'to harness research innovations to unleash the potential of yam'

PROGRAM AND BOOK OF ABSTRACTS

IITA
Research to Nourish Africa

INTERNATIONAL SOCIETY FOR TROPICAL ROOT CROPS
AFRICA BRANCH

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
CSIR
GHANA

CGIAR
RESEARCH PROGRAM ON
Roots, Tubers and Bananas

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First Global Conference on Yam

'to harness research innovations to unleash the potential of yam'

3 - 6 October 2013

Alisa Hotel

Accra, Ghana

Symposium organized by
International Institute of Tropical Agriculture

IITA
Research to Nourish Africa

in partnership with

International Society for Tropical Root Crops - Africa Branch (ISTRC-AB)
Council for Scientific and Industrial Research (CSIR), Ghana
The CGIAR Research Program on Roots, Tubers and Bananas (CRP-RTB)

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CGIAR RESEARCH PROGRAM ON Integrated Systems for the Humid Tropics

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YIIFSWA Yams for Livelihoods

CRP Genebanks
CGIAR Research Program for Managing and Sustaining Crop Collections

Program & Book of Abstracts

International Institute of Tropical Agriculture

Headquarters: IITA, PMB 5320, Ibadan, Nigeria
www.iita.org

Dear Participants,

On behalf of the International Institute of Tropical Agriculture (IITA) and the conference organizing committee we warmly welcome you to the first **Global Conference on Yam** themed ***'to harness research innovations to unleash the potential of yam'***. We are delighted to have your attendance in this conference.

This conference will explore the recent innovations on yam improvement, share lessons learned, identify R&D needs and develop global alliances to unleash potential of the crop. It will provide a platform for consultation and development of a global strategy for improving the yam sector based on genetic enhancement; crop protection and mitigation of risks due to pests, diseases and climate change; conservation of genetic resources; prevention of post-harvest losses; improved seed systems; crop diversification; enhancing industrial potential of yam and improved market access.

The ultimate goals of this event are to establish (i) a global alliance for yam improvement; (ii) gain more investments to advance and expand yam R4D agenda globally, and (iii) contribute to the strengthening of R&D capacity and human resource development for sustainable yam improvement. This event will be organized as various sessions, including review of the status of knowledge through invited keynote presentations and offered papers (oral and posters), thematic discussions on key strategic issues and an optional field visit.

We acknowledge the contribution and help of all the members of the Organizing Committee for generously contributing their time and other resources. We specifically wish to thank our co-organizers: International Society for Tropical Root Crops-Africa Branch (ISTRC-AB), Council of Scientific and Industrial Research (CSIR), Ghana, and the CGIAR Research Program on Roots, Tubers an Bananas (CRP-RTB); and sponsors: CRP-Humidtropics, CRP-Genebanks, Forum For Agriculture Research in Africa (FARA), Tokyo University of Agriculture, Yam Improvement for Income and Food Security in West Africa (YIIFSWA) and Inqaba Biotec, for their generous support to this event, including facilitating the participation of several scientists and students to this conference.

Special thanks to staff of IITA Ghana Station for their excellent support with local organization, and IITA's Communication Unit who worked closely with the organizing team in publicizing this event and in generating the communication and conference materials.

We hope that you will find this symposium engaging and informative. We wish you a productive and successful event.

Dr Nteranya Sanginga
Director General, IITA
Chief Patron

Dr Robert Asiedu
R4D Director-West Africa, IITA
Convener

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John Kwesi Ocran, CSIR Head Office, Accra

Overview of the Program

Day 1. 03 October 2013: Thursday : Plenary session		
1430-1630	**Session – I** **Inception of the First Global Conference on Yam** (Joint plenary session of ISTRC-AB and Global Conference on Yam) Group Photo and light refreshments	
1630-1900	**Session – II** **Yam future trend** Plenary presentations and discussion forum	
1900 onwards	Conference dinner	
Day 2. 4 October 2013: Friday : Concurrent sessions		
	Ridge Arena	**Botsio Auditorium**
0830-1230	**Session – III** **Genetic resources, Genomics and Breeding** Keynote presentations and offered papers	**Session - IV** **Post-harvest, Markets and Policy** Keynote presentations and offered papers
1230-1400	Lunch break	Lunch break
1400-1530	**Session – V** **Agronomy** Keynote presentations and offered papers	**Session – VI** **Processing and Utilization** Keynote presentations and offered papers
1530-1700	**Session VII** **Posters and Exhibits**	
Day 3. 5 October 2013: Saturday : Plenary session		
0830-1230	**Session – VIII** **Seed systems and Plant health** Keynote presentations and offered papers	
1230-1400	Lunch break	
1330-1600	**Session – IX** **Group work on future priorities**	
1600-1730	**Session – X** **Conclusions, Recommendations & Next steps**	
Day 4. 6 October 2013: Sunday		
Field day (optional)		

Abstracts of the Oral Presentations

3 October 2013, Thursday: 1430 - 1630

Session 1: Inception of the First Global Yam Conference

[Plenary Session]

3 October 2013, Thursday: 1630 - 1900

Session 2: Yam future trend

[Plenary Session]

OP-2.1 Keynote

Science-based innovations for yam improvement

Robert Asiedu

International Institute of Tropical Agriculture (IITA), PMB 5320, Ibadan, Nigeria

OP-2.2 Keynote

Progress and challenges in yam technology development and transfer in West Africa

Felix Nweke

Visiting Professor, African Studies, Michigan State University, USA

OP-2.3 Keynote

Whole-genome sequencing of guinea yam (*Dioscorea rotundata*)

***Ryohei Terauchi*[1]**

Whole genome sequencing-based analysis of diversity in guinea yam (*D. rotundata*) breeding materials: a preliminary result

***Muluneh Tamiru*[1]**

Satoshi Natsume[1], Hiroki Takagi[1], Pachakkil Babil[2], Shinsuke Yamanaka[2], Antonio Lopez-Montes[3], Melaku Gedil[3], Ranjana Bhattacharjee[3], G. Girma[3], H. Takagi[2], R. Asiedu[3] and Ryohei Terauchi[1]

[1]Iwate Biotechnology Research Center (IBRC), Kitakami, Japan; [2]Japan International Research Center for Agricultural Sciences (JIRCAS), Ishigaki, Japan; [3]International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

OP-2.4 Keynote

Chemical and integrated nutrient management options for sustainable yam production

***S. A. Ennin**, E. Owusu Danquah and P. P. Acheampong*

CSIR -Crops Research Institute, P.O. Box 3785, Kumasi, Ghana

OP-2.5 Keynote

Domestication and evolutionary dynamics of cultivated yam (*Dioscorea cayenensis /D. rotundata* complex) in Benin

***A. Dansi*[1]**, *A. Adjatin[1], R. Bhattacharjee[2], R. Asiedu[2], R. Vodouhè[3], A. Akoègninou[4] and A. Sanni[5]*

[1]Laboratory of Biotechnology, Genetic Resources and Plant and Animal Breeding (BIORAVE), Faculty of Sciences and Technology of Dassa, University of Abomey-Calavi,071BP28, Cotonou,Benin,[2]International Institute of Tropical Agriculture, PMB 5320, Ibadan, Nigeria;[3]Bioversity International, Office for West and Central Africa, 08 BP 0932, Cotonou, Benin, [4]National Herbarium, Department of Botany and Plant Biology, Faculty of Sciences and Technology (FAST), University of Abomey-Calavi (UAC), BP 526, Cotonou, Benin,[5]Laboratory of Biochemistry and Molecular Biology, Faculty of Sciences and Technology (FAST), University of Abomey-Calavi (UAC), BP 526 Cotonou, Benin

OP-2.6 Keynote

R4D priority for yam improvement: summary of yam survey results

***Tahirou Abdoulaye*[1]**, *Joseph Rusike[1], Alene Arega[1], Guy Hareau[2], Ulrich Kleinwechter[2], Bernardo Creamer[3], Diemuth Pemsl[4], Holger Kirscht[1], Djana Mignouna[1] and Akinola Adebayo[5]*

[1]International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria; [2]International Potato Center (CIP), Lima, Peru,[3]International Center for Tropical Agriculture (CIAT); International Food Policy Research Institute (IFPRI); [4]Bioversity International; [5]Obafemi Awolowo University, Ile-Ife, Nigeria

4 October 2013, Friday: 0830 – 1230

Session 3: Genetic resources, Genomics and Breeding

[Concurrent Session]

OP-3.1 **Jewels of the trade: conserving and using crop genetic resources**

Keynote ***Charlotte Lusty***

Global Crop Diversity Trust, Platz der Vereinten Nationen 7, 53113 Bonn, Germany

OP-3.2 **Characterization and utilization of genetic resources in yam**

Keynote ***M. T. Abberton*** *and* ***B. Gueye***

International Institute of Tropical Agriculture (IITA), Oyo Road, PMB 5320, Ibadan, Nigeria

OP-3.3 Keynote **Molecular phylogenetics of *Dioscorea* L.: What does it tell us about the wild relatives of cultivated yams?**

Paul Wilkin[1]*, Pilar Catalan*[2]*, Lauren Raz*[3] *and Juan Viruel*[2]

[1]*HLAA, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK* ,[2]*Departamento de Agricultura y Economía Agraria, Escuela Politécnica Superior de Huesca (Universidad de Zaragoza), Carretera de Cuarte s/n, 22071, Huesca (Huesca), Spain,*[3]*Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Carrera 45 No 26-85 - Edificio Uriel Gutierréz, Bogotá D.C. Colombia*

OP-3.4 **Diversity studies on Guinea yam (*Dioscorea rotundata*) for utilization of genetic resources**

Shinsuke Yamanaka[1]*, Pachakkil Babil*[1]*, Ryo Matsumoto*[1]*, Muluneh Tamiru Oli*[2]*, Gezahegn G. Tessema*[3]*, Ranjana Bhattacharjee*[3]*, Badara Gueye*[3]*, Michael Abberton*[3]*, Antonio Lopez-Montes*[3]*, Satoru Muranaka*[1]*, Ryohei Terauchi*[2] *and Hiroko Takagi*[1]

[1]*Japan International Research Center for Agricultural Sciences (JIRCAS) -TARF, Ishigaki, Okinawa, Japan;* [2]*Iwate Biotechnology Research Center (IBRC), Kitakami, Iwate, Japan;* [3]*International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria*

OP-3.5 **Ploidy level, morphological variation and genomic diversity between and within Guinea yams**

Gezahegn Girma[1,2]*, Katie E. Hyma*[3,4]*, Melaku Gedil*[1]*, Michael Abberton*[1]*, Robert Asiedu*[1]*, Sharon E. Mitchell*[4] *and Charles Spillane*[2]

[1]*International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria;* [2]*Genetics and Biotechnology Lab, Plant and AgriBiosciences Research Centre (PABC), School of Natural Sciences, NUI Galway, Ireland;* [3]*Institute for Genomic Diversity, Cornell University, Ithaca, New York, United States of America;* [4]*Bioinformatics Facility, Cornell University*

OP-3.6a Keynote **Modernizing yam breeding for rapid development and deployment of varieties with farmer and consumer preferred traits for value addition and improved food and income security**

A. Lopez-Montes, ***R. Bhattacharjee****, M. Abberton and R. Asiedu*

International Institute of Tropical Agriculture (IITA), Oyo Road, PMB 5320, Ibadan, Nigeria

OP-3.6b **Application of advanced genomic technologies to accelerate yam breeding**

Ranjana Bhattacharjee, ***A. Lopez-Montes****, M. Abberton and R. Asiedu*

International Institute of Tropical Agriculture (IITA) Oyo Road, Ibadan, Nigeria

OP-3.7 **Recent innovations in yam *Dioscorea alata* improvement through polyploidy breeding**

G . Arnau*, A. Nemorin, D. Cornet, E. Maledon and E. Nudol*

CIRAD, UMR AGAP, Station de Roujol, 97170 Petit Bourg, Guadeloupe, France

OP-3.8 **Metabolite profiling of *Dioscorea spp.***

Elliott J. Price[1]*, Elisabete Carvalho*[1]*, Viswambharan Sarasan*[2] *and Paul D. Fraser*[1]

[1]*School of Biological Sciences, Royal Holloway, University of London, Egham, Surrey TW20 0EX, UK,* [2]*Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, UK*

OP-3.9 **Yam anthracnose resistance in *Dioscorea alata* L. – Genetic mapping and QTL analysis**

***Dalila Pétro*[1]**, *Abou Kouassi[2], Joseph Onyeka[3], Sandrine Etienne[1], Denis Lafortune[1] and Sébastien Guyader[1]*

[1]INRA, UR1321, Agrosystèmes tropicaux, Petit-Bourg, Guadeloupe, France; [2]Université Félix Houphouët-Boigny, UFR Biosciences, Laboratoire de Génétique, 22BP 582 Abidjan22, Côted'Ivoire; [3]National Root Crops Research Institute, Umudike, Umuahia, Nigeria

OP-3.10 **Comparative evaluation of dwarf and tall hybrids of white yam for morphological agronomical and biochemical traits**

***M. N. Sheela**, P. V. Abhilash and K. Abraham*
Central Tuber Crops Research Institute, Sreekariyam, Trivandrum, Kerala, India

OP-3.11 **CSIR-CRI yam biotechnology research Initiatives toward crop improvement**

***M. D. Quain*[1]**, *RN Prempeh[1], A Agyeman[1], JY Asibuo[1], EY Parkes[2], PF Ribeiro[1], E. Otoo[1] and M Egnin[3]*

[1]CSIR-Crops Research Institute, P. O. Box 3785, Kumasi, Ghana; [2]IITA Ibadan Nigeria, PMB 5320, Ibadan, Oyo State, Nigeria; [3]Plant Biotechnology and Genomics Research Laboratory, Tuskegee University USA

4 October 2013, Friday: 0830 -1230

Session 4: Post-harvest, Markets and Policy

[Concurrent Session]

OP-4.1 Keynote **Yam farming as a business**

*D. Phillips[1], **U. Kleih*[1]**, E. Otoo[4], P. Boadu[6], M. Ogbonna[2], H. Etudaiye[2], D. Mignouna[3] and B. Siwoku[5]*

[1]Natural Resources Institute, University of Greenwich, UK,[2]National Root Crops Research Institute, Nigeria,[3]International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria,[4]CSIR-Crops Research Institute, Ghana; [5]Federal University of Agriculture, Abeokuta, Nigeria; [6]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

OP-4.2 Keynote **Yam value chain strategy for Ghana: a new vision of the sector**

Tony Sikpa
Chairman of the Ghana's Yam Value Chain Coordinating Committee and Director of Ghana Export Promotion Association, Accra, Ghana

OP-4.3 Keynote **Participatory governance for sector development: a case study**

***H. Manson*[1]** *and A. Lopez-Montes[2]*
[1]International Trade Centre, UN, Geneva; [2]International Institute of Tropical Agriculture (IITA), PMB 5320, Ibadan, Nigeria

OP-4.4 **The contribution of the yam sector in the food security in DR Congo**

***K. K. Kendenga*[1]** *and N. Mahungu[1]*

[1]International Institute of Tropical Agriculture (IITA), B.P. 16761, Kinshasa 1, D. R. Congo

OP-4.5 **Local market food sector analysis and design: the example of the yam sector in Guadeloupe**

***Carla Barlagne*[1]**, *Jean-Marc Blazy[1], Marianne Le Bail[2], Louis George Soler[3], Alban Thomas[4] and Harry Ozier-Lafontaine[1]*

[1]INRA, UR1321, Agrosystèmes tropicaux, F-97170, Petit-Bourg, France ,[2]PR Agroparistech - UMR 1048 INRA SADAPT, France; [3]INRA, UR 1303, 94205 Ivry-sur-Seine cedex, France; [4]Toulouse School of Economics, Lerna, Inra UMR 1081, France

OP-4.6 **Targeting agricultural research for development investments in cassava and yam production systems in Africa: evidence from Nigeria**

***Paul M. Dontsop Nguezet*[1]**, *Victor Mayong[2] and Joseph Rusike[2]*

[1]International Institute of Tropical Agriculture (IITA), Bukavu, DR Congo; [2]IITA – Dar Es Salam, Tanzania

OP-4.7 **Factors affecting willingness to adopt improved production technology and yam trade among yam farmers in Northern area of Oyo State, Nigeria**

***O. F. Adesiyan*[1]**, *A. T. Adeiyan and G. Mohammed*

Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Nigeria

OP-4.8 **Enhanced utilization and productivity on yams through advanced technologies**

***Hidehiko Kikuno*[1]**, *Hidekazu Toyohara[2] and Hironobu Shiwachi[2]*

[1]Tokyo University of Agriculture, Miyako Subtropical Research and Training Farm, Okinawa, Japan; [2]Tokyo University of Agriculture, Tokyo, Japan

OP-4.9 **Comparative cost and profit analysis of yam production in Nigeria and Ghana**

***D. B. Mignouna*[1]**, *T. Abdoulaye[1], A. Alene[2], R. Asiedu[1], V. M. Manyong[1] and W. N. Leke[1]*

[1]International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria; [2]IITA, Lilongwe, Malawi; [3]IITA, Dar es Salaam, Tanzania

OP-4.10 **Understanding yam tuber wound-healing in order to reduce losses during storage and transport**

***Debbie Rees*[1]**, *Louise Abayomi, Pesila Govinden, Aurelie Bechoff and Corinne Rumney*

Natural Resources Institute, University of Greenwich, Chatham, Kent ME4 4TB, UK

4 October 2013, Friday: 1400 - 1530

Session 5: Agronomy

[Concurrent Session]

OP-5.1 Keynote **Research gaps in yam production environment: a review**

***C. L. A. Asadu*[1]**, *S. Hauser[2] and B. O.Unagwu[1]*

[1]Department of Soil Science, University of Nigeria, Nsukka, Nigeria; [2]International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

OP-5.2 Keynote **Mechanical yam harvesting: Some lessons from mechanical cassava harvesting in Ghana**

***Emmanuel Y. H. Bobobee*[1,2]**, *Joseph Y. Gemegah[1], Bernard S. Ayittey[1]*

[1]Agricultural Engineering Department, Kwame Nkrumah University of Science and Technology, Kumasi. Ghana; [2]Institute for Agricultural Engineering, Agricultural Research Council (ARC-IAE), Private Bag X519, Silverton, Pretoria, South Africa

OP-5.3 **Prevention of dormancy in seed tubers of *Dioscorea Spp***

E. I. Hamadina *and E. Awologbi*

Department of Crop and Soil Science, University of Port Harcourt, Port Harcourt Nigeria

OP-5.4 **Progress in staking options in yam production for adaptation to climate change**

S. A. Ennin, *E. Owusu Danquah and P. P. Acheampong*

CSIR -Crops Research Institute, P.O. Box 3785, Kumasi, Ghana

OP-5.5 **Social and technologic development model for yam (*Dioscorea* spp) production systems: Scaling-up biological and organic inputs with the effective participation of farmers**

G. A. Corredor, *C. Baquero, A. Espitia, M. Ramírez, J. Benavides, G. Narvaez and H. Moreno*

Biotechnology Institute of University National of Colombia (IBUN)) Bogotá, Colombia; Colombian Agricultural Research Corporation (CORPOICA), AA 240142 Las Palmas, Bogotá, Colombia, Small farmers GPL Caribbean region of Colombia

4 October 2013, Friday: 1400 - 1530

Session 6: Processing and Utilization

[Concurrent Session]

OP-6.1 **Impact of the Dioscoreaceae derivatives on human welfare**

Keynote ***Ines Toro Suárez***

Colombian Agricultural Research Corporation (CORPOICA), AA 240142 Las Palmas, Bogotá, Colombia

OP-6.2 **Influence of extrusion conditions on the characteristics of *Dioscorea alata* flour ready-to-eat snack products**

J. Thajudhin Sheriff*[1], *G. Padmaja and M. S. Sajeev

Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram 695071, India

OP-6.3 **Enhanced value of hard cooking yams through bread formulations with low glycemic index for type 2 diabetes**

***Olivier K. Kouadio*[1,2], *Charlemagne Nindjin*[1,2], *Maria C. Casiraghi*[3] *and N'guessan G. Amani*[2]**

[1]Departement of Biodiversity and Food Security, Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS), 01 BP 1303 Abidjan 01, Côte d'Ivoire,[2]Unité de formation et de Recherche des Sciences et Technologie des Aliments (UFR-STA), Université Nangui Abrogoua, Abidjan, Côte d'Ivoire; [3]Department of Food Environmental and Nutritional Sciences-DeFENS, University of Milan, Milan, Italy

OP-6.4 **Effect of blend levels on composite wheat doughs performance made from yam and cassava native starches and bread quality**

***Charlemagne Nindjin*[1,2], *Georges N. Amani*[1] *and Marianne Sindic*[3]**

[1]Training and Research unit in Food Science and Technology, University of Abobo-Adjamé, 01 BP 801 Abidjan 01, Côte d'Ivoire; [2]Department of Biodiversity and Food Security, Swiss Centre of Scientific Researches, 01 BP 1303 Abidjan 01, Côte d'Ivoire; [3]Department of Food Technology, University of Liege, Gembloux Agro-Bio Tech, Passage des Déportés, 2, 5030 Gembloux, Belgium

OP-6.5 **Physico-chemical and functional properties of acid modified yam starches**

Bolanle.O. Otegbayo *and Mayokun Lawale*

Department of Food Science & Technology, Bowen University, Iwo, Osun State, Nigeria

4 October 2013, Friday: 1530 - 1730

Session 7: Posters & Exhibits

5 October 2013, Saturday: 0830 – 1230

Session 8: Seed systems and Plant Health

[Plenary session]

OP-8.1 **Over 30 years of the yam minisett technique in Nigeria: What are the challenges and prospects?**

Keynote ***Beatrice A. Aighewi*** *and R. Asiedu*

International Institute of Tropical Agriculture, Ibadan, Nigeria

OP-8.2 **Developing a sustainable seed generation system of yams: the Ghanaian experience**

Keynote ***E. Otoo**, T. Appiah-Danquah and P. Oteng-Darko*

CSIR-Crops Research Institute (CRI), P.O. Box 3785, Kumasi, Ghana

OP-8.3 **A new bioformulation for the management of mealybug *Rhizoecus amorphophalli* Betrem in stored tubers of yams**

C. A. Jayaprakas *and R. S. Sreerag*

Division of Crop Protection, Central Tuber Crops Research Institute, Sreekariyam 695 017, Thiruvananthapuram, India

OP-8.4 **Economic analysis of seed yam production using minisett technique in Nigeria**

Kenneth C Ekwe, *J. G. Ikeorgu and Onwuka Samuel*

National Root Crops Research Institute, Umudike, Abia State, Nigeria

OP-8.5 **Encouraging seed yam entrepreneurship in Nigeria**

Nora McNamara[1]*, Stephen Morse[2] and Adamu Shuaibu[3]*

[1]Missionary Sisters of the Holy Rosary, West Park, Artane, Dublin 5, Ireland,[2]Centre for Environmental Strategy, University of Surrey, Guildford, Surrey, UK,[3]FCT Conditional Grant Scheme Task Team, Project Office, Apo Legislative Quarters, Zone A, Abuja, Nigeria

OP-8.6 **Preliminary results on aeroponics system as effective high ratio propagation technique for healthy seed yam production**

Maroya Norbert[1]*; Balogun Morufat[2] and Asiedu Robert[1]*

[1]International Institute of Tropical Agriculture, PMB. 5320, Oyo Road Ibadan, Nigeria; [2]Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria

OP-8.7 **Status and prospects for improving yam seed systems using temporary immersion bioreactors**

Morufat O. Balogun[1]*, Norbert Maroya[2] and Robert Asiedu[2]*

[1]Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria; [2]International Institute of Tropical Agriculture, P.M.B. 5320, Ibadan, Nigeria

OP-8.8 **Mini-tubers production from vine cuttings of *Dioscorea rotundata* and *D. alata* collected at two ages of mother plants**

Alex C. Edemodu[1]*, Ryo Matsumoto[2,3], A. Lopez-Montes[2], Hidehiko Kikuno[3], Hironobu Shiwachi[3] and Malachy O. Akoroda[1]*

[1]Department of Agronomy, University of Ibadan, Ibadan, Nigeria; [2]International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria; [3]Tokyo University of Agriculture, Tokyo, Japan

OP-8.9 **Developing diagnostics to detect badnavirus and endogenous pararetrovirus DNA sequences in West African yam breeding lines**

Aliyu Turaki[1], P. Lava Kumar[2], A. Lopez-Montes[2], M. Bomer[1], G. Silva[1], and ***Susan E. Seal[1]***

[1]Natural Resources Institute, University of Greenwich, Chatham Maritime, Kent ME4 4TB, UK,[2]International Institute of Tropical Agriculture, Oyo Road PMB 5320, Ibadan, Nigeria

0P-8.10 ***In vitro*** **approaches to manage *Yam mild mosaic virus* (YMMV) in greater yam**

M. L. Jeeva[1]*, Dhanya Jayaseelan, M. Rajitha, T. Makeshkumar and Vinayaka Hegde*

Central Tuber Crops Research Institute, Thiruvananthapuram, 695 017 Kerala, India

OP-8.11 **Local dispersal and epidemics of the yam anthracnose disease agent *Colletotrichum gloeosporioides***

Laurent Penet[1]*, Sébastien Guyader[1], Dalila Pétro[1] and François Bussière[1]*

[1]INRA, UR1321, Agrosystèmes tropicaux, F-97170, Petit-Bourg, France

OP-8.12 **Differential host-pathogen interaction in yam anthracnose pathosystem: a challenge to deployment of resistant cultivars for disease management.**

Joseph Onyeka[1]*, Dalila Pétro[2] and Sandrine Etienne[2]*

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[2]INRA, UR1321, Agrosystèmes tropicaux, F-97170, Petit-Bourg, Guadeloupe, France

OP-8.13 **Strategies for the production of virus-free seed yam**

P. Lava Kumar[1]*, B. Gueye, O. Oyelami, A. Owati, C. K. Nkere, W. N. Leke, B. Aighewi, A. Lopez-Montes and M. Abberton*

International Institute of Tropical Agriculture (IITA), Oyo Road, PMB 5320, Ibadan, Nigeria

5 October 2013, Saturday: 1400 – 1600

Session 9: Setting future priorities

[Breakout group discussions on future priorities and partnerships for yam improvement]

Group 1: Genetic resources, genomics and breeding

Group 2: Post-harvest, markets and policy

Group 3: Agronomy, mechanization and utilization

Group 4: Seed systems and plant health

5 October 2013, Saturday: 1600 – 1730

Session 10: Concluding session

[Plenary session]

Conclusions, recommendations and next steps

Concluding message and official close of the First Global Conference on Yam

- Hon. Minister for Trade and Industry, Ghana

Abstracts of the Poster Presentations

Section I: Seed systems and plant health

PP-7.1 **Training of farmers on seed yam production using the yam minisett technique: experiences from the yam belt of Nigeria.**

***J. G. Ikeorgu*[1]**, *A. I. Ikoro[1], K. C. Ekwe[1], M. H. Tokula[1] and E. A. Asiedu[2]*

[1]National Root Crops Research Institute, Umudike, Nigeria,[2]CORAF/WECARD Headquarters, Dakar, Senegal

PP-7.2 **Determinants of technical efficiency among seed yam entrepreneurs in Benue state**

***S. Onwuka*[1]**, *J. A. Mbanasor[2] and K. C. Ekwe[1]*

[1]National Root Crops Research Institute, Umudike, Nigeria, [2]Michael Okpara University of Agriculture, Umudike, Nigeria

PP-7.3 **Women farmers in seed yam production: Implication for increased productivity and sustainable yam improvement in Southeastern Nigeria**

***A. G. Ironkwe*[1]** *and R. Asiedu[2]*

[1]National Root Crops Research Institute, Umudike, P.M.B. 7006, Umuahia, Abia State,[2]International Institute of Tropical Agriculture, Ibadan, Nigeria.

PP-7.4 **Farmers' perception of yam pests and diseases, and control measures in selected agricultural zones of Oyo state, Nigeria**

Rasheed G. ADEOLA *and Gabriel O. ADESINA*

Ladoke Akintola University of Technology, P. M. B. 4000, Ogbomoso, Oyo State, Nigeria

PP-7.5 **The Guadeloupe Biological Resources Centre and its role in viral diagnostic and sanitation**

Claudie Pavis[1], Franciane Gamiette[1], Marie Umber[1], ***Dalila Pétro*[1]**, *Danièle Roques[2], Marc Boisseau[2], Franciane Nuissier[1], Thierry Candresse[3], Philippe Roumagnac[4] and Pierre-Yves Teycheney[2]*

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PP-7.6 **Aeroponic as innovative system for clean seed yam production**

Peter Kolawole, *N. Maroya, R. Asiedu, Bamidele Buraimoh and Rod Bishop*

International Institute of Tropical Agriculture, PBM 5320 Oyo road Ibadan, Nigeria

PP-7.7 **Promoting improved yam minisett technology to improve productivity and trade capacity for seed yam in Nigeria**

***G. N. Asumugha*[1]**, *M. C. Ogbonna[1], J. G. Ikeorgu[1] and E. Asiedu[2]*

[1]National Root Crops Research Institute Umudike, Nigeria; [2]CORAF/WECARD Staple Crops Programme, Dakar, Senegal

PP-7.8 **Distribution of yam Internal brown spot disease in Côte d'Ivoire**

***Marie N. Y. Toualy*[1,2],** *H. Atta Diallo[1] and P. Lava Kumar[2]*

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PP-7.9 **Seed yam marketing in Nigeria**

Beatrice A. Aighewi, *M. Djana and R. Asiedu*

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PP-7.10 **Establishment of 'Yam Development Forums' to promote seed yam enterprise for income and food security in West Africa**

***A. Beatrice*[1]**, *O. Oiwoja[1], D. Mignouna[1], U. Kleih[2], S. Sey [3], E. Otoo[4], P. Boadu[5], D. Philipp[2], A. Shuaibu[6], M. Ogbonna[7], R. Kultse[3], H. Etudayo[7], N. Maroya[1] and P. Lava Kumar[1]*

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PP-7.11 **Yam improvement for Income and food security in West Africa (YIIFSWA): Some achievements of the first 2 years of implementation**

***N. Maroya[1]**, R. Asiedu[1], P. Lava Kumar[1], B. Aighewi[1], M. Balogun[1], D. Mignouna[1], T. Abdoulaye[1], A. Lopez-Montes[1], O. Odihi[1], U. Kleih[2], D. Phillips[2], F. Ndiame[3], J. Ikeorgu[4], E. Otoo[5], N. McNamara[6], S. Abimiku[7], Sara Alexander[8], E. Bobobee[9] and R. Asuboah[10]*

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PP-7.12 **Screening of F1 mapping population of yam (*Dioscorea alata*) for resistance to anthracnose (*Colletotrichum gloeosporioides*) in the screenhouse and field**

***C. O. Nwadili[1]**, R. Bandyopadhyay[1], R. Bhattacharjee[1], J. Augusto[1], A. Lopez-Montes[1] and T. J. Onyeka[2]*

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PP-7.13 **Evaluation of conservation methods for phytopathogenic fungi in yam**

Yeimy Alexandra Pinzón Gutiérrez, Silvia Lizette Bustamante* and Gustavo Buitrago Hurtado*

Biotechnology Institute of University National of Colombia.

PP-7.14 **Differentiation of *Colletotrichum gloeosporioides* isolates causative of Anthracnose in yam (*Dioscorea sp.)* by arbitrarily primed PCR (AP-PCR)**

Yeimy Alexandra Pinzón Gutiérrez, Silvia Lizette Bustamante and Gustavo Buitrago Hurtado

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PP-7.15 **Differential molecular diagnosis of *Colletotrichum gloeosporioides* and *Fusarium oxysporum* in yam (*Dioscorea* sp.).**

***Silvia Lizette Bustamante**, Yeimy Alexandra Pinzón Gutiérrez and G. B. Hurtado*

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PP-7.16 **Morphological and molecular characterization of *Colletotrichum gloeosporioides* isolates from yam and the establishment of a virulence test to characterize its pathogenicity**

***Yeimy Alexandra Pinzón Gutiérrez**, Silvia L Bustamante and Gustavo B. Hurtado*

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PP-7.17 **Efficacy of *Oryza sativa* husk extract for the *in vitro* and *in vivo* control of fungal rot disease of white yam (*Dioscorea rotundata* Poir)**

***V. O. Dania[1,2]**, O. O. Fadina[2], M. Ayodele[1] and P. Lava Kumar[1]*

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PP-7.18 **Expression of the coat protein genes of *Yam mosaic virus* and *Yam mild mosaic virus* in *Escherichia coli* and production of polyclonal antisera**

*M. Hema[1,2], P. Ogunsanya[1], S. E. Seal[3] and **P. Lava Kumar[1]***

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PP-7.19 **Plant-parasitic nematode diversity in the main yam production regions of West Africa**

Y*. A. Kolombia*[1,2], *P. Lava Kumar[1], W. Bert[2] and D. Coyne[3]*

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PP-7.20 **Control of yam nematodes: resistance screening and biological control approaches**

***Y. A. Kolombia*[1,2]**, *T. Aremu[1,3], O. Adewuyi[1], A. Lopez-Montes[1], A. Claudius-Cole[3], W. Bert[2] and D. Coyne[4]*

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PP-7.21 **Preservation of yam (*Dioscorea* spp.) leaf samples for epidemiological investigations on yam viruses**

***C. K. Nkere*[1,2]**, *G.I. Atiri[2], S. E. Seal[3] and P. Lava Kumar[1]*

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PP-7.22 **Assessment of major disease threats to yam (*Dioscorea* spp.) cultivation in Ghana and Nigeria**

***C. K. Nkere*[1,2,3]**, *T. Oviasuyi[1], G. I. Atiri[2], E. Otoo[4], E. Chamba[5], J. T. Onyeka[3], S. E. Seal[6] and P. Lava Kumar[1]*

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PP-7.23 **Meristem regeneration protocol of *Dioscorea* spp. for optimal production of clean materials**

***Olayemi Oyelami*[1]**, *Hidehiko Kikuno[2], Badara Gueye[2], Dominique Dumet[2], Kabindra Kandel[3], Yuichi Hasegawa[3], O. J. Oyetunji [1] and Hiroko Takagi[4]*

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Section II: Agronomy, Posthaverst, Mechanization and Utilization

PP-7.24 **Replacement value of yam peel meal for maize on the growth performance and carcass characteristics of weaner rabbits**

***P. E. Nwakpu**, E. N. Uchewa and C. N. Orogwu*

Department of Animal Science, Ebonyi State University, Abakaliki, Nigeria

PP-7.25 **Adoption of innovations in agriculture in Cote d'Ivoire: the case of new yam varieties**

SORO Dogniméton

Jean Lorougnon Guédé University, Daloa, Côte d'Ivoire

PP-7.26 **Potentials of underutilized bitter yam (*Dioscorea dumetorum*) for industrial use**

***Bolanle A. Akinwande*[1]**, *Olufunmilola A. Abiodun[2] and Isaac A. Adeyemi[1]*

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PP-7.27 **Advocacy for yams in the DR Congo**

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PP-7.28 **Relationships between chemical, instrumental measurements and organoleptic properties of pounded yam**

A. G. Konan[1,2] *and C. Nindjin[1,3]*

[1]Université Félix Huphouet Boigny, UFR Biosciences, Laboratoire de Biochimie et Science des aliments, Côte d'Ivoire; [2]Université Nanguy Abrogoua, UFR des Sciences et Technologie des aliments, Côte d'Ivoire; [3]Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS), 01 BP 1303 Abidjan 01, Côte d'Ivoire

PP-7.29 **Sustainable yam management in Guadeloupe (French West Indies)**

Régis Tournebize[1], Denis Cornet[2], Jorge Sierra[1], Francois Bussière[1], Jean Louis Kelemen[3], Julian Osseux[4] and ***Carla Barlagne[1]***

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PP-7.30 **Epidermal terpenes of *Dioscorea composita* hemsl.**

I. Odimegwu Joy[1]*, A. Odukoya Olukemi[1], C. S. Chanotiya[1], A. Ogbonnia Steve[1] and S. Sangwan Neelam[2]*

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PP-7.31 **Integrated agronomic management models: guide for increased yam productivity in West African sub-region**

O. Neke-okoro *and J. Ikerogu*

National Root Crops Research Institute, Umudike, PMB 7006, Umuahia, Nigeria

PP-7.32 **Nutritional composition and diversification of the use of *D. rotundata* varieties in Fako Division of Cameroon**

Achidi Aduni Ufuan*, Ikome Evelyn Mesaka, Forba Josepha Tendoh and Dopgima Levai*

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PP-7.33 **Is organic yam production feasible? Lessons from India**

G. Suja*, J. Sreekumar and A. N. Jyothi*

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PP-7.34 **Case study: Successes in a farmer-led approach to research and development in yam (*Dioscorea alata)* production**

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PP-7.35 **Management of greater yam + maize intercropping system for productivity and livelihood improvement of smallholder farmers**

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PP-7.36 **Impact of plant architecture in yams; an agronomic evaluation**

James George

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PP-7.37 ***Development of simple screening index to evaluate tuber growth and maturity in* Dioscorea rotundata *and* D. alata**

Ryo Matsumoto[1]*, Satoru Muranaka[1], Antonio Lopez-Montes[2], Shinsuke Yamanaka[1], Pachakkil Babil[1] and Hiroko Takagi[1]*

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PP-7.38 **Impact of 2030 climate on suitability of yams in sub–Saharan Africa and Asia**

***G. Byju**, Sabitha Soman, K.R. Remya Remesh and M. Vani*

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PP-7.39 **Assessment of genotypes of *Dioscorea rotundata* for moisture stress**

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PP-7.40 **Yam minisett intercropping studies for improved productivity of cropping systems and soil fertility enhancement**

***A. O. Ano**, J. Adiele, L. I. Chukwu, and P. O. Nwosu*

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PP-7.41 **Land suitability classification of an ultisol in southestern Nigeria for *Dioscorea dumentorum* yields**

***P. Nwosu[1]**, I. N. Onyekwere and C. C. Okolo[2]*

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PP-7.42 **Fungi associated with post-harvest tuber rot of water yam (*Dioscorea alata*) and their effect on nutritive value**

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Section III: Genetic resources, Genomics and Breeding

PP-7.43 **Yam germplasm management in Côte d'Ivoire**

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PP-7.44 **DNA fingerprinting of yam cultivars from Nigeria and Ghana using microsatellite markers**

***R. Bhattacharjee[1]**, O. Ogedengbe[1], A. Lopez-Montes[1], J. Ikeorgu[2], E. Otto[3], E. Chamba[4] and P. Lava Kumar[1]*

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PP-7.45 **EDITS-Yam: a collaborative research project on the "use of genomic information and molecular tools for yam germplasm utilization and improvement for West Africa"**

***Hiroko Takagi[1]**, Ryohei Terauchi[2], Antonio Lopez-Montes[4], Shinsuke Yamanaka[1], Takuma Ishizaki[1], Muluneh Tamiru[2], Satoshi Natsume[2], Hiroki Takagi[2], Pachakkil Babil[1], Ryo Matsumoto[1], Kazutaka Yamamoto[3], Gezahegn G. Tessema[4], Badara Gueye[4], Ranjana Bhattacharjee[4], Satoru Muranaka[1], Michael Abberton[4] and Robert Asiedu[4]*

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PP-7.46 **Facilitation of conservation and utilization of yams in the pacific by the secretariat of the pacific community**

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PP-7.47 **Assessment of diversity among greater yam (*Dioscorea alata*) accessions of India and prospects of utilization in genetic improvement programme**

***M. N. Sheela**, K. Abraham, K. I. Asha and P. V. Abhilash*

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PP-7.48 **Morphological characterization of cultivated and wild yam (*Dioscorea* sp.) in Malawi**

***Wezi E. Mkwaila*[1]**, *Wisdom J. Changadeya[2] and Aggrey J. D. Ambali[3]*

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PP-7.49 **Yam production in Jamaica: challenges and solutions**

***Jeannette A. Williams**, Sheldon M. Elliott and Michelle A. Sherwood*

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PP-7.50 **Assessment of yam diversity at community level: to increase farmers' access to conserved genetic resources of yam in West Africa**

***N. C. Ezebuiro**, O.N. Eke-Okoro, J. N. Amanze, J. G. Ikeorgu and J. Nicholas*

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PP-7.51 **Exploiting conserved yam (*Dioscorea alata* L*)* germplasm at PRC towards livelihood and market**

***Nguyen Van Kien**, Le Van Tu, Vu Linh Chi and Nguyen Phung Ha*

Plant Resources Center, Vietnam

PP-7.52 **Production constraints and farmers' cultivar preference criteria of cultivated yams (*Dioscorea cayenensis - D. rotundata* complex) in Togo**

*A. Dansi[1], H. Dantsey-Barry[2], **A. P. Agré*[1]**, I. Dossou-Aminon[1], P. Assogba[1], Y. L. Loko[1], E. K. N'Kpenu[2], K. Kombaté[2], M. Dansi[1] and R. Vodouhè[3]*

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PP-7.53 **Morpho-agronomic, cytogenetic and molecular characterization of the CIRAD yam collection for their enhancement and utilization in genetic improvement programs**

G*. Arnau, A. Nemorin, E. Maledon, F. Lambert and E. Nudol*

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PP-7.54 **Developing an effective protocol for embryo rescue in *Dioscorea* species**

***U. E. Amazue*[1]**, *R. Asiedu[2] and I. F. Akaneme[1]*

[1]Department of Botany, University of Nigeria, Nsukka, Nigeria,[2]International Institute of Tropical Agriculture, Ibadan

PP-7.55 **A challenge to create more genetic diversity and variability in yam: Pollen preservation, embryo rescue, and interspecific hybridization**

***Yukiko Kashihara**, Oluyinka Ilesanmi and Antonio Lopez-Montes*

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PP-7.56 **Regional GRC yam collections: Opening the access road to yam (*Dioscorea* Spp.) diversity**

***Folarin O. Soyode**, Abigael O. Adeyemi, Temitope A. Jekayinoluwa, Gueye Badara and Michael T. Abberton*

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PP-7.57 ***In vitro* multiplication of *Dioscorea rotundata*: effects of gelled and gel-free medium on growth and conservation**

***A. O. Ubalua**, I. J. Ihezie, A. Ikpeama, U. E. Okoroafor and G. C. Nsofor*

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PP-7.58 **Effect of genotype and sett weight on vine cutting performance in water yams (*D. alata*) and white yam (*D. rotundata*)**

***O. S. Pelemo*[1,2]**, *H. Kikuno*[3], *R. Matsumoto*[2,3], *M. O. Akoroda, A. Lopez-Montes*[2] *and N. Maroya*[2]

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PP-7.59 **IITA Bioscience Center: a platform for molecular laboratory techniques and training**

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PP-7.60 ***Participatory variety selection to reintroduce genetic variability in production systems of water yam (*Dioscorea alata*) in the Colombian Caribbean region***

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PP-7.61 **Participatory research program for yam crop in Colombian Atlantic coast**

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Biotechnology Institute of University National of Colombia

PP-7.62 **Diversity of wild yams (*Dioscorea* L., *Dioscoreaceae*) in Africa**

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PP-7.63 **Possible genotyping effect on the moisture content and pH of stored elubo (slightly fermented yam flour)**

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PP-7.64 **Characterization and conservation of wild genetic resources of yams in India**

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PP-7.65 **Agronomic evaluation of white yam (*Dioscorea rotundata* Poir.) under organo-mineral fertilizer treatment in southern Nigeria**

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Abstracts of the Oral Presentations

Keynote presentation

OP-2.1: Science-based innovations for yam improvement

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Yam systems contribute a lot to the livelihoods of millions of people in the tropics, especially in Africa, but there is tremendous potential for much greater contribution. Unearthing and facilitating productive use of this potential is subject to the effectiveness, efficiency, and pace of research and development (R&D) efforts devoted to the crop and its associated systems. It has taken a while to gather significant momentum but progress is being made in R&D, based on new technologies and knowledge in various scientific disciplines. There is also better, and increasing, understanding of the socio-economic and cultural contexts in which actors along the relevant value chains operate. This paper will review key advances made in research, development, and capacity strengthening as a basis for proposing a concerted effort to accelerate the improvement of yam-based systems.

Keynote presentation

OP-2.2: **Progress and challenges in yam technology development and transfer in West Africa**

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Considerable progress has been achieved in yam breeding and seed yam technology since the beginning of formal yam research in West Africa in 1971. The achievements some of which qualify as breakthroughs were accomplished within record short time and with relatively low budgets pointing to high return to investment in yam R and D. Yet significant challenges remain in these areas while high labor cost and pests and diseases problems are still begging for resource investment and research attention. Facing up to these challenges will promote yam as Africa's second world crop after cassava.

Keynote presentation

OP2.3a: Whole genome sequencing of Guinea yam (*Dioscorea rotundata*)

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To enhance Guinea yam improvement by fully exploiting modern genomics tools, generating a reliable reference sequence is a prerequisite. To this end, we have been making efforts to obtain the first whole genome sequence (WGS) information of a Guinea yam (*Dioscorea rotundata*) accession TDr96/00629 × TDr99/02626, which was generated at IITA. At this first global conference on yam, we would like to share with those involved in yam research and development the current status of the ongoing *de novo* assembly of Guinea yam genome, as well as introduce outcome of the preliminary assessment of yam genetic diversity based on the whole genome analysis. Furthermore, emphasis will be given to the implications of the availability of a reference genome for yam improvement and how genomic information aids mapping and identification of important genes and quantitative trait loci (QTLs) to accelerate yam breeding in future. As soon as the complete WGS information is obtained, the finding will be shared with the global yam community.

Keynote presentation

OP-2.3b: Whole-genome sequencing-based analysis of diversity in guinea yam (*Dioscorea rotundata*) breeding materials: a preliminary result

Muluneh Tamiru[1]*, Satoshi Natsume[1], Hiroki Takagi[1], Pachakkil Babil[2], Shinsuke Yamanaka[2], Antonio Lopez-Montes[3], Melaku Gedil[3], Ranjana Bhattacharjee[3], Gezahegn Girma[3], Hiroko Takagi[2], Robert Asiedu[3] and Ryohei Terauchi[1]

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Next generation sequencing (NGS) allows large-scale genome wide discovery of genetic markers that are important for genomic and genetic applications such as construction of genetic and physical maps, and analysis of genetic diversity. As a component of the on-going effort to construct the first draft sequence of Guinea yam (*D. rotundata*) and accelerate breeding program, we applied whole-genome sequencing (WGS)-based genetic diversity analysis to ten yam breeding materials. The materials include five landraces and five breeding lines that show variability with respect to traits such as maturity time, yield, tuber quality, and resistance to nematode and yam mosaic virus (YMV), and have been extensively used as parental lines in IITA yam breeding program to generate mapping populations. DNA samples extracted from each of the ten lines/accessions were subjected to WGS on the Illumina Genome Analyzer IIx platform with one lane used per sample. Accordingly, a total of 4.3-Gb to 7.6-Gb illumine paired-end reads were obtained for each line/accession, providing 7.5 to 13.2× coverage of the estimated 570-Mb *D. rotundata* genome. Aligning the illumine paired-end short reads to *D. rotundata* draft sequence scaffolds allowed genome-wide extraction of single nucleotide polymorphism (SNP) and insertion/deletion (indel) markers, which were used to estimate the genetic relatedness among the lines/accessions studied. Details of this preliminary finding and its implication for subsequent genetic and genomic studies, including among others, the application of SNPs, the most abundant genetic markers in genomes, for the development of high throughput genotyping platforms and marker-assisted breeding is also discussed.

Keynote presentation

OP-2.4: Domestication and evolutionary dynamics of cultivated yam (*Dioscorea cayenensis /D. rotundata* complex) in Benin

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Guinea yams (*Dioscorea cayenensis-rotundata* complex; *D. rotundata* Poir and *D. cayenensis* Lam) have been described as resulting from a process of domestication of wild yams of the section *Enantiophyllum* by African farmers. Although currently practised by few farmers, the process of yam domestication is still on-going in Benin. In order to document the practices used and the indigenous knowledge maintained by farmers, 40 villages were surveyed. In total, 110 farmers domesticating yam and 142 yams newly domesticated (or in domestication) were identified. Farmers domesticate yam mainly to widen the genetic base of the existing diversity (65% of responses) or for simple curiosity (35% of responses). Two wild yams species (*D. abyssinica* Hochst and *D. praehensilis* Benth) were used. However some rare farmers signalled the similarity between cultivars of the "cayenensis" group and *D. burkilliana* J. Miège. Tuber of the wild yams are collected either in the bush (most often near the village) or in the forests (far from the village) during hunting. The domestication process consists of bringing into cultivation selected individuals that go through intense vegetative multiplication and selection procedures (over a lengthy but variable period of time) that induce morphological and biochemical changes in the plant mainly at the tuber level. Individuals resulting from these manipulations were found to be, either similar or identical to known landraces or completely new based on both morphological and isozyme analysis. Considering the generation of new cultivars this process of domestication has potential in yam breeding and appears to be a strategy that could be useful to breeders, while developing a methodology for participatory breeding of yam. The role of the domestication process in the evolutionary dynamics of cultivated yam (*Dioscorea cayenensis /D. rotundata* complex) was analyzed through *in situ* conservation of natural populations of the related wild species (*D. praehensilis*, *D. abyssinica* and *D. burkilliana*) and the possibilities of integrating the process in a national yam participatory breeding scheme in the current context of climate change.

Keynote presentation

OP-2.5: Chemical and integrated nutrient management options for sustainable yam production

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Two main studies consisting of on-station trials at Fumesua (Forest) and Ejura (Forest-Savannah transition) and on-farm verification on 12 farmers' fields were conducted from 2009 to 2012 in Ghana. One on- station study was in a split-factorial combination design with two preceding systems (Pigeon pea and Yam) as main plot treatments and a factorial of poultry manure (0t/ha, 3t/ha and 6t/ha) and chemical fertilizer (0, 15-15-20, and 30-30-40 kg ha^{-1} N-P_20_5-K_20) as subplot treatments. The second on-station study was split-plot with seedbed preparation (Ridge and Mound) and chemical fertilizer (0, 45-45-60, 60-60-60 and 60-60-80 kg ha^{-1} N-P_20_5-K_20) as main and subplots respectively. The on-farm study was conducted in split plot with seedbed (Ridge and Mound) and Chemical fertilizer (0, 45-45-60 kg ha^{-1} N-P_20_5-K_20) as main and sub-plots respectively on continuously cropped fields. The results of the on-station studies revealed significant ($P \leq 0.05$) interaction between preceding system, poultry manure and chemical fertilizer on the tuber yields. When yam followed pigeonpea as a preceding crop, tuber yields were higher, and yields from 3t/ha poultry manure and 15-15-20 kg ha^{-1} N-P_20_5-K_20 was similar to yields when manure and chemical fertilizer were doubled to 6t/ha and 30-30-40 kg ha^{-1} N-P_20_5-K_20. It was also observed that tuber yields on 45-45-60 kg ha^{-1} N-P_20_5-K_20 plots were similar to the higher rate of 60-60-80 kg ha^{-1} N-P_20_5-K_20 treated plots on continuously cropped fields. The on-farm study revealed significant ($P \leq 0.05$) interactions between fertilizer (0; 45-45-60 kg ha^{-1} N-P_20_5-K_20) and seedbed (Ridge and Mound), with ridging having significantly ($P \leq 0.05$) higher tuber yields. Integrated nutrient management approach with preceding systems such as pigeonpea at 16,667 plants ha^{-1} and 3t poultry manure/ha would reduce the chemical fertilizer requirement to a third for sustainable yam production on continuously cropped fields.

Keynote presentation

OP-2.6: R4D priority for yam improvement: summary of yam survey results

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The CGIAR Research Program on Roots, Tubers, and Bananas (RTB) is conducting a priority setting exercise to identify major constraints that are hindering the development of six major RTB crops (cassava, potato, yam, sweet potato, bananas and plantains). As part of that global exercise, a survey with yam sector stakeholders was conducted to identify major constraints for yam value chain improvement in West Africa. A total of 191 yam sector stakeholders including scientists, extension agents, farmers' organization leaders were interviewed using direct interviews and online. Participants were asked to rank options of improvement from 1 (worst) to 5(best). Mean scores and standard deviations was then tabulated and ranked. The survey was followed with expert survey to identify key research options that can be used to address identified constraints within the RTB. An economic surplus model was later used to quantify potential benefits of each research option including number of people potentially taken out of poverty if those research options are funded and implemented. Survey results indicate that the 5 top suggested research options include (i) improving yam tuber self life (4.34/5), (ii) improving small scale processing (4.14/5), (iii) improving soil fertility (4.09/5), (iv) planting materials distribution (4.06/5) and (v) breeding for higher yields (4.04). For each broad category of research option the most suggested options are: Processing and value addition (improving shelf life, improving small scale processing and development of new yam based products); Breeding (for higher yields, for mechanization ready varieties, nutrient use efficiency, for resistance to yam mosaic, for drought tolerance, for early harvest); Access to planting materials (alternative for disease free—stocks, mass propagation techniques, Improving techniques for farmers based propagation); soil fertility and crop management (improving soil fertility and yam cropping systems; pest and diseases (management of yam tuber rot and yam mosaic) and socioeconomics (assessing adoption and impacts). The expert consultation in IITA and national programs in Nigeria, Ghana, Benin and Togo has yield 8 priority research options and the associated parameters needed for the evaluation of the benefits. The research options also take into consideration what research in general and specifically RTB programs can deliver.

Keynote presentation

OP-3.1: Jewels of the trade: conserving and using crop genetic resources

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In 2012, more than 130,000 samples of crop accessions were disseminated to 105 countries by the genebanks of the CGIAR. The pivotal role of crop genetic resources in breeding and research is illustrated in rare studies of the pedigree data of released varieties. For instance, of 4,317 released rice varieties documented in the International Rice Information System database in 2008, 90% of non-IRRI varieties and 100% of IRRI varieties had at least one genebank accession in their pedigree. There are several thousand accessions of yam (*Dioscorea* spp.) maintained in ex situ collections, possibly as many as 15,903 according to the FAO State of the World's Plant Genetic Resources report of 2010. These collections help to play a major role in conserving yam diversity, which according to a number of studies is increasingly threatened by irreversible genetic erosion. How well these collections are used is less well understood. A global community of yam conservers and users met in 2010 to assess the security and use of yam collections. Their discussions resulted in a document called "Towards a Global Strategy for the Conservation and Use of Yam", in which they outline the major constraints that hamper the conservation and use of yam genetic resources and propose 29 recommendations for addressing these issues. The continued collaboration within and beyond this community and the development of defined roles, shared initiatives, and refined action plans to act on these recommendations will be important to ensure that this document helps to fuel a positive locomotion.

Keynote presentation

OP-3.2: Characterization and utilization of genetic resources in yam

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The Genetic Resources Centre (GRC) of IITA has major collections, held in trust under the Multilateral System, of many of the staple crops of sub-Saharan Africa. In particular within the CGIAR system it has the mandate for the collection, characterisation and exchange of yam species, particularly *Dioscorea alata* (676 accessions) and *D. rotundata* (1891 accessions) but also related species. The great majority of these accessions are of West African origin, which is the largest production zone. As with other clonally propagated crops conservation is through *in vitro* and field genebanks. This brings a number of challenges with regard to genebank management and exchange such as genotype mixtures, genetic stability, possibility of mislabelling, germplasm health and documentation. In recent years approaches utilising molecular markers have increasingly been used alongside with agro-morphological methods to address these issues. More emphasis is also put in a participatory and global strategy, involving all stakeholders (genebank holders, breeders, germplasm health specialists, socio-economists, the seed system sector and farmers). The work of the GRC is strongly focused on the development of partnerships with national partners and on capacity building and training. In addition to *ex situ* conservation and use of cultivated yams we are also strengthening programs centred on *in situ* conservation and the wild relatives of yam. Under the Genebank CGIAR Research Programme (CRP), co-ordinated and partly funded by the Global Crop Diversity Trust, we are working across crops and CG centres to move forward the state of the art in the conservation and use of genetic resources. This includes more effective use of databases and information management systems to improve the accessibility of our collections.

Keynote presentation

OP-3.3: Molecular phylogenetics of *Dioscorea* L.: What does it tell us about the wild relatives of cultivated yams?

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The genus *Dioscorea* L. comprises over 600 species, of which at least 10% are edible with or without pre-preparation. Five of those species are the principal cultivated yams; *Dioscorea alata* L., *D. esculenta* (Lour.) Burkill, *D. polystachya* Turcz., *D. rotundata* Lam./*D. cayenensis* Poir. and *D. trifida* Lam. The economic value of yams lies predominantly with *D. rotundata-cayenensis* and *D. alata*, with these taxa feeding at least 60 million people in Subsaharan Africa. However, the wild relatives of both these two taxa and the other three remain unknown, despite their potential for use as sources of desirable traits for breeding such as disease resistance, climate change resistance, yield, flavour and growth form. The current limits of knowledge in this area will be explored using both published molecular marker-based phylogenies and those in preparation for publication in conjunction with other population-based genetic data. The phylogenies can be used to provide the best available estimates of gene pool and taxon group membership for species of *Dioscorea* in relation to the principal cultigens (following the crop wild relative concept of Maxted *et al*.). This information provides guidance regarding both conservation priority and potential utility as a source of genes underpinning the traits sought by breeders. The presentation will conclude with priorities for future studies in this area increasing both the breadth and depth of the sampling.

OP-3.4: Diversity studies on Guinea yam (*Dioscorea rotundata*) for utilization of genetic resources

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"EDITS-Yam", the on-going JIRCAS/IITA/IBRC collaborative project, aims to develop and utilize genomic and molecular tools to facilitate yam germplasm utilization and improvement for West Africa. As a part of the project, assessment of genotypic and phenotypic diversity of *Dioscorea rotundata* germplasm collection is being implemented to develop tools for further enhancement of genetic resources utilization. IITA holds over 2,000 accessions of *D. rotundata*, of which about 800 accessions are included in the core collection. This is large for thorough genotypic and phenotypic (morphological and agronomic traits) characterization. An attempt was made to select a representative set of accessions that will retain the diversity of the entire *D. rotundata* collection in terms of both molecular and morphological levels. Based on SSR polymorphisms, a set of 106 accessions with wide coverage of SSR variation was selected. On these accessions, multivariate analysis using 22 key morphological characters, including ploidy level, has been conducted to assess morphological variation. The results showed that these selected 106 accessions retained wide morphological variation as in the original IITA *D. rotundata* core collection. The selected accessions will be used as "Diversity Research Set" of *D. rotundata* (DRS-EDITS) for our further studies. Using the DRS-EDITS, we have been conducting 1) detailed genotyping by using DNA markers, such as SNPs, available from genome reference sequence of *D. rotundata* developed by IBRC in the EDITS-Yam Project, 2) morphological characterization and identification of practical key descriptors for regional *D. rotundata* collection, 3) detailed phenotyping of economically important traits such as yield, earliness of tuberization, and tuber quality traits. We believe that expected outputs from the detailed analyses of the DRS-EDITS, such as DNA marker-set for genetic analysis, practical key descriptors for *D. rotundata*, and evaluation methods/criteria for important traits, will facilitate efficient management of yam genetic resources and effective utilization of genetic diversity for the crop's improvement in West Africa.

OP-3.5: Ploidy level, morphological variation and genomic diversity between and within Guinea yams

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Patterns of genetic diversity within and between two cultivated Guinea yams (*D. rotundata* and *D. cayenensis*) and five wild relatives (*D. praehensilis*, *D. mangenotiana*, *D. abyssinica*, *D. togoensis* and *D. burkilliana*) were investigated using a reduced representation next-generation sequencing approach, Genotyping-By-Sequencing (GBS). Additionally, the two cultivated species were assessed for intra-specific morphological and ploidy variation. The ploidy level of *D. praehensilis* and *D. mangenotiana*, which have genome sizes similar to *D. rotundata*, were also determined using diploid *D. rotundata* as a standard. In yams, ploidy level is highly correlated with species. A single ploidy level was observed across *D. cayenensis* (3x, N=21), *D. praehensilis* (2x, N=7), and *D. mangenotiana* (3x, N=5) accessions, whereas both diploid and triploid accessions were observed in *D. rotundata*. (n=29 and n=11, respectively). For the genetic diversity analysis, a single GBS library was created from 95 samples using the enzyme PstI. The GBS library was sequenced on a single Illumina HiSeq lane, producing a total of 118,383,523 100 bp reads. These reads represented 3,595,662 unique 64 bp "tags". The Universal Network Enabled Analysis Kit (UNEAK), which is the non-reference GBS analysis pipeline in TASSEL, was used to identify single nucleotide polymorphisms (SNPs). A total of 11,574 SNPs were identified across the samples analyzed. Analysis of genetic divergence between species using these 11,574 SNPs demonstrates that the wild Guinea yam populations form discrete genetic groupings according to species. The populations of *D. togoensis* and *D. burkilliana* are the most distant from the cultivated species, whereas *D. mangenotiana* and *D. praehensilis* have closer proximity to the two cultivated yam populations. In contrast, the cultivated species are genetically less well defined. While *D. cayenensis* forms a single genetic group, *D. rotundata* forms three separate groups consisting of: (1) a set of diploid individuals that are genetically similar to *D. praehensilis*, (2) a set of diploid individuals that are genetically similar to *D. cayenensis*, and (3) an isolated set of triploid individuals. The current study demonstrates the utility of GBS analysis to assess genomic diversity in yam, and in combination with morphological and biological data provides a powerful tool for testing hypotheses regarding the evolution, domestication and breeding of Guinea yams.

Keynote presentation

OP-3.6a: Modernizing yam breeding for rapid development and deployment of varieties with farmer and consumer preferred traits for value addition and improved food and income security

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Progress in yam breeding has been hindered by polyploidy, negative flowering traits, low propagation rate and inter-specific genetic barriers. As a result, the time for the entire breeding cycle to release a new variety still takes between 18 to 22 years for water yam and white yam. National and international breeding interventions so far have been focused on high yields of fresh tuber as the main trait for breeding, whilst demand for valued addition and industrial uses are increasing. To this effect, efforts are being made at IITA to improve breeding efficiency. A global review of breeding and genetic resources activities and an analysis of West Africa capacities to carry out yam research were undertaken. This along with a detailed analysis of IITA breeding activities during the last 15 years allowed the formulation of a new strategy that includes: (a) Increasing diversity at three levels (species, varieties and genome), (b) integration of farmers' agro-ecological knowledge and decision-making, and (c) a participatory value chain approach. Redefinition of environments for selection, speeding the selection process, knowledge sharing and use of diversity and accelerated adoption processes are the four strategic components for implementation. Environments are redefined by biophysical characterization integrating soil, weather, crop management and poverty levels. Breeding efficiency is improved by utilizing rapid propagation techniques such as vine cuttings and improved screening protocols which together will reduce the time to recommend varieties from 10 to 3.5 years. Genomic tools will be used in pre-breeding and breeding, parents and progeny selection is based on measurement of genetic gain and heritability, trait capture and discovery of associated genes, along with robust phenotyping. Haploids will help to improve inter-specific hybridization. Exploring the advantages of inbreeding in monoecious clones will unveil recessive traits. Finally, variety development will strongly be implemented by a participatory approach involving farmers, processors, traders, households and industry.

O-3.6b: Application of advanced genomic technologies to accelerate yam breeding

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Yam (*Dioscorea* spp.) is a multi-species crop constrained by its polyploid nature, poor to non-flowering and long crop growth cycle which protracts breeding cycle limiting rapid development and deployment of improved varieties. To overcome these challenges, in the next five years, efforts will focus on (a) development of new breeding tools and strategies to shorten the breeding cycle, (b) trait capture and discovery of associated genes, (c) pre-breeding for new traits, and (d) development of new varieties incorporating farmer and consumer preferred traits. Yam genomics and marker-assisted breeding platform will be established to fast-track development of new varieties and training NARS. The draft genome sequence of *Dioscorea rotundata*, soon to be available, will provide better knowledge for different genes in the species, the regulatory elements that control their function and a framework for understanding genomic variation. It will also allow us to understand the roles of genes in efficiently exploiting the natural and induced genetic diversity in *D. rotundata*. Additionally, *de novo* assembly of two parental populations of *D. alata* resistant and susceptible to anthracnose disease has been completed. Genotyping-by-sequencing (GBS) of about 400 genotypes of *D. rotundata* including landraces and improved cultivars is also underway. This next generation sequencing of both *D. rotundata* and *D. alata* will generate a large set of SNP markers available for linkage mapping, genome-wide association mapping, map-based cloning and evolutionary studies. Further, high-throughput phenotyping for targeted traits is underway using metabolomics to understand the biochemical pathways responsible for such traits. These new developments are expected to enhance yam breeding through development and release of new varieties, strengthen seed yam delivery systems, training, communication and promotional strategies for the dissemination of improved varieties.

OP-3.7: Recent innovations in yam *Dioscorea alata* improvement through polyploidy breeding

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Yams are an important food crop in tropical and sub tropical regions. *Dioscorea alata* or the greater yam, is the most widely distributed species throughout the tropics. It has a great potential for yield, a good storage quality (3- 5 months) and can be easily machine harvested. However, several factors limit its development. These include abiotic and biotic constraints, including anthracnose disease as a constant threat. *D. alata* includes varieties with three ploidy levels 2n= 40, 60, 80 chromosomes. A recent study has shown that the accessions are diploid, triploid and tetraploid respectively (2n=2x, 3x, 4x), and not hexaploid and octoploid as previously assumed. Ploidy increase is correlated with growth vigour, higher tuber yield and increased tolerance to abiotic and biotic stress. Although polyploidy has been recognized for a long time, all breeding programs were exclusively based on the creation of diploid varieties, until 2006. The first triploid and tetraploid hybrids were recently created by conventional hybridization through the discovery of the fertility of tetraploid varieties and development of an *in vitro* immature embryo rescue method. Three promising hybrids are under evaluation in farming systems using participatory approach in Guadeloupe and Martinique. The several possible ways that could be exploited to produce polyploids have been studied. Progress could be reached through the use of biotechnological tools (cytogenetic techniques and molecular markers). It has been demonstrated that some diploid varieties are able to produce unreduced 2n gametes and that this phenomenon can be used to create polyploids. Polyploidy breeding opens the way to develop hybrids with higher yields, combined with tuber characteristics adapted to commercial production (quality, tuber shape, etc.) and resistance to anthracnose disease.

OP-3.8: Metabolite profiling of *Dioscorea spp.*

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In order to assess the biochemical diversity within *Dioscorea* (yam) species metabolite profiling protocols have been developed on GC-MS and LC-MS platforms. Methods and compound libraries for GC/LC-MS and UPLC-PDA systems have been generated to provide cross-platform comparisons with those currently applied to *Solanum lycopersicon* (tomato) and other crop species. The developed methods will be applied to diverse collections of *Dioscorea spp.*, from Western Africa and Madagascar. In addition to the assessment of the yam metabolome, yam material offers a potential source for many high-value secondary metabolites. Targeted analysis of phytosterols and saponins will be carried out to assess their: biosynthetic pathways, regulation and integration with genomics. Collectively these data will provide useful information for further breeding programs and biotechnological application. At present, GC-MS on polar fractions has identified 221 components comprising amino acids, fatty acids, organic acids, monosaccharides, alcohols and disaccharides. From the non-polar fractions 90 components have been identified. UPLC-PDA analysis is progressing with flavonoid, sterol, carotenoid, tocopherol and terpene compounds identified. Targeted analysis procedures are under development. Results of this work will be compared to other platforms to access the biodiversity within *Dioscorea* crop and highlight the composition of bioactive secondary metabolites within yam species. In particular, comparisons with tomato, *Musa spp.* (banana), *Ipomea batatas* (sweet potato) and *Manihot esculenta* (cassava) will be drawn.

OP-3.9: Yam anthracnose resistance in *Dioscorea alata* L. – Genetic mapping and QTL analysis

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Food yam is a multi-species crop, cultivated for its tuber production in the tropics and subtropics. Greater yam (*Dioscorea alata*, 2n = 2x = 40) is the most widely cultivated yam species. In spite of its importance, the development of its production is limited by anthracnose disease caused by *Colletotrichum gloeosporioides* (Penz. & Sacc.). This is the most important disease of *D. alata*, with yield losses of up to 85% under favourable condition. Severe damages have been reported on susceptible varieties in the Caribbean, South Pacific, West Africa and India. Considering the high genetic diversity of *C. gloeosporioides* from yam, the use of durable resistant yam varieties is the most reliable approach to disease management. However, breeding in water yam, a heterozygous plant with an erratic flowering, is a difficult and long process. The speed and precision of breeding can be improved by the development of genetic linkage maps which would provide the basis for locating and hence manipulating quantitative traits such as anthracnose resistance in breeding programmes. Two F1 populations were developed using two different sources of resistance, 'Boutou' and 'Oriental' (female clones showing field resistance to anthracnose) crossed by the susceptible male clone 'Pyramide'. Genetic linkage maps were generated with polymorphic AFLP and microsatellite markers. The resulting maps are the most saturated of all yam maps to date. QTL analysis of anthracnose resistance was performed based on response to two pathogen isolates under controlled inoculations. QTLs detected for anthracnose resistance explained 7 to 40 % of the phenotypic variation. These QTLs displayed isolate-specific resistance as well as broad-spectrum resistance. Validation of the identified QTLs was performed based on the reactions of one mapping population in field conditions. This work constitutes a first step towards the use of QTLs in selection programmes aimed durable resistance to yam anthracnose.

OP-3.10: Comparative evaluation of dwarf and tall hybrids of white yam for morphological agronomical and biochemical traits

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Yam (*Dioscorea* spp) is an important food and nutritional security crop grown in tropical countries for its underground tubers. Greater yam, white yam, lesser yam and aerial yam are the major edible yams grown in India. White yam (*Dioscorea rotundata*), an introduced crop, is emerging as an important tuber crop in India. Central Tuber Crops Research Institute (CTCRI, India) holds a field genebank of 1100 *Dioscorea* accessions including 158 white yam genotypes. High yielding hybrids with good tuber shape and culinary quality were developed through hybridisation of divergent accessions. Use of stakes for trailing in white yam led to high cost of cultivation limiting the spread of the crop. A dwarf mutant, Sree Dhanya was released in 1993 as the first dwarf variety suitable for planting with closer spacing without any staking. Dwarfness, a recessive trait, was transferred to elite clones and dwarf hybrids with high yield, good tuber shape, high harvest index and culinary quality were developed. Among the hybrids evaluated in on farm trials, Drd-1068 and Drd-1157 recorded the highest average yield (25 t ha^{-1}) followed by Drd-1142. Drd-1060 recorded excellent cooking quality among the hybrids. The dry matter content of the bushy dwarf hybrids ranged from 29.2% (Drd290) to 39.9% in Drd 1095. The high yielding hybrids Drd 1157 and Drd 1068 also recorded high dry matter content of 39.8 and 37.3 percent respectively. The dry matter content of the dwarf hybrids were found to be on par with tall hybrids. Progress is also being made to develop population for mapping of dwarfing gene in white yam to facilitate the transfer of this valuable trait among different yam species. The paper presents the comparative evaluation of morphological, agronomical and biochemical traits in dwarf and tall hybrid clones of white yam.

OP-3.11: CSIR-CRI yam (*Dioscorea species*) biotechnology research Initiatives toward crop improvement

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Yam is a common name for some species in the genus *Dioscorea* and belongs to the family *Dioscoreaceae*. It is an important crop in Ghana. In terms of the area under cultivation, 6.32% of Ghana's arable land is used for yam cultivation. Yam makes a significant contribution of about 16% of the value of Agricultural Gross Domestic Product. Agriculture research has contributed to the improvement and promotion of the crop. Between 1996 to present, the CSIR-CRI biotechnology unit has made several efforts towards the improvement of the crop where tissue culture and molecular biology research is complimenting conventional research efforts for the conservation, rapid multiplication and molecular characterization of local yam accessions. Prominent among these attempts is the development of a reliable cryopreservation system for the conservation of germplasm at ultra-low temperatures. A successful system for the genetic manipulation of yam has also been developed with collaborators at the Tuskegee University Alabama, USA. A more efficient *in vitro* rapid multiplication system for local accession has been formulated and genotyping systems have been used to rogue out duplicates in conserved germplasm collections. This paper presents initiatives that can be sourced to enhance the various research efforts of yam for Ghana and sub-Saharan Africa.

Keynote presentation

OP-4.1: Yam farming as a business

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Value chain analyses (VCA) form an important part of the Yam Improvement for Income and Food Security in West Africa (YIIFSWA) project, which is being implemented by IITA in partnership with national and international organizations in both Ghana and Nigeria. In addition to preliminary analyses and rapid value chain assessments, more in-depth analyses have been completed in both countries to improve understanding of value chains for ware, seed, and processed yam. The findings of the value chain analyses will be summarized. The second part of the presentation will focus on the way forward with regard to activities within objective 1 of the YIIFSWA project (strengthen small-scale farmer market linkages, particularly in less accessible areas). The main aim of this objective is to progress yam farming as a business with a focus on enterprise and marketing capacity building activities. Key activities being carried out as part of a development 'roadmap' include the organization of cross-objective district level workshops and capacity building measures in project areas, and creation of yam development forums in order to ensure buy-in of key stakeholders and business champions. Capacity building in business plan development and record keeping includes aspects of marketing plans and profitability analysis in the form of gross margin calculations. Improving contractual arrangements remains a challenge in that different groups of stakeholders have differing expectations and requirements. In view of this, further piloting of business models and contractual arrangements will be required. Communication is a strong element of the training component of this objective. In addition to training workshops, training material prepared for this and other project objectives will be disseminated through radio and other media that can reach large numbers of smallholder farmer beneficiaries in the project target areas. The importance of follow-up activities and tracking of project progress in recognized and being incorporated into future project plans in collaboration with project partners and key stakeholders.

Keynote presentation

OP-4.2: Yam value chain strategy for Ghana: a new vision of the sector

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Ghana is the second largest producer of yams after Nigeria with nearly 6.3 million tons of yams produced in 2011. Main system of farming is low input agriculture, with little mechanization. Production is mainly consumed as fresh tubers in the domestic market, although fresh tubers al also exported to UK, Europe and in land to neighbor countries. No value addition and no articulation of the sector are the mains constraints to improve the contribution of the yam sector to the GDP. Some isolated policies and programs has been implemented, however no initiative has so far been put in place to articulate the sector. The objective of this paper is to present the yam value chain strategy for Ghana. The Yam Sector Strategy has been created in response to a request from the Government to support the development of the yam sector in terms of production, value addition and commercialization. The International Trade and Centre (ITC) and the International Institute of Tropical Agriculture (IITA) have provided technical support and facilitation to the strategy, whereas local stakeholders from the private and public sectors representing all stages of the yam value chain have informed and led the strategy development process. The objective of the Yam Sector Strategy is to advance yam and associated crops industry and its support networks through increased value addition for domestic, regional and international markets. The strategy provides six detailed strategic objectives and market targets that reflect buyers and producers' priorities at national and sub-regional levels. The long-term impact of the strategy is to contribute to improve the livelihoods of farming communities through a market-led approach that holistically considers economic and social issues together with crosscutting and enabling factors. The overall outputs of the Strategy are to: facilitate public-private dialogue at the national, provincial sub-regional levels, reach a common understanding by private and public stakeholders of sector's issues and opportunities, develop a common set of goals based on industry's challenges and market priorities, define support structures and align programs with validated market targets and development priorities identified by the private sector, increase influence and negotiation power for policy-making and funding, increase impact of business and attract investments.

Keynote presentation

OP-4.3: Participatory governance for sector development: a case study

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The Busan partnership for effective development and cooperation ratified that the world stands at a juncture in global development and that poverty remains the central challenge. Similar conclusions were reached in the European Consensus on Development policy by specifically making reference to coordination and harmonization of efforts, ownership and participation of beneficiaries to increase aid effectiveness, sector development interventions and enabling environment policies. Consequently it seems that traditional cooperation and decision-making methods are being questioned due to unconvincing impact and to the perceived lack of inclusion and participation. The aim of this paper is to present a review of participatory governance and development approaches, and discussing the Ghana case of study with yam. The methodology is based on participatory approaches during development, implementation, monitoring and evaluation phases. Results indicated that: the creation of public private networks, or rather policy support networks, can result in improved performance of private sector, support institutions and policies. The latter is possible when policy design, implementation and monitoring include the creation of a framework for generating partnerships and support networks. In the context of Ghana, seven pillars each with detailed implementation plans and implementing partners were identified**.** It is possible that several common interest points are identified among actors of the alliance, but it is very important to identify those that are more important and offer the highest potential to facilitate changes that help to increase the competitiveness of the value chain. It is around the most important common interest points that the alliances must be built so that the benefits obtained are higher than the interaction costs originated during its design and implementation. The multi-stakeholder participatory approach has been piloted as a means of arriving to policy recommendations and priorities relying both on implicit and local knowledge as well as on solid evidence. As conclusions, it is suggested that broad participation, as well as competition can be a key pillar for improved policy formulation, implementation and evaluation. Perhaps, innovative mechanisms linked to increased stakeholder involvement can be proposed by including bottom up approaches that feed into top down processes supported by multilevel policy networks, but that remains the topic for further research.

OP-4.4: The contribution of the yam sector in the food security in DR Congo

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Considered as one of the oldest known and starchy plants consumed by African and indigenous people of the Democratic Republic of Congo, the lack of interventions or the shy interventions for the promotion of yams and the weak attachment to this tuber by farmers failed and prompted the emergence and intensification of this culture. The lack of information that can help the development of this yam sector in DRC led us to this study, which was conducted at three levels through the main producing areas of the country: producers, sellers and consumers. Through this paper, we would like to study the competitiveness of this crop in relation to two other starch rich crops (cassava and maize) and also to see his contribution to food security where this culture is used. The paper showed that the yams costs of production are greater than the costs of production of these two cultures, but that the marketing of yam is more profitable in the provinces of Equateur and Bandundu compared to other provinces studied, which could justify that the yam is practiced and developed with more intensity in that province where it is planted not only for consumption (as elsewhere), but mostly for sale as it is an important source of income for the population of these territories and contributed to improve the food security. Compared to most major starchy plants grown (cassava, maize, sweet potato, plantain, taro, potato, yam and rice), yam is an important source of starch in the territories where this culture is practiced, as it would be in the top four starchy plants in terms of the importance attached to it and that the female gender is very active in this sector except in the territory of Bumba, where it is rather the man who cares.

OP-4.5: Local market food sector analysis and design: the example of the yam sector in Guadeloupe

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Food sectors have to face lots of hurdles today and their sustainability is called into question. We present here an original method that we developed to analyze the yam *(Dioscorea sp.)* food sector in Guadeloupe (FWI) and devise recommendations for its sustainable development. This three-step method aims at giving an overview of the sector by describing and analyzing the strategies and expectations of farmers, retailers and consumers. This overview makes it possible then to draw conclusions for improving the sustainability of the sector. In the first step we enquired yam farmers in order to characterize their productive strategies. We identified six different types of farms according to the importance placed on yam for income generation. In the second step we focused on marketing chains. We found that local yam is mostly traded informally via five main distribution chains that reflect farmers and retailers' strategies. In the third step, we focused on yam consumers in order to identify ways to boost yam consumption. Focus group discussions helped us to identify the determinants of yam consumption and to devise hypotheses about ways to increase it. We then tested those hypotheses through a laboratory experiment in which we elicited consumers' willingness to pay for different types of market signals: i) the intrinsic quality of a variety resistant to pathogens and of high testing quality, ii) a label about the local origin, iii) a label about the organic production. Our results showed that consumers were ready to pay a premium for the local and organically grown yam. We then discussed the interest of moving onto a certification scheme for the different types of farms and agents identified in the first and second stage. This study suggests that a way to improve the sustainability of the yam sector in Guadeloupe would be to mobilize farmers around a collective product qualification strategy.

OP-4.6: Targeting agricultural research for development investments in cassava and yam production systems in Africa: evidence from Nigeria

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There is increasing consensus that roots and tuber production systems have the greatest potential in tropical areas in Africa for increasing staple food production, farm incomes and nutrition in order to reverse the current downward trends in per capita food production and availability and food security. Because technological change is the major driver of productivity increases in agriculture and the source of new income streams, it is especially important to examine how agricultural research for development are affecting food production, incomes and nutrition outcomes. We use national household survey data and apply the treatment effects methods developed in the literature on econometric and statistical evaluation of social programs to analyze the current and potential impact of agricultural research investments on adoption, production, income and nutrition outcomes in the context of heterogeneous responses to interventions and diversity in impacts. We find that there are large gaps between current and potential impacts. These mostly result from inefficiencies in markets for agricultural input and output, land, labor, credit, risk, information and externalities in the adoption process. We recommend that to tap the unexploited potential agricultural research for development investments be targeted to favorable regions and complementary investments be targeted to improving supply of clean disease-free planting materials and fertilizers; mechanization of production and cassava processing; capacity building of farmers; farmers' organizations; marketing arrangements; and agricultural innovation systems.

OP-4.7: Factors affecting willingness to adopt improved production technology and yam trade among yam farmers in Northern area of Oyo State, Nigeria

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Yam production provides food and serves as a source of income to peasant farmers and laborers who work on yam farms as well as those who engage in its sales. Yam peels is also often used for feeding livestock. In spite of the importance of yam and its socio-cultural value in Nigeria, the invest in yam production enterprise is becoming difficult for farmers due to high cost of production, theft, unfair market prices, pest and diseases attack. Despite several strategies that have been put in place by research institutes and governments in ameliorating these problems, low adoption levels of production technologies remain a challenge. This study, therefore, evaluated factors affecting willingness to adopt improved yam technology and selling of output among yam farmers. Multistage sampling technique was used to select 100 yam farmers in the Northern area of Oyo State, Nigeria. Probit model was specified to estimate the factors affecting willingness to adopt improved yam technology and willingness to sell yam and its products. Results showed that gender, age, educational level, farming experience, household size, labour extension service and farmers' perception of improved income were the significant factors affecting farmers' adoption of improved yam technology. Farmers' willingness to sell yam and its products were significantly affected by household size, profitability of the production enterprise, farmer's educational level, transportation costs and credit facility. Therefore, incentives that will attract people into agriculture should be introduced so as to attract more young people into agriculture and also encourage them to stay and take agriculture as primary occupation. Extension visits should be enhanced in the study area and farmers should be taught various modern farm technologies to increase their awareness level on improved information which increase their willingness to adopt improved yam techniques. Also, educational program for farmers should be intensified and sustained to improve yam trade in the study area. Policies to enhance literacy of farmers should be initiated.

OP-4.8: Enhanced utilization and productivity on yams through advanced technologies

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Yam (*Dioscorea* spp.) is a valuable and staple crop in tropical and sub-tropical regions, especially in West Africa, South pacific islands, the Caribbean islands and Southeast Asia. The yield potential of yam under fertilization and mechanization was not yet tested. Improving the productivity and establishment of effective production systems is necessary as a response to the the increasing demand for yam. Furthermore, utilization of yams is still low compared to other root and tuber crops as potato and cassava. Tokyo University of Agriculture (TUA: Tokyo NODAI) has been studying yams since 1993. Germplasm mainly of water yam (*D. alata*) has been collected from South Pacific countries, Southeast Asia landraces in Okinawa and Kagoshima prefectures, Japan. Since 2000, some African yams i.e. white yam (*D. rotundata*) has been brought from Africa through IITA. These collections are mainly propagated and maintained at TUA Miyako subtropical research and training farm in Miyakoisland of Okinawa prefecture, Japan. In this presentation, the authors will highlight yam researches or projects hitherto implemented by TUA. The topics covered are; 1) new findings about functional ingredient in yam tuber such as diosgenin, which have high potential for medicinal or supplemental products; 2) new yam products, i.e. distilled spirit made from water yam, 3) registry of new varieties of water yam selected for mechanized cultivation; 4) polyploidy breeding generated colchicine treatment; 5) yam cultivation with mechanization; and 6) seed tuber production system through vine propagation with mechanization carried out in Miyakoisland.

OP-4.9: Comparative cost and profit analysis of yam production in Nigeria and Ghana

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Improving the food sector in most- developing countries has been focused on increasing farm-level production through introduction of improved technologies and practices. This paper critically examines and discusses conditions of the rural population living in high input systems within the yam belt of Nigeria and Ghana, with particular attention paid on the production constraints and the assessment of the cost of production. The study was meant to provide basic information that could be used to advice farmers and researchers on the best input mechanism that will lead to an increased on yam production. A random sampling procedure was used to select 800 and 600 households across Nigeria and Ghana, respectively. The survey was carried out using a structured questionnaire. The study established that yam farming is a male dominated business with a proportion of male-headed households of 97% in Nigeria and 90% in Ghana. In both countries,various costs were incurred for producing yam of which high cost of labour was reported as most important constraint. The differences in cost structures reflect variable conditions relating to yam production. According to the production data, costs per hectare were higher in all the surveyed areas. Nigeria had the cost of labour as largest share of the total cost (about 83%) while the cost of seed had the largest share (about 58%) in Ghana. Yam production is more profitable in Ghana than that in Nigeria and differences in gross profit may be explained by different yields and selling prices.

OP-4.10: Understanding yam tuber wound-healing in order to reduce losses during storage and transport

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Like many root crops yam tubers are able to heal wounds if exposed to appropriate conditions. In this process wounds are sealed by an impermeable layer (lignin in the case of yam tubers), and a new periderm grows, thereby preventing loss of water and invasion of rotting pathogens. It is assumed that if yam farmers optimize the environment for curing for a period of time immediately after harvest, that this will reduce the amount of rotting and thereby reduce losses and allow longer-term storage. A program of trials was initiated to establish the range of conditions, (temperature, humidity) at which wound-healing could occur most efficiently, so that on-farm conditions could be optimized accordingly. The trials were conducted at NRI, using chambers with temperature and humidity control. The progress of wound-healing inflicted by cutting off a portion of periderm using a knife was followed by the synthesis of the lignin barrier as detected by intensity of phloroglucinol staining, recorded as a score. The first trials were conducted on pona yam (*Dioscorea rotundata*) stored at high humidity (85% RH). Scoring for lignification after 3, 7 and 10 days for four temperatures; 25, 30, 35 and 40°C, indicated that lignification is essentially complete after 7 days and is most efficient at 30 and 35 °C with a significant decrease in efficiency at 40°C. During a preliminary trial on humidity effects it was found that at 85% RH the wounds healed cleanly, but at 50%RH there was clear desiccation and no lignin formation. The research program will continue to compare characteristics for a range of varieties/species.

Keynote presentation

OP-5.1: Research gaps in yam production environment: a review

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Yams (*Dioscorea* spp.) are monocotyledonous plants belonging to the family *Dioscoreaceae* and genus *Dioscorea*. The economically important species are *D. rotundata, D. alata, D. cayenensis, D. bulbifera, D. dumetorum,* and *D. esculenta* (Hahn 1995).Yam tuber is an important staple food, providing nourishment to people in the tropics and subtropics. It is rich in carbohydrate with about 50–80% starch on dry weight basis. Other constituents of high nutritional values are vitamins C and B6, potassium, iron, manganese, and amino acids; contents of sodium and saturated fats are low. About five million ha of land are cultivated worldwide and about 49 million t of yam are produced with 94% of this value being grown in West and Central Africa (FAO 2005). Indeed, yam is very important in Africa and it has a place in festive occasions, rites, and taboos of the people. Yield of yam is currently dwindling and calls for urgent attention to tackle associated problems by filling the gaps that may have necessitated the decline in yields. Hence, this review identified some research gaps that need to be addressed for increased and sustainable yam production in yam growing areas. Such gaps include research on new uses of food yam to boost production and attract more entrepreneurs to yam farming and business, identification of possible uses of non-food yam species, new or alternative ways of shortening or preventing dormancy, and nutrient interactions to explain low yields in yams. In addition, site specific trials are needed to establish the mineral fertilizer requirements for optimum yam production as well as the economics of growing yams under irrigation in areas without an adequate rainfall regime.

Keynote presentation

OP-5.2: Mechanical yam harvesting: Some lessons from mechanical cassava harvesting in Ghana

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Yam is an important crop for at least 60 million people, comprising rural poor producers, processors and consumers in West Africa. World yam production is falling and this has fuelled calls for increased global funding for research activities in yam. Farmers are still using their own traditional methods of yam production. Constraints to yam production and declining yield include high labour demand for most cultural operations, high cost of labour, and other inputs and the slow pace of getting new technologies to farmers. The labour requirements in yam cultivation for mounding, staking, weeding, and harvesting exceed those for other starchy staples. Large scale yam harvesting especially during the dry season is a major constraint as manual harvesting is slow and associated with drudgery and high tuber damage. Research on mechanization of yam harvesting is low and currently there exists no known functional mechanical yam harvesters in Ghana. This paper reports some field test results of mechanical cassava harvesting technology and its potential adoption to yam harvesting on commercial basis. The mechanical harvester works best if roots and tubers are planted on ridges, and in dry soils with low moisture content from 1 - 17% (*db)* containing minimum trash or weeds. The harvester can penetrate to depths of 13-40 cm, develops average drafts of 10.86 kN. At forward travel speeds of 5–8 km/h, the harvester consumes 15-19 litres/ha of fuel, and develops a field capacity of 2hrs/ha. The implement leaves the field ploughed after mechanical harvesting with savings on fuel, time and production costs. There is need to adopt new cultural practices such as planting on ridges, raised flat beds instead of on mounds to facilitate mechanical harvesting and to reduce costs. The harvester which is ready for mass production is being tested for wear and durability in major agro-ecological zones and through a wide range of soil moisture regimes in Ghana to support nationwide adoption.

OP-5.3: Prevention of dormancy in seed tubers of *Dioscorea Spp.*

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Yam tubers that are harvested at any time during bulking and maturity at 180-270 days after vine emergence are dormant, and difficult to induce to sprout. The objective of this study was to determine whether tuber dormancy could be prevented by developing the tubers in a medium containing fluridone (a putative inhibitor of the biosynthesis of the growth inhibitor, abscissic acid). Two yam species that exhibit long dormancy were used: *D. rotundata* var TDr 131 and *D. alata* var TDa 98/01166, and three fluridone rates were tested (30, 50, 100 µM). At 69 days after vine emergence, plants of both species were grown in coco coir medium hydroponics system using the Hoagland's Nutrient Solution with or without a test concentration of fluridone. In all fluridone treatments, most leaves of both species of yam had 30-90% of their surface bleached while the stems appeared purplish. By 113 days after vine emergence all tubers harvested from the controls were dormant. In contrast, over 70% of the seed tubers that developed in 30 and 100 µM fluridone had already developed up to seven new shoots (sprouts). Fluridone did not have any significant effect on tuber weight. This result suggests that early application of fluridone can prevent the development of dormancy in seed yams. The importance of this finding in the efforts to increase yam tuber productivity and availability are discussed.

OP-5.4: Progress in staking options in yam production for adaptation to climate change

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Staking options studies were conducted on-station at Fumesua (Forest) and Ejura (Forest-Savannah Transition) and on-farm at Ejura, Hiawoanwu and Atebubu communities of Ghana from 2011 to 2012. The on-station study was in a split-plot design with three yam varieties (Dente, Water Yam and TDr 95/19177 line) and staking options (no staking, vertical staking and horizontal staking with 50% number of vertical stakes) as main plots and subplots, respectively. The on-farm study was also in a split-plot design with staking options (farmers' staking and horizontal staking with 50% number of farmers' stakes) and seedbed (ridge and mound) as main plots and sub plots respectively. Significant differences were found in staking options in Ejura where rainfall pattern was favorable but not in Fumesua. The horizontal staking option with 50% less stakes gave similar yields (16.6 t/ha) as vertical staking (17.1 t/ha). No staking resulted in significant ($p \leq 0.05$) yield reduction of 22.2% from the vertical staking. TDr 95/19177 gave the highest yield in Fumesua but was next to water yam in Ejura where yields were generally higher. Though Dente had the lowest yields in both locations, economic analysis would determine the profitability of the varieties and the no staking option. The staking options had similar effects on weed suppression, however variety significantly ($p \leq 0.05$) affected weed suppression with TDR95/19177 suppressing weeds 34% and 32% more than Dente and Water yam, respectively. Results from on-farm revealed a significant ($p \leq 0.05$) interaction between staking option and seedbed with ridged and horizontal staking recording significantly ($p \leq 0.05$) higher tuber yield of 30%, 29% and 11% as compared with horizontal staking on mounds, farmers staking on mound and farmers staking on ridges respectively. These results suggest that effort should be made to breed for varieties more suited for no staking option, a 50% reduction in number of stakes for yam production is possible with horizontal staking to reduce the deforestation associated with staking in yam production.

OP-5.5: Social and technologic development model for yam (*Dioscorea* spp) production systems: Scaling-up biological and organic inputs with the effective participation of farmers

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The production of food in the Caribbean region of Colombia, is in charge of small and medium farmers that must produce food under unfavorable conditions such as low soil fertility, limited availability of high quality seeds, and little or no presence of technology enable them to improve their productivity and thus ensure a better standard of living The production and consumption of tubers, including the yam (Dioscorea spp) as one of the main foods by traditional culture. Fundamental changes in agricultural development involving a rapid expansion of participatory approaches that are based on interactive learning between professionals and farmers. This project evaluated and implemented a model of social and technological development of yam production system, based on the scaling of biological and organic inputs with the effective participation of small farmer. This project evaluates the potential use of biological inputs as mycorrhizal arbuscular fungi (AMF) fungi and organic inputs earthworm compost, in order to improve the productivity of under low fertility soil conditions. To contribute on the solution of these limiting factors, two pilot plants scale production for MA and earthworm compost were established at the regional centers of research Caribia and Turipaná with capacity of 90 ton/year to MA and 35 ton/year to earthworm compost each on. These plants to provide the initial biological and organic inputs to six local plants, placed strategically to have access to 54 participative groups who are directly responsible for the production to their farms. Inoculation with A-mellea y E_colombiana early in the post vitro weaning stage enhanced percent survival and improved tolerance to the transplanting stress. Shoot and root development of the micro-propagated plants of yam was increased following inoculation with different arbuscular mycorrhizal (AMF) fungi. Under field conditions in farmers' fields, yam crops inoculated with AMF showed high resistance to Anthracnose than non- inoculated .The activities developed to this model of social and technological innovation with direct participation of small farmers during all the process of research and technology transfer guarantees the adoption of these technologies. These activities have a significant impact on production systems in the organization of the community and generation of new employment opportunities at the regional level without negative impact on natural resources and the environment.

Keynote presentation

OP-6.1: Impact of the Dioscoreaceae derivatives on human welfare

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The steroidal saponins are substances widely used to produce, by hydrolysis, sapogenines, precorsors of cortisone and steroidal hormones. They are present in many plant families, such as monocotoledoneas Dioscoreaceae, Liliaceae (Agavaceae) and Amaryllidaceae. However, diosgenine, the original chemical molecule, that was used as a base to produce hormones and corticoids, was given its name from the dioscoreas, its major source. The purpose of this paper is to discuss the impact of the chemicals present in the dioscoreas in the human health, the pest control, and their economic benefits; in other words, in the human welfare. To accomplish this objective, a comparison among the different type of molecules were used for the semi-synthesis preparation of cortisone and of sex hormones, such as testesterone and progesterone, obtained from different family of plants, along with the review of the history of the scientific process that gave origin to the pharmacologic substance used as "the human pill". Besides this, the source of the corticoids and its derivatives, that have had a great importance in the human health, is considered, together with the new drugs developed against many kind of diseases and the use of other derivatives. The final part of the paper propose, a strategy estimate the economic potential of the dioscoreas in the chemical world.

OP-6.2: Influence of extrusion conditions on the characteristics of *Dioscorea alata* flour ready-to-eat snack products

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Fresh *Dioscorea alata* tubers of Sree Keerthi variety were washed, peeled, sliced, dried and powdered into flour. The flour was sieved and conditioned to 12%, 14% and 16% moisture content, refrigerated overnight at 8℗C and used for extrusion process. Extrusion cooking was carried out using Brabender KE19 single screw stand alone extruder with screw diameter of 19mm, length to diameter ratio of 25:1, nominal compression ratio of 2:1 and die opening of 5mm. The temperatures of feed zone, compression zone and metering zone were maintained at 70, 80 and 90℗C, respectively. The die zone temperature (130, 140, 150℗C) and extruder screw speed (80, 100 and 120 rpm) were varied. The feed rate was maintained at 720g/h throughout the process. The extrudate samples were collected and their properties were analyzed. The expansion ratio of flour extrudates ranged between 1.52 to 2.84, bulk density from 165 to 735Kg.m^{-3} and porosity from 23.5 to 75.3%. The high expansion was achieved at 12% moisture content of flour processed at 120 rpm of extruder screw speed at 140℗C of die zone temperature. The low bulk density and high porosity product was obtained at 12% flour processed at 120 rpm of extruder screw speed at 140ºC of die zone temperature. The textural properties of flour extrudates were analyzed using Textural analyzer (Model: Ta-HDi, Stable micro systems). The hardness and snap force of the extrudate ranged from 50.92-168.68N and 49.05-68.68N, respectively.

OP-6.3: Enhanced value of hard cooking yams through bread formulations with low glycemic index for type 2 diabetes

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Resistant Starch (RS) contents in pasty edible product of mealy and hard cooking of yam tubers were determined to evaluate their contribution in their cooking quality. The results of this study suggested that RS contents could be considered as the main determinants of cooking quality of yam samples. In particular, hard cooking yams displayed high RS levels up to 21.8 ± 9.9 g/100 g d.m. From a nutritional point of view, the high RS content of hard cooking yam deserves particular attention as resistant starch have drawn broad interest for their health benefits and functional properties. Several potential physiological benefits ascribed to RS include attenuation of blood glucose levels in both healthy and diabetic individuals. Thus, yam varieties (TDa 95/00010, TDa 01/00074, TDr 95/18894) of high resistant starch content (21.8 ± 9.9 g/100 g d.m), will permit to develop food formulations with low glycemic index for type 2 diabetics. The incorporation of these yam flours in bread production is occurring. It's an innovative approach which could permit to diversify the very selective diabetic diets in the context of dietary measures to combat and control of type 2 diabetes. Diabetes is a public health problem in Côte d'Ivoire with a prevalence of 4.7%. The consideration of this nutritional approach will have an impact on the health system and could serve as a basis for technology transfer in other African countries where diabetes is endemic.

OP-6.4: Effect of blend levels on composite wheat doughs performance made from yam and cassava native starches and bread quality

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Due to the high cost, geographical scarcity and high demand of wheat flour, efforts are been directed toward the provision of alternative sources of flours, notably in tropical areas. The substitutions of wheat flour, by starchy staples from tropical areas, led to more or less satisfying bread products. However, composite wheat breads generally displayed reduction in loaf volume and impairment of sensory qualities (e.g. appearance, texture, and flavor), as the level of substitution of wheat with non wheat flour increased. Due to the fact that the main selection criteria of wheat are based on their ability to give bulky white breads, it appeared useful to seek products of substitution which had less negative impacts on the volume of the bread. Consequently, the present work aimed to determine the blend proportions of composite soft wheat flours made from starches of native cassava and yam clones, leading to the maximum bread volume for the maximum level of white wheat flour substitution. The effects of refined wheat flour substitution with two native starches from yam tuber and cassava root, and two commercial products, a specialty starch, C*Actistar and a wheat bran flour, at 10%, 20%, 30%, 40% and 60% dry basis, on the rheological properties of dough and bread characteristics, have been examined. The baking phase showed that yam starch enriched breads from 10% to 40% of substitution and cassava starch enriched breads from 10% to 30% of substitution gave as bulky loaves as the refined wheat bread. Beyond these concentrations, the resulting breads were less voluminous. Hedonic tests revealed that, 30% yam starch substitution and 20% added cassava starch led to composite breads which met consumer satisfaction on all attributes, as the control. Such study enters in the frame of local food crops promotion and the reduction of negative balance of trade in developing countries.

OP-6.5: Physico-chemical and functional properties of acid modified yam starches

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Yam is a non-conventional source of starch that has potentials for being utilized in food and non-food industries. Exploitation of industrial potentials and improvement of the functionality of yam starch will lead to expansion of yam utilization. Native starches have certain drawback in utilization such as low shear resistance, thermal decomposition, high retrogradation, etc. The functional and physicochemical properties of starches can be improved by modification. This study was conducted to investigate the physicochemical and functional properties of acid modified yam starches. Starches were extracted from three yam species: *Dioscorea rotundata*, *D. alata*, and *D. dumetorum*. Acid modified yam starches were processed by hydrolyzing the starches with mineral acid by standard procedures. Pasting characteristics (peak viscosity, final, breakdown and set back viscosities), physicochemical (amylose/amylopectin, swelling power, solubility index, water binding capacity) and functional properties (gelation, paste clarity, syneresis) were determined by standard methods. The results showed that *D.alata* was more extensively hydrolyzed than the other species. Pasting characteristics showed that the acid hydrolyzed starches had low peak viscosity, final, breakdown and set back viscosities compared to the native starches, while there was no significant difference ($p > 0.05$) in their pasting temperatures. Physico-chemical properties such as swelling power, water binding capacity, water absorption and amylose (native yam starches: *D. rotundata;* 24.98%, *D. alata*; 35.68%, *D. dumetorum;* 18.30%) of the modified starches decreased (21.10%, 26.27%, 15.76%) while their solubility index (SI) increased. Functional properties of the starches indicated that the paste clarity and gelation capacity of the modified starches increased. This study showed that the physicochemical and functional properties of *Dioscorea* starches can be improved by acid modification, hence they can find wide application industrially as ingredients in a variety of food and non products.

Keynote presentation

OP-8.1: Over 30 years of the yam minisett technique in Nigeria: What are the challenges and prospects?

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Nigeria is the largest producer of yam in the world, with *Dioscorea rotundata* being the yam of choice for most people. The challenges in propagating this species make the availability of good quality seed tubers a major constraint to increased production. More than 30 years after the minisett technique of seed yam production was developed to solve this problem, it continues to be indicated as a major setback in expanding yam production. This paper sorts to examine issues that have been raised, especially as regards non-adoption of the technique and to suggest a way forward. A review of adoption studies of the technique revealed varied adoption rates in different parts of the country, with low adoption being attributed to factors such as high cost of labour, inadequate training of farmers, and lack of capital, inputs, and awareness of the potential of seed yam enterprises. Group discussions with yam farmers in the Federal Capital Territory, revealed that some were aware of the technique but did not adopt it because they cannot perceive a separation of seed and ware tuber production, and the fact that culturally the social status of a yam farmer is judged by the size of his ware and not seed yam harvest. Deployment of more resources for an aggressive awareness drive, as well as development and establishment of seed yam enterprises, and diversification of use of "seed tubers" will promote the adoption of the minisett technique.

Keynote presentation

OP-8.2: Developing a sustainable seed generation system of yams: the Ghanaian experience

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Inadequate access and high cost of seed yam has prevented producers from expanding the area under yam cultivation, In spite of the availability of fertile land and demand for yam domestically and abroad. Yams are grown by small scale farmers using traditional methods for seed generation. This involves "milking" or harvesting the ware yam early and using the seed yams that result from this process for planting. However, this results in a poorer quality, and sometimes-diseased tubers. It is important to increase yam production and create a niche market in the yam value chain. Additionally, having good quality seed yams can lead to fewer diseased yams. This paper discusses efforts made in the past 10 years in generating seed yams and potential of new technologies such as aeroponics and hydroponics, if developed to be used to rapidly produce seed yams can boost yam production and therefore increase food security and farmers livelihoods.

OP-8.3: A new bioformulation for the management of mealybug *Rhizoecus amorphophalli* Betrem in stored tubers of yams

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Dioscorea species are widely cultivated in tropical and warm temperate regions of the world. Tubers when stored for long term are often severely infested by sucking pests, particularly by mealy bug, *Rhizoecus amorphophalli* Betrem. Infestation by this pest depletes the quality and appearance of the tuber and makes it unpalatable and less marketable. Colonies that develop from inside the crevices and depressions of the tubers make insecticidal treatment ineffective or partially effective. Realizing the adverse effects of synthetic insecticides to man and environment, there is a global drive to search for eco-friendly chemicals in pest management strategies. Mealy substance is a protective coat and unless it is removed, no pesticide can kill the insects. In order to formulate an effective biopesticide for the management of mealy bugs and other sucking pets, the mealy substance was subjected to chemical analyses and SEM studies, and its morphology and chemical structure was elucidated. Various solvents that are polar, non-polar and organic in origin were screened for the removal of the mealy substances. A new biopesticide was formulated using the promising solvent along with the active principles extracted from cassava and neem seeds. The dose was standardized and it was found that the biopesticide at 10-15 ml L^{-1} could completely remove the mealy substances and kill the pest. A biofumigant was also isolated from cassava leaves and it was also found very effective against all stages of the pest. Locally available chemical insecticides in different doses were used for comparison. The LD50 value and residue analysis were also worked out. A Pilot Plant to scale up the production of biopesticide from cassava was designed by us and the machine has been installed at our laboratory. A fumigation chamber was also fabricated for the large scale treatment of infested yam tubers with cassava biofumigant.

OP-8.4: Economic analysis of seed yam production using minisett technique in Nigeria

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This paper seeks to examine the profitability and economic determinants of seed yam farmers in the yam belt of Nigeria. For these purposes, a study was carried out in the major yam belt zone of Nigeria. A multi stage sampling technique was used to select ninety (90) seed yam producers in the yam belt of Nigeria which spans across the North-central, South-East and South-West agro-ecological zones in the country. Data were collected with structured questionnaire. Analytical tools like profitability and regression model analyses were employed to respectively determine the economic performance of yam production as well as the factors that affect seed yam production in the study area. The findings of this study from the profitability analysis showed that on the average seed yam farmers in north-central, south west south east agro ecological zones made net income of N522,420; N220, 203 and N40, 980, respectively. Again, from the pooled regression analysis, it was shown that age of the respondents, labour, depreciation cost, household size and educational status of the farmers were the variables that contributed to the general variation in the total yield of seedy am in the yam belt of Nigeria at various levels of significance. The R^2 value was high at 0.985 indicating that 98.5% of the total variation in the output of the seed yam farmers was explained by the included variables. From the study, it has been established that seed yam enterprise using minisett technology is highly profitable in Nigeria. It holds great prospects for income generation, employment and huge livelihoods opportunities for farm households.

OP-8.5: Encouraging seed yam entrepreneurship in Nigeria

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As part of the YIIFSWA project activities 3.2 and 3.6 have been focussed on the encouragement of clean seed yam (*Dioscorea rotundata*) production in some of the most important yam growing areas of Nigeria. We use the term 'encouragement' rather than promotion because many of the yam farmers in these areas are keen to grow more clean seed yams and the limiting factors are more linked to getting the business plan right. In this paper we will present our experience to date in the project, focussing more on the human side of the activities rather than the technical or economic. We will set out some of the differences we have encountered in the three main yam growing areas in which we have worked (Abuja, The Niger system and Benue) and how those differences have had an impact in terms of the forms the encouragement has taken and what farmers have managed to achieve both in terms of production and gross margin as well as the involvement of local communities. Abuja is a major metropolitan area and thus is a significant consumer of yam produced both in its immediate hinterland and beyond. The Niger system is an especially interesting one given the way in which seed yam production is physically and socially separated from ware yam production. The Niger floodplain has rich soil ideal with yam production, and ware yams growers in many of these areas source their seed from specialist growers based in a village called Ilushi. The paper sets out some aspects of the unique social and economic relationships that operate between the seed and ware yam growers of the Niger and how that discovery has aided the project.

OP-8.6: Preliminary results on aeroponics system as effective high ratio propagation technique for healthy seed yam production

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Yams (*Dioscorea* spp.) are very important sources of food and income for millions of producers, traders, processors and consumers particularly in West Africa. The priority problem for yam production is the unavailability and limited affordability of clean seed yam. The seed yam system in West Africa is mainly informal and entirely market driven. Seed yams are expensive, accounting sometimes for as much as 50 to 70% of total variable production costs. The conventional yam multiplication ratio is very low in comparison with other root and tuber crops. To overcome that major constraint, improved techniques were developed. The latest after the minisetts technique is known a vine cutting propagation technique. It is the higher ratio farm level yam multiplication technique with 30 fold increase but so far reported in hard substrates carbonized rice husk (CRH) or sterilized soil. This paper presents successful experiences of yam propagation using aeroponics system focusing on vine cutting rooting and minitubers production. If for CRH vines should be taking only from plants between 60 and 90 days of age, on aeroponics there is no limit as vines of plants of 150 days were successfully propagated. Aeroponics is effective from propagation of pre-rooted vine cutting transplanting as well as direct vine cutting planting. Time for vines rooting, minitubers production and sprouting are shortened on aeroponics than in CRH. The type and rate of nutrients to use at different physiological phases are challenges that need to be addressed to optimize the efficiency of the aeroponics system as a valuable tool for formal seed yam production. Plants once tested clean of virus and other diseases before introduction in aeroponics system can be sub-cultured through vine cuttings for many generations. to produce true to type minitubers free from all soil born diseases and pests.

OP-8.7: Status and prospects for improving yam seed systems using temporary immersion bioreactors

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A significant challenge of yam production is scarcity of clean seed yam in the informal seed system which is still operational. Yield reduction is up to 90%, due to poor quality planting materials, pests and diseases combined with low soil fertility. Although Tissue culture technique of meristem culture combined with heat/cold/chemo therapy is effective for producing healthy seed, its use is limited by slow rate of propagation in conventional yam tissue cultures. In most crops for which it has been tested, Temporary Immersion Bioreactor Systems (TIBs) increased propagation rates. This review was conducted to determine the potential of TIBs in improving the yam seed systems. Existing literature on use of TIBs in general, and for yam in particular was consulted using 20 databases. Very few reports exist in 2 databases on application of TIBs to yam in general, and only one for *D. rotundata* in particular. Both plantlets and microtubers can be produced in TIBs. Based on these findings, yam propagation in TIBs has the potential to facilitate production of high quality breeder, foundation and commercial certified seed yams and to enhance genetic improvement. Control of contamination, direct use of field explants, culture of micro-explants like immature embryos and anthers, increasing the size of microtubers produced and standardization for various economically important genotypes are knowledge gaps that require immediate research attention for yam propagation in TIBs. Although no report has put a cost on installation of TIBs, there will be a need to use cost-effective TIB set-ups to encourage public-private partnership in integrating TIBs into formal seed yam production chain. Use of TIBs is critical for evolution of the seed yam production system from informal to a formal seed system.

OP-8.8: Mini-tubers production from vine cuttings of *Dioscorea rotundata* and *D. alata* collected at two ages of mother plants

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Yam production is majorly constrained by high cost and availability of planting material which is associated to low multiplication rates. Efforts so far have been concentrated in increase multiplication rate using tuber mini-sett. Vine cuttings technique increases the multiplication rates of yams but its productivity is affected by different physiological conditions of mother plants at the time of vines harvesting. The objectives of this study was to evaluate some physiological parameters of plants used as vine cuttings mother plants at two ages for vine harvesting, including growth and yield, varietal and species effects. Mother plants from tubers were established on the field in early June of 2012 in IITA, Ibadan station. Single nodal with two leaves vine cuttings, harvested at 90 and 120 days after planting (DAP) of mother plants were planted in a medium composed of topsoil and carbonized rice husk under field nursery conditions. Leaf chlorophyll content (SPAD), shoot and tuber dry weight, days to shoot senescence, average shoot growth rates and average tuber growth rates were registered monthly on the mother plants from 60 DAP. Survival rates, number of roots per cutting and other parameters were elicited at 21 and 60 days after the vine cutting were cut (DAC); while yield (number and fresh weight of tubers) was assessed at 120 DAC. Cuttings harvested at 90 DAP performed better than ones harvested at 120 DAP in *D. rotundata* while there were no significant differences between cuttings harvested at the two ages in *D. alata.* Mother plants SPAD was negatively correlated with survival rates of vine cuttings. It was concluded that for good yield vine cutting should not be harvested at ages beyond 90 DAP for *D. rotundata* and 120 DAP for *D. alata.*

OP-8.9: Developing diagnostics to detect badnavirus and endogenous pararetrovirus DNA sequences in West African yam breeding lines

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Yams (*Dioscorea* spp.) are propagated vegetatively, which results in the accumulation and perpetuation of virus infections through yam tubers. These virus infections can reduce yam yields and are an impediment to the international movement and exchange of yam germplasm. The only effective method of controlling these virus diseases is to use virus-free planting material. The virus species that have been reported to infect yams worldwide fall into nine taxonomic genera, but only three of these, *Badnaviruses, Potyviruses* and *Cucumoviruses*, have been shown to be widespread across West Africa. Badnaviruses were detected in all West African landraces and breeding lines tested suggesting their wide distribution. Analysis of over a hundred partial badnavirus RT-RNaseH sequences has grouped them into 12 species each sharing <80% nucleotide identity to each other. As such species differences were not identifiable from their single RT-RNaseH PCR products, various techniques have been evaluated for their usefulness to discriminate these sequences. DGGE was found to be a successful technique for rapid identification of the true diversity of yam badnavirus sequences in a given sample. The existence of badnavirus PCR-positive, but ISEM/ELISA negative results indicated that some breeding lines and landraces contain integrated badnavirus sequences, and this has been supported by nucleic acid hybridization studies. Future research will concentrate on developing methods to determine which of these sequences represent dead integrants, and which are activatable sequences that pose a serious problem and need to be eliminated from yam 'seed' multiplication programmes.

OP-8.10: In vitro approaches to manage Yam mild mosaic virus (YMMV) in greater yam

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Greater yam is commonly cultivated in different states of India. Nearly ten different viruses have been reported to infect yams (*Dioscorea* spp.) around the world and seven infecting greater yam (*D. alata).* However, information on presence of such viruses in India is scanty except the presence of *Yam mild mosaic virus* (YMMV) in the farmers' fields. Production and distribution of healthy planting material of yams is one of the major mandates of Central Tuber Crops Research Institute, Thiruvananthapuram. A single tube regeneration system and meristem culture for *in vitro* propagation of *D. alata* to eliminate YMMV were standardized. Virus free tissue culture plants have been developed through different approaches, *viz.,* chemotherapy with quercetin 15 mg l^{-1}, thermotherapy at 36° C for 45 days, hot water treatment at 36°C for 30 minutes and combination of chemo-thermotherapy and thermotherapy (Quercetin 10 mg l^{-1} and 36° C for 45 days). Hot water treatment and combination of chemo-thermotherapy were most promising methods for virus elimination. By these techniques, around 70 and 90 % of the nodal cultured plants were made virus-free respectively. The tissue cultured plants were indexed for YMMV through ELISA and RT-PCR. Strategy for large scale multiplication of virus free greater yam has been developed successfully which includes production of tissue cultured plants, virus indexing, hardening, development and large scale multiplication. The occurrence of YMMV in India and the production of virus free planting materials of greater yam through *in vitro* studies are discussed in this paper.

OP-8.11: Local dispersal and epidemics of the yam anthracnose disease agent *Colletotrichum gloeosporioides*

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The fungus *Colletotrichum gloeosporioides* is responsible for yam anthracnose, the main disease of *Dioscorea alata* crops. When epidemics occur, *C. gloeosporioides* is dispersed locally via rain splashing. Splashing is nevertheless a very local dispersal process and most spores are expected to land within a few decimeters after dispersal. In this study, we investigated dispersal by rain, estimating spore removal as a function of the number of impacting drops, modeling the dispersal gradient, differentiating primary splashing from re-splash (subsequent splashing from soil during rain events), and the effect of prior soil contamination on spore dispersal distance. We assessed rainsplash dispersal in two types of experimental settings, using either a single drop generator or a rain simulator, and disposed microscope slides as spore traps. Blue cotton staining was used to differentiate primary splashing from subsequent splashing (re-splash) and spores and drops were counted under light microscope. Results showed that a minimum of 3 impacting drops was needed to remove the first dispersed spores, while 20 incident drops were enough to remove 50% of the spore stock in a necrotic lesion. It was also found that inoculum source from leaves allowed for a dispersal up to 50 cm or more, though with an exponential decrease in distance traveled from source, while re-splash is weak but contributes more and more to dispersal with increasing distance from initial source. The results also demonstrated that prior soil contamination does not contribute to dispersal between rains.

OP-8.12: Differential host-pathogen interaction in yam anthracnose pathosystem: a challenge to deployment of resistant cultivars for disease management.

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The use of resistant varieties is the most sustainable approach to managing yam anthracnose across all the yam producing countries in the tropics. The efficiency of deploying resistant varieties will however depend on a good understanding of interaction between yam genotypes and different strains of anthracnose pathogen. Differential interaction was evaluated in the resistance of 17 *Dioscorea alata* genotypes to 10 isolates of *Colletotrichum gloeosporioides* the causal agent of yam anthracnose using tissue culture-derived whole-plant assay under controlled environment. Resistance was generally quantitative, and could be isolate specific or non-specific. Isolate-specific resistance appears to be mostly partial, characterized by reduced rate of disease development despite infection. However, incompatible isolate-specific reactions resulting in no disease development were obtained in 14 of the 170 G × I combinations. These indicate the possibility of qualitative resistance that could fit the classical definition of gene-for-gene model in yam anthracnose. The implications of these results for resistance breeding and cultivar selection for stable and durable sources of yam anthracnose resistance will be discussed.

OP-8.13: Strategies for the production of virus-free yam

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Yam (*Dioscorea* spp.) is a multispecies clonally propagated crop predominantly cultivated for its edible tubers in West Africa. Yam is susceptible to several viruses. The most frequently occurring viruses in West Africa are *Yam mosaic virus, Yam mild mosaic virus*, *Cucumber mosaic virus* and a range of viruses belonging to the genus *Badnavirus*. Due to clonal propagation, viruses advance from one generation to another through infected planting materials and eventually the entire clonal population becomes infected. Various recent studies in West Africa demonstrated a high incidence of virus infections in landraces and improved varieties. Virus eradication from infected clones is critical to invigorate production of virus-free yam stocks and control of virus diseases. Conventional sanitation techniques based on tissue culture, meristeming, thermotherapy and chemotherapy, are not well established for the production of virus-free yam clones. Alternative techniques based on knowledge of virus distribution within the virus infected plant, in combination with macropropagation and tissue culture are being attempted to generate virus-free yam clones and to establish a robust procedure for eradication of virus in the infected clones. This paper reports on the state of virus eradication techniques applied to yam and results of alternative approaches in generating virus-free yam.

Abstracts of the Poster Presentations

PP-7.1: Training of farmers on seed yam production using the yam minisett technique: experiences from the yam belt of Nigeria.

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Farmer- trainings were carried out between January and March of 2011 in each of the 4 yam-growing agro-ecologies of Nigeria for a total of 1400 farmers (20% were women) under the CORAF/WECARD Yam Minisett Project, sponsored by USAID. The trainings resulted in higher seed yam production in the succeeding year. This is a clear indication of the importance of training farmers on new production techniques. Private and Non-government agencies like All Farmers Association of Nigeria performed better than government agencies in training their members and significantly produced more seed yams. Projects like this should focus more on the private sector.

PP-7.2: Determinants of technical efficiency among seed yam entrepreneurs in Benue state

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This study examined the technical efficiency of seed yam entrepreneurs in Benue State using minisett technology. A multi-stage random sampling technique was adopted in choosing the sample. Primary data generated from the survey were analyzed using descriptive statistics and econometric tools. The result showed that men constituted a greater percentage (90%) of those involved in seed yam enterprise, while mean age of the respondents was 50 years. Respondents were also shown to be educated at various levels. 75% of the respondents had farming experience below 20 years. More so, the analysis showed an average household size of 8 people. The Trans-log Stochastic Function was adjudged the best fit for technical efficiency based on the high values of the Log-likelihood function, number of significant variables and appropriateness of a-priori expectations. It showed that the coefficients of depreciation on farm tools, farm size, planting materials were all positive but fertilizer use which was negative. Socio-economic determinants which directly affected technical efficiency were age of respondents, and education and they were significant at 1%. Fertilizer use and membership to cooperative were indirectly related to technical efficiency and were significant at 1% respectively. It was recommended that youths should be encouraged to go into seed yam enterprise since it holds great prospect for income generation and export; this will definitely reduce unemployment in the nation. Policies that effectively enhance technical efficiency of farmers should be put in place by the government. This will reduce poverty and enhance food security, which is cardinal in the millennium developmental goal.

PP-7.3: Women farmers in seed yam production: Implication for increased productivity and sustainable yam improvement in Southeastern Nigeria

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Empirical evidence revealed that rural women in Nigeria constitute majority of the farming population. These women are involved in yam production and marketing as means of livelihood. Yam is an important staple crop with nutritive, socio-cultural and economic values. However, the production of the crop is faced with the problems of scarcity and high cost of seed yam during its planting season. This necessitated the development of yam minisett technology which has been transferred to the farmers in the zone for adoption. This study was therefore conducted to analyse the effects of the technology and some socio-economic factors on the output of women farmers in seed yam production. Multi-stage sampling technique was used in selecting 240 respondents from five states in the Southeastern Nigeria. Interview schedule was employed in eliciting data which were analysed with descriptive and inferential statistical tools. Results revealed that the technology enhanced the seed yam production of the women farmers in the zone. The results further showed that age, household size, educational status, as well as access to credits, income and involvement in technology development and transfer had positive influence on the output of female farmers in seed yam production. The important constraints they encountered in using the technology include scarcity and high cost of labour and fertilizer, unavailability of miniset dust, credits and loan. It was therefore recommended that efforts to increase the productivity of women farmers in seed yam production should be directed on educated and more experienced ones while more emphasis should be on involving women in technology development and transfer, improving their educational status, and increasing their access to productive resources, information, credits and market for sustainable yam improvement in Nigeria.

PP-7.4: Farmers' perception of yam pests and diseases, and control measures in selected agricultural zones of Oyo state, Nigeria

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Yam is an important food crop in Nigeria and is grown in almost all agro-ecological zones. Pests and diseases have been observed to be important constraints to yam production. In Oyo state, yam is cultivated by resource-poor farmers with small holdings. The objectives of this study were to examine prevailing pests and diseases of yam in the study area, evaluate farmers' perception of pests and diseases, and control measures in yam production. A multi-stage sampling technique was used to select 240 farmers in the study area. Focus Group Discussion (FGD) and structured interview schedule were used to collect data from yam farmers registered by the Oyo State Agricultural Development Programme (OYSADEP). The data collected were analyzed using frequency counts, means, percentages and chi-square. Termites, rodents, mealybug, nematodes, anthracnose, yam beetle, centipede, dry rot, and die-back were common pests and diseases of yam in the study area. Farmers' perception of pests and diseases of yam included, growth retardation, yield loss, food insecurity, increase in production cost, low quality tubers and loss of market value. Control measures employed by farmers in the study are, use of resistant cultivars, crop rotation, seed treatment, use of insecticides, short fallow and destruction of infected tubers. Significant relationships exist between farmers' perception and management practices used in the control of pests and diseases in yam production. The study therefore recommends that, farmers' knowledge of pests and diseases, and their circumstances should be considered in order to design appropriate and effective control measures against yam pests and diseases.

PP-7.5: The Guadeloupe Biological Resources Centre and its role in viral diagnostic and sanitation

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Since 2010, INRA and CIRAD have jointly set up the Biological Resources Centre (BRC) for 'Tropical Plants' in the French West Indies. The BRC is a germplasm repository, which carries out its activities with quality control procedures in the fields of acquisition, conservation and provision of plant material. The purpose of the BRC is to secure conservation of Banana, Mango, Pineapple, Sugarcane and Yam germplasm collections and to provide users such as research institutions, extension services and the private sector with healthy plant material. The BRC currently hosts a total of 1 800 accessions conserved *in vitro* and/or in the field, including 450 yam accessions belonging to the main cultivated species and wild relatives. Databases and a web portal (http://collections.antilles.inra.fr/) provide access to the conserved accessions and related information. Besides BRC's core activities, scientific projects are developed aiming to enhance safety of plant material movements through sanitation and improved viral diagnostic. On yam species, the molecular diversity of the main viral families present in the germplasm is being analyzed, including endogenous viral elements. In addition, classical diagnostic methods are being optimized, taking into account the new data on viral diversity thus generated, with the objective to develop new multi-pathogen diagnostic methods based on metagenomics and deep-sequencing technologies.

PP-7.6: Aeroponic as innovative system for clean seed yam production

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To produce quality and healthy seed yam that can be accessed by the formal seed production system that will satisfy the needs of small farmers at affordable cost, an Aeroponic system (a soilless and artificial environment) was set up and adapted for seed yam propagation. This was constructed by team of engineers from Kenya and IITA in a screen house, SHC43 at IITA-Ibadan Nigeria. Fourteen operating boxes of 4 tables each were made with styrofoam sheets with proper insulation. The boxes were framed with light metallic angle irons for firmness. The distribution of the boxes was done width wise within the screen house. A 1500 watts Hot- blast torch plastic welding Gun was used to hold the black plastic lining of the boxes to avoid any admittance of light; windows covered with black plastic were installed at each side, thus controlling the rooting system and harvesting simpler. A convenient size of top cover (table) of 1.20 m x 1.20 m was designed with Styrofoam. Each table was perforated at 20 cm by 20 cm to accommodate a total of 36 plants per table. The heights of boxes were made 1m from the base and 16 mm pipe ran under each cover through the central top of boxes with misters to supply nutrients to the plants. Each table or top covering was allowed to fit exactly over the rest of the structure. After the completion and testing of the system, rooted plants pre-established on pot as well as direct vine cuttings were carefully planted through each perforation at 20cm by 20 cm. Nutrients' delivery to the roots was made possible via 20–50 micro-metre mist heads using 80 pounds per square inch (550 kPa) impeller pump. The nutrients were kept in an underground 1000 litres plastic tank maintained in the power house outside the screen house. PVC pipes were connected to return nutrient solution after feeding the plants from the boxes to the nutrient tanks. The roof top of the screen house was protected from heat. The operating system was automated including electric timers spraying the nutrient solution for 15 minutes and rest for 20 mn during the day and 30 mn in the night. The system was established using filters, centrifugal pumps and nutrient tanks enclosed in the power house beside the screen house. The result confirms this adopted system as a valuable research tool for healthy and high rate seed yam propagation method.

PP-7.7: Promoting improved yam minisett technology to improve productivity and trade capacity for seed yam in Nigeria

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Scarcity and high cost of seed yams remain the greatest constraints in yam production. By promoting the improved yam Minisett technology, only 5 - 10% of yam harvested will be required to produce seed yam compared to 30-50% normally used. The focus of this paper is to x-ray various ways of promoting the improved yam minisett technology to increase yam production, food security of farmers as well as yam trade in Nigeria. Specifically this looked into policy options in the promotion of improved yam minisett technology; various opportunities and strategies existing in the promoting the technology; the existing capabilities of farmers and tackling their constraints in this technology; ascertain basic market structures and trade capacity for intra and inter regional trade on seed yam. A study was conducted in 2010 in ten selected yam growing States from two zones of Nigeria namely Savannah and Rainforest zones, five States per zone using rapid rural methodology. Data collected were analyzed using community analysis techniques and these included target groups like farmers' and sellers' association and other specialized agencies and key informants. Findings showed that farmers employed least cost approach such as use of trellis staking method to reduce cost. The area under the new technology for an average farmer is expanding from 1.5 to 3 hectares. The new storage system developed is seen to be expensive, and has not been adopted more so as the yams were said to rot when heat is much. There are no reported case of inter-regional trading between Nigeria and other neighbouring countries but cases of smuggling across the borders, which are not recorded in international trade and export, exist. This needs to be documented as the volumes of ware and seed yams traded outside Nigeria are speculative. In Eastern Nigeria, most farmers are still advocating an increase in the size of minisett. Most of them practice the use of 40-45gram sett size. Milking or topping is the traditional system developed by the farmers to produce seed yams for ware production. Research should look on how to improve this system as some farmers still prefer and use them. Mechanization is advocated as the high dependence on manual labour contributes to increase in production cost of seed yam. There is also need for increased awareness through sensitization on the benefit of yam minisett technique. Training programme should be organised for producers with support from extension. Farmers' suggestion on introducing cassava into the yam minisett technology as a second crop ought to be standardised. There is need for access to loans and credits from co-operative banks. Informal sources of loans such as ISUSU still thrive and these cannot help farmers expand to optimal farm size. Minisett technique is now being incorporated into farmers' field school in Nasarawa State in the North as well as schools outreach programmes in Abia State in the South. Yam traders at the identified markets in Nigeria sell all grades of yam tubers mostly during planting season. It is only the surplus produce that is sold. The initiative of Nasarawa State through its Agro-Export Processing Development Centre to export yam tubers should be built on. It is noteworthy that the agency has exported fresh ware yam tuber to United Kingdom with a trial shipment in June 2009. This was officially launched in July, 2009 at the Nigerian Embassy in UK. Shipping of yam continued in 2010/2011.

PP-7.8: Distribution of yam internal brown spot disease in Côte d'Ivoire

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Yam cultivation in Côte d'Ivoire is mainly focused on the species *Dioscorea alata* with 60% of the production and *D. rotundata-cayenensis* with 40% of the production. Yam culture is facing several constraints including parasitic pressures due to viruses. Also, among the varieties grown in Côte d'Ivoire, Bètè-bètè and Sao two varieties of *D. alata* that are heavily consumed, is weakened by the prevalence of small to large, dark brown, corky necrotic lesions in the tuber flesh similar to Yam Internal Brown Spot Disease (YIBSD). The YIBSD is visible after tubers are cut. The etiology of this disease is still unknown. A survey was conducted in 4 locations of yam cultivation in Côte d'Ivoire to determine the incidence and distribution of YIBSD-infected plants. YIBSD incidence was determined on 178 tubers obtained from 18 fields. In each field, ten tubers were harvested and examined for YIBSD symptoms by making five transverse sections. Symptom severity in each section was scored based on 1 to 5 rating scale. The average incidence of YIBSD ranged from 20% to 90% in the field, and it ranged from 43% to 73% in the locations visited, with an average incidence of 60%. Average incidence of YIBSD symptoms inside the five parts (Apical, Medio-apical, Median, Medio-basal and Basal) of cutting tubers varied from 47.9% to 60.3% and were statistically the same. Four homogeneity groups of symptoms severity were observed: class 1: severity 1; class 2: severity 2; class 3: severity 3; class 4: severity 4 and 5 ($F<0.0001$). Severity inside the five parts varied from 2.12 to 1.65 and the symptoms severity was statistically significant ($P<0.0001$) with the apical parts more severely affected than the basal parts of the tuber. The cause of YIBSD is not known, but its impact has the potential to cause severe damage to yam cultivation in Côte d'Ivoire.

PP-7.9: Seed yam marketing in Nigeria

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Seed yam production systems in Nigeria can be classified into two broad groups: ware-to-seed system in which a ware yam crop is planted and seed tubers are obtained at harvest in addition to ware tubers, and seed-to-seed system where seed tubers are planted to produce seed. A study was carried out of some seed yam markets in locations where these systems are practiced to determine the peculiarities of the markets. It was observed that the production system influenced the type of market and the seed tubers available in the market. At Illushi and Otuocha markets located in a seed-to-seed system area, there was exclusively seed tubers and more seed than ware tubers, respectively, with seed tubers of better quality than those found in markets found in the ware-to-seed system locations (Lambata, Dobi, and Obi markets), which had more ware than seed tubers. Seed tubers of different varieties were available at different markets at different periods based on consumer preferences and earliness of the variety. Seed tubers of variety Pepa, which were abundant in markets in Niger, Nasarawa and Benue States about five years ago were rarely found, except in Lambata market, Niger State, where farmers were discarding the variety. The markets were mostly made of non-permanent structures which become dilapidated during periods of no activity, thus needing rehabilitation at the beginning of a new marketing season. There is a need to develop the entire seed yam system from production through marketing.

PP-7.10: Establishment of 'Yam Development Forums' to promote seed yam enterprise for income and food security in West Africa

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Compared to other crops of regional importance in West Africa, yam (also known as 'king of crops' by many farmers of the region) has had very little development in terms of productivity. West Africa produces more than 92% of world yams mostly at subsistence level. The Yam Improvement for Income and Food Security in West Africa (YIIFSWA) Project was designed and is being implemented to change this situation. A major focus of the project is to improve productivity by improving seed tuber quality and availability. As one of the strategies to achieve this, the project intends to establish 'Yam Development Forums' in the major yam growing areas where its activities are located. Representatives of key implementing partners (IITA, NRI, FOSCA, CRI, NRCRI, MSHR) of YIIFSWA met at training workshops designed to bring together different stakeholders of the yam value chain (producers, traders, transporters, loaders, processors, extension staff, policy makers, etc). During the workshops, results from baseline and value chain analysis studies of the host community and its environs were presented and after validation, issues arising were discussed. Thereafter other technical findings of YIIFSWA objectives were presented, followed by capacity building at community level which emphasized seed improvement. Two of such workshops were held during second half of 2013, one in Kintampo, Ghana and the other in Abuja, Nigeria. Participants were educated on the benefits of working together and forming the yam development forum as an innovation platform for discussing and sharing all issues concerning seed yam supply and yam business. This concept generated great interest among participants. In Abuja the enthusiasm of the stakeholders was such that the first group, 'Gwagwalada Yam Development Forum' was initiated two days after the end of the workshop, followed by other groups, in Abaji and Municipal Area Councils.

PP-7.11: Yam improvement for Income and food security in West Africa (YIIFSWA): Some achievements of the first 2 years of implementation

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Yam Improvement for Income and Food Security in West Africa (YIIFSWA) was planned to increase yam productivity by 40% for 200,000 smallholder yam farmers in Ghana and Nigeria between 2011 to 2016; and and contribute to ensuring food security for producers and consumers in West Africa. Scientists from 20 specialized organizations with IITA have in two years impacted yam value chain stakeholders with key results of research for development interventions through the 7 objectives and 3 cross cutting components. YIIFSWA has scrutinized yam production systems of 600 and 800 households in Ghana and Nigeria, respectively, to collect indicators against which future interventions could be objectively measured. Value chain analyses were carried out to identify locations and characteristics of ware and seed yam production, marketing systems, and relevant organisations. Pest risks assessments were conducted in Ghana and Nigeria to identify risk of pests spread through planting materials and locations for clean seed production. Last year the project trained over 3,600 producers in Nigeria and has planned to reach 9,000 and 5,000 this year in Nigeria and Ghana, respectively. Trials to evaluate yam genotypes, as well as drought and low soil fertility management are being carried out with farmers. YIIFSWA has initiated the formal seed yam system with the production of foundation seed yam in Ghana by the Grains and Legumes Development Board, and in Nigeria by two private seed companies. Training workshops were organized on seed yam "Quality Management Protocol (QMP)" "Breeder and Foundation seed production (BFP)" and "Yam Virus Disease Diagnostics (VDD)" to equip official agencies in charge of seed production, quality control and certification. Novel techniques initiated for high ratio yam propagation such as aeroponics and temporary immersion bioreactors systems are giving promising results and can be used as effective alternative methods for clean seed yam production.

PP-7.12: Screening of F1 mapping population of yam (*Dioscorea alata*) for resistance to anthracnose (*Colletotrichum gloeosporioides*) in the screenhouse and field

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Although a broad genetic base exists for breeding yam (*Dioscorea sp.*) genotypes for resistance to anthracnose (caused by *Colletotrichum gloesporioides*) in Nigeria, the effectiveness of the deployment of anthracnose-resistant genotypes partially depends on the availability of a reliable screening method of yam germplasm for anthracnose reaction. A total of 98 yam genotypes (96 F1 mapping population and 2 resistant and susceptible parents) from the International Institute of Tropical Agriculture (IITA) were screened for anthracnose resistance in 2011, 2012 and 2013 in the greenhouse using whole-plants derived from vine-cutting propagation technique, and evaluated in 2012 in IITA-Ibadan experimental fields. Spore suspension of virulent isolate Kog01A1 of *Colletotrichum gloeosporioides,* at concentration of 1×10^6 conidia/ml, was uniformly applied to yam foliage to run-off at 10 L/ha one month after planting to increase disease pressure. Genotypes were rated two weeks after inoculation for anthracnose severity, lesion size, and spore production in the greenhouse and, only for severity in the field. All the three methods of evaluation efficiently discriminated F1 mapping population in anthracnose resistance in a 1:3:1 ratio (highly resistant/resistant: moderately resistant: susceptible/highly susceptible). Spore production method of screening yam genotypes was highly correlated with severity method in the greenhouse (0.72716; $P<.0001$), in field (0.43225; $P<.0001$), and with lesion size method (0.7065; $P<.0001$). Severity rating in the greenhouse was highly correlated with field severity (0.617; $P<.0001$) and with lesion size (0.62402; $P<.0001$). Field severity rating was also highly correlated with lesion size screening method (0.40783; $P<.0001$). Field data corroborate the greenhouse screening results. Although spore production screening method may be more desirable than others, as it suggests the ability of the pathogen to multiply in a particular yam genotype, severity screening method is rapid, easy and practical.

PP-7.13: Evaluation of conservation methods for phytopathogenic fungi in yam *(Dioscorea* sp*)*.

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An essential element in research with pithopathogenis microorganisms is their preservation and safe use. The purpose of this study was to evaluated methods of preservation of fungi that produce diseases in yam, using as response factors, the potential viability, stability and presence or absence of macro and microscopic characteristics changes. As a result of the work were proposed the appropriate methods for the genera *Colletotrichum* and *Fusarium* which are the fungi that cause the greatest losses in yam plantations in the Colombian Caribbean Coast. The strains used in this study come from University of Sucre and the Institute of Biotechnology of National University of Colombia (IBUN) collections and a donation of Doctor Lucia Afanador of the National University - Medellín. These strains were subjected to different methods of conservation, including cryopreservation, lyophilization and periodic culture with and without mineral oil. The results allowed choose the cryopreservation as the most efficient method for the conservation of the collection and periodic culture with mineral oil as alternative and complementary method. These minimize the risk biological material losses and provide conditions for fungus handling for biological characteristics conserve under study for are being tested in topics such as microbiology, biochemistry and molecular biology, among others.

PP-7.14: Differentiation of *Colletotrichum gloeosporioides* isolates causative of Anthracnose in yam (*Dioscorea sp.)* by arbitrarily primed PCR (AP-PCR)

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The yam crop in Colombia represents one of the most important economic pillars on the Atlantic Coast. Currently, its demand as an exportation product has increased, which can be attributed to its nutritional, pharmaceutical and industrial properties. For this reason, there is a rising interest in disease control, such as the anthracnose caused by the fungus *Colletotrichum gloeosporioides*, responsible for major losses reported in Columbia. The management until now has been based on chemical practices which, besides a rise in the production costs, have in the long term induced environmental contamination and resistance to the strains of the pathogen. In order to design new control alternatives that efficiently reduce the agro-economic damage caused by this pathogen, it is necessary to acquire knowledge regarding its biological population. With this aim, we evaluated the variability of 31 isolates of *C. gloeosporioides* obtained from yam crops from five farms located in the departments of Córdoba, Sucre y Bolívar which are the main producers of this tuber in Colombia, through the comparison of its molecular profiles obtained with AP-PCR methodology. The results showed a high genetic variability of the *C. gloeosporioides* in yam and it suggests widening its characterization to determine associations between fungi subpopulations and its effects in the crop.

PP-7.15: Differential molecular diagnosis of *Colletotrichum gloeosporioides* and *Fusarium oxysporum* in yam (*Dioscorea* sp.).

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Fungal diseases are responsible for the greatest losses in the Colombian yam crop, among these the anthracnose stands out as the most devastating. In recent years, fungi with low prevalence but high spread power such as *F. oxysporum* have expanded its presence in yam crops favoring the development of rot disease. Despite the importance of yam crop on the Colombian Caribbean Coast, the Pacific and the Amazon, this is considered an orphan crop because are few efforts made in its investigation in the world and particularly in Colombia. In order to contribute to the correct and timely diagnosis of fitopathogens that affect the yam crop, this study obtained fungal isolates from leaves with necrotic spots. Of these isolates, five showed morphological characteristics of *Colletotrichum* and three of *Fusarium* genus. The species identity was determined by ITS secuencing, corresponding to *Colletotrichum gloeosporioides* and *Fusarium oxysporum.* The evaluation of molecular markers for differential and simultaneous detection of these pathogens allowed to choose the elongation factor alpha (EF-α) as the best diagnostic test. Pathogenicity test confirmed the capacity of *C. gloeosporioides* to cause anthracnose symptomatology in leaves and *F. oxysporum* isolates to trigger rot in tuber, whose presence in leaves could been associated to its easy and fast conidial spread, to its heightened incidence in soil which is its natural habitat, and its prolonged survival.

PP-7.16: Morphological and molecular characterization of *Colletotrichum gloeosporioides* isolates from yam and the establishment of a virulence test to characterize its pathogenicity

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This research is currently under development and until now the findings obtained suggest a high phenotypic and genotypic variability among *Colletotrichum gloeosporioides* populations isolated from yam crops located in the main production regions in Colombia. To date, there has been a low correlation between morphological and molecular features. Moreover, the standardization of a virulence test enables assessment of the yam´s response to fungi, as well as the effect of the already characterized *C. gloeosporioides* subpopulations in the yam. This will contribute to the knowledge about the population structure of this pathogen in the Colombian Caribbean coast, a region where the tuber represents one of the main products in the culture and economy. Choosing the most virulent isolates and quickly identifying the existing association with morphological or molecular features will enable the study of the fungi pathogenicity and plant resistance with the aim to design efficient and sustainable control measures.

PP-7.17: Efficacy of *Oryza sativa* husk extract for the *in vitro* and *in vivo* control of fungal rot disease of white yam (*Dioscorea rotundata* Poir)

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Fungal rot is a major constraint to white yam (*Dioscorea rotundata*) production in Nigeria. The potential of *Oryza sativa* husk extract for the *in vitro* and *in vivo* control of six virulent rot-causing fungal pathogens, *Lasidioplodia theobromae, Aspergillus niger, Rhizoctonia solani, Penicillium oxalicum, Sclerotium rolfsii* and *Fusarium oxysporum* was evaluated using five different extract concentrations of 0.5%, 1.0%, 1.5%, 2.0% and 2.5% w/v. The fungi were isolated from rotted tubers of *D. rotundata* across three agroecological zones in Nigeria, Humid rainforest, Derived savanna and southern Guinea savanna. Reinoculated tubers were incubated for six months at 28±2^{0}C in a yam barn at IITA, Ibadan, Nigeria. Radial mycelial growth of the test pathogens was completely inhibited at concentrations ≤ 2.5% w/v *in vitro.* Rotting was significantly reduced (P ≤ 0.05) by 20.8% to 24.9% and ≤ 13.2% in tubers inoculated with the test pathogens 48 h before and after the application of the rise husk extract respectively. Phytochemical analysis of the plant extract revealed the presence of biodegradable compounds in mg/g: alkaloids (9.21±2.2), flavonoids (0.17±0.1), saponins (3.30±0.4), steroids (0.18±0.1), phlobatanins (0.35±0.1), ferulic acid (14.1±1.2), terpenoids (0.71±0.1), phenols (1.31 ±0.5), anthocyanin (0.09±0.1) and cardiac glucosides (0.77±0.1). This study demonstrated the potential of *O. sativa* extract in prolonging the shelf life of bruised yam tubers.

PP-7.18: Expression of the coat protein genes of *Yam mosaic virus* and *Yam mild mosaic virus* in *Escherichia coli* and production of polyclonal antisera

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Yam mosaic virus (YMV, genus *Potyvirus*) and *Yam mild mosaic virus* (YMMV, genus *Potyvirus*) are two economically important viruses infecting yam (*Dioscorea* spp.) in West Africa. This study focused on the production of polyclonal antibodies to recombinant YMV and YMMV coat proteins (CPs) expressed in *E. coli*. The genes encoding CP of YMV (906 bp) and YMMV (798 bp) were amplified by RT-PCR from the total RNA extracts of infected leaf tissues using gene specific primers with anchoring cloning sites. The PCR amplicons were cloned into pRSET-A expression vector with Histidine (His) tag fused at the 5' end. The recombinant constructs were transformed into *E. coli* BL21(DE3)pLysS cells. The coat proteins of these two viruses were expressed in inclusion bodies of *E. coli*. The expressed CP along with His-tag at N-terminus was purified under denatured conditions by Ni-NTA column chromatography. Authenticity of expressed coat proteins was confirmed by SDS-PAGE and Western blotting using anti-His antibodies, and they were used for immunization of rabbits. The polyclonal antibodies will be used for the development of a sensitive enzyme-linked immunosorbent assays (ELISAs) for the detection of these two viruses in plants and tubers.

PP-7.19: Plant-parasitic nematode diversity in the main yam production regions of West Africa

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Two surveys were conducted in the main yam production regions in West Africa (Ghana and Nigeria) in order to establish the diversity of phytophagous nematodes on yam and to evaluate farmer's practices and their perception of nematode damage on yam production and storability. During the first survey, soil samples were collected in the vicinity of yam plants in farms located in 11 Ghana districts (Abase East, Ashante, Atetebu, East Gonja, Ejura, Kintampo, Kintampo North, Kumasi, Prang, Pru and Tolon) and eight Nigerian states (Abia, Abuja, Anambra, Benue, Edo, Imo, Kogi, Nasarawa and Oyo). Nematodes were extracted using a tray method and nematodes identified to genus level. Results revealed that three genera, *Meloidogyne* spp., *Scutellonema* spp. and *Pratylenchus* spp. were the most frequently encountered in all visited states and districts. Genera such as *Helicotylenchus* spp., *Rotylenchus* spp*., Hoplolaimus* spp., *Criconema* spp., *Criconemoides* spp. were also observed but less frequently, while *Xiphinema* spp. and *Trichodorus* spp. were encountered infrequently. Species identification will be undertaken using morphological, enzymatic and molecular approaches for the two most prevalent genera, *Scutellonema* spp., and *Meloidogyne* spp., following harvest. For *Scutellonema*, also a survey was conducted on 183 yam market stalls from 22 markets in Nigeria, with interviews form. During this survey, farmers in the same locality of the visited market were identified and their yam barns rated for nematodes diseases. Thus 26 farmers were interviewed using a pre-established questionnaire, to appraise their perception of nematodes as pests. Results showed that galling damage by root knot nematodes and dry rot caused by *Scutellonema bradys* are the most frequent diseases observed by both market stall vendors and farmers, with losses estimated at 2-18% and 0-48%, respectively. Although farmers and vendors were very familiar with nematode damage symptoms on yam tubers, few were aware of any management options, demonstrating the importance of both diagnosis and communication for effective management.

PP-7.20: Control of yam nematodes: resistance screening and biological control approaches

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The yam nematode (*Scutellonema bradys*) and the root-knot nematode (*Meloidogyne* spp.) are economically important constraints to yam production and tuber storability. The current investigation is aimed at reducing losses through the identification of suitable sources of resistance and biocontrol options against the nematodes. Initially, an innovative new screening method using a suspended vertical bag will be applied to evaluate the resistance potential of yam accessions. A total number of 51 accessions, including improved cultivars and landraces, are being assessed under screenhouse conditions using yam vines as planting material. Each accession was inoculated with 500 nematodes (juveniles and eggs for *Meloidogyne* spp. and males, females and juveniles for *S. bradys*) in an aqueous suspension. At harvest, damage symptoms of root necrosis, galling, rot or cracks will be scored visually. Parameters such as host efficiency and host susceptibility will be used to determine yam accessions for resistance. The classification of accessions into tolerant, resistant, susceptible or hypersusceptible will be based on the plant damage and host efficiency. For biocontrol options, 4 isolates of arbuscular mycorrhizal fungi (AMF) and four isolates of *Trichoderma* spp., all native to West Africa, were inoculated onto yam tubers to assess their protective affect against the nematodes under screenhouse conditions. Pre-sprouted yam minisetts were transplanted in 10 litres pots and inoculated with AMF and or *Trichoderma* isolates followed by nematodes two weeks later. Plant biomass, root dry weight, tuber weight, number of tubers, root necrosis, galling, rot and cracking of tubers rate will be used to assess the biocontrol agents, in addition to nematode densities at harvest.

PP-7.21: Preservation of yam (*Dioscorea* spp.) leaf samples for epidemiological investigations on yam viruses

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Proper preservation of yam (*Dioscorea* spp.) leaf samples, especially from field collection to laboratory analysis of nucleic acids in surveys, has been a major challenge for reliable virus diagnostics. This study was conducted to identify the most appropriate sample storage conditions, as well as the effects of storage time and temperature on the quality of nucleic acid preparations for PCR-based diagnostics. Leaf samples from a virus-infected accession of a *D. rotundata* plant were collected, sliced into small bits and stored in either anhydrous $CaCl_2$, silica gel, 70% (v/v) ethanol, 95% (v/v) ethanol, 2% (w/v) CTAB in Tris buffer pH 8, aluminium foil wrap, or as a sap extract on FTA Classic Card™. One set of these samples were stored at room temperate (26 ± 4°C) and the other at 4°C. A set of samples preserved in FTA card and aluminium foil were stored at -20°C. Nucleic acids were extracted from samples at intervals of 10, 24 and 38 days and used for the detection of *Yam mosaic virus, Yam mild mosaic virus* and *Cucumber mosaic virus* using a previously established multiplex RT-PCR. Viruses were detected in almost all the samples preserved in various agents after 10 days at room temperature. Beyond this period, viruses were detected only samples preserved in 95% ethanol and CTAB buffer. These experiments suggested that preservation of leaf samples in Tris buffer containing CTAB was the best storage method tested for yam leaf samples for virus diagnostics for epidemiological studies.

PP-7.22: Assessment of major disease threats to yam (*Dioscorea* spp.) cultivation in Ghana and Nigeria

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Yam (*Dioscorea* spp.) is an important food staple in Ghana and Nigeria, propagated vegetatively using whole or portions of tubers (mini-setts). Yam is susceptible to a number of pests and diseases, particularly viruses because of their tendency of accumulation and perpetuation during vegetative propagation of the crop. These pathogens hence pose a serious risk to seed yam production. This study was conducted to assess the major diseases of yam in Guinea Savanna agroecologies in Ghana and Nigeria. A total of 41 fields in 31 locations in Ghana, and 61 fields in 34 locations in Nigeria were surveyed in 2012. There was 100% prevalence of virus infection in all fields surveyed in Ghana and Nigeria, with mean virus incidence of 95% and 92% respectively for Ghana and Nigeria. The virus indexing detected *Yam mosaic virus* (YMV), *Yam mild mosaic virus* (YMMV) and *Dioscorea* bacilliform viruses (DBVs) in all the surveyed locations either as a single or mixed infections. Anthracnose, caused by *Colletotrichum gloeosporioides*, was detected in 72% and 77% locations in Ghana and Nigeria, respectively. However, anthracnose incidence was less than 9% in both countries. No other disease was found to cause economically significant damage. This information is expected to determine the risk of reinfection of clean seed yams in different locations and establish appropriate preventive measures.

PP-7.23: Meristem regeneration protocol of *Dioscorea* spp. for optimal production of clean materials

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Yam (*Diocorea* spp.) germplasm collections conserved at the IITA genebank are useful to crop improvement programs, national programs, and researchers throughout the world. To secure the *ex situ* conservation of vegetative propagated crops collections and supply services of save material transfer to collaborators, establishment of reliable tissue culture protocols and efficient working schemes are certainly essential. Especially, meristem culture is a fundamental technique to obtain clean materials. Although many different protocols for yam meristem culture were reported (Ng & Hahn 1985, Malaurie *et al*. 1995, Adeniyi *et al*. 2008), meristem regeneration of yam is still the major bottle neck of the IITA's yam collection *in vitro* processing which consisted of more than 3,000 accessions covering eight *Dioscorea* species. This experiment is conducted to identify an appropriate media with combination of plant growth regulators to improve *in vitro* regeneration of yam meristem for routine genebank activities. Setting the best culture media, *ex* plant origins that can increase the success rate of regeneration and to test plant growth regulators balance (auxin/ cytokinin) in order to find the most effective combination for yam meristem regeneration. We identified an appropriate media to regenerate shoot and development of meristem culture of yams *in vitro* establishment. Two media; Murashige and Skoog (MS), and Gamborg (B5) media were studied on 11 accessions contained in five species of yams: *TDr* 1789, *TDr* 2351 and *TDr* 2720, *TDa* 3204, *TDa* 3251 and *TDa* 3761, *TDc* 2790 and *TDc* 2812, *TDe* 3034 and *TDe* 3040, and *TDe* 3106 were utilized as test plants. Performance was measured on ability to produce shoot and to survive. No significant difference in hormone combination in all the accessions tested but there was significantly different at the two medium studied (B5 & MS). Yam apical shoot or nodal cutting *ex* plant obtained from the vine can be grown on the tissue culture media, this remained a viable option: introducing nodal cutting for tissue culture and following by meristem culture in this research have a potential for tissue culture conservation and meristem regeneration for optimal production of clean materials more than apical/lateral shoot meristem culture. Secondly, B5 media has a potential for quick regeneration of shoot derived from meristem cultured without or when supplemented with appropriate concentration of plant growth regulators.

PP-7.24: Replacement value of yam peel meal for maize on the growth performance and carcass characteristics of weaner rabbits

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A 56 day feeding trial was conducted to evaluate the utilization and performance of rabbits fed on Yam Peel Meal (YPM) as replacement for maize. The aim of this study was to determine the influence of YPM as a replacement for maize, on the performance, carcass characteristics and economics of production of weaner rabbits. Two hundred and seventy (270) crossbred rabbits (Dutch x chinchilla) were weaned at approximately 8 weeks of age (averaged between 1043.67 ± 17.03g in body weight) and randomly allocated to three dietary treatments in three replicates per diet with thirty rabbits per replicate in cages in a Completely Randomized Design (CRD). Experimental diets were formulated such that, diet 1 which served as the control contained 0% Yam Peel Meal (maize-based); Diets 2 and 3 contained 50% YPM and 100% YPM respectively. Results showed that the proximate analysis indicated that YPM contains reasonable amounts of crude protein (12.69%), Ether Extract (15.59%), Nitrogen Free extract (55.53%), Ash (8.41%), metabolizable energy (Kcal/kg of 3690.73) and crude fiber (7.78%) respectively. Result also revealed lack of significant differences ($P>0.05$) in the body weight (g) and feed conversion ratio among the three treatment groups. There was a significant ($P<0.05$) increase in the feed intake with increase in dietary level of YPM. Rabbits fed diets 2 and 3 consumed significantly more feed than rabbits fed with diet 1. The carcass parts expressed as percentages of live weight were not significantly different ($P>0.05$) among the treatments except the kidney organ which had significantly ($P<0.05$) higher values in rabbits fed with diets 2 and 3 respectively YPM inclusion at 100% proved more advantageous in terms of feed cost per kg live rabbits and in percentage cost savings. Diets 3 had the least cost/kg feed, cost/kg feed intake, cost/kg weight gain, total cost and feed conversion ratio. It is concluded from the result of this study that YPM is a potential feedstuff in rabbit feeding.

PP-7.25: Adoption of innovations in agriculture in Cote d'Ivoire: the case of new yam varieties

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The yam is one of the most important food crops in the Ivory Coast in terms of production and consumption. Thirty improved varieties from the International Institute for Tropical Agriculture (IITA) were introduced by the Centre Suisse de Recherches Scientifiques (CSRS) in Côte d'Ivoire for diffusion. ANADER (the National Agency for Rural Development) participated in the identification of the pilot farmers and helped to conduct the trials in order to understand the mechanisms for technological transfer in agriculture. The varieties introduced proved to give better agronomical performance than the local ones. Still, their poorer culinary quality limited their acceptability. In fact, the decision of farmers was based on two principal criteria: quality and productivity. Two varieties of *Dioscorea alata* and two varieties of *D. rotundata* were particularly appreciated for their quality and productivity. In addition, *D. alata* varieties proved to be better ground cover. Some yam varieties were appreciated by producers for their broad distribution phase but were finally rejected due to their purplish coloured flesh. After selection, the most appreciated varieties were spontaneously distributed among producers. This distribution was initially supported by the national agency for development, the main agency. The distribution took into account the economic value and the relative utility of the varieties. The diffusion curve was sigmoid for all species. In total, 38% of producers (n = 1,283) accepted the varieties and the adoption process of these varieties today is still going on.

PP-7.26: Potentials of underutilized bitter yam (*Dioscorea dumetorum*) for industrial use

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Advantage of steam pressure treatment in starch modification was used to explore the potentials of underutilized yam (*Dioscorea dumetorum*) tuber for utilization. Properties of the processed tuber were compared with commonly utilized *D. rotundata*, *D. cayenensis* and *D. alata*. Raw and pre-gelatinized flour were produced from the four species of yam. Pre-gelatinization was done by steaming diced cubes in autoclave at 68,950 Nm^{-2} for 5 min and in Barlet steamer at 98 ± 2 ^{o}C for 10, 20 and 30 min. Flour samples were analyzed for pasting properties and mineral contents, while reconstituted dough was analyzed for sensory properties. There was reduction in values of peak viscosity, holding strength, breakdown, final viscosity and setback of all pre-gelatinized samples when compared to their raw counterparts with significant difference (p<0.05). Values also decreased with increase in steaming time. Samples that were steamed with autoclave for 5 min had values close to those steamed for 20 min using Barlet steamer for all the species in most cases. The mean values of the raw and Barlet steamed samples for all the species showed that, except for holding strength, least values for pasting properties were obtained in *D. dumetorum.* Except for phosphorus, highest values for all the minerals that were analyzed were obtained in *D. dumetorum*. Reconstituted dough of *D. dumetorum and D*. *alata* were better in terms of smoothness while those of *D. rotundata* and *D. cayenensis* were more elastic and easier to mold. Colour of *D*. *dumetorum* was closer to that of *D. rotundata* when compared to others. Low breakdown and setback value obtained in *D. dumetorum* paste are useful in applications which require paste stability as replacement for chemically modified starches. High mineral contents and low final viscosity of *D. dumetorum* flour is desirable in infant formulation.

PP-7.27: Advocacy for yams in the DR Congo

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Apart from other non-timber forest products, yams used to be the major ingredient of the then DRC population diet prior to the Bantu, the Sudanese and Nilotic arrival there. DR Congo, then made of empires, kingdoms and chiefdoms, villages and camps, the inhabitants there used to feed on yams, bananas, *coleus, Sphenotylis stenocarpa* and NTFPs (non-timber forest products), prior to Portuguese explorers early arrival along with their carriage of some variety of cassava.

Presently, cassava contributes to 73% of food production in DR Congo, followed by bananas (8%), maize (4%), rice (2%) and sweet potato (2%), according to the DRC Ministry of Agriculture statistics (*la voix du Congo Profond* - Voice of the Congo Hinterlands, *pp14, 2011)*. Yam could make up around 1%. Before 2021, *after the much hoped for launch of "Yams National Decade",* the production of the edible yams is expected to reach 8% contributing thereby to diversify and improve quantitatively and more so qualitatively, the diet of tens of millions of Congolese.

In the last 20 years or so, Cassava has repeatedly been challenged by both viral and non-viral diseases. While covering over 73% of food production in the DRC, it seemed logical to rush to its bedside with many national and international projects involving with either the selection of local resistant lines, or the introduction and acclimatization of foreign lines. It is high time to fulfill these curative interventions with an intensive program of diversification of tubers and to bring yams at least to the current level of bananas production (8%).The ongoing climate change also provide some rationale to support this concern in a bid to promote agro-biodiversity. Let us not forget that depending on species and lines, yams contain up to 8 times more protein than cassava. Furthermore, nutritionists believe that the more variety you find in a diet, the better. Yams are known to fight against malnutrition prone diseases such as Kwashiorkor and edible yams consumption does not lead to ailment of the kind of goiter, or dwarfism, or spastic paralysis locally known as *Konzo.* Yams are free from the danger of exposure to cyanide poisoning which often result from poorly detoxified or poorly retted cassava.

All yams belong to the family of *Dioscorea* where you find 600 species known to date and have always existed in DRC and Africa since God's Creation. Hence its huge wealth and its large genetic diversity (i.e lots of species and lines, some subject to farming and others wild for gathering) which is not the case for cassava, we well know came from South America, 5 centuries ago in the slave traders' boats in the course of the triangle trade. Yams can yield 20 to 40 tons/ha in less than a year and could be stored relatively up to several months. Their market value is currently higher than that of cassava in DRC. In general, yams should not undergo detoxification as cassava. They grow both in savanna (cultivated species) and in the forest (especially wild species, proto-gathered). We can count from 8 to 10 farmed species of yams. Pygmies practice forest proto-farming of several species. Also traditionally edible in DRC and elsewhere in Africa are the young shoots and leaves of some species.

When will there be a Yams day, Yams years and even a "Yams decade"?

PP-7.28: Relationships between chemical, instrumental measurements and organoleptic properties of pounded yam

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The present study aims to identify chemical and instrumental tools that can used for the prediction of organoleptic quality of pounded yam, the main yam dished in Côte d'Ivoire, called locally *foutou*. To this regard, four mostly consumed yam varieties (*D. cayenensis-rotundata* and *D. alata*) were processed into pounded yam according to the traditional procedure. The obtained pastes were assessed by sensory evaluation and instrumental analyses. Furthermore, chemical analyses were performed on yam raw tubers. Correlations analyses on sensory attributes versus instrumental and chemical data indicated that firmness of pounded yam measured with the penetrometer (for fruits) is in synergy with texture firmness and extensibility as assessed by the sensory panel. Adhesion measurements using a dynamometer (a laboratory prototype) were also correlated with sensory mean rates of stickiness of the pastes. Moreover, the dry matter content of fresh tubers was in association with firmness and stickiness of pounded yam. Reducing sugar content of fresh tubers was in opposition with the judgements of the panellists for the attribute sweetness. Our study revealed that instrumental tools i.e. the penetrometer and the dynamometer used for the investigations can be used for the prediction of the firmness and extensibility (for the penetrometer) and stickiness (for the dynamometer) of pounded yam. The dry matter content of fresh tubers is an indicator of the firmness and stickiness. The reducing sugar content of the raw tubers predicts inversely the sweet taste of the pounded yam.

PP-7.29: Sustainable yam management in Guadeloupe (French West Indies)

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In Guadeloupe, yam cultivated area has decreased in the last 20 years from 1,200 ha to 300 ha. This is partly due to the prohibition of the use of chemical herbicides and to the high cost of labor in Guadeloupe (16.54 € $hours^{-1}$) which reduce farmers' investment and risk-taking in favor of this crop. Highly variable yields add to the uncertainty of growing yam and variations ranging from 5 to 40 tons ha^{-1} have systematically been recorded. Research was carried out to decrease the workforce used in yam cultivation, especially as relates to weeding; and mineral content of the plant focusing on the intake of both fertilizer and organic matter (chemical and organic nutrient management). A new kind of mulch, made of biodegradable Kraft paper was developed, and the costs and efficiency for controlling weeds in three yam cropping systems: Kraft paper mulch (0.2 kg m^{-2}), sugar cane residues of leaves mulch (2kg m^{-2}), and no mulch were compared. The cost for installing mulches is around 4 000 € ha^{-1} but it reduces the weeding time by 75% and saves 8 000 € ha^{-1}. With these mulches, yam does not compete with weeds for water or minerals and the yield is at least equal or higher (up to + 40%) to that of a culture conducted in normal conditions. On the other hand, we studied the effects of chemical fertilizer and compost on yam yield. It was observed that a mixture of chemical fertilizer and compost was more favorable (yield + 20%) than separate use of either one. A way to boost the yam sector in Guadeloupe would be to mobilize new mulching techniques, and to provide the nutrients needs of the crop and understand how soil density influences yam yield.

PP-7.30: Epidermal terpenes of *dioscorea composita* hemsl.

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Terpenes are of paramount importance in both nature and human applications. Better understanding of isoprene biosynthesis and chemistry has accelerated research in these areas. The search for lead compounds in drug discovery takes diverse dimensions and wild species of crops are being extensively explored for these useful compounds. Stereomicroscopy and Scanning Electron Microscopy studies of the shoots of *Dioscorea composita* revealed presence of capitate glandular trichomes on the epidermal layers of the plants. Gas Chromatography/Mass Spectroscopy (GCMS) confirmed the nature of the oils to be terpenes; α-terpinene, nerolidol, citronellyl acetate, farnesol, elemol, α-farnesene, valerenyl acetate and germacrene. Elemol an insecticidal sesquiterpene was the most abundant component comprising 41% of the total essential oil yield in the leaf.

PP-7.31: Integrated agronomic management models: guide for increased yam productivity in West African sub-region

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Low yields of West African yam varieties could ever remain except a rapid move is made now the problem is obvious .Technologies can be made available through Integrated Agronomic management Model (IAMM) for West African yams as a long- term intervention to boost yields and sustain productivity. There are many discrete or individual technologies or agronomic models developed in many countries to enhance yam production. These technologies or agronomic models are used on discrete basis or applied as individual models in different West African region for yam production. There is no information or evidence on the combination of different rates of these individual technologies in a manner so as to identify an optimum combination or requirement for the development of an integrated agronomic management practice for yam production. This might explain why National and Farmers yields are still below 40t/ha and 15t/ha respectively. There is possibility of increasing yields of West African yam varieties beyond the present yields of25-35t/ha. This can be achieved by adopting integrated agronomic management models (IAMM) using optimum combination of proven models or technologies available in West Africa.

PP-7.32: Nutritional composition and diversification of the use of *D. rotundata* varieties in Fako Division of Cameroon

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Of all the root and tuber crops, white yam ranks third in Cameroon but with little or no transformation. Nutrient information and diversification will increase culinary use, storability and economic value. In Fako Division five varieties are predominantly grown; Batoke Aga, Egbe, Muyuka and Sandpaper. The objective of this work was to evaluate the nutrient content and diversify the use of white yams in Fako Division. Five varieties of *D. rotundata* were characterized, their functional properties determined and local products made for an organoleptic evaluation. All data obtained were subjected to statistical analysis at $P \leq 0.05$. There existed a significant difference in the proximate composition except in the lipid content. The moisture content ranged from 64.16% for Muyuka to 71.86% for Egbe. Ash and protein contents ranged between 1.75% and 2.53% for Muyuka, and 3.30% and 6.75% for Egbe, respectively. The sugar content ranged from 0.32% for Batoke to 3.09% for Sandpaper, And ahe starch content from 42.75% for Egbe to 60.10% for Batoke. The crude fiber content ranged from 0.16% for Batoke to 0.87% for Muyuka. There was also a significant difference ($P \leq 0.05$) in the functional properties with solubility index ranging from 7.10% for Muyuka to 11.22% for Batoke. The swelling power was between 10.78% for Egbe and 13.12% for Batoke while the water binding capacity ranged from 103.64% for Batoke to 185.73% for Muyuka. There was no significant difference ($P > 0.05$) between the mineral content and the pasting properties but there was a trend. There was no significant difference ($P > 0.05$) among the products of amala and pounded yam made from the varieties except in colour and appearance, respectively. Pounded yam had a significant ($P \leq 0.05$) preference over amala.

PP-7.33: Is organic yam production feasible? Lessons from India

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Consumer awareness of food safety, health and environmental issues has stimulated interest in alternative agricultural systems like organic farming. Field experiments were conducted over a seven-year period at Central Tuber Crops Research Institute, India to compare the impact of organic and conventional production systems on yield, proximate composition and mineral content of tubers and soil physico-chemical and biological properties in three species of *Dioscorea* (white yam: *D. rotundata* (both trailing and dwarf genotypes), greater yam: *D. alata* and lesser yam: *D. esculenta*). There was 9%, 11% and 7% higher yield in organic practice over conventional practice in trailing genotypes of white yam, greater yam and lesser yam respectively. Dwarf white yam preferred chemical farming as slight yield reduction (2%) was noticed under organic farming with same tuber quality. In trailing genotypes, tuber quality was improved with significantly higher Ca (72.67 mg $100g^{-1}$), slightly higher dry matter, crude protein, K and Mg contents. Organic management lowered the bulk density and particle density slightly and improved the water holding capacity (by 15%) of soil. Organic plots showed significantly higher available K and pH, by 0.46 unit, and higher soil organic matter by 14%. The dehydrogenase enzyme activity (1.174 µg TPF formed g^{-1} soil h^{-1}), population of bacteria, fungi and P solubilizers were promoted by 14%, 23%, 17% and 22% respectively. Organic farming is an eco-friendly management strategy in yams for sustainable yield of quality tubers and soil health. Technology involving farmyard manure, green manuring, neem cake, biofertilizers and ash was standardized.

PP-7.34: Case study: Successes in a farmer-led approach to research and development in yam [*Dioscorea alata*.] production

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Root Crop Research has significantly contributed to improved yields by agronomic and crop protection interventions in the Caribbean. Almost all Research and Development activities conducted singly or in collaboration among researchers in the Universities, State Departments, Ministries of Agricultures, Research Institutions or International Agricultural Agencies have contributed to the enhanced productivity of the root crop industry. However, this has always been Researcher or Scientist led. The main problem with the project-based approach was that they are funded by grants or governmental budget, and there is always a terminal point and often the transfer of technology or the demonstration/validation of intervention is incomplete. This paper presents a case study of the successes of an innovative and entrepreneurial farmer, by whose diligence and research skills, has conducted many yield assessment and improvement trials on over 12 varieties of yam and other root crops. He has developed an integrated technology package for improved crop nutrition, agronomy, harvest and post-harvest, and crop protection, which has manifested in a 2 to 3 fold yield increase. This study highlights the individual and combined approaches as farm-based research, development and innovation [RDI] and its successful outreach and transfer to other famers at the national and regional level.

PP-7.35: Management of greater yam + maize intercropping system for productivity and livelihood improvement of smallholder farmers

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Greater yam (*Dioscorea alata* L.) is a subsistence food crop in tribal and hilly areas and vegetable cash crop in the rest of the area in India. Being a trailing herb, it requires staking, which is a costly input next to seed in greater yam cultivation. Availability of staking material is a big constraint for large-scale cultivation. Greater yam provides opportunity to cultivate some intercrops due to its planting at a wider spacing. The quick and tall growing intercrops will provide staking to greater yam apart from some yield. Research conducted at the Regional Centre of Central Tuber Crops Research Institute, Bhubaneswar, India during 2001-2010 revealed that maize (*Zea mays*) was suitable intercrop, as it grow quicker and taller and it facilitated the spread of greater yam foliage (more primary, secondary branches as well as number of leaves and greater leaf area duration), transmission of radiation to the lower layers of the canopy that leads to higher photosynthetic rate throughout the foliage column, and higher dry matter accumulation. The intercropping also reduced the incidence of anthracnose disease by 52.7-62.3% compared to greater yam sole cropping without staking. Intercropping also increased tuber yield by 13.9-26.3% over unstaked sole cropping. The greater yam + maize intercropping system gave an additional return of $ 441.1 with an additional investment of $ 61.4 towards the introduction of maize as an intercrop. Mulching (2 t/ha) greater yam + maize resulted in 21.0% more yield in greater yam, 10.3% increase in maize yield and increased N, P and K uptake by 20.6, 25.9, and 20.3%, respectively. Application of N-P_2O_5-K_2O (120-90-120 kg/ha) to the above intercropping system recorded higher greater yam and maize yields as well as net returns.

PP-7.36: Impact of plant architecture in yams; an agronomic evaluation

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Excessive foliar and unwieldy plant architecture in *D. alata* is a matter of concern to all yam researchers. Dry matter apportioning indicates that most of the photosynthates synthesized are not translocated to the storage tuber. Hence it was envisaged to study the dry matter partitioning in yams to estimate the apportioning of DM to storage tubers. Pruning of the crop is expected to give an idea of how much foliage is essentially required by tuber production. Trailing being a major cost contributing factor, an attempt is made in the present study to optimize reasonable yield by non-trailing of vines and spatial geometry. Cultural manipulations with regard to plant architecture involved pruning, trailing, size of planting material, etc. Pruning was imposed at 1 m and 2 m height and compared with no pruning treatment. Trailing was compared with non-trailing in three spatial treatments to optimize the ideal plant population to obtain economic yield when non-trailed. The study was laid out under Factorial RBD in three replications for three years. Pruning was found to drastically reduce tuber yield resulting in significantly poor yield as compared to "no pruning" treatment. Pruning at 2 m height gave higher tuber yield than pruning at 1 m height. Significant reduction in dry matter translocation to tubers was noted in pruned treatments. Trailing of vines was found to be essential for obtaining higher tuber yield than non-trailing since it facilitated better display of leaves and canopy thereby enhancing photosynthetic efficiency of the plant. Study on interaction effect between pruning and trailing of vines revealed that non pruned – non trailed vines gave comparable yield to trailed – non pruned vines. Non pruned-closely spaced (60 x 60 cm) vines gave significantly higher tuber yield than the non pruned and widely spaced ones.

PP-7.37: Development of simple screening index to evaluate tuber growth and maturity in Dioscorea rotundata *and* D. alata

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In several crops, phenotyping has remained a major constraint to fully utilize genotyping data for germplasm evaluation and breeding. In yam, effective evaluation and selection for economically important traits is still being challenged by lack of non destructive methods to measure bulking, long growth cycle, significant genotype x environment interaction, and low multiplication rate, among others. It has also frequently been observed that farmers in the region grow varieties with various maturity periods to widen the harvesting season, suggesting the importance of tuber maturity period as a key agronomic trait. However, no study has been reported so far to develop efficient phenotyping protocols on important agronomic traits on yam. This study aimed to identify shoot characteristics, tuber growth and maturity to establish a non-destructive phenotyping method in D. rotundata and D. alata. The easier evaluation with this method will facilitate the field selection, and utilization of molecular tools for breeding. Using six varieties of D. alata and five of D. rotundata with different tuber maturity periods, the relationship between the growth of aerial parts and tuber was studied. A simple screening index for tuber growth and maturity period was generated. Aerial parts (fresh and dry weights, number and length of stems, SPAD, flowering, leaf senescence) and tuber characteristics (No. of tubers, fresh and dry & tuber weights) were monitored monthly for two years. For the two species, there were clear differences in tuber bulking rate and maturity period among the tested varieties: the varieties with early tuber maturity period tended to show earlier initiation of tuber bulking, and the maturity period of tuber clearly corresponded with foliage senescence both in late and early varieties. Based on these results, in both D. rotundata and D. alata, time to leaf senescence can be used as an estimation of maturity period of the tuber in the large-scale phenotyping. However more research needs to be done to investigate the use of foliage senescence as simple index parameter for large-scale phenotyping of tuber growth and maturation.

PP-7.38: Impact of 2030 climate on suitability of yams in sub–Saharan Africa and Asia

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The objective of this study was to analyse the impact of present day climate and future climate (2030) on suitability of yams in major yams growing areas of sub-Saharan Africa and Asia. We studied the changes in climatic parameters in major yams growing areas of sub-Saharan Africa and Asia, current climate suitability and constraints to yams production, future climatic changes in yams growing areas in these regions and changes in suitability of these areas for yams cultivation. The study used long-term average climatic data (1960–2000) of monthly maximum, minimum and mean temperatures, and total monthly precipitation at 30 arc-seconds (<1 km) spatial resolution (WorldClim data) aggregated to the resolution of 10 arc-minutes (~ 20 km at the equator). Statistically downscaled outputs of 25 selected Global Circulation Models (GCMs) from the 3rd and 4th assessment reports of IPCC for 2030 period under SRES A1B emission scenario was used as the future climate data. The world inventory of soil emission potentials (WISE) database was also used to find out the suitability of yam in these areas. The impact of climate change on suitability of major yams growing areas of sub-Saharan Africa and Asia was studied using the ecological niche model, ECOCROP. All spatial analyses were done in GIS environment using DIVA GIS and ARCGIS 10. The study showed that, there is positive impact in many areas where yams are cultivated. The study also resulted in developing a map of the potential yams growing areas of the study area. A detailed quantification of the impact of climate change in major yam growing environments is also done in the paper. The study clearly indicated the areas which are positively and negatively impacted for yams cultivation.

PP-7.39: Assessment of genotypes of *Dioscorea rotundata* for moisture stress

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Forty nine *Dioscorea rotundata* genotypes were screened to assess their response to moisture stress in a glasshouse at the International Institute of Tropical Agriculture (IITA), Ibadan. Yam minisetts (40 g) of each genotype were cut and pre-germinated for 3 weeks in a growth medium (carbonized rice husk). These were later transplanted into sterilized soils filled into pots, irrigated and left to equilibrate for 24 hours. Data was collected on the following: weekly pot weight, plant biomass, number of leaves and vigour. The data were subjected to analysis of variance and multivariate cluster analysis. The forty nine genotypes differed significantly ($P<0.01$) with respect to the measured variables. The two first canonical axes explained 94.31% of the total variation among the 49 genotypes which grouped into five clusters. The best performances were found among the genotypes in cluster 1, with a mean of 10.7 g, 10.3 g, 20.4 g and 0.7 for fresh leaf weight, fresh root weight, fresh shoot weight and plant vigour respectively, while genotypes in cluster 5 had the least performance. The highest vigour (0.9) was in cluster 2. The studied genotypes of *D. rotundata* exhibited differential potential for biomass production at water stressed condition.

PP-7.40: Yam minisett intercropping studies for improved productivity of cropping systems and soil fertility enhancement

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National Root Crops Research Institute in collaboration with the International Institute of Tropical Agriculture, developed a seed yam production method called the minisett technique where in small sized cut tuber pieces (varying from 25 g – 50 g) are used as planting material as opposed to the traditional practice where seed tubers or cut sett of 100 g – 150 g are planted. Production of seed yams using the minisett requires only 6.33% of the number of mother tubers needed for the traditional farming systems on per hectare bases. Despite the novel nature of the technology and its economic viability, adoption rate has been found to be low as a result of its emphasis on mono-cropping. Most farmers in the yam growing zones of Nigeria practice intercropping. For intercropping to be viable, the intercropped crops must be compatible. This paper reviewed yam minisett-based intercropping studies carried out at National Root Crops research Institute, Umudike, Nigeria over the past decade. The effect of the intercrops on the productivity of the systems and the soil resource-base were examined.

PP-7.41: Land suitability classification of an ultisol in southestern Nigeria for dioscorea dumentorum yields

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Trifoliate yam (*Dioscorea dumentorum*) is an important food security crop in Nigeria, it occupies a prominent position in diets and farming system in the south East agro ecological zone especially in Abia State. Olokoro soils, Umuahia south, Abia state grow to the Trifoliate yam (*Dioscorea dumentorum*) were studied, characterized and classified. Profile pits were dug and studied, using the rigid grid survey techniques soil sample pedogenetic horizons were collected processed and analyzed, and result showed that the soil colour ranged from dark grayish brown (10 YR 4/2) to dark reddish brown (5YR 4/2), the soils were weekly to strongly aggregated, and posses loamy sand to sandy clay loam textures. pH ranged from 4.5 to 4.9 organic carbon ranged from 5 to 36mg kg-1. The exchangeable base and CEC were low while the base saturation ranged from 31 to 50% .Based on the criteria of soil Taxonomy the soils have been classified as Haplic Nitosol in the FAO/ UNESCO soil Map of the world legend. Integrated use of lime inorganic and organic fertilizer is recommended to ameliorate the soils and to increase and sustain good yields.

PP-7.42: Fungi associated with post-harvest tuber rot of water yam (*Dioscorea alata*) and their effect on nutritive value

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This study was conducted to isolate and identify fungi pathogens associated with post-harvest tuber rot of water yam (*Dioscorea alata*) and also determine the effect of fungal infection on its nutritive value. Thirty two yam tubers collected from two sources (IITA and Bodija, Ibadan, Nigeria) were examined for rot and associated fungal pathogens. Pathogenicity test was conducted on the isolated fungi and proximate analysis was also carried out on inoculated tubers. Our results showed that four fungal pathogens: *Aspergillus niger*, *Aspergillus flavus, Rhizopus* sp. and *Botriodiplodia theobromae* were isolated from the rotted yam tubers. *Aspergillus flavus* and *Rhizopus* sp. has the highest frequency of occurrence (31.25%) while *Botriodiplodia theobromae* has the least (15.6%). *Aspergillus niger* and *Botriodiplodia theobromae* were the most pathogenic causing 17.9% and 13.2% damage respectively. Data from proximate analysis showed that fungal infection on the tubers has a reductive effect on the nutritive value.

PP-7.43: Yam germplasm management in Côte d'Ivoire

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Yam is in volume, the most important food crop of Côte d'Ivoire. Unfortunately, the abandonment of its cropping by the traditional yam growers for cultures of revenues, the practice of the mono-varietal system of yam cultivation and the destruction of forests and savannas contribute to the reduction of its genetic diversity. This genetic erosion, thus seriously threatens the future of this plant for which genetic potentialities are not still well exploited. This threat exits at the producers' level than the scientists'. Yet, the large genetic diversity of the species gives the opportunity to breed for the end-users' needs. Consequently, since thousands of years, the producers exploit it to improve their crops. In the case of the yam, the qualities required for an elite variety are a high yield, a good resistance or tolerance to diseases and pests and a good organoleptic and nutritional quality. However, for yam, creating a new variety, even if possible, remains difficult. To make progress in that direction, it is important to better understand the genetic basis of the species. To lead to that, the collection and the introduction of clones of various origins are carried out. The use of these clones for the varietal improvement requires their conservation. One of the first studies to realize for a good management is the characterization of the germplasm. To improve the effectiveness of the conservation, CNRA proceeds by two complementary methods: *in vivo* conservation in the field and *in vitro* conservation in the laboratory. Many expeditions and collections were conducted and the agro-morphological, enzymatic and molecular characterizations were also carried out. A safety duplication of the germplasm is going on with IITA.

PP-7.44 DNA fingerprinting of yam cultivars from Nigeria and Ghana using microsatellite markers

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Yam (*Dioscorea* spp.) is an integral part of the West African food systems, particularly in Nigeria, Ghana, Côte d'Ivoire, Benin and Togo, collectively dubbed as the 'yam belt' which accounts for nearly 93% of the global yam production. Majority of the yam cultivars grown in the *yam belt* are local landraces selected from *D. rotundata* indigenous to West Africa, and *D. alata* introduced from Asia about 500 years ago. More recently, over 15 improved varieties of these two yam species have been released in Nigeria and Ghana, some of which have been widely adopted by farmers under local names. It is likely that cultivar names could include synonyms (different names for same variety) and homonyms (same name for different varieties). Accurate identification of varieties based on morphological characters is not easy, yet this knowledge is critical to the production and distribution of quality planting material. To help resolve this situation, this study focused on use of simple sequence repeats (SSR) markers for the identification of yam cultivars grown in Nigeria and Ghana. A collection of 139 accessions, 60 from Nigeria and 79 from Ghana, were assembled for DNA fingerprinting using 30 SSRs, which included 10 genomic SSRs and 20 EST-SSRs. The results showed two distinct groups with one cluster representing mainly the improved cultivars and the second cluster representing the landraces. However, within the cluster of landraces, it was found that most of the tubers although collected from different markets within Nigeria and Ghana either grouped together or separately. This suggests that often farmers use a common popular name to these landraces or varieties, which has some relation with the marketability and consumer preferences. This study also identified a set of informative SSRs to discriminate yam varieties analyzed in this study. These markers will contribute to identification of true-to-type cultivars during propagation and in seed yam and ware yam markets.

PP-7.45 EDITS-Yam: a collaborative research project on the "use of genomic information and molecular tools for yam germplasm utilization and improvement for West Africa"

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Yam is a traditional staple crop with significant economic and socio-cultural importance in West Africa with a projected increase in demand due to population growth in the region. However, little improvement of farm yields has been registered in this crop in the last few decades, indicating an urgent need for more investment in yam research and development. The last couple of years saw a breakthrough in genome sequencing technologies, and in their application to plant breeding. Genome analysis and improved molecular techniques would tremendously facilitate germplasm characterization, genetic mapping and tagging, and functional genomics of yams. The new tools, if incorporated into breeding program, will pave a road for effective genetic improvement of yam. JIRCAS has been implementing a collaborative research project named "EDITS-Yam" with IBRC, NFRI and IITA to develop and utilize advanced genomic and molecular tools to enhance germplasm evaluation and improvement for *D. rotundata* in West Africa. The project aims to 1) execute whole genome sequencing of *D. rotundata*, 2) develop and utilize genomic information and molecular techniques, 3) provide improved tools for biodiversity analysis and identification of potentially useful germplasm, 4) develop phenotyping protocols for important agronomic traits, and 5) develop improved systems for plant regeneration and genetic transformation in yam. The outputs from this collaborative research are expected to contribute to the enhancement of yam breeding activities in the region. Consequently, new improved yam varieties will provide better food security and income for the people of West Africa and beyond.

PP-7.46 Facilitation of conservation and utilization of yams in the pacific by the secretariat of the pacific community

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The Pacific region has considerable variation in its yam germplasm, with more than 1000 cultivars being grown. In early 2000's, the Secretariat of the Pacific Community (SPC) coordinated an EU-funded South Pacific Yam Network (SPYN) carried out the collection, characterisation and clonal selection of mainly the cultivated specie, *D. alata,* from Pacific island countries for establishment of a core collection, which was later transferred to the Centre for Pacific Crops and Trees (CePaCT), located in Suva Fiji for *in vitro* conservation. The *alata* collection was DNA fingerprinted using SSRs markers in 2011 by the International Institute of Tropical Agriculture as part of a global partnership. CePaCT since has acquired other species of yam, which include wild species as well, through various donor funded projects in particular the Global Crop Diversity Trust (GCDT) to expand its unique Pacific yam collection. SPC receives a long term grant for sustainable conservation of its yam collection. CePaCT is currently conserving 8 species of yam comprising of 286 yam cultivars as follows: *Dioscorea alata* (n=189), *D. rotundata* (n=32)*, D. esculenta* (n=34)*, D. bulbifera* (n=8)*, D. nummularia* (n=2)*, D. pentaphylla* (n-1)*, D. transversa* (n=1)*, and D. trifida* (n=1). It is a dynamic yam collection that keeps expanding as new species and varieties are received from within and outside of the Pacific. Of special interest is the diversity of the *D. esculenta* in the Pacific, one of the most nutritious yam species. *D. esculenta* has proven to be well adapted to atoll conditions and a possible crop to aid in climate change adaptation. The centre is faced with challenges in conserving and utilising its yam collection as the virus diagnostic activities are not progressing well due to the unavailability of yam badnavirus diagnostic protocols. This has greatly restricted access to unique cultivars important for building resilience of food and nutritional security of communities to disasters and climate change. Currently less than 10% of the CePaCT yam collection is available for access. Integrated badnavirus is a global problem that continues to impact the utilisation of yam germplasm and other important food crops. There is a need for greater collaboration between international institutes and development partners to develop reliable sensitive diagnostic protocols to address this challenging problem.

PP7.47 Assessment of diversity among greater yam (*Dioscorea alata*) accessions of India and prospects of utilization in genetic improvement programme

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India holds a rich genetic diversity of Yams and the occurrence of about 50 different *Dioscorea* species was reported in India, largely in the west, east and northeast regions. Among the *Discorea* species, Greater Yam, (*Dioscorea alata* L.) is the most important species grown throughout India. In Ayurveda, Indian system of medicine, it is considered as an anti0diabetic vegetable and used for the treatment of hemorrhoids, intestinal worms, post-menopausal syndrome and general weakness. India holds a germplasm of 817 accessions of greater yam conserved as field gene bank. Being the National Active Germplasm Site (NAGS) for tropical tuber crops, Central Tuber Crops Research Institute (CTCRI, India) conserves 537 accessions of greater yam collected from the major yam producing states of India *viz.* Kerala, Bihar, Orissa, Tamil Nadu, Assam, Gujarat, Maharashtra and north eastern hill states. In the present study, morphological characterization was carried out on 96 greater yam accessions collected from 14 states which represent the major growing regions in India. A total of 54 morphological traits were recorded using IPGRI descriptors for Yams. Genetic diversity analysis revealed distinctness of the accessions collected from southern and north eastern parts of India. Ten microsatellite markers were used for the molecular characterization of the core collection. Da 57, Da228, Da 367 and Da 374 were identified as the divergent genotypes and were utilized in breeding program. Several triploids were identified and hybrids with high yield, good tuber shape, culinary and nutritive quality were developed. The paper presents the wide spectrum of genetic variation present in greater yam conserved as field gene bank at CTCRI, India and its utilization in genetic improvement program.

PP-7.48 Morphological characterization of cultivated and wild yam (*Dioscorea* spp) in Malawi

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Root and tuber crops are an important source of food and cash worldwide. In Malawi, the potential of yams in crop diversification to achieve food security has long been identified. Collections of cultivated yams have been made and conserved ex-situ but the accessions have not been fully characterized. This study used IPGRI(1997) yam descriptors and a key by Hanon et al., (1995) to characterize cultivated and wild yams (*Dioscorea spp*) collections in order to generate morphological profiles of the yams which can be used in the domestication and enhancement of the species. A total of 80 wild and 43 cultivated yam accessions were collected and assessed. Initial assessment of the yam collections showed that there is a considerable species diversity of yams in the wild and cultivated yams with a long history of cultivation on small farms. Principal Component Analysis produced eight distinct groups of the yams with one group constituting all cultivated yams and the other seven groups representing different wild yams. The most abundant wild yam species were *D. dumetorum* and *D. schimperiana.* Cluster Analysis of the domesticated subset revealed that the cultivated yams in our collection are highly similar (70%) but they are not duplicates except accession MSYC18 and MSYC 23. All the cultivated yam accessions in the study were identified as *D. alata*, the winged yam. The cultivated species classified earlier as *D. rotundata* and *D. bulbifera* were therefore misidentified. The Malawi yam collection represented a considerable morphological diversity with wide spectrum of characters that can be exploited by plant breeders in the improvement of the crop.

PP-7.49: Yam production in Jamaica: challenges and solutions

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Yam (*Dioscorea* spp.) is widely cultivated in Jamaica and the three most economically grown species are *D. cayenensis*, *D. rotundata* and *D. alata*. Ninety five percent of production is consumed locally and 5% is exported. The annual value of yam exports to the USA, Canada and UK from 2010 to 2012 was approximately US$ 20 million with the majority (75%) being *D*. *cayenensis*. Despite an obvious export market demand, yam production and productivity are severely limited by the need for genetic improvement, and poor adoption of modern agronomic practices, plant protection strategies and standard post-harvest practices. The country's ability to meet international phytosanitary standards such as the Food Safety Modernization Act (FSMA) which imposes new food standards on Jamaica's yam exports is an issue which also needs to be addressed. In recent years, the Government of Jamaica has embarked on a strategic plan to direct efforts and resources to support increased production of yam as part of its import substitution and export expansion programme. The Yam Industry Development Project was designed in 2010 to address the urgent issues affecting the industry. This paper highlights four components of the project (i) conservation of genetic resources (ii) use of improved production technology i.e. minisett (iii) screening for disease resistance in *D. alata* and (iv) evaluating postharvest practices for compliance to international food safety standards.

PP-7.50: Assessment of yam diversity at community level: to increase farmers' access to conserved genetic resources of yam in West Africa

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Out of three hundred and sixty three yam cultivars (landraces) collected across Nigeria, eighty four were selected for morphological and tuber characterization with the objective to provide information on the traits of accessions, assuring the maximum utilization of the germplasm collection to the final users. Four major yam species were collected during the survey, out of which 51.2% were *D. alata*, 39.3%, *D. rotundata*, 7.1%, *D. dumentorum* and 2.4% *D. cayenensis*. These are the major yam species cultivated and consumed in the area. The yams were cut into minisett sizes of 35-40gm and planted out in plot sizes of $15m^2$ ex situ with replicates at Umudike and Otobi and characters that were highly heritable and easily seen by the eye and expressed in the environment were recorded using the IPGRI format. The use of proven landraces for yam improvement has remained un-exploited fully due to inadequate evaluation of the traits. The potentials exhibited by some of the accessions could be incorporated into the hybridization plots for breeding purposes.

PP-7.51: Exploiting conserved Yam (*Dioscorea alata* L*)* germplasm at PRC towards livelihood and market

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Yam (*Dioscorea alata L.)* is considered as a crop for the poor and marginal land areas. Today, beyond of Yam's food and nutrient values are still a big unknown to scientists and policy-makers. In Vietnam, indigenous knowledge proofed that Yam provided and ensured both of food and nutrient aspects to remote/ high and disadvantageous areas. Furthermore, Yam also was cultivated in wetland and lowland areas in Southern Vietnam. All of them formed a variety set of diversity and rich one. Yam collection was collected, established in Plant Resources Center (former Plant Genetic Resources Center) since 1996. Until now, there were 500 accessions of Yam collected around Vietnam but just 200 accessions is currently maintained. Then, experience, skills, practices are withdrawn to Yam collection in conservation. During the process, description and evaluation works were also carried out last years. From that, a various good set of Yam variety (8 varieties) were identified, discovered. They were brought to different eco-regions to plant trial/demonstration and to calculate socio-economic benefits. Results showed that the germplasm is been meeting to famer and consumers needs in term of livelihood, commerce, economic and nutrients. The paper is represented conserved Yam resources at PRC that is exploiting to cope with production and consumption demands

PP-7.52: Production constraints and farmers' cultivar preference criteria of cultivated yams (*Dioscorea cayenensis - D. Rotundata* complex) in Togo

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Fifty (50) villages randomly selected throughout agroecological zones in Togo were surveyed, using participatory approach, to identify and prioritize factors that affect production and farmers' varietal preference criteria of Guinea yam (*Dioscorea cayenensis-D. rotundata* complex). A total of nineteen (19) constraints of varying importance across agro-ecological zones were identified among which the most important were insects' damages on both leaves and tubers, nematodes attack on tubers, drought, soil fertility and wilting. For majority (78.94%) of the constraints, use of tolerant cultivars remains the most sustainable, economically profitable and environment friendly solution. Farmers' cultivar preference criteria identified are many (24 in total). Among them, high productivity, good quality of pounded yam, resistance to drought and adaptability to all types of soils are the most important. A perfect match is noted between enumerated constraints and identified preference criteria. The knowledge of farmers' selection criteria is of capital importance for breeders and also extension services for eventual yam cultivar exchange between agro-ecological zones in Togo.

PP-7.53: Morpho-agronomic, cytogenetic and molecular characterization of the CIRAD yam collection for their enhancement and utilization in genetic improvement programs

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The greater yam (*Dioscorea alata*) is a crop with a potential for increased commercial production. However, several problems limit its development: tuber characteristics are often not adapted to commercial production, and anthracnose disease, caused by the fungus *Colletotrichum gloeosporioides*, is always a threat. In 2003, CIRAD initiated a selection and varietal improvement program in Guadeloupe (French West Indies) to provide producers with new varieties adapted to agronomic, phytosanitary and socio-economic constraints. For this purpose, we have a collection of 150 *D. alata* accessions from different countries (South Pacific, etc), representing wide genetic crop variability, as well as 145 accessions of five other *Dioscorea sp*., closely related to *D. alata*, which present useful characteristics. This collection has been characterized at the morpho-agronomic, cytogenetic and molecular levels. Data on 13 morpho-agronomic characteristics were collected based on the IPGRI descriptors. Chromosome counting and flow cytometry were used to assess the ploidy levels. Fifteen microsatellite markers were used to estimate the genetic diversity of *D. alata* germplasm. The data obtained have made it possible to streamline cross-breeding and have also allowed us to select some good varieties that combine productivity, tuber quality and anthracnose resistance, which are directly usable by producers.

PP-7.54: Developing an effective protocol for embryo rescue in *Dioscorea* species

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Embryos were detected in developing seeds of *D. alata* from 40 days after pollination (DAP) in Ibadan, Nigeria. Embryos harvested from 40 to 80 DAP were cultured *in vitro* in Murashige Skoog (MS) medium supplemented with different combinations of growth regulators and vitamins to give six combinations. Medium M1 comprised MS basal salts + 3% sucrose + 0.1 mg/l Indole -3 acetic acid (IAA); M2 comprised MS + 6% sucrose + 0.1 mg/l IAA; and the composition of M3 was MS + 3% sucrose + 0.5 mg/l nicotinic acid + 0.1 mg/l thiamine + 100 mg/l inositol + 2 mg/l glycine. Trans-zeatin, at 0.1 mg/l, was added to medium M1 to produce medium M1TZ; to M2 to produce M2TZ; and to M3 to produce M3TZ. The responses of different ages of embryos of *D. alata* to the six different media under two incubation conditions were studied. The youngest embryos rescued were excised at 50 DAP and embryos cultured at 80 DAP showed the highest ($P<0.05$) percentage (74.1%) germination. The highest germination percentage and plantlet percentage (74.1% and 72.3% respectively) were obtained in medium M2TZ. Germination and plantlet formation varied with embryo age and media. The incubation conditions had no significant effect on percentage germination. The described protocols proved to be successful in regenerating seedlings from immature embryos of intra-specific hybrids in *D. alata*.

PP-7.55: A challenge to create more genetic diversity and variability in yam: Pollen preservation, embryo rescue, and interspecific hybridization

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In 2011, about 65% of the 56 million tonnes of yam that were grown worldwide were produced in Nigeria. Yam is an excellent source of carbohydrate energy for the people in West Africa and also contains nutrients such as vitamins, minerals, and dietary protein. Although the crop is important as a staple food in West Africa, it has not received much attention from research and development. To contribute to reducing poverty and increasing food security, IITA is breeding yam to produce new varieties based on demand and value addition. However, the breeding process is still being constrained by poor flowering, low fruit setting, and a low rate of seed germination. To create more genetic diversity and variability, improved efficiency in hybridization is needed for the transfer of traits among *Dioscorea* species. One of the fertilization barriers to hybridization of yam is a lack of synchronization in flowering period between male and female clones and among species; consequently the availability of viable pollen will contribute to improve hybridization efficiency. A pollen preservation method based on wet–cold storage was investigated. The *in vitro* pollen germination rate on the medium was examined in four species. To produce further variations, interspecific hybridization through the embryo rescue technique was applied. Results indicated that it was possible to store yam pollen at -20 °C for one year and that there were differences within species. The data obtained may be useful for planning crosses in hybridization experiments. Further investigation is needed to determine if a plant obtained from an ovule interspecifically crossed between *Dioscorea rotundata* and *D. bulbifera* is a hybrid.

PP-7.56: Regional GRC yam collections: Opening the access road to yam (*Dioscorea* spp.) diversity

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Observations have been made that there is inefficient use and conservation practices of plant germplasm by gene banks all over the world. One of the underlying causes for this has been the varying levels of genetic redundancy that hampers approaches to the conservation and use of germplasm collections. Though safe duplications are made in *in vitro* bank, the conservation of yam in the Genetic Resources Center, IITA Ibadan is predominantly in the field bank. Presently, there are about 4000 yam accessions, some of which have been requested and distributed to research institutions and plant scientists around the world. The yam collections get increased regularly through exploration and receipt of germplasm from national programmes and research institutes from other African countries. With pre-breeding activities like characterization and evaluation being carried out on the yam collections, more efforts are needed to reveal the missing link between yam cultivation and its sustainable production that can lead to poverty alleviation in sub-Saharan Africa. It is known that modern production techniques and marketing of yam in Africa is dependent on a limited number of varieties that are genetically uniform. There has been vested interest only in these varieties for uniform food products while most of the other varieties have been neglected. As the second most important root/tuber crop in Africa, the assurance of a better food security crop in yam due to its better shelf life, it is apparent that more exploration of the genetic diversity of yam can proffer answers to pressing issues like poverty alleviation in Africa.

PP-7.57: *In vitro* multiplication of *Dioscorea rotundata*: effects of gelled and gel-free medium on growth and conservation.

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Gelled and gel-free medium were assessed for growth and conservation of yam plantlets (*Dioscorea rotundata*). Single and two leafed nodal cuttings of the plantlets were placed into culture tubes containing 1ml of the gel-free Murashige and Skoog's (MS) basal salt medium supplemented with vitamins, growth hormones, 20g/l sucrose while 15 ml of MS medium was gelled with 0.2 % gelrite and 0.7 % agar separately. The cultures were maintained at 28^0C±2, 16 h illumination and at 2000-2500 lux light intensity. Proliferation rate, shoot length, number of leaves and nodes were higher in the gel-free medium compared to agar and gelrite gelled media. Percentage survival of the plantlets ranged from 90 – 100% after 60 days in culture. Easier diffusion of the medium components and decreased vitrification of the plantlets were observed in the gel-free medium.

PP-7.58: Effect of genotype and sett weight on vine cutting performance in water yams (*D. alata*) and white yam (*D. rotundata*)

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Field established plants from vine cutting have been less successful and this can be attributed to varietal differences and the sett weight for their establishment. Reliance on lateral branches obtained from plants produced by larger (yam) sett weights has proved difficult for vine cuttings. Minisetts derived mother plants used for vine cutting were evaluated between June 2011 and February 2012 at International Institute of Tropical Agriculture Ibadan, Nigeria. The objectives of this study were to know the influence of sett weights and genotypes on the potential of vine cuttings for plant establishment. Two varieties of *D. alata* and 4 of *D. rotundata* were selected for this study. Minisetts grouped as 10, 20, 30, 40, 50 and 100g were obtained from whole tubers. They were then treated with fungicide, air dried and planted at a spacing of 25 × 100 cm based on randomized complete block design with 3 replications. At 75 DAP, single nodal vine cuttings were excised from the mother plants and planted in nursery bags containing carbonized rice husk and top soil at ratio 1:2, then cultured under shade condition on outer space. Survival and shoot formation rate (%) in vine cuttings derived from mother plants originated from varied sett weights across all varieties was tested. Result showed that plants emerged from 10, 20 and 30g sett weight gave higher mean survival and shoot formation rate through vine cuttings than those of 40, 50 and 100g sett weight in all varieties. The ease of survival and new shoot formation conversely decreased as sett weight increased. As a better alternative source of seed production in yams, vine cuttings from less woody mother plants could be the option.

PP-7.59: IITA Bioscience Center: A platform for molecular laboratory techniques and training

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IITA Bioscience Center, for the past twenty years, has expanded and evolved to keep abreast of the rapid changes and growth in biotechnology and molecular biology. The Center is a service laboratory where we provide solutions to various biotechnological needs. It has stood in the forefront, providing scientists, students, staff and general users in Sub-Saharan Africa with a platform to carry out various experiments. The center in her effort to provide adequate services to users has designed various experiment procedures, developed important consumables and adequate training approaches. It is expected that with efforts made the Center the impacts will go a long way helping all users in attaining qualitative research. The genotyping and training services we provide include DNA sequencing, DNA fingerprinting, and training on laboratory techniques. Sequencing and Fragment Analysis is being performed on 3130xl Genetic Analyzer from Applied Biosystems. This instrument is fluorescence based where the genotyping methods are based on the sizing of fluorescently labelled DNA fragments. The instrument is capable of performing sequencing and fragment analysis of applications like microsatellite or short Tandem Repeats (STR), AFLP, LOH, SNP, rapid sequencing, standard sequencing and resequencing. Our sequencer is typically set up for rapid sequencing and fragment analysis but upon request, we can install 50cm array for standard sequencing (≤900bp) and 80cm array for ≥1000bp reads. DNA Extraction and Genotyping: Extraction of DNA from different organisms entails optimization of protocol depending the composition of the cell. As a result, we have optimized rapid and cost-effective DNA isolation methods from plants including; Yam, Cassava, Maize, Cowpea, Rice, Sorghum, Shea butter, Okra, Vernonia (bitter leaf), Hibiscus sabdariffa(Rossel), Kola nut, Corchorus as well as animal tissues, Insect, Fish, Bacteria, Virus and fungi etc. Genotyping for diversity analysis constitutes significant portion of tasks. Capillary based (semi-automated) and gel-based genotyping using SSR, AFLP, RAPD are in routine use. We have repertoire of SSR primers for cassava, yam, maize, cowpea, soybean, and banana.Research Institutes in Nigeria (and across West Africa), and young scientists would to realize the full benefits of this technology through our comprehensive training, adequate infrastructure and expertise in biotechnology. The Center has a laboratory research facilities and equipment that have been widely used by researchers from the national programs, post graduate students, National Youth Service Corps members and Student Industrial Work Experience Scheme (SIWES) members. We are equally proud to have former trainees who hold high government offices, work in CGIAR centers, and other advanced laboratories across the world.

PP-7.60: Participatory variety selection to reintroduce genetic variability in production systems of water yam (*Dioscorea alata*) in the Colombian Caribbean region

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In the 80's anthracnose disease caused by *Colletotricum gloeosporioides* devastated water yam production in Colombia. Chemical control although in some extent was effective, cost of the treatment increased the cost of production to unsustainable levels. Less cultivated varieties became common in the market but international market was taken over by Costa Rica as the new varieties did not meet the export market's volume and standards. A prospective research was undertaken aimed to release varieties with moderate resistance to the pathogen, to increase yam variability in farmers' fields and recover yam production and area in the country. The methodological process consisted of collection of national water yam diversity, on station screening of the collected germplasm, on farm farmers' participatory selection of pre-selected germplasm, on farm multiple cropping systems evaluations, and release of varieties. GIS tool, incomplete regression, and logistic analysis supported farmers and breeder evaluations to define recommendations for each released variety. On station field screening allowed to identify resistant, moderately resistant and susceptible varieties. From 15 resistant and moderately resistant clones, on farm breeder evaluation and farmers participatory selection conducted to release four varieties, one for dual purpose (industry and table), one for export, and two for local consumption. Recommendations were coincident only for two varieties and there were also gender oriented preferences. As consequence of this intervention yam production, yam area and yam export were reactivated in the country. Although genetic variability was re-introduced more detailed studies to understand pathogenicity of the fungus was proposed along with the generation of broader genetic base of improved varieties

PP-7.61: Participatory research program for yam crop in Colombian Atlantic coast

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Yam is one of the crops considered to be an orphan at national and international level. In Colombia, research into this crop has been promoted principally by support from the Dutch Cooperation Ministry (DGIS) as the first Colombian Agricultural Biotechnology Programme, it has led to carry out research using biotechnology in different areas of interest for a particular crop. National support is currently being provided by Colciencias and the Ministry of Agriculture and Rural Development who have financed several of the group's projects. Socioeconomic studies in the Colombian Caribbean region led to the conclusion that small farmers could not overcome their conditions of poverty if they could not count on support from research institutions offering them orientation, thereby leading to changing the traditional way in which such farmers' crops have been managed. The best way of improving their level and quality of life was through participative research with a main aim of setting up an integral technological and sustainable improvement strategy for yam growing, thereby contributing towards increasing the income and improving the quality of life for small producers from the Caribbean littoral. Our group has developed and consolidated solutions to overcome the main technological and environmental limitations affecting the yam crop and integrally tackling fundamental components for small producers' organizational development. This is being achieved via the participation of other institutions involved in the programme such as the Universidad de Sucre, Universidad de Córdoba, Corporacion Colombiana de Investigacion Agropecuaria (CORPOICA) and CIAT (Colombia). Our research group's efforts, together with that of other institutions, have led to extending yam grower's biodiversity via different technological strategies such as continuing to study pathogens affecting the crop. A start has been made on evaluating yam's potential in Colombia's cosmetics, chemical and food industries; through strengthening of participative research strategy. The inter-institutional research strategy has been consolidated through our participation in national and international yam research networks.

PP-7.62: Diversity of wild yams (*Dioscorea* L., *Dioscoreaceae*) in Africa

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The majority of exploited wild species of *Dioscorea* L. are threatened. To contribute to their conservation, their diversity in Africa was analyzed. About 4040 specimens mainly from Herbaria (P, K, BR, B and YA), literature and our own collections were examined. Collection localities were geo-referenced and mapped using DIVA-GIS software. The zone was subdivided into equally-sized square grid cells (1.75° x 1.75°) and biodiversity indicators were quantified. A total of 49 taxa of wild yams were recorded including 44 species, five subspecies and four varieties. The number of species per grid cell varied from 1 to 18. Geographically, The richest and the most heterogeneous grid cells (number of species more than 10, Shannon's index from 2.10 to 2.45 and Simpson's index from 0.86 to 0.92) were located in Democratic Republic of Congo (DRC), Republic of Congo, Cameroon, Ivory Coast, Central African Republic (CAR), Benin, Togo, Ghana and Malawi. In terms of phylo-geography, these grid cells are found in the Guineo-Congolian regional centre of endemism, the Guineo-Congolia/Sudania regional transition zone and the Zambezian regional centre of endemism. They could then be considered as priority sites for conservation.

PP-63: Possible genotyping effect on the moisture content and pH of stored elubo (slightly fermented yam flour)

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Local yam flour or *elubo* samples made from five white yam (*Dioscorea rotundata*) genotypes were used to assess possible genotypic effect on the moisture content and pH of *elubo* (slightly fermented yam flour) stored in lidded plastic cans for five months at 26-32^{o}C. Four newly bred white yam genotypes (TDr 89/2665, TDr/89/26777, TDr 95/19158, TDr 95/19177) with Nwopoko cultivar as a local check were used to produce the relatively dry flour samples through oven and sun drying. The moisture content of the freshly prepared oven dried samples ranged from 7.83% to 8.93% while those of sundried samples ranged from 8.50% to 9.03%. The pH values for all the fresh samples ranged from 5.52 to 5.91. After five months of storage the pH values became 5.21 to 5.63 with significant (P = 0.05) genotypic effect. Significant (P = 0.05 genotype variation was also observed in the moisture content of the oven dried stored *elubo* samples after the medium term storage.

PP-7.64: Characterization and conservation of wild genetic resources of yams in India

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Genetic variability is the basis for crop improvement and the source of such variability exists both in the advanced and primitive cultivars as well as in the wild and weedy relatives of the cultivated species. Genetic improvement programs at International Institute of Tropical Agriculture (IITA, Nigeria) and Central Tuber Crops Research Institute (CTCRI, India) are going on to achieve different breeding goals. Fifty species of *Dioscorea* are reported from India, of which 16 occur in the South Western Ghats and among these some are commonly found throughout (*D. bulbifera, D. pentaphylla, D. tomentosa, D. hispida, D. wallichii, D. pubera* and *D. oppositifolia*) while, others are restricted to specific niches (*D. hamiltonii, D. belophylla, D. wightii, D. spicata* and *D. intermedia*) depending upon elevation and forest type. The CTCRI addresses issues like collection/augmentation, characterization, evaluation, conservation, exchange and breeding work on yams. Being the National Active Germplasm Site (NAGS) for tropical tuber crops, CTCRI conserves 5175 accessions comprising of 50 species including 231 of wild *Dioscorea*. Here, 12 wild species of *Dioscorea* collected from different agro-climatic regions of India were characterized and conserved (*ex situ* and *in vitro*). The morphological characterization comprising of juvenile and mature plant characteristics, aerial bulbil and underground tuber characteristics were carried out based on IPGRI descriptors and interrelationships among 12 species was worked out. Protocols were standardized for rapid clonal multiplication of these 12 species through different routes such as nodal segment culture, direct and indirect organogenesis and *in vitro* bulbil formation through which conservation *in vitro* and exchange of germplasm could be achieved. The results enabled us to characterize and assess the extent of genetic variability available in wild yams with a view to design effective management and conservation programmes for sustainable utilization in breeding programmes for crop improvement.

PP-7.65: Agronomic evaluation of white yam (*Dioscorea rotundata* Poir.) under organo-mineral fertilizer treatment in southern Nigeria

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Degraded soil fertility status has been attributed to be one of the major constraint to sustainable yam production in sub-Saharan Africa, hence the need for improvement through appropriate low input and sustainable fertilizer application. Field trials were conducted at Ikenne, Ogun State, Nigeria in 2004 and 2005 to evaluate the effects of applied organic fertilizer with or without NPK on agronomic evaluation of white guinea yam (*D. rotundata* Poir.) in a forest alfisol of southwest Nigeria. Treatments comprised 10 rates of either organic fertilizer (OF) (cow dung + sorted city refuse), NPK12-12-12, their combination and a control. They were laid on a split plot arrangement in a randomized complete block design with four replications. Number of leaves, vine length, number of vine branches, leaf area and plant dry matter content were recorded at monthly interval while tuber yield was recorded at harvest. Data were analyzed using analysis of variance and means were separated using least standard error (S.E) at $P<0.05$.Results showed that number of leaves, vine length and tuber yield were significantly higher in fertilized plots than in the control. However, fertilizer treatments had no influence on number of vine branches, leaf area and plant dry matter content. Combination compost and NPK (2.5 t/ha OF+300 kg/ha NPK and 5.0 t/ha OF+300 kg/ha NPK) and NPK fertilizer alone at 450kg/ha were found to be superior to other treatments in most of the parameters evaluated and are therefore recommended in this study.

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