely grown commercially (in the USA) are pa sweetpotato and the dark-skinned variety America erroneously call yam (the true yam is not related to tl sweetpotato). The pale sweetpotato has thin, light yello skin and a pale yellow flesh. Its flavour is not sweet ar after being cooked, the pale sweetpotato is dry ar crumbly, much like a white baking potato. The dark variety has a thicker, dark orange skin and a vivid orang sweet flesh that cooks to a much moister texture. Tl edible root is long and tapered with a smooth skin. Its fle colour ranges from white to yellow, orange or purpl depending on variety. All varieties are more-or-less swe flavoured. The storage root is not actually a tuber ev though it looks like one, since it develops from root tiss rather than stem tissue as true tubers do. Some botanis describe it as a tuberous root.

Sweetpotato is a crop plant whose large, starchy, swee tasting tuberous roots are important as vegetable. They a rich in dietary fibre, vitamin C, and B_6. In some tropic areas, they are a staple food crop. The storage roots, leav and shoots are all edible. The tubers are most frequent boiled, fried, and baked. All parts of the plants can be us for animal feeds (Wikipedia 2005). Sweetpotato is important source of human food and animal feeds. Sichuan Province, China, it is popularly referred to as "t green golden mine" that should be fully developed (Jia *et al.* 2005).

Sweetpotato in the Food Systems of Eastern ar Southern Africa

Sweetpotato is an important crop in two types of fo systems with complex cropping patterns, producti technologies, food consumption habits and marketing lin that determine what and how well people eat. The fi type has been defined as a food system in whi sweetpotato is a *major staple* in the diet, along with otl starchy foods such as banana, potato, and cassava. T second type is food systems where sweetpotato is

important secondary food. The crop is widely grown on a small-scale, primarily to help to secure the food security of the rural household. Sweetpotato has important potentials for these roles in large, drought-prone regions which have been sparsely populated, historically, but where food insecurity is increasing.

Potential Importance for Nutrition

Like other root and tuber crops, sweetpotato is a concentrated source of energy measured in terms of nutritional content per 100 g of cooked root. It is rich in protein, giving it an advantage over cassava. Sweetpotato leaves are also a source of protein, containing 2.7–3.4 g/100 g of raw fresh leaves. Sweetpotato is a valuable source of vitamin A and other nutrients. Eaten in combination with other foods, either as a co-staple or as a secondary supplement, cooked sweetpotato roots play roles as low-cost sources of nutrients (Tsou 1985).

The issue of food security is now taking a global dimension. The world is being sensitized on the need to produce more food. This calls for more food production, improved food processing, and development of new food products. In Nigeria, there is the need to grow more food crops through mechanized farming and improved farm management. We also need to prevent food wastage through poor handling, by adopting new methods of food handling and processing. More importantly, there is the need to develop and encourage the production of our indigenous or local food crops on a large scale to meet our domestic needs and for export.

Sweetpotato is one food that has been underdeveloped, under-produced and under-utilized in Nigeria. However, if well harnessed, it can fill the gap in our food requirements towards ensuring food security by complementing other crops. Nigeria is blessed with vast arable land. It is a known fact that the greater percentage of our arable land is under-utilized. Therefore, there is enough land for the cultivation of sweetpotato on a large-scale. The crop is amenable to mechanized farming, and there are improved varieties with better root yields and productivity. The crop can be grown twice in a year in the middle belt and Southern parts of Nigeria. Its production requires little purchased input.

Sweetpotato is an energy-rich food which can complement other crops like cereals and tubers in meeting our food energy intake. Its other products could be used to diversify our diets to ensure food security. Growing sweetpotato has a great potential for generating employment opportunities and alleviating poverty. A large-scale cultivation of the crop, based on a greater demand would translate to greater production and greater sales which would enhance bet profit for farmers. This would also encourage more peo to go into sweetpotato farming, thus creating more opportunities. There is also high demand for the prod in the international market. Therefore, after meeting lo demand, excess root yields could be exported to gene foreign exchange. The potentials of the crop for exp would raise interest in its large-scale production if awareness were well-promoted. The industrial potentia sweetpotato, as earlier mentioned, is great. This should exploited as is done in China and other Asian count such as Indonesia and Malaysia. Sweetpotato process can generate stable income, create more employment, contribute to rural development. This is especially when the processed raw materials are from loca produced sweetpotato tubers, as the production chair sweetpotato takes many years to develop. There employment opportunities in each part of the commo chain, if the chain is within the locality.

The development of agro-processing of agricult commodities can generate additional employment several ways:

i. There is employment in the processing industries;

ii. There is employment in wholesale and retail trade, brin raw materials from farms to processors, and fini products from processors to consumers;

iii. Agro-processing can generate more employment increasing the demand for the agricultural commodity, stimulating more farm production than would have bee case without agro-processing, encouraging more farm v

iv. Finally, expansion of agro-processing creates employ in related industries, such as suppliers of machinery other inputs to the processing enterprise

Conclusion

Without any ambiguity, sweetpotato has great potenti an agricultural commodity. To borrow from the Chi "the green golden mine" should be developed exploited to meet our food requirements, employment opportunities, and alleviate poverty. however, depends largely on the political will o various levels of government towards creating awar and generating public interest in sweetpotato develop and utilization.

Recommendations

In order to enhance the role of sweetpotato in security, creation employment opportunities, p alleviation, the following recommendations are made

a. Farmers should be educated on the potentials of swee

as a food and export crop.

b. Farmers should be encouraged and supported to grow different varieties of sweetpotato. The crop is mostly mono-cropped in the country, however, it should be inter and relay-cropped with cassava, maize, sorghum, and other crops.

c. Efforts should be geared towards organizing training workshops and seminars on processing and utilization of sweetpotato, with the active participation of all tiers of government and NGOs.

d. Research centres involved in the production, processing and utilization of sweetpotato should be well-funded and their activities well-coordinated.

e. Small-scale entrepreneurs should be actively involved in the processing and utilization of sweetpotato. They should be supported by governments through "soft" loans for acquiring basic training and necessary processing equipments.

f. Export potentials of the commodity should be well-exploited.

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Enhanced Livelihoods for Women through Women-in-Agriculture Unit (WIA Training Activities on Sweetpotato Processing in Nigeria

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Abstract. This paper examined the extension activities Women-in-Agriculture (WIA) unit of the Agricultu Development Programme (ADP) of Nigeria, for t economic empowerment of low-income women throu sweetpotato snacks production. Stratified rando sampling technique was used to select three (South-Ea South-West, and North-West) out of six geo-politic zones in the country. Five states were selected from ea geo-political zone. Both qualitative and quantitati methods of data collection were used to elicit informati from the respondents. In-depth interviews were conduct with 15 directors of the WIA unit in all these States. Eig sweetpotato processors were sampled and interviewe during field survey from each of the 15 States, making total of 120 processors from the three geo-political zone A focus group discussion was conducted for female grou in each state. Frequency counts and percentages were us to summarize the data while a multiple regressic statistical tool was used to analyze the data. Findings c the socio-economic characteristics revealed that th variables that were significant in determining the numb of times of extension training activities in sweetpota across these geopolitical zones include educational leve secondary occupation of processors, duration of time ar benefits derived from sweetpotato processing at 5 % lev of significance. ($R^2 = 0.141$, $P < 0.05$). The result furth showed that the extension activities of the WIA un include teaching on sweetpotato processing ,several us of sweetpotato, Problems encountered with the processin of sweetpotato products, teaching of nutritional value c sweetpotato, and identification of sweetpotato products. I conclusion, women participating in the WIA trainin programmes enjoy a number of advantages over the nor participants. This is because they have a greate knowledge of and easier access to training an technologies through WIA extension agents.

Keywords: Women-In-Agriculture Unit, low income wome sweetpotato snacks, Nigeria

Introduction

In Nigeria, Extension has been an important unit of th Agricultural Development Programme (ADP) since 198

The World Bank recognized the roles of rural women, and so employed and trained few female extension agents. In the last two decades, a lot of attention has been drawn to the important role of rural women in agricultural production in developing countries, especially Nigeria. However, prior to the realization that rural women constitute an "economically active population", they were largely not considered productive because they usually worked as unpaid family labour (Olawoye 1994). Women are involved in many activities relating to food production. They should therefore be empowered economically to improve the standard of living of rural households for enhanced food security in Nigeria.

Food processing is defined as any activity that increases the economic value of a crop by improving its consumer appeal, quality, storability, uses and availability over time and space (Okigbo 1982). Longe (1985) pointed out that rural women are involved in food production, processing and preservation. According to her, food processing is necessary for reduction of wastage, as well as conservation of food crops into forms that are acceptable to different socio-economic classes depending on their dietary habits.

Sweetpotato is one of the crops processed by the rural women for income generation. It has tremendous potentials for providing food for human beings. It is consumed as part of the main meal or as a snack. They are fried into chips or roasted as whole roots. Though processed products are very attractive to customers, fresh use is the major form of utilization in Nigeria (Odebode 2004). Sweetpotato is high in calorific value and can be processed into flour, (which can be fortified with wheat flour) and fried into puff-puff, chin-chin, cake and buns. It can also be fermented into industrial alcohol, vinegar, yeast and acetone. (Scott and Ewell 1992). It therefore has a potential of playing an important role as a food security crop and provides a variety of human food, animal feed and industrial products for empowering the low-income women producers in Nigeria. Enhancing women productivity will improve the chances of achieving the overall, economic and social objectives of the WIA unit thus increasing their income and bringing them into the mainstream of development.

Women involvement in agriculture is significant, not only in terms of labour input, but also in terms of decision-making. Despite the high involvement of women in agriculture, and other related activities, limited agricultural extension services are extended to them. Most of the extension messages have been geared towards male farmers (Odebode 1997). In Nigeria, all ADPs in the different States have integrated Women-In-Agriculture (WIA) component under the extension sub-programme order to meet the need of women in all aspects agricultural production and to increase the income a standard of living (Ojeniyi 1992).

Agricultural extension is an on-going process of gett useful information to people assisting these people acquire the necessary knowledge, skills and attitudes use information technology effectively (Ladele a Ogunlade 1999). The aim of the extension process is enable people to use these skills, attitudes and knowle to utilize effectively information in order to improve quality of life. The Integrated Agricultural Developm Programme (IADP) led to the establishment of (ADI which are now present in each of the 36 States and Federal Capital Territory of Nigeria (Odebode 1997).

The ADPs constitute the single largest agency, char with the responsibilities of agricultural extension servi in Nigeria. The ADPs started a decade before the WIA introduced. The Unified Agricultural Extension Systen designed to use one extension agent to bring mod technology to farmers in more than one agricult discipline, to remove the current practice of para extension services. This paper, therefore, examined extension activities of the WIA unit of the ADPs Nigeria for enhancing low-income earning women thro the intervention of producing sweetpotato snacks. WIA unit is operated under the extension departments fully incorporated into the United Agricultural Exten System. The main objective of the WIA unit of the AD to improve the standard of living standard of rural wo farmers in the areas of increased crop product introduction of improved technology for food c processing and marketing of farm produce.

Other objectives of the WIA unit of the ADPs, Nig include:

1. Improvement of extension services through increas number of female extension agents;
2. Introduction of improved/appropriate technology to labour, remove drudgery, yet affordable to women farme
3. Organization of women groups and encouragement of wc to register as viable cooperative groups so as to have ac to credit facilities.
4. Introduction of newly recommended farm technologie conducting small plot adaptive technologies (SPATs) establishing women's groups.
5. Updating and up-grading the skills of WIA agent agricultural/food production, preservation, sto processing, utilization and nutrition;
6. Training of women farmers to increase their agricultural production income and to improve their nutritional status
7. Development of local recipes from farm produce;