Advancement in Cocoyam Research in Nigeria.


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Coordinator, ‘Giant Crop Family’
They are carrying cocoyam cv:NXs 003

BEHOLD COCOYAM ‘NIGERIA’S GIANT CROP’ !!
Let’s shout the Slogan!!
Cocoyam Rebirth for Food Security &Empowerment!!!
Outline of my presentation.

- Introduction.
- Challenges of cocoyam research & production in Nigeria-these informed research priorities.

- Breeding and genetic development
  - germplasm collection, characterization and conservation.
  - update on breeding activities.

- Biotic and abiotic stresses for cocoyam

  - Research highlights on taro leaf blight.
Apathy for cocoyam

Scarcity of planting materials

Storage problem

Value addition and Physico-chemical characterization.

Our Expectations from the proposed global network.
Introduction.

- Cocoyam is the 3\textsuperscript{rd} most important root and tuber crop (after cassava and yam) in Nigeria.
- Nigeria accounts for > 40\% Global production and >70\% production in West Africa.
- Research on root crops (cassava and yam) started in Nigeria in 1924 (Idachaba, 2004) but research on cocoyam started in 1976, about 56 years later.

- In a Technical Bulletin on major crops in Nigeria in 1959 cocoyam was absent.
- Cocoyam was first recognized as a major crop by the defunct Biafran government in 1969.

- Consequently effective research on cocoyam started in Nigeria in 1976, when the former Provincial Farm in Eastern Nigeria metamorphosed into NRCRI, Umudike.
Challenges in Cocoyam Research.

- Apathy (neglect) for cocoyam.
- Low genetic base.
- Lack of planting materials and low multiplication ratio.
- Declining soil fertility.
- Poor value addition to cocoyam.
- High deterioration in storage due to lack of effective storage method.
- Pests and diseases problem.

All these informed research prioritization.
Breeding and genetic improvement

Germplasm -14 accessions (of edible cocoyam) are available thus:

Colocasia esculenta (10 landraces)(NCe 001…+ NCe 010);
Xanthosoma mafafa(3 landraces and 1 hybrid from Cameroun)(NXs 001, 002, 003 and NXs 004).
Germplasm Collection.

• It started in 1972 at NRCRI and in 1972 at IITA, Ibadan.

• 94 accessions (22 *Xanthosoma* and 72 *Colocasia*) were collected at the NRCRI (Arene and Ene, 1987).

• As at 2005 there was 944.4% genetic erosion as (9 accessions) were left.

• Recent collections of 103 accessions in 2006 are suspected to be multiples of the existing 9 distinct accessions. Five (5) accessions were added in 2009 making a total of 14.
Germplasm characterization.

A morphological characterization of 9 accesions was done as at 2007 and a handbook produced.

Germplasm conservation
There are two approaches in Nigeria.

(i) *In vitro* by Biotechnology programme.
(ii) *In vivo* Conservation.

- Genetic resources unit (planted in the field);
- Improved storage using *gocing cocoyam barn*;

- *In-situ storage* (burying in the swamp; harvest some and purposely left others);

- Naturally growing in the wild (*uncultivated*);

- *On-farm management* (*Intercropping*).
Gocing cocoyam barn for increased shelf life.
Cocoyam (NCe 005) Growing Wild (Uncultivated).
Constraints and Difficulties.

- Poor infrastructural development (electricity, water, etc) for tissue culture and going storage;
- High rate of genetic erosion due to:
  - moisture stress,
  - theft;
  - Diseases and pests;
  - Weed problems;
  - Soil erosion, rodents attack and wild (forest) fires.
Major Biotic and Abiotic Stresses.

Diseases: Taro leaf blight of Colocasia

Cocoyam root rot blight complex of Xanthosoma
Other biotic and abiotic stresses

**Pests:** Weeds and animals (rodents, mealy bug, etc)

**Climate change:** Delay in onset and cessation of rainfall, prolonged dry season etc.

**Moisture stress and pedological constraints:** For instance, excess moisture and moisture deficiency-it limits land suitability for cocoyam.
Land Suitability Classification Map for Cocoyam in Nigeria.
Floral Induction and Fruiting.

• Induce flowering and production of viable seeds in *Colocasia* and *Xanthosoma* species was achieved with gibberellic acid (GA3), at a rate ranging from 500-1500 ppm (Caveness et al., 1987).

• Unfortunately, this could not be sustained as IITA discontinued with cocoyam research.

• All 9 accessions at NRCRI as at 2007, flowered when GA3 was applied at 2000 ppm but resultant fruits lacked viable seeds (Mbanaso et al., 2006).
Flowering in cocoyam

cv: NCe 003

cv: NXs 002

A boy brandishing the flower from Nce 005
Challenges in conventional breeding in cocoyam include:

- Irregular flowering
- Poor seed setting
- Non-viable seeds
Mutation Breeding

- Gamma radiation to induce variability is an alternative to conventional breeding.

- Advantages:
  Improvement of one or two traits in (a) farmer-preferred cultivars, and (b) well adapted varieties.

First Approach:
To identify suitable irradiation dose range for purposeful mutation induction and breeding.
Materials and Methods

Treatment Comprised 4 Cultivars

*Xanthosoma spp*
- NXs 001
- NXs 002

*Colocasia spp*
- NCe 002
- NCe 005

Gamma radiation doses (Gy): 5
- 5
- 10
- 15
- 20
RESULTS

• *Colocassia* (NCe 001) exhibited more sensitivity to irradiation than NCe 005 in terms of sprouting and establishment of setts.

• Low doses of irradiation are known to elicit stimulatory effects on irradiated materials. (IAEA, 1977).

CONCLUSION

• From 2 year’s study, dose range of 6.0 –11Gy for *Xanthosoma* and 3-18Gy for *Colocassia* are recommended for mutation induction in cocoyam.
Second Approach

Objectives:

(i) To improve yields and resistance of NXs 001 and NXs 002 to CRRBC

(ii) To improve adaptability of NCe 006 to drier environment.
# Materials and Methods

<table>
<thead>
<tr>
<th>CULTIVARS USED</th>
<th>TRAITS SOUGHT</th>
<th>DOSES OF GAMMA IRRADIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXs 001</td>
<td>Resistance to CRRBC, High yield</td>
<td>10 Kg corms / cormels exposed to 5 &amp; 10 GY respectively</td>
</tr>
<tr>
<td>NXs 002</td>
<td>Resistance to CRRBC, High yield</td>
<td>10 Kg corms / cormels exposed to 5 &amp; 10 GY respectively</td>
</tr>
<tr>
<td>NCe 006</td>
<td>Adaptation to drier environment</td>
<td>10 Kg baby suckers exposed to 10 &amp; 20 GY respectively</td>
</tr>
</tbody>
</table>
Results

Irradiation effects of on NXs 001 and NXs 001.

Chlorophyll mutant
Table 1. Corm and cormel numbers as influenced by gamma doses and variety after 3 cycles of growth in the field.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Gamma dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NXs 001</strong></td>
<td></td>
</tr>
<tr>
<td>Corm</td>
<td>127</td>
</tr>
<tr>
<td>Cormel</td>
<td>824</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>951</strong></td>
</tr>
<tr>
<td><strong>NXs 002</strong></td>
<td></td>
</tr>
<tr>
<td>Corm</td>
<td>165</td>
</tr>
<tr>
<td>Cormel</td>
<td>1269</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1434</strong></td>
</tr>
<tr>
<td><strong>Lsd (0.05)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>69.7</td>
</tr>
<tr>
<td></td>
<td><strong>19.0</strong></td>
</tr>
</tbody>
</table>
Follow up in 2011.

- The corms and cormels were planted in poly bags in January to be transferred to the field this April.

- We are to monitor the crops in 2011 for:
  - resistance and tolerance to CRRBC;
  - corm and corm yields; and
  - desirable physiological traits such as earl bulking, early maturity, etc.
Follow up

- The corms and cormels have been planted in poly bags to transferred to the field later.
- We are to monitor the crops in 2011 for:
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  - to evaluate them for corm and corm yields; and
  - Desirable physiological traits such as early bulking, early maturity etc
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  - Desirable physiological traits such as early bulking, early maturity etc.
Scarcity of planting materials: A breakthrough.

Gocken Rapid Multiplication Technology (GRMT)

An advancement in cocoyam research that recycles “waste” cocoyam cormels to solve multiple problems of:

- scarcity of planting materials,
- low productivity,
- soil fertility, and
- low multiplication ratio.
Materials And Methods

• Design: Factorial
• Treatments:
  • (a) Variety-NCe 001 and NCe 003.
  • (b) Type of planting materials from cormel:
    Micro setts (7 g each).
    Micro cormel (7 g each).
Poultry manure was applied or rice mill waste was applied at 4t/ha followed by NPK15 15 15 at 400 kg/ha

Results
### Table 1: Variety Effect on Corm and Cormel Yields (t/ha).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NCe 001</th>
<th>NCe 003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
</tr>
<tr>
<td>Corm</td>
<td>2.53</td>
<td>3.73</td>
</tr>
<tr>
<td>Primary cormel</td>
<td>4.67</td>
<td>8.38</td>
</tr>
<tr>
<td>Secondary cormel</td>
<td>3.57</td>
<td>2.25</td>
</tr>
<tr>
<td>Tertiary cormel</td>
<td>0.73</td>
<td>1.42</td>
</tr>
<tr>
<td>Total Yield</td>
<td>11.4</td>
<td>15.7</td>
</tr>
<tr>
<td>Control</td>
<td>3.50</td>
<td>4.37</td>
</tr>
<tr>
<td>Lsd (0.05)</td>
<td>0.47</td>
<td>0.92</td>
</tr>
</tbody>
</table>
Table 2: Variety Effect on SHMR.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variety</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NCe 001</td>
<td>NCe 003</td>
<td>NCe 001</td>
<td>NCe 003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2008</td>
<td>2009</td>
</tr>
<tr>
<td>Corm</td>
<td></td>
<td>7.00</td>
<td>11.0</td>
<td>9.00</td>
<td>22.0</td>
</tr>
<tr>
<td>Primary cormel</td>
<td></td>
<td>13.0</td>
<td>24.0</td>
<td>11.0</td>
<td>31.0</td>
</tr>
<tr>
<td>Secondary cormel</td>
<td></td>
<td>10.0</td>
<td>6.00</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Tertiary cormel</td>
<td></td>
<td>2.00</td>
<td>4.00</td>
<td>4.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Total yield</td>
<td></td>
<td>33.0</td>
<td>42.0</td>
<td>35.0</td>
<td>71.0</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>9.00</td>
<td>11.0</td>
<td>10.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Lsd (0.05)</td>
<td></td>
<td>1.95</td>
<td>2.40</td>
<td>1.95</td>
<td>2.40</td>
</tr>
</tbody>
</table>
Improvement in soil fertility over the control as shown:

- pH from 4.80 – 5.60 (16.7%)
- OM from 1.26 - 2.10 (66.7%)
- Total N from 0.06 - 0.10 (66.7%)
- Avail. P from 43 - 60 (39.5%)
- Exch. K from 0.05 - 0.15 (194.1%)
Apathy for Cocoyam. Solution through Cocoyam Rebirth Initiative.

- Cocoyam rebirth T-shirt;
- Cocoyam rebirth cap;
- Cocoyam rebirth car sticker;
- Cocoyam consumption awareness campaign (COCAWAC);
- School cocoyam project;
- Farmer participatory research and demonstration of GRMT;
- TV shows and radio talks;
- Participation in cultural activities;
- Cocoyam songs;
- Scientific meetings, workshops, conferences and symposia, and
- Scientific publications.
Cocoyam Rebirth T-shirt, Caps & Car Sticker
Cocoyam: A Material Culture

A dramatic display of NXs 003 by Dr G.O.Chukwu

Talking about cocoyam crisps
Students cutting cocoyam micro setts and planting at Mbaise Girls’ High School, Onicha Ezin ihite, Imo State.
Planting of cocoyam by Kolping Families.

Umuezeala Ogwara, Ehime, Imo State

Asaga Ohafia, Abia state
Impact of Cocoyam Rebirth Initiative

(i) Cocoyam rebirth seminar is included in the 2010 Liturgical Diary of the Catholic Diocese of Umuahia NIGERIA.

(ii). 18 organizations/famers’ groups applied to Participate in CRI in 2009-2010.
Value Addition to Cocoyam

- Pyhsico-chemical characterization of starch and flour of selected landraces.
- Gocken MRT. Show table of SHMR and Available yield.
- Marketing
- Tlb studies
- Adopted village projects
Why add value to cocoyam?

- Make more money.
- Reduce spoilage in storage.
- Diversify uses of cocoyam.
- Increase consumption of cocoyam by categories of people.
- Widen market for cocoyam.
- Increase cocoyam production.
- Encourage the growth of subsidiary industries.
Packaged cocoyam crisps.
Value-added Products of Cocoyam.

- Crisps
- High quality flour for confectionaries
- Soup thickener
- Cocoyam *fufu* flour
- Achicha
- Chin chin
- Cocoyam queens cake
- Doughnut
- Chips, etc
Our Expectations

• Increased in genetic diversity of cocoyam.
• Increase in cocoyam production
• Reduction in biotic and abiotic stresses of cocoyam
• Improvement in farmers’ socio-economic status.
• Diversification in the uses of cocoyam.
## Major Research Achievements

<table>
<thead>
<tr>
<th>Challenges</th>
<th>2008</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apathy</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Germplasm</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td><strong>Multiplication ratio</strong></td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Technology generation</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Storage losses</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Scarcity of panting materials</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Declining soil fertility</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Disease problems</td>
<td>high</td>
<td>high</td>
</tr>
</tbody>
</table>