Biosciences for Farming in Africa: Media Fellowship Programme

Seventh Workshop Report Round 2 – Uganda

Front cover photo: B4FA media fellows touring a Confined Field Trial site for nematode-resistant GM bananas at the National Agricultural Research Laboratory, Kawanda, April 2013 – photo by Bernie Jones

Table of Contents

1. Fellowship advertisement and application form

Professional Development Opportunity

B4FA Media Fellowship

Application for participation

The Cambridge, UK-run ***Biosciences for Farming in Africa (B4FA)*** project is offering a Pan-African Professional Development programme over a six month periods to media professionals (including journalists, editors, broadcasters and producers) in our focus countries in sub-Saharan Africa – Ghana, Nigeria, Uganda and Tanzania. We are now recruiting participants for the second round of media fellowships in each country.

What is the programme about?

The theme of the Fellowship is to promote better understanding and dialogue on developments in agriculture and biosciences throughout Africa with specific emphasis on activities and research in our focus countries.

Subjects to be covered during the Fellowship include: the history of plant breeding and agricultural techniques, basic plant genetics, modern plant breeding and biotechnology for agriculture, the role of international and African industry (eg seed producers), regulatory frameworks and future opportunities and applications.

What will the Fellowship programme involve?

- Dynamic 4 day training course in each focus country
- Mentored field trips to regional scientific locations and projects of interest
- Supportive professional dialogue and mentoring from leading scientists, journalists and policy makers
- Opportunities for international travel and conference attendance for high achieving participants
- Opportunities for future paid mentoring
- Commitment to use learned skills and knowledge in the production of media pieces and facilitation to publish and produce relevant media pieces

What will participants get out of it?

- The Fellowship is unpaid. However, Fellows will receive expenses and per diems for training courses and field trips.
- The Fellowship will not infringe upon your responsibilities to current employment.
- Certificates will be provided on successful completion of courses and the Fellowship.
- Greater appreciation and understanding of current issues in agriculture, and the scientific work being carried out in Africa to help address these.
- Opportunities to hone reporting skills to bring important local stories to the attention of readers and listeners.
- Interaction with local and international experts.
- Benefit from mentoring by experienced African and international journalists.

If you wish to be considered for one of these Fellowships, please complete the online form available on b4fa.org in as much detail as possible, and submit it by 31 December 2012 together with all supporting material.

We will accept written material in Microsoft Word or PDF format, and audio material in mp3 format. If you wish to submit video material, please check with us first regarding the size and format of your file. If you are in employment in a media organisation, we require you to submit a letter of support from your editor, producer, managing editor etc indicating their willingness for you to participate and to permit you to attend the training courses.

We will be carrying out face-to-face interviews after shortlisting in late January and early February 2013. Proposed training dates for this year are mid-March for West Africa and mid-April for East Africa. Please ensure you will be available at these times before applying.

More details of the project and Fellowship can be found at b4fa.org

---

B4FA Media Fellowship - Online Application Form

- Which country are you applying for?*
  - ◉ Ghana ○ Nigeria ○ Uganda ○ Tanzania
- Name* (Given Name) & (Family Name)
  [ ] First [ ] Last
- Address*
  [ ] Street Address [ ] Address Line 2 [ ] City
  [ ] State / Province / Region [ ] Zip / Postal Code
- Date of Birth* mm/dd/yyyy
  [ ]
- Gender*
  - ☐ Male
  - ☐ Female
- Office and/or mobile telephone number* (preferred contact no first)
  [ ]
- Email*
  [ ]
- Name of media organisation for which you work (if any)*
  [ ]
- Job title (Reporter, editor, freelance etc)*
  [ ]
- Please describe your role, and for how long you have worked in it *

- Media qualifications*
- Previous media experience (jobs, traineeships etc)*
- Previous training courses taken (especially any science/ agricultural reporting courses)*
- List your current areas of interest in reporting*

- Please describe why you are interested in this Media Fellowship*

- Please describe why you believe you are a strong candidate for this Media Fellowship*

- Do you have the approval of your editor/producer etc to participate in this Fellowship for 6 months? *

  ☐ Yes

  ☐ No

- Name and position of approver*

- Please attach a letter of support*

- Examples of previous work:*
  All these pieces must be your own work – pieces found to have been copied will result in the disqualification of the candidate. Please submit up to 3 short pieces (up to 500 words each for print, or up to 3 minutes for audio/video) which you have produced in the last two years on an agricultural, scientific or technical issue. Please give a date and where the piece was printed or broadcast in each case. If you have NOT produced any agric, scientific or technical pieces in the last two years, please send us up to 2 examples of what you consider your best reporting on other issues, AND please write or record a NEW piece of up to 500 words or 3 minutes on an issue to do with agricultural, plant breeding or biotechnology currently in your country. Please copy and paste the text of your pieces in the boxes below, with their titles and when and where they were published. Alternatively, please attach them here, if your file is too big to upload on this form, contact us on the email address above

- Work 2
- Work 3
- Upload your work Preferably as a zip file
- Please list any experience you have of either farming or scientific research (if any) – eg former work, family engagement in these activity, experience from childhood etc.*
- If successful, are you able to commit to attending the mandatory training course and engaging with the Fellowship opportunities over the six month period?*

  ☐ Yes

2. Interview findings and candidates selected

For the second round in Uganda we interviewed 33 print and especially broadcast journalists. Word of mouth had raised the profile of the fellowship, so there were some senior and high profile applicants, including several who were well-known faces on national television. Most journalists had a specific farming or scientific interest, though there were also a number with a key interest in business as well.

Repeating the phenomenon we saw in the first round, surface knowledge of the issues seemed good, but beneath the surface, fundamental understanding of the issues was weak. Since the issue of biotechnology was an increasingly hot potato politically in Uganda, there was a great deal of interest in the regulatory side of the equation as well as the technical.

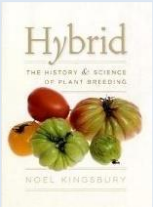
The ten most productive fellows from the first round were also asked to return as "alumni fellows" to act as mentors in their own right and also to consolidate their learning.

Prospective fellows selected from the interview round were:

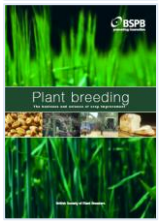
1. **Adiah Nakuti** Uganda Broadcasting Corporation (UBC) Television.
2. **Charles Kazooba** Africa News Group.
3. **Cliff Abenaitwe** Radio West, Mbarara.
4. **Craig Kadoda** NTV Uganda.
5. **David Livingstone Okurut** Kyoga Veritas Radio, Soroti.
6. **David Mafabi** Bureau Chief – Mbale, Monitor Publications Ltd.
7. **Diana Wanyana** KFM/Dembe FM Radio.
8. **Florence Naluyimbe** NTV Uganda.
9. **Grace Kengoro Kyomugisha** UBC Television.
10. **Herbert Musoke** Bukedde Newspaper.
11. **Joseph Akiiso** ETOP Radio.
12. **Joshua Mutale** Radio Simba.
13. **Paul Lubwama** Bukedde FM, Kampala.
14. **Richard Katongole** Sunrise Newspaper.
15. **Richard Katami Bwayo** UBC Radio Uganda.
16. **Ronald Musoke** The Independent.
17. **Rose Namale** Radio One/Akaboosi.
18. **Sarah Mawerere** UBC Radio Uganda.
19. **Tyaba Ssettumba Abubakar** NBS Television.
20. **William Odinga Balikuddembe** Uganda Science Journalists Association.

3. Pre-course reading material

Material distributed on USB stick and physically (book) before training workshops took place.



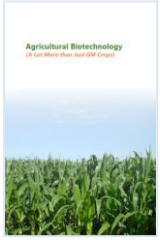
Noel Kingsbury: Hybrid – the history and science of plant breeding (Book)



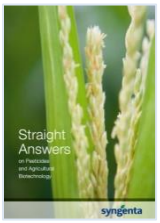
British Society of Plant Breeders – Handbook on Plant breeding

Conway and Waage: Science and Innovation for Development (Book)

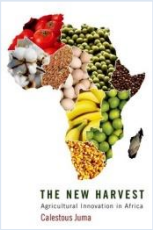
Sense About Science: I don't know what to believe – making sense of science stories



ISAAA guide to Agricultural Biotechnology



Syngenta's Straight Answers on Pesticides and Agricultural Biotechnology



Calestous Juma: The New Harvest – Agricultural Innovation in Africa

Mark Lynas' Speech at the Oxford Farming Conference (video)

4. Workshop Programme

Initial Dialogue and Training Workshop on Plant Breeding, Genetics and Biosciences for Farming in Africa

PROGRAMME

10 – 13 April 2013
Speke Resort and Conference Centre, Kampala

Please arrive at the hotel on Tuesday 9 April. Accommodation has been arranged.

Day 1 – Wednesday 10 April 2013

0900	**Welcome and Introductions** *Prof Sir Brian Heap; B4FA Project Leader* *Bernie Jones; B4FA Course Leader*
1000	**Issue Brainstorming** – *tea/coffee*
1030	**History of Plant Breeding and Agriculture** *Bernie Jones*
1100	**Fundamentals of Plant Genetics** *Moses Adebayo; Ladoke Akintola University, Ogbomoso, Nigeria*
	Practical Exercise – Inheritance of Traits
1200	**Practical Experiment – DNA extraction**
1300	**Lunch**
1345	**Fundamentals of Science Journalism** *Peter Wamboga and Patrick Luganda*
1415	**F1 Hybridisation** *Claudia Canales; B4FA*
	Practical Exercise – F1 Hybrids and saving seed
1530	**Break** – *tea/coffee*
1600	**Fundamentals of Genetic Modification** *Jim Dunwell; University of Reading, UK*
1715	**Journalism – Feedback**
	Dinner

Day 2 – Thursday 11 April 2013

Breakfast

Field Trip 1

0800 Depart

Mukono Zonal Agricultural Research and Development Institute

Return to Hotel

1300 **Lunch**

1400 **Local case-study 1 - Sorghum**
Clet Wandui Masiga, ASARECA, Entebbe

Local case-study 2 - Tissue Culture
Erostus Nsubuga, Agro-Genetic Technologies Ltd, Kampala

Local case-study 3 - Banana
Reuben Tendo Ssali, National Agricultural Research Laboratories, Kawanda

1530 **Discussion** – *tea/coffee*

1600 **Round table discussion sessions**

- **Journalism – Story Ideas**
- **Journalism – Crafting a "Top"**

1730 **Bus departs for Emin Pasha Hotel**

Launch of B4FA "Insights" booklet on biosciences in Africa

1900 **Launch Presentations**
Prof Sir Brian Heap
Hon Tress Bucyanayandi, State Minister of Agriculture, Animal Industry and Fisheries

Buffet reception

2100 Return to Speke Resort and Conference Centre

Day 3 – Friday 12 April 2013

Breakfast

Field Trip 2

0800 Depart

National Agricultural Research Laboratories, Kawanda

Return to Hotel

1300 **Lunch**

1400 **Marker Assisted Selection**
Tinashe Chiurugwi, National Institute for Agricultural Botany, UK

1430 **Local case-study 4 - Cotton**
Lastus Katende Serunjogi, Cotton Development Organisation, Kampala

Local case-study 5 - Maize
Yona Baguma, National Agricultural Crop Resources Research Institute, Namulonge

1530 **Discussion** – *tea/coffee*

1600 **Round table discussion sessions**

- **GM reality – from SeedFeedFood**
- **Will Ugandans buy GM food?**
- **Practical Exercise – Marker assisted breeding**
- **Policy document: Regulation of GM in Africa**

Dinner

Day 4 – Saturday 13 April 2013

	Breakfast
0900	**Ethical and moral issues** *Brian Heap; University of Cambridge, UK*
1000	**International case study - Maize** *Moses Adebayo; LAUTECH Nigeria*
1030	**Break** – tea/coffee
1100	**Agricultural biotechnology and the regulatory environment** *Arthur Makara, SCIFODE, Kampala*
1145	**Agricultural biotechnology and industry** *Daniel Otunge; African Agricultural Technology Foundation, Nairobi*
	Discussion
1300	**Lunch**
1400	**Keynote speech** tbc
1445	**Prize-giving and closing** Next steps and opportunities Announcement of prize-winners for best articles produced Award of Certificates
1600	**Official Close** – tea/coffee

5. List of participants and biographies

B4FA Media Fellows

Adiah Nakuti Uganda Broadcasting Corporation (UBC) Television.

Adiah is a Ugandan by nationality, and is 29 years of age. She attended university education at the Islamic University in Uganda and holds a Bachelors degree in Mass Communication. She is currently working for Uganda Broadcasting Corporation as a news reporter for the Television

Charles Kazooba Africa News Group.

Charles is a journalist by profession and an entrepreneur by purpose. He studied Journalism and Media Management (Diploma) 2001 at the Grotius School of Law and Media Studies, Human Rights (certificate) at Makerere University in 2000 and is currently pursuing a Bachelors of Laws Degree at Kampala International University. He has also attended several short courses in Journalism over time. He started as a freelance reporter with Vision Group (2002) and on to The Stream publications (2003-2005) as a sub editor before joining The New Times (Rwanda) as a n editorial team leader at the Kampala Bureau later joined the East African/Nation Media Group as a Special Correspondent for parliamentary news. He manages News of East Africa which produces monthly print and online publications.

Cliff Abenaitwe Radio West, Mbarara.

Cliff Abenaitwe is a journalist and has been working with Radio West Mbarara for the last 4 years. He is 25 years old and has a Bachelor's degree of Mass Communication from Makerere University Kampala and other trainings in counseling, public speaking, health and crime reporting. The eldest in a family of four, Cliff has special interests in writing about farming, health, water, business and environment. He is currently the business news Editor at Radio West and a blogger.

David Livingstone Okurut Kyoga Veritas Radio, Soroti.

David was born in the current Ngora district in eastern Uganda in 1978 and completed his Diploma in Journalism and Mass Communication in United Media Consultants and Training School of Journalism and Mass Communication, before enrolling for undergraduate studies in Mass Communication and Public Relations in Cavendish University, Uganda. He is currently employed by Kyoga Veritas Radio as a programme manager and a presenter.

David Mafabi Bureau Chief – Mbale, Monitor Publications Ltd.

David holds a BSc in Mass Communication and a Diploma in Secondary Education (Literature and English). He started working with Daily Monitor as a freelance in 2004, raised from this position to that of a retainer (correspondent) before he became a staff reporter and later a Bureau Chief in charge of Eastern region covering five sub-regions: Sebei, Karamoja, Teso, Bugisu and Bukedde with 32 districts. He is a 2007 winner of the Uganda Investigative Journalism Awards, Eastern Region (Print), and a health fellow from Makerere University school of Health Sciences 2012. He also holds

various certificates in environmental journalism, human rights, child rights, investigative journalism, democracy and good governance.

Diana Wanyana KFM/Dembe FM Radio.

Diana has a diploma in mass communication and journalism. She is pursuing a degree in social sciences. SHe has a particular interest in science and agricultural reporting in broadcast media.

Florence Naluyimbe NTV Uganda.

Flora is a senior health and science reporter with NTV Uganda. She graduated with a First Class Honors Bachelor of Arts Degree in Communication and French from Makerere University Kampala in January 2008. She also has a certificate in Broadcast Journalism from Multimedia College in Kenya, masterly in TV scripting, video editing and camera operation. She started her Journalism career while working as an English Sub-Editor for Flash FM station in Kigali, Rwanda for a month in 2009. In December 2009, she joined The Nation Media Group, with a particular focus on science and health.

Grace Kengoro Kyomugisha UBC Television.

A Ugandan by nationality, Grace is 40 years of age, and started broadcasting on television in 1999. Since then she has focussed particularly on producing agricultural programs on television, worked for Uganda Broadcasting Corporation TV. She has a bachelor's degree in social sciences, and a UNEB diploma in Journalism

Herbert Musoke Bukedde Newspaper.

Herbert is a journalist and has worked for five years for Bukedde newspaper. He also reports for the New Vision paper as a Features' Reporter which covers Farming, General features, Motor mart, Business and Health. He is a graduate of Kyambogo University with a Bachelors Degree of Development Studies

Joseph Akiiso ETOP Radio.

Joseph is currently working with Vision Group, a multi media organizatio,n as the station manager of the business unit Etop radio. He also has experience of programme management, presenting and marketing from several other media houses. He has hands on multimedia experience in both community and urban media. He has the passion of using media for community engagement. Joseph has enjoyed working with community radio programming to foster change through providing the community a platform for information sharing and debate.

Joshua Mutale Radio Simba.

Joshua is 26 years of age, attained a diploma in Journalism and began work as a local journalist for Radio Simba. He is currently pursuing a bachelors degree in industrial and organizational psychology at Makerere University. He has a six years experience in different fields of journalism such as Politics, health and environment.

Paul Lubwama Bukedde FM, Kampala.

Paul is a graduate of the Uganda Institute of Business and Media Studies. He worked at NBS Radio Station in Jinja, before moving to his current role in Kampala, working for Bukedde FM Radio.

Richard Katongole Sunrise Newspaper.

Working for the sunrise newspaper, Richard has been into media for four years now. Three years part timing and one fully committed to freelancing. He has been a general writer and a photographer contributing to the Save Media House. He is also graduating from Ndejje University with a bachelor's degree in Journalism and Mass Communication. Other skills he has include cartoon drawing, videography and writing.

Richard Katami Bwayo UBC Radio Uganda.

Richard Katami Bwayo has worked for Radio Uganda for over 15 years. He is a presenter and programme producer and has a particular interest and specialisation in agricultural and environmental programming.

Ronald Musoke The Independent.

Ronald possesses more than five years of journalism experience and currently reports for The Independent newspaper. His field of specialization is environmental reporting. After finishing his Bachelor of Arts studies in 2004, he started his journalism practice with a small newspaper, The Eye. Between 2006 and 2007, he went back to Makerere University to specialize in Environmental Journalism and Communication from where he graduated in 2008 with a Post Graduate Diploma. He went on to work for two years with one of the leading environmental magazines in the East African region, EnviroConserve AFRICA. He has also worked with The Green Chronicles Magazine and also freelanced with The Sunrise. He also contributes as guest writer to The New Vision, Uganda's biggest daily newspaper.

Rose Namale Radio One/Akaboosi.

Rose Namale is a journalist and broadcaster by profession and is currently working with Radio One and Radio Two Akaboozi. She particularly specialises in reporting on science.

Sarah Mawerere UBC Radio Uganda.

35 years of age, Sarah is a radio broadcaster working for Uganda Broadcasting Corporation Radio. She has worked for UBC for the last 10 years. She currently works as a radio producer and presenter awith a particular focus on coverage of health and agriculture.

Tyaba Ssettumba Abubakar NBS Television.

Aged 30, an employee with NBS TV in Kampala, Tyaba Ssettumba Abubakar is currently the features editor, having risen through the ranks over the years. His interests lie mainly in reporting agriculture, health and the environment. He occasionally reports at parliament. He is also the state house reporter at NBS radio station. He attained a bachelors degree in tourism from Makerere University, Kampala.

William Odinga Balikuddembe Uganda Science Journalists Association.

Born in Luweero in 1978, William is a journalist, researcher, writer and film maker by profession. He enjoys farming and construction.

B4FA Media Fellow alumni

Christopher Bendana New Vision

Christopher attained a Bachelor's Degree in Mass Communication, followed by a one year internship at the Observer newspaper in Kampala as a reporter. He has also worked as a Freelance writer, before his current role writing features pieces with the Vision Group.

Henry Lutaaya Sunrise Newspaper

Henry attained a Bachelors of Arts degree in Mass Communication, during which he specialized in print journalism. He also holds certificates in Investigative Reporting, Applied French (including a Diplome de Langue), and in Public Speaking. Henry is currently a news editor for the Sunrise newspaper, and also serves as Treasurer of the Uganda Science Journalists Association.

Isaac Wafula Khisa The East African

Isaac Khisa is a Ugandan business journalist working with the Nation Media Group's "East African" newspaper. Following special training in journalism in Nairobi with Nation Media Group, he worked with Monitor Publications Limited in Kampala as a freelance journalist, focusing on hard and soft news reporting, before moving to his current position. He has participated in the journalism training courses on climate change by the British Council Uganda and analytical news reporting by Makerere University.

Kasooha Ismail Kagadi Kabale Community Radio

Kasooha Ismail attained a National Diploma in Journalism. He works with Kagadi Kibale Community Radio as a presenter and producer of agricultural programmes, as well as a news reporter and news editor. He also serves as a reporter for the Vision Group of companies. He also works in partnership with Farm Radio International and the African Farm Radio Research Initiative.

Lominda Afedraru Daily Monitor

Lominda attained a higher diploma in Marketing but studied short courses in environmental reporting. She also completed a short training course in rural agricultural reporting courtesy of the International Women's Media Foundation in the United States of America. After undergoing a science reporting mentoring programme, she began to specialise more in this direction. Now the Secretary General of the Uganda Science Journalists Association, Lominda currently works with the Monitor Publications as a freelance journalist writing articles on Agriculture, ICT, Health, Environment and Climate Change.

Michael Ssali Daily Monitor

Michael trained as a secondary school teacher specializing in English and Fine Art. In 1981, while in Nairobi, he trained as a journalist and wrote articles for the Daily Nation and Kenya Times. He returned to Uganda to work with the New Vision. Michael has a Gemini sponsored course in Development Journalism in Dar-es-Salaam, and enrolled for a 2 year course in Agricultural Reporting. Following successful completion, he writes articles on the Farmer's Diary, a column in the Daily Monitor every Wednesday. Michael also heads up the Masaka Bureau of the Daily Monitor.

Odong Jamesbond Etop Radio and Newspaper

Jamesbond attained a diploma in journalism and Mass Communication and is currently pursuing a Bachelor's degree in Public Relations and Media Management. He has worked with Vision Group's Radio Department before being attached to Etop Radio as a programmes producer and presenter. He is a writer for Etop Newspaper covering areas of Agriculture and environment.

Paschal Boris Bagonza Radio Sapientia

Paschal attained a Bachelor's Degree in Guidance, Counseling and Psychology, as well as Diploma in Journalism and Media studies. He has attended trainings in climate change, environment and water integrity. He is News Editor /Producer at Radio Sapientia (Social Communications Department, Uganda Catholic Secretariat), as well as a member of the Water Journalists Africa and Biodiversity Media Alliance. A science reporter with a focus on water reporting and climate change, Paschal also serves as a UN online volunteer writing education articles. He is currently pursuing a Masters Degree in Comparative Social Work.

Ronald Kato Bukedde FM Radio

Ronald is a radio journalist at Bukedde FM. He also serves as a reporter for Catholic FM Radio Sapientia, and the features and magazines desk of Vision Voice. He has had involvement with both "Harvesting Money", the premier English language farming show on Radio, and with the farming program "Kungula"

Sarah Natoolo UBC Radio

A journalist by profession, Sarah Natoolo is working with Uganda Broadcasting Corporation. In addition to her role as reporter covering Parliament on number of issues including committees and plenary sessions, Sarah is passionate about covering agricultural, technology and environmental issues.

B4FA Experts, Presenters & Mentors

Adebayo Moses Adeolu Ladoke Akintola University, Ogbomoso
adebayovam@yahoo.com

Moses holds a BAgric in Plant Science from Obafemi Awolowo University, Ile-Ife, Nigeria and an MSc in Plant Breeding and Crop Science from the University of Ibadan. He was successful in winning a place in the first year intake to the West African Centre for Crop Improvement (WACCI) scholarship programme at the University of Ghana, Legon, through which he has been pursuing his PhD studies and submitted his thesis. He is on the academic staff at the Dept of Crop Production and Soil Science, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso where he has responsibility for genetics and plant breeding. He has also carried out his research work at the International Institute for Tropical Agriculture (IITA), Ibadan, where he worked on drought tolerance in maize. Moses is happily married with three children.

Arthur Makara Science for Development (SCIFODE)

Clet Wandui Masiga Association for Strengthening Agricultural Research in East and Central Africa (ASARECA)

Clet Wandui Masiga works for the Association for Strengthening Agricultural Research in East and Central Africa's (ASARECA's) Agrobiodiversity and Biotechnology Programme. He is a Conservation Biologist and Geneticist with extensive experience in agricultural research and development work. His work has focused on different aspects of research in biology, genetics and breeding. He worked on several agricultural consultancies and development projects in Uganda, Kenya, Sudan, Syria, Tanzania and United Kingdom before joining ASARECA in 2009. He is a regular writer on biotechnology topics in Uganda and contributes regular biotechnology articles in Uganda's leading newspapers. He is a former genetics lecturer at the Uganda Christian University. Currently, he provides managerial , intellectual and research monitoring support to scientists implementing 10 projects that focus on utilizing biotechnology as a tool to improve agricultural production in East and Central Africa.

Daniel Otunge African Agricultural Technology Foundation, Nairobi
d.otunge@aatf-africa.org

Daniel Otunge, a Kenyan, is a development communication expert with over 10 years' experience. He holds a MA in Philosophy, a Postgraduate Diploma in Mass Communications, and a BA in Sociology from the University of Nairobi. Prior to joining AATF, Daniel was the head of Communication and Advocacy at the African Seed Trade Association (AFSTA) where he helped establish and manage the communication department responsible for corporate communication, membership relations, events management, strategic communication, logistics and biotechnology outreach programme targeting seed companies and national seed trade associations in Africa. Before joining AFSTA, Daniel worked for six years as communication officer with ISAAA AfriCenter. Daniel also teaches mass communication and development communication at St Paul's University, Limuru, Kenya. As Regional Coordinator of the Open Forum for Agricultural Biotechnology (OFAB), Daniel is responsible for effective and efficient coordination and management of OFAB activities in Africa.

Jim Dunwell University of Reading, UK
j.m.dunwell@reading.ac.uk

After graduating in Botany from Oxford University, Jim Dunwell worked for 16 years at the John Innes Institute in Norwich where he obtained a PhD in Plant Physiology. His research interests included the production of haploid plants and the development of in vitro regeneration techniques for a range of crop plants. He then spent 10 years in the commercial sector at ICI Seeds, later Zeneca Plant Sciences, at the Jealott's Hill Research Station, where he was responsible for an international programme on the development and exploitation of transgenic crops. With the support of a BBSRC Industrial Fellowship, he moved in 1996 to the University of Reading where he is Professor of Plant Biotechnology and has research interests in plant breeding, gene expression and protein evolution. He recently served on the UK Food Standards Agency Advisory Committee on Novel Foods and Processes, and the Royal Society Working Group on biological mechanisms for enhancing food-crop production. He am now a member of the Defra Advisory Committee for Releases to the Environment, the group that advises the UK government on the growing of GM crops.

Julia Vitullo Martin Journalist
jvm@belnord.org

Julia Vitullo-Martin (PhD, University of Chicago) is a New York-based independent journalist who is a Senior Fellow at Columbia University's Center for Urban Real Estate and Director of the Center for Urban Innovation at the Regional Plan Association. Her work focuses on development issues such as comparative economic analysis, planning and zoning, waterfront development, public housing,

environmental review, and historic preservation and design. Her current project, The Future of Urban Food, looks at the functions and benefits of food in local economies.

Vitullo-Martin has been widely published in a variety of newspapers and magazines, including the Wall Street Journal, the New York Times, the New York Review of Books, the New York Post, the New York Daily News, Monocle, Forbes, and Fortune, as well as academic journals. She has authored and edited three books, including Breaking Away: The Future of Cities (Century Foundation Press, 1996). She served as co-director of the Templeton-Cambridge Journalism Fellowships at the University of Cambridge from 2033 through 2011.

Lastus Katende Serunjogi Uganda Cotton Development Organisation

Patrick Luganda Farmers Media Network

A print journalist by training, Patrick works with the media, science organisations and farming communities to improve science and agricultural communication and understanding throughout Africa.

Peter Wamboga-Mugirya Science for Development (SCIFODE)

A B4FA journalism mentor, Peter's organisation communicates, demystifies and engages policy makers and stakeholders on matters of science and technology and sustainable natural resources management in Uganda and the African continent.

Reuben Tendo Ssali National Agricultural Research Institute, Kawanda

Reuben is a Research Officer with the National Agricultural Research Organisation working on the improvement of bananas as a plant breeder. He holds a masters degree in Crop Science and a Bachelor of Science degree from Makerere University and is currently a PhD student with the University of Stellenbosch in South Africa. His vision is to contribute to the knowledge in the field of crop science for the welfare of humanity. He is currently developing molecular markers for Fusarium wilt resistance in bananas, evaluating six advanced banana hybrids with farming communities of Mpigi and Mukono districts and developing diploid male parents for the conventional banana breeding strategy, in addition to being the curator of the regional (ECA) banana germplasm collection in Mbarara. Some of his accomplishments include: 1) Developing mutant germplasm resources for Musa 2) Releasing the first Matooke Hybrids (Kabana 6H and Kabana 7H) in Uganda, 3) Collecting and characterising most of the banana germplasm in the East and central African region. Mr Ssali is a member the Uganda plant breeders association(UPBA) and the African crop science society(ACSS)

Sharon Schmickle Journalist
sschmickle@gmail.com

Sharon Schmickle is an award-winning journalist with 30 years of experience covering local, national and international news. As a reporter for the Minneapolis Star Tribune, her beats included the Washington bureau during the 1990s and covering wars in Iraq and Afghanistan during the 2000s. She also covered science with emphasis on agriculture and biotechnology. More recently, her science coverage has appeared in the Washington Post, MinnPost.com and the web site of the Pulitzer Center on Crisis Reporting in Washington DC. Beyond graduating from the University of Minnesota's School of Journalism, Sharon has studied under fellowships including the Templeton-Cambridge 2007 science journalism fellowship at Cambridge University in England, the Knight Science Journalism program at Massachusetts Institute of Technology and the Council For the Advancement of Science

Writing Inc. in New York. Her journalism awards include: McClatchy Presidents Award for a series about attitudes in Japan toward genetically modified foods, Pulitzer Prize finalist for coverage of the U.S. Supreme Court justices and federal judges, National Press Club's Washington Correspondent of the Year for coverage of the federal budget as it affected one Minnesota community, Overseas Press Club of America first place award for coverage of agricultural trade friction between France and the United States. Sharon has taught writing, journalism and public affairs at Macalester College, the University of St. Thomas and the University of Minnesota's Humphrey Institute.

Dr Tinashe Chiurugwi **National Institute for Agricultural Botany, Cambridge**

Dr Chiurugwi currently works for National Institute of Agricultural Botany (NIAB) in Cambridge, UK on a B4FA scoping study to explore how the NIAB Innovation Farm concept could be applied in various African countries. Graduated with BSc (Hons) Crops Science (Zimbabwe) and PhD Plant Molecular Biology (Reading), and has worked on a range of horticultural and arable crops in Zimbabwe and the UK with Pioneer Hi-Bred, Seed Co Ltd, University of Reading and Rothamsted Research.

B4FA Staff

Bernie Jones B4FA
bernie@b4fa.org

Based in Strasbourg, France, Bernie Jones specialises in the development and science policy and communications area. He has been Interim Executive Director for the InterAcademy Panel and the InterAcademy Medical Panel, International Director of Shaw Trust – a UK disability charity, Head of International Policy at the Royal Society, and Executive Director, European Academies Science Advisory Council. He has also worked in the commercial arena, spending 8 years working in a variety of roles at British Airways plc. Bernie is a graduate of the Universities of Edinburgh and Cambridge in the UK, with degrees in Cognitive Science, Computer Science and Experimental Psychology.

Claudia Canales B4FA; University of Oxford, UK
claudia@b4fa

Claudia Canales is a plant molecular biologist based at Oxford University, United Kingdom with a near decade of experience in plant genetics research. She worked as Senior Project Officer for the ISAAA, based in the Philippines. A graduate of the University of Reading in Environmental Biology, she gained a DPhil in Plant Genetics at Oxford.

Eve Watts B4FA
eve@b4fa.org

Eve Watts is based in Kampala, Uganda, and has worked in Africa for the past 10 years in a variety of projects including both human development and agricultural private enterprise. Her main focus has been on governance, policy development, agriculture and social development. She holds a Bachelor of Social Work and a Doctor Juris from Murdoch University.

Molly Hurley Dépret B4FA
molly@b4fa.org

Based in London with a strong experience of communicating about why science and technology matter, Molly has worked as a global consultant and for a number of innovative global companies in the science and technology sector and has developed and implemented multiple communication strategies, including social media, web sites, infographics and other creative materials. She holds a Master's degree in Cultural Anthropology from the City University of New York and taught anthropology at Baruch College (CUNY) and George Mason University in the United States.

6. Training course and Field Trip highlights

The training workshop once again took place at the Speke Resort and Conference Centre outside Kampala over a four day period, and included an enhanced number of games/simulations, a practical exercise (DNA extraction), and two afternoons of field trips to the Mukono Zonal Agricultural Research and Development Institute (MUZARDI) and a repeat visit to the National Agricultural Research Laboratories Kawanda. We also held the Uganda launch of the B4FA book of essays "Insights" on one of the evenings of the workshop.

Participation

All but one of the fellows selected at interview attended the workshop – the other had to drop out due to pressure of work.

Programme

The programme followed the new format for the second round that was successfully implemented in West Africa. The only additional innovations were the addition of an interactive presentation and discussion session on the ethics and morals of GM and biotechnology (building on a short presentation trialled in Nigeria) and a session on the potential new products that could arise from the use of GM technology (capitalising on the knowledge in the area of one of our international experts).

Reflecting the great technical sophistication of the Uganda fellows, we held a presentation on marker-assisted selection to complement the game we devised.

Fellows

The big issues facing the Ugandan fellows in their reporting and analysis was the political row that was increasing over the signature of the biosafety bill by the President The inaction and ever deepening debate had already caused Monsanto to pull out of the country which was a big story in itself (not that they sold any GM material in Uganda).

The increasing disease burden on Ugandan crops is also becoming more significant in terms of reporting – as we were meeting, another new disease – maize lethal necrosis – was making the local and global headlines.

Language remains an issue as well – almost all fellows speak excellent English, but the problem they face is when writing or broadcasting about biotechnology in their local languages. They report that there are simply no (agreed) terms for many of the new concepts, like hybrids seeds, or GM or tissue culture, or where terms have been coined, that they are overwhelmingly negative.

Innovation

Feedback continued throughout the course appreciating its innovative nature – especially the combination of scientific presentations and expertise combined with the opportunity to learn about the fundamentals, and take part in practicals and games to consolidate the learning. The addition of the interactive debate sessions proved popular, tackling journalism issues as well as public acceptability and uptake of GM foods.

Local scientific participation

Scientific participation was good, with the B4FA project and B4FA fellows beginning to build up a reputation in the Ugandan scientific community as good partners and people to interact with.

Field trips

At Kawanda fellows had a brief tour of the tissue culture labs before going to see the coffee mother garden (gene bank), hybrid banana trial plots and touring additional GM confined field trial sites (for nematode resistance this time).

At MUZARDI fellows were given a presentation of the range of locally-focussed activities the Institute carries out, before seeing a breeding and tree grafting facility, vegetable trial plots, and experiments to evaluate the local suitability of new crop varieties.

Journalism exercises

We only asked fellows to produce a single piece of journalism for mentoring and judging. This afforded us the chance to work with them in depth on improving the piece, as well as carrying out side-exercises on crafting the title, and a top, and thinking about audiences for their piece. Some fellows nevertheless produced more than one. Alumni fellows had the choice of whether to produce their own piece or whether to mentor the new fellows in the production of theirs.

Continuity

Fellows were delighted that we had decided to extend all the fellowships to the end of the project, and felt there was high value in remaining part of the fellowship and benefitting from further engagement and future opportunities.

7. List of in-course journalism pieces produced

Journalism exercises – in course pieces produced by media fellows.

Bio-Science key to Achieving MDG1 in Africa

Cliff Abenaitwe

African countries have a long way to go if they are to achieve the millennium development goal one (MDG1) of halving by 2015 the proportion of people suffering from extreme hunger and poverty.

Less than 3 years to the deadline, the continent is still synonymous with millions living below the poverty line and it is still affected by hunger which seems to be going nowhere.

According to the UN food and agriculture 2010-2011, sub Saharan Africa is home to 26 percent of the world's undernourished population, has the highest number of countries experiencing food emergencies due to in part, to climate extremes such as drought and exacerbated by civil unrest. The same reports reveals that Sub Saharan African still experiences increased food imports and is very vulnerable to global food price increases.

Experts attribute this trend to the poor performance of the agricultural sector.

The academy of science of South Africa (ASSAF) in its 2012 regulation of agricultural GM technology in Africa report reveals that the poor performance of the agricultural sector undermines Africa's prospects of attaining the MDGs and sustainable development in general. "The low agricultural productivity is associated with a wider range of factors, including low investments in education, infrastructure, research and development and over reliance on convectional technologies", the report explains.

The solution for Africa is to improve the performance of the agricultural sector.

However this report warns that much as the application of the best conventional agricultural technologies can make significant contribution to improving food security, it is not sufficient in itself. " The expansion of cultivated land through mechanization and provision of fertilizers can make a positive impact on food security in Africa but further benefits can be achieved by the application of modern biotechnology methods to plant improvement programs, principally for the so-called 'orphan crops' of particular importance to Africa", the report suggests.

According to Doctor Fen Beed, a pathologist from the USA who has worked in Uganda, Tanzania, Malawi and Ghana, it would be surprising if Africa met the MDG1 by 2015 but according to him, this can be achieved in years to come."If African countries can adopt bio-technology and other good farming practices, poverty and hunger can be reduced but this will be after 2015," he added.

Other scientists also agree with Doctor Beed on the role of bio-technology in agricultural improvement in Africa.

In the book Insights; Africa's future.. can bioscience contribute?, Calestous Juma, a world renown scientist argues that African agriculture will need to intensify the use of science and technology more than would have been the case without the threats of climate change. "Investment in science and technology will be required along the entire agricultural value chain from resource intelligence through production, marketing, storage and ecological rehabilitation," he explains.

Synonymous with what the researchers are recommending, African countries are making commendable progress in the use of Bio-science.

At Mukono zonal agricultural research and development institute research into improved crop species is under way and the institute has already developed improved fruit varieties. "The breeds we are developing as a result of grafting and cross breeding are disease resistant, quick maturing and high yielding," Robinah Gafabusa, a fruits and vegetables research technician at this institute explains.

At the National research Organization NARO, researchers are developing different crop varieties to help farmers cope with the problem of diseases and low yields. According to Tendo Sali Lauben, a

crop breeder at NARO, they have already developed banana varieties like M20, M9, M21 which mature fast, are disease resistant and they give high yields.

Numerous research institutions and scientists are currently working on developing different Bio-technologies and the African continent is getting itself ready for genetically modified technologies. However, Doctor Charles Lagu from the Mbarara agricultural research and development institute is calling for more sensitization of the farmers to adapt to these technologies if the current efforts are to bear fruits.

It is estimated that by 2050, the world population will increase to 9 billion people and this will increase food demand. The food and agriculture organization of the United Nations (FAO) is predicting that food production will need to increase by 70 percent.

To me, scientists and researchers, embracing Bio technology and genetically modified technology for agricultural improvement is the way to go and we all have a role to play in this.

Agricultural Innovation

Adiah Nakuti, UBC TV

Video file archived on B4FA.org

Come clear on GM, Scientists urge African policymakers

By William Odinga Balikuddembe

Scientists have urged policymakers and regulators to publicly defend their decisions on Genetic Modification (GM).

Through a publication titled Regulation of Agricultural GM Technology in Africa, the scientists warn that: "National policies and laws on agricultural biotechnology can only be successfully and effectively implemented if there is a real political will and conviction."

The book, published by the Academy of Science of South Africa (ASSAf) in November 2012, warns that while biotechnology can help transform Africa's agriculture, increase food production and enable African communities adapt to climate change, the continent is still preoccupied with the debate on the role and safety of technology in food production and sustainable development.

"Africa is failing to effectively harness and use new knowledge and innovations to fight hunger, eliminate malnutrition and achieve higher levels of human development," the book states in part.

The Ugandan Parliament is currently consulting on the Biotechnology and Biosafety Bill which, if passed, will regulate the use and management of biotechnology, including genetic engineering, in Uganda. Genetic engineering is a process which involves the transfer of a select gene from one living thing to another to serve a particular purpose. For example a gene can be introduced in a plant to help it resist drought, diseases or pests.

"The mixed response to GM technology by European Union (EU) countries and the negative sentiment in the EU, Africa's major trade partner, has undoubtedly influenced the political acceptance process in Africa," the book states. It recommends that regulation of agricultural biotechnology and genetic modification should be based on peer-reviewed evidence.

The book calls for use of transparent and inclusive institutional mechanisms to engage the public in GM technology regulatory processes.

Low uptake of agricultural biotechnology and GM crops, the books states, is associated with inadequate investment in scientific research and promotion of innovation, policy makers' indecisiveness and passive participation of African scientists and science associations in the GM discussion.

Meanwhile, MP Denis Obua, Chair of the Science and Technology committee of Parliament, and representing Ajuri County, Aleptong district, has stressed the need for public educating about biotechnology.

"We need to do more education of our people in what biosciences can do to transform lives of large and small scale farmers," he said on April 12 at Emin Pasha Hotel during the launch of another book Insights: Africa's future… Can biosciences contribute?

"Most of the issues talked about on biotechnology are about fears of the unknown," he added.

Insights, published by the Biosciences for Farming in Africa (B4FA) programme, is a collection of essays examining the implementation of biosciences for farming in Africa.

End

Is sensitivity of Ugandans towards biotechnology justified?

By Ronald Musoke

The failure by the governments in the developing world, especially those in sub-Saharan Africa to substantially invest in agriculture has been linked to the now real failure by many governments to hit Millennium Development Goal targets by 2015.

The US-based International Food Policy Research Institute (IFPRI) recently noted in one of its policy papers, "Role of Agriculture in Attainment of MDGs," that whereas the linkage with agriculture is particularly strong for the first MDG (halving the proportion of people suffering from extreme poverty and hunger), all MDGs have direct or indirect linkages with agriculture.

"Agriculture is the foundation of Africa's social, political and economic systems. It is also the source of livelihoods, political stability and the growth of national economies."

In sub-Saharan Africa, the UN's Food and Agricultural Organization (FAO) estimates that the sector employs about 65% of the population and accounts for at least 30% of the GDP. In countries like Uganda, the agricultural sector provides a source of livelihoods for up to 80% of her 34m people.

Why Africa's agriculture sector remains underdeveloped despite its clear importance is difficult to understand and is one more example that shows that often times African governments fail to identify their priorities.

For instance, the sector still depends on rainfall, is largely subsistence and produces yields much lower than those achieved in more advanced agricultural systems.

IFPRI notes that agriculture is further dogged by infrastructural and institutional sophistication and is less mechanized when compared to the US, Europe, Asia and South America.

It has been said by other experts that the underdevelopment of the continent's agriculture sector is one of the primary reasons for the vicious cycle of food insecurity and poverty.

In comparison with other regions in the world, agricultural growth has been slow in Africa. A case in point is the yield gap for cereals between sub-Saharan Africa and other regions which has widened in the last 20 years.

Cereal yields on the continent have marginally improved and are still at around 1.2 tonnes per hectare compared to an average yield of some three tonnes per hectare in the developing world. Fertilizer consumption was only 13 kilogrammes per hectare in sub-Saharan in 2002, compared to 73 kilogramme in the Middle East and North Africa and 190 kilogramme in East Asia and the Pacific regions according to IFPRI data.

Yet Africa is home to 26% of the world's undernourished people and has the highest number of countries experiencing food emergence due in part to climate change conditions such as drought and other environmental changes such as pests, diseases and soil exhaustion among others.

The low agricultural productivity on the continent has been associated with a wide range of factors, including low investments in education, infrastructure, research and development and over reliance on conventional and 'safe' and traditional modes of food production technology.

Experts say Africa's food security fortunes can change once governments expand acreage of cultivated land through mechanization and provision of fertilizers. These two variables can make a positive impact on food security in Africa, but further benefits can be achieved by the application of modern biotechnology methods to plant improvement programmes across the continent.

According to the Open Forum on Agricultural Biotechnology in Africa (OFAB), a Nairobi based organization founded to access proprietary technologies such as biotechnology to increase

productivity of African smallholder farmers, innovative agricultural technologies have been identified as offering potential towards improving agricultural output on the continent.

African governments and the African Union have recognized improved technologies as essential for achieving sustainable food security and reducing rural poverty across Africa. However, some of the technologies, including biotechnology have attracted severe debate with regards to safety, trade and ethical consideration.

During some of the intense debates, scientific facts have been distorted with social, ethical and political issues. Predictably, the concerns have often times shifted discussions on the importance of adopting biotechnology in Africa's agricultural sector. But for how long can this continue while the number of mouths to feed on the continent grows in millions every other year?

Calestous Juma, a Kenyan-American Agricultural professor has argued that timing defines nations. About three decades ago, South Asians economies embarked on their growth path at the dawn of the microelectronics revolution, he says.

He continues: "Africa's economic transformation is starting in the new age of biology—both as a field of scientific endeavour and as a metaphor on how we view our world. The world of genetics captures both phenomena and will most likely offer Africa its opportunity to become an important player in the global knowledge economy."

It will most likely offer Africa the fastest route out of chronic poverty and hunger, if only the continent moves fast to change its uninformed attitudes and perceptions towards biotechnology or genetic engineering projects whose very aim is intended to save people from possible starvation in the next couple of decades.

Agricultural Researchers Decry Low Funding

BY TYABA SSETTUMBA ABUBAKAR

Very few farmers are benefitting from the ground breaking MT56 tomato that research shows is pest and drought resistant. The variety, currently under multiplication by the Mukono Zonal Agriculture Research and Development Institute (MUZARDI) was developed by Makerere University as a follow up to the MT55 tomato produces bigger fruits than its predecessor.

According to researchers, the main challenge to the tomato's propagation is that a few farmers who have accessed its seeds plant them along side other varieties. This has hindered efforts to increase the variety's off springs.

The institute is experimenting on grafting nakati, a local vegetable and the MT56 variety to analyze its strength. The tomato variety is also being experimented with goose berries to further improve its success through acquiring the good traits from either plant.

"We want to see how productive this tomato variety is once it is grafted with these stronger vegetables that easily resist weeds. Perhaps this will help us come up with a stronger variety that will solve the market demands. Our main challenge however is inadequate funding," says Biso Godfrey, a researcher at the facility.

A scarcity of tomatoes in areas around the capital city has seen prices shoot up, with a commercial crate now going for between 80,000 - 85,000 shillings in Nakasero and Owino markets, up from 50,000 – 53,000 shillings in early March, 2013.

Researchers at the institute have called for increased funding of their activities, if the country is to achieve food security in the near future. The institute is also stuck with varieties of food crops that have failed to be disseminated to farmers.

According to Robinah Gafabusa Naggayi a research technician, the institute that is part of the National Agricultural Research organization, NARO is mainly stuck with vegetables.

"Government does not consider vegetables like tomatoes are priority for funding. We are therefore stuck with the drought resistant MT56 tomatoes that would have helped alleviate farmers' needs in the area." Much of the institute's budget is allocated to research on citrus fruits and Bananas.

The MT56 tomato variety is not a genetically modified crop but a hybrid of random selections.

"it is only this small nursery bed that we have to propagate this wonderful tomato variety," says Naggayi. "Farmers come demanding for the seeds but we can not provide them with enough since we do not have enough funds. Government says there is no money for research in vegetables", she adds.

Researchers are developing crop varieties as part of the country's National Adaptation Plans of Action (NAPAs) on climate change and to also meet the demands of an ever increasing population.

Researchers testing better millet variety

By Richard Katongole

A high yielding millet type will be accepted into the country if scientists confirm it can endure local conditions.

Researchers responsible with testing and confirming new crop varieties which farmers in district zones accept are studying Foxtail millet.

Evaluating the crop includes observing if the crop can withstand local infections, and whether changes, and if it can be grown across the country.

The hybrid was brought by United Nations' Food and Agricultural Organization which has fed hunger stricken north eastern Uganda.

"Foxtail was brought from China: it's plant has a bigger head (of grain) and bigger grain as compared to Uganda's Pearl millet," said Dr Godfrey Sseruwu, assistant Director of Mukono Zonal Agricultural Research and Development Institute (MUZARDI), an adaptation research center under the National Agricultural Research Organization.

For a new crop to be welcome into the country, Zonal Agricultural Research and Development Institute (ZARDIs) in districts test it with the community and farmers in respect of yield amounts, infection resistance power, and closeness to local preferences.

If Foxtail hybrid will be accepted, independent food production in food insecure areas will be boosted due to its big harvest stock, better than pearl millet which is different in size and health appearance, if the two can be seen in a farm.

Foxtail millet which has the longest history of cultivation among the millets however will need protection from local millet and other cereal diseases like leaf and head blast disease caused by Magnaporthe grisea.

To attain its potential the hybrid's success might mostly depend on the science of breeding it with disease resistant varieties or plants like it has been done with tomatoes to prevent them from the bacterial wilt fear; MUZARDI has crossed it with a local vegetable plant, Nakati, which is proof of worse infections

Activists misleading Uganda on biosciences – says Obua

By Ismael Kasooha

RADIO PIECE: The chairperson of the parliamentary standing committee on science and technology Denis Obua Hamson says that activists are misleading Uganda through harmful propaganda on developments done by the scientists.

Obua was Friday evening presiding over the launch of a book entitled "INSIGHTS, Africa's future..Can biosciences contribute," at Emin Pasha Hotel in Kampala that has been written by Biosciences for farming in Africa-B4FA with the purpose of helping small holder farmers in Africa to deal with the increasing challenges.

He says the activists who have nothing to do with science are challenging scientists. Obua says that there is fear of the unknown yet we can explore more.

Obua on Activists .MP3

Obua asked journalists to educate the people on what biosciences can do in addressing the challenges of the small holder farmers instead of doing postmortem on politics.

Obua on journalists .MP3

Obua asked the scientists to come up and defend their gains their in biotechnology and research.

Obua on scientists .MP3

Meanwhile Professor Sir Brain Heap the Biosciences for farming in Africa-B4FA project leader says that Biosciences aims at helping smallholder farmers use the available resources to benefit a lot using biotechnology.

Prof Brian .MP3

Dr. Adebayo Moses from Ladoke Akintola University, Ogbomoso, Nigeria says that Africa needs to quickly adopt biotechnology especially genetic engineering to deal with the increasing population.

Dr. Adebayo Moses.MP3

The world population is expected to hit 9 billion people by 2050 yet the cultivable land is not increasing.

Africa can use biotech to boost development

Mutale Joshua

Africa can use agricultural bio technologies particularly Genetic Plant Modification (GM) to boost development on the continent, scientists have emphasized.

Professor Sir Brian Heap, the project leader Bio sciences for Farming in Africa (B4FA), says genetic plant modification, has got enormous benefits ranging from improving the quality, diversity, to performance, and increased yield of crops.

Heap explains that plant breeding varies between, crop species, but it is basically done by fusing together specific gene extracts from two selected plants to produce an improved breed with particular intended traits.

Cue in: Brian>>>

Dr Bernie Jones the director B4FA's media program says that conventional plant breeding has been used to develop new varieties of crops for hundreds of years but cannot sustain the global demand for food with the increasing population. Declining resources such as land and water have also caused a drop in agricultural production.

Cue in: Dr Bernie>>

This while presenting a paper on the history of plant breeding and agriculture at the second round of the media fellowship in Uganda at Speke Resort Munyonyo.

Ends

Gm Technology To Improve Farmers Livelihood

LUBWAMA PAUL 12TH/04/2013.

Banana farmers in the central region of Uganda may have longer lasting plantations and higher yields after successful trials of the genetically modified bananas.

Tonny Tazibwa the assistant researcher at National Agricultural Research Laboratories at Kawanda reveals that unlike the hybrid species ,the genetically modified bananas shall remain with the natural taste of every particular specie.

Tazibwa insists that plantations shall last for over 10 years unlike the current ones that are affected by nematodes where plantations last for 2 to 3 years.

The improved species have nematode resistant genes and farmers shall take long yielding from their gardens unlike today where plants are destroyed by the disease.

TAZIBWA 12.mp3

The trials shall take 2 years but the only challenge could be the delay by parliament to pass the bill on bio-technology into law to allow commercialization of the improved breeds that are resistant to nematodes.

END

Food Insecurity In Africa Needs Urgent Attention.

LUBWAMA PAUL 12TH/04/2013.

Over 900,000 people go without food daily across the world as a result of climate change and other factors but scientists think bio-science could be the solution to the food insecurity.

Paul Lubwama talked to Dr. Serunjogi Lastas Katende a crop breeder and former legislator in the Uganda parliament who is also a farmer.

GM INTERVIEW 12042013.mp3

.

Grafting

LUBWAMA PAUL 12TH/04/2013.

Urban dwellers in Uganda with relatively small pieces of land can now enjoy a variety of mangoes from a single tree as revealed by scientists at Mukono Agricultural Research and Development Institute.

Winfred Nakyagaba a researcher at the institute reveals that after a thorough research and experiments a variety of mango species can be grafted on a single tree which is resistant to diseases and pests.

Grafting is done by getting different species seedling merging them with the indegenous seedlings locally without incurring expenses.

Meanwhile, Dr Claudia Canales a specialists in crop genetics and a team of scientists from B4FA reveal that farmers can as well get improved yields with fast growing and resistant seedling which are genetically modified.

This has been approved in the United States and other parts of the world and many farmers have improved their livelihood.

END.

GM and Patents

Ronald Kato

Ugandan scientists currently involved in ground breaking GM crop research stand to benefit greatly from their inventions through patents. Also, the government of Uganda that funds public research stands to benefit by patenting work done by its scientists.

But Uganda could find itself paying royalties to multinational research companies like Monsanto if it used patented GM technology in her research.

Ronald Kato sat down with Professor Sir Brian Heap, the Bio- Sciences for Farming in Africa project leader to talk about patents and GM technology.

GM and Patents.mp3

Embracing Bio Technology

Kyomugisha Grace UBC TV
10/04/2013

Uganda is less hungry but more needs to be done. According to the 2012 Global hunger index report released, Uganda has the lowest hunger score of 16.1 in Africa. The report also shows that in East Africa, Ugandans are less likely to suffer from hunger compared to their counter parts in Burundi,Rwanda,Kenya and Tanzania.

That however does not mean that Uganda can relax that it has enough. Other than food security, selling of the surplus produce can help fight poverty. Cash crops require a push in order to increase their productivity. Coffee for example contributes much on Uganda's foreign exchange earnings. The crop however suffered the invasion of coffee wilt disease in 1990 that left many plantations destroyed.

Scientists are trying their level best to find a lasting solution for coffee wilt disease. At coffee research Centre in kituuza mukono district, reseachers have developed coffee wilt resistant varieties that are high yielding and drought resistant. The head of the centre Dr Africano Kangire says they are using several seed multiplication technologies to have more coffee planting materials for distribution to farmers. He observed that the bio technology method produces many planting materials in the shortest time possible. This has increased their capacity to multiply coffee wilt resistant varieties that can be distributed to farmers around the country.

So, Boosting African food production is important in fighting poverty, food insecurity and environmental crisis.

Although African farmers are often difficult to convince about the value of bio technology owing to the subsistence life they have lived on their land for many years, it's time for them to consider advanced farming techniques developed to increase production.

The positive aspects of bio technology such as rapid multiplication of planting materials, food production increase though generation of drought,pest resistant varieties should not be under looked.Together,we can improve our lives.

END

When A Farmer's Hard Work Doesn't Pay

By Florence Naluyimba

Sanitation keeps the banana weevils away but it also spreads bacteria. This is quiet a contradictory statement but one which farmers in Western Uganda may soon have to take heed of from the National Agricultural Research Organisation, NARO.

The banana farmers may soon have to work less on their farms if they want to get any yields at all.

"They love their crop a lot and hence use many tools as they clean their gardens and end up spreading disease to non infected plants," says Reuben Tendo Ssali a banana breeder from Kawanda Research Centre

The appeal has mostly been made to growers in Western Uganda who are said to be passionate about tending their gardens.

The agonising tools they use include hoes, pangas and pruning knives among others that may injure the plant when contaminated.

The contamination is by the Banana Bacteria Wilt – BBW, which was first reported in Uganda in Mukono district in 2001.

"This spreads so fast when such are used. You need one single tool for every plant or you have to sterilise it at all times," asserts Tony Tazuba a breeder with Kawanda Research centre.

A hybrid of bananas has been introduced and the researchers fear that the passionate energy of Western farmers may render it as good as useless.

Simply put, hybrids are offspring of two different species with desirable qualities after interbreeding. It entails giving plants the desired traits that don't occur naturally such as resistance to pesticides.

In humans, a child born of a man and woman sets a perfect example of what a hybrid is.

The Banana Bacterial Wilt, however, is unfortunately a pest that attacks all types of bananas according to National agricultural research Organisation, NARO including the well highbred bananas.

Some farmers reason that they are chasing away the banana weevils which are a menace to their plants.

In banana production, the main constraint is pests, with bananas having up to 60% yield loss in 4 years, nematodes at 51% in 4 years, banana streak virus 40%, black sigatoka at 30% to 50%, Fusariun wilt and bacteria wilt at up to 100%.

"All this can be partly or even wholly solved by genetic engineering", asserts Banana Breeder Reuben Tendo Ssali - who believes that bananas of combined good qualities can be modified to ensure the security of food.

"...including nutrients like vitamin A and iron, improved fruit quality, growth period and disease resistance in one crop that can make the passionate farmers of the west still till and prune until the sun sets without fear of infesting non infected crops."

“There are needs out there, the disease pressure is mounting but the food demand is also up.”

Genetic engineering involves combining genetic characteristics from entirely different plant species to get unique traits while growing up including withstanding drought and disease.

At Mukono Zonal Agricultural and Development Institute they have not yet started practicing it saying they don’t have need for it.

“We still need to study it, for now we are still employing the conventional methods which work just fine,” so clearly emphasises Godfrey Biso a researcher, who looks to genetic engineering as a future intervention which can “stay on hold for now.”

He agrees with Tendo that it can solve food shortages, “but as Ugandans we need to continue with simple things like spraying as we study GMOs.”

GMOs or Genetically Modified Organs are manipulated by the use of biotechnology.

“Fears are not justified for biotechnology, we only need to create awareness.” Sserunjogi Lastus Katende, a Cotton Breeder says.

The Kawanda banana breeder Tony Tazuba and Professor Jim Dunwell from the University of reading cannot re-echo his words any louder.

In the Journal Straight Answers on pesticides and Agricultural biotechnology by Syngenta International AG, a plant breeding company, it says that genetic plant breeding improves genetic resistance of crops against viral and fungal infection.

In case, farmers get to grow such types of banana, their love of the tools to touch base with their gardens with abandon will not be interfered with by any authority because there will be no fear of infection.

ENDS

Aside:

BBW Symptoms
- Plant wilts starting with flowers or leaves
- Fruits ripen prematurely and appear discoloured
- Male buds shrivel, blacken & dry

BBW Control
- Uproot all infected plants
- Use forked stick to remove buds
- Disinfect tools with JIK
- Keep cows & goats off the plantation
- Resume pruning, corm removal, ploughing & harvesting after 3-6 months

Apple can grow in Tropical Climate

Richard Katami Bwayo

SFx: **Actuality:** Cutlery and plates.

NARRATOR: *It is lunch time, and here I get a number of people who seem to be enjoying eating apples-a fruit that is commonly eaten in big eating places, at the place of work, at home, at school or anywhere by adults and children. To some this is a luxury for the wealthy class because it is exotic and expensive. I asked them to tell me where apples are grown;*

SFX: Actuality of munching an apple before and fade under as they reply.

VOX POPS: "Well since history immemorial I have always known that they come from South Africa but of recent I have just come to learn that you know we actually we just grow them in Kabale; I think some of them are imported from Kenya but others are grown in Kabale in Uganda; Many of them come from Kenya and South Africa; A number of countries, I know Kenya, South Africa even here we grow them; In Uganda we hear they grow them in Kabale but I hear most of them are grown in Australia; In Zimbabwe, we do produce some in cold areas but most of them come from South Africa"

NARRATOR: *Well those are their observations and this represents the views of many Ugandans although many more don't know that apples can grow in Uganda. This is part of what is contained in the Uganda Second Round initial Dialogue and Training Workshop for Media on Plant Breeding, Genetics and Biosciences for Farming in Africa. Dr Clet Wandui Masiga-an expert in Agro-biodiversity and bio-technology programme from Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) Entebbe, Uganda says bioscience has made it possible for the apple crop to grow in tropical climate.*

DR. WANDUI: "To grow apples in the tropics, all you need is to manipulate a situation which mimics it to behave like it is in winter. So when we bring them in the tropics, all you do is grow the apples it reaches a certain maturity, remove the leaves one by one using the hand or any other mechanism"

NARRATOR: *When I asked him to explain to me how easy this can be done, Dr. Wandui had this to say.*

DR. WANDUI: "By removing all the leaves the plant will sense or behave the same way it is in winter so that way it triggers it to produce the flowers, and once the flowers are produced, closes and fertilization takes place and there you have your fruits growing, so the process is as simple as that; and that is the only thing that was missing and that is why apples were not growing here"

NARRATOR: *Interesting to learn that; However for whatever innovation introduced, many Ugandans will quickly ask for the economic benefit in it. To this Dr. Wandui replied that having apples grown here, Ugandan traders shall save a lot of revenue that would be injected in the importation of apples.*

DR. WANDUI: "By growing apples here you are saving a lot of forex, and we can as well export these apples to our neighbouring countries and therefore our farmers will make more money. The studies done in Kabale and in Mount Elgon area has shown that one apple can give you up to 150 apples, that is a tree; If each one is going for a minimum of 500, is a lot of money to a farmer's pocket and a spacing is the same as the one for coffee"

NARRATOR: *Though it is good for the scientists to make it possible for the apples to grow, but many like this consumer thinks the imported apples are better than those grown in Uganda.*

CONSUMER: "They used to be so nice but there is a change. Sometimes you eat an apple and you don't feel like you've really eaten an apple; you feel like you are just chewing through paper, so I don't understand. Of recent I have just come to learn that we actually grow them in Kabale, so I believe that those guys are trying to bring them to Kampala of course because this is where most of the market is but am for South Africa"

NARRATOR: *Dr. Wandui to some extent agrees that the apples grown in the tropics may not have the same texture like those grown in temperate climate.*

DR. WANDUI: As you improve you lose some of the good traits people were used to but in order to conserve those ones, you always go back to the source.

NARRATOR: So, what was not possible, bioscience can make it possible; therefore apples that were known for temperate climate can grow elsewhere.

Richard Bwayo, UBC Radio.

Banana Innovations

Sarah Mawerere **Banana Script- B4FA Training April 12, 2013**

Narrator: Banana is a perennial crop that can yield throughout the year. It is a staple food which people eat at breakfast, at lunch and at dinner.

To some people, banana is a simple fruit that is sweet, healthy, and tasty. In Uganda, the native name for banana is "Matooke". Other fruit types of banana in the local dialect are Sukali Ndiizi and Bogoya. This important crop has in the recent years been affected by diseases and pests, causing reduction in the yields.

Scientists have developed new technologies to tackle the pests and diseases that attack banana. However, farmers continue facing the challenge of pests and diseases. Scientists from all over the world are combining efforts to find a solution to the challenging pests and diseases attacking bananas. A scientist from the Philippines says continuous innovations are required to fight the pests and diseases that attack banana worldwide.

Cue in: [Insert] I am Doctor Augustine Mulina……..

Cue out:……..problems of banana.

Narrator: Conventional methods, including selective breeding of resistant strains have been applied to fight the pests and diseases. Imagine, even wild bananas are susceptible to such diseases!

Uganda's scientists have developed and introduced high yielding, disease- and pest-resistant varieties. Various research institutions have adopted different breeding schemes and other technologies with the purpose of maintaining yields for banana and secure the farmers and consumers against losses and hunger. Mukono Zonal Agricultural Research Development (MUZARD) has adopted technologies, developed by the National Research Iinstitutes to multiply varieties of banana that are resistant to diseases. A technician attached to Banana at MUZARD Biso Godfrey says from a healthy plant heavy bunches of banana are got.

Cue in: [Insert] In order to impart…….

Cue out:……. requirements of the consumer.

Narrator: National Agricultural Research Organization [NARO] is where research and technologies are developed in Uganda. The technologies are used by other research centers to multiply varieties of banana. A research Officer and Banana Breeder at the national Research Organization Reuben Tendo Ssali told participants attending a Bioscience for farming in Africa training that trials are made at the zonal research institutes and if adoptive, then multiplication takes place.

Cue in: [Insert] After transforming……

Cue out:…….climate conditions.

Conclusion [Narrator]: To ensure its productivity and sustainability, it is possible by use scientific innovations. I am Sarah Mawerere reporting.

…….. ENDS…….

US firm pulls out of Uganda over GMO law

By Charles Kazooba

Monsanto, a U.S. based, multinational, agribusiness Company, is suspending its biotechnology research to develop genetically modified cotton in Uganda because of the delay in the enactment of an enabling law that is supposed to pave way for commercial production.

Instead, the biotech firm will be concentrating on the neighbouring Kenya and other African markets where there is unquestionable cooperation but also a proper legal framework.

"We prioritize biotech research in countries where there is broad farmer and political support for GMOs as well as a functioning, science-based regulatory system to govern their use. A year ago we determined that other countries were further advanced than Uganda in these respects," revealed Brandon Mitchener, a communications spokesperson for Europe and Middle-East, in an email correspondence on April 12.

Monsanto, after, successfully completing the process of stacking (joining) the genes from Bacillus thuringiensis (Bt) cotton and Herbicide-tolerant (Ht), suspended the next stage involving the introgression of the gene into farmer preferred cotton varieties.

In Uganda, Monsanto's level of research was quite ahead and successful compared to Kenya. So it is possible that if Uganda passed the biotech law sooner than later Mansanto could reconsider its decision.

The first confined field trials of Bt cotton and Ht cotton started in July of 2009, and took six months for the cotton to mature. The trials were carried out at the National Semi-Arid Resource Research Institute's fields at Serere in Soroti District and Mubuku in Kasese District.

Bt cotton has the ability to withstand bollworm infestation, and Ht cotton tolerates RoundUp herbicide which kills weeds. Currently, the bollworm is the greatest threat affecting cotton production in Uganda. The second greatest threat is weed infestation

A Ugandan official working the Cotton Development Organisation had earlier told *News of EastAfrica*, in an interview during Biosciences for Farming in Africa media fellowship in Kampala from April 9 to 13 that Monsanto has "stopped talking to us" because of parliamentary ping pong the Executive and Parliament over the biotech draft law.

"In 2012, Monsanto just kept quiet. There hasn't been official communication from them but what we hear is that they have suspended their operations because there is no law here (to facilitate commercial production of genetically modified seeds.)," said Dr Serunjogi Lastus Katende, a plant breeder/technical advisor with Cotton Development Organisation.

Dr Serunjogi, who also happens to have been a Member of eighth Parliament and vice chairman of the parliamentary committee of agriculture that was tasked to scrutinize the National Biotechnology and Biosafety Bill-2012 and come up with a good law, claims the Bill delayed passing because most MPs were ignorant of the biotech industry.

But also the legislators have had a rough time dealing with erratic anti-biotech activists, who suggest that the draft law should afterall be abandon because it only would frustrate farming in Uganda through reliance on genetically modified seeds.

"Subjecting the agricultural sector to the imperatives of the agro-industry and its GMO-model will gradually destroy traditional family farming, local seed systems and Ugandan food. The massive introduction of GMO's will increase family farmer's dependency on agro-industry, because they will be obliged to buy costly patented seeds and expensive fertilizers," argues Morris Rwakakamba, the Chief Executive Officer of Agency for Transformation.

Leading biotech companies like Monsanto, Syngenta, Bayer and Dow are currently racing to develop crops that will grow in drought conditions caused by climate change, and by participating in the Water Efficient Maize for Africa (WEMA) program, Monsanto is, however, gaining a leg up by establishing new markets and regulatory approvals for its patented transgenes in five Sub-Saharan African countries including South Africa, Uganda, Tanzania, Kenya and Mozambique.

The WEMA program was launched in 2008 with a $47 million grant from mega-rich philanthropists Warrant Buffet and Bill Gates to help farmers in several African countries increase their yields with drought- and heat-tolerant corn varieties.

The National Biosafety Committee had approved introduction of varieties for large-scale commercial production in Uganda but the vacuum in the legal framework has deterred Monsanto from proceeding.

It is believed that Monsanto could have halted their operations after realizing that without a proper legal framework it would not be possible for them to claim their royalty rights. In the past, Monsanto has sued farmers for growing crops that cross-pollinated with Monsanto crops and became contaminated with the company's patented genetic codes yet they are not legally obliged.

Once commercialised, Ht cotton helps farmers reduce the cost of herbicide application and weeding, which is currently one of the biggest expenditures for farmers. Cotton needs to be weeded at least three times before maturity, which usually discourages farmers from growing the crop.

But scientists in Uganda are not just watching with folded arms. ASARECA's Clet Wandui Masiga disclosed that on April 18 the world's renowned authority on the role of innovation in economic development, Prof. Calestous Juma of Harvard Kennedy School of Government, Harvard University and together with other scientists will meet President Yoweri Museveni to discuss among other issues Uganda's biotech law.

The introduction of biotechnology has been one of the most important scientific breakthroughs of the last decade and is shaping the future of the entire agricultural industry world-wide.

Over the last five years, there has been a remarkable growth in Monsanto's global business as 12 million farmers around the world have selected the company's seeds and trait technologies to help them meet the challenges they face on their farms.

End

Tomato Wilt Disease

Rose Namale 11-Apirl-2013.

Researchers at Makerere University have developed a tomato variety resistant to bacterial wilt disease. The variety MT56 will enable thousands of farmers to gainfully cultivate tomatoes on a commercial scale.

Robinah Gafabusa Naggayi, a technician with the fruits and vegetables division at Mukono Zonal Agricultural Research and Development Institute (MUZARDI) says the new variety is resistant to tomato bacterial wilt that is destructive to farmers' fields throughout central Uganda.

'The tomato bacterial wilt is a big problem to farmers mostly in central Uganda and many of their field have been destroyed because of this wilt 'according to Gafabusa.

Gafabusa says scientists at MUZARDI are multiplying seeds of this variety to ensure that most farmers access these seeds that are currently unavailable.

'Farmers can also use the Tangero 97 from Tanzania to control this wilt' says Gafabusa**.**

She emphasizes the need for framers to maintain all the agro practices such as spraying, irrigation, adding manure to the soils among others. She says farmers are able to produce tomatoes in three months if they implement those agro practices.

'The new variety will greatly increase on my tomato production'. according to one Joseph Wasswa a tomato farmer in Kakiri in Wakiso District.

ENDS

Grafted fruit trees reduce the cost and scarcity of fruits

By Diana Wanyana KFM Radio Kampala Uganda

d.wanyana@gmail.com

Agriculturalists have revealed that adopting grafting as a new method growing fruits can triple the yields.

They said that when you graft a fruit tree you can yield much, earn big and make your family happy.

A fruit researcher at Mukono Agriculture Research and development institute Robina Nagayi describes grafting as any of a number of techniques in which a section of a stem with leaf buds is inserted into the stock of a tree.

“Grafting is useful however only on an original cultivar and the technique is most commonly used on fruit plants or plants in the same family “said Nagayi.

“In stem grafting, a common grafting method, a shoot of a selected, desired plant cultivar is grafted onto the stock of another type “she added.

Nagayi said for successful grafting to take place, the vascular tissues of the stock must be placed in contact with each other.

She added that both tissues must be kept alive until the graft has taken usually a period of a few weeks

“After that simple task for a few weeks one can take the fruit tree from the nursery bed to the garden for planting.”Nagayi noted.

Nagayi said that the reason as to why fruits are too expensive and scarcity is because fruit farmers are still using traditional way of farming.

A quick survey I carried out in Nakasero market show that one mongo of a thumb size goes for 2000 to 3000 shillings and four passion fruit go for 2000 shillings while a one kilo of papaw is close to 2500 shillings.

This has left many families to stop enjoying the delicious fruits and just live them to the rich and sick. But what causes all this and how can it be solved.

However with the adoption of grafting as advised by Nagayi will help to solve the scarce fruit crops.

End

Prize winners

Small prizes for the best reporting were awarded to the following media fellows for pieces produced during the workshop:

Adiah Nakuti – Agricultural innovation

Cliff Abenaitwe – Bioscience key to achieving MDG1 in Africa

Florence Naluyimba – When a Farmer's hard work doesn't pay

Charles Kazooba – US firm pulls out of Uganda over GMO law

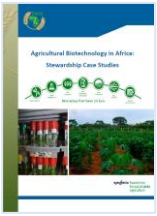
8. Material supplied to Fellows during training courses

Material distributed during courses on USB stick

AGRA: The African Seed Company Toolbox

AGRA: Seeds

Academy of Sciences of South Africa: Science-based improvement of rural/subsistence agriculture

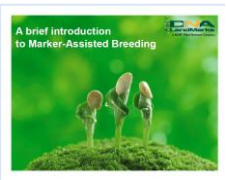


Syngenta/FARA: Agricultural Biotechnology in Africa – Stewardship Case-Studies

ASARECA Newsletter: The Agri-Forum

CABI Annual Report

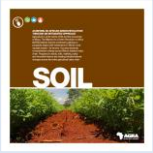
ATPS Policy Study: Why Informal Seed Sector is Important to Food Security



DNA Landmarks: A brief introduction to marker-assisted breeding

Oregon State University: Advanced Plant Breeding course

Collard & Mackill; IRRI: Marker-assisted breeding for Rice Improvement



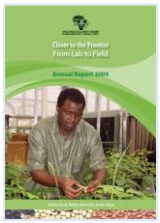
AGRA: Soil brochure

IITA: Annual Report 2011

ATDF Journal: Food Sovereignty edition

UN Commission on Sustainable Agriculture and Climate Change: Achieving Food Security in the face of Climate Change

IFPRI report: Agricultural R&D in the Developing World



AATF annual report 2009

AGRA: Markets brochure

ATDF Journal: Orphan Crops issue

Calestous Juma; Nature, Nov 2011: Preventing Hunger – Biotechnology is key

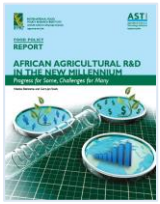
AGRA brochure: Africa's Green Revolution

Science Africa: Volume 17

National Academies of Sciences/National Research Council: Exploring sustainable solutions for improving global food supplies

Africa Technology Policy Studies Network: Annual Report 2010

William Kerr: Food Sovereignty – Old Protectionism



IFPRI Report: African Agricultural R&D in the New Millennium

FARA Report: Inventory of Innovative Farmer Advisory Services using ICT

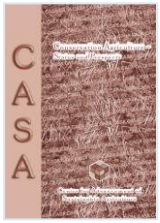
IITA: Research for Development Review

IFPRI Report: Country R&D Facts

Science Africa: Volume 15

AGRA Review 2011

AATF Annual Report 2010



Centre for the Advancement of Sustainable Agriculture: Conservation Agriculture – Status and Prospects

University of Arizona – lecture course on Early Farming

NCERT Course on Genetics and Heredity

Bjorn Lomborg; Project Syndicate: A Golden Rice Opportunity

ASSAf: GMOs for African Agriculture – Challenges & Opportunities

EuropaBio: Pocket Guide to GM Crops and Policies

ISAAA Biotech Crops Country Report 2012: Argentina

ISAAA Biotech Crops Country Report 2012: Bolivia

ISAAA Biotech Crops Country Report 2012: Brazil

ISAAA Biotech Crops Country Report 2012: Burkina Faso

ISAAA Biotech Crops Country Report 2012: Chile

ISAAA Biotech Crops Country Report 2012: China

ISAAA Biotech Crops Country Report 2012: Colombia

ISAAA Biotech Crops Country Report 2012: Honduras

ISAAA Biotech Crops Country Report 2012: India

ISAAA Biotech Crops Country Report 2012: Mexico

ISAAA Biotech Crops Country Report 2012: Myanmar

ISAAA Biotech Crops Country Report 2012: Pakistan

ISAAA Biotech Crops Country Report 2012: Paraguay

ISAAA Biotech Crops Country Report 2012: Philippines

ISAAA Biotech Crops Country Report 2012: South Africa

ISAAA Biotech Crops Country Report 2012: Uruguay

ISAAA Biotech Cotton – Annual update

ISAAA Biotech Maize – Annual update

ISAAA Biotech Canola – Annual update

ISAAA Biotech Soybean – Annual update

ISAAA Report on Global Status of Biotech/GM Crops

EMBO reports: “Stop worrying; start growing – Risk research on GM crops is a dead parrot”

COGEM: Biotech in the news – lessons from a quantitative analysis of news articles on biotech

Morris 2011: Modern Biotech – potential contribution & challenges for sutainable food production in sub-Saharan Africa.

Kikulwe et al 2011: Attitudes, perceptions and trust – insights from a consumer survey regarding GM banana in Uganda.

The Royal Society: Genetically modified plants for food use and human health – an update

The Royal Society: Responses to call for evidence on "Reaping the Benefits – towards sustainable intensification of global agriculture"

The Royal Society: Reaping the Benefits – towards sustainable intensification of global agriculture

Sense About Science: "Making Sense of GM"

Sense About Science: "I don't know what to believe" – making sense of science stories

ACME: A guide for African Science Media Officers

ACME: Handbook of Independent Journalism

In addition we placed copies of around 50 different plant breeding and biotech videos from internet sources onto the same USB drive as the documents, since bandwidth constraints in Africa would make it almost impossible for fellows to download and watch these themselves.

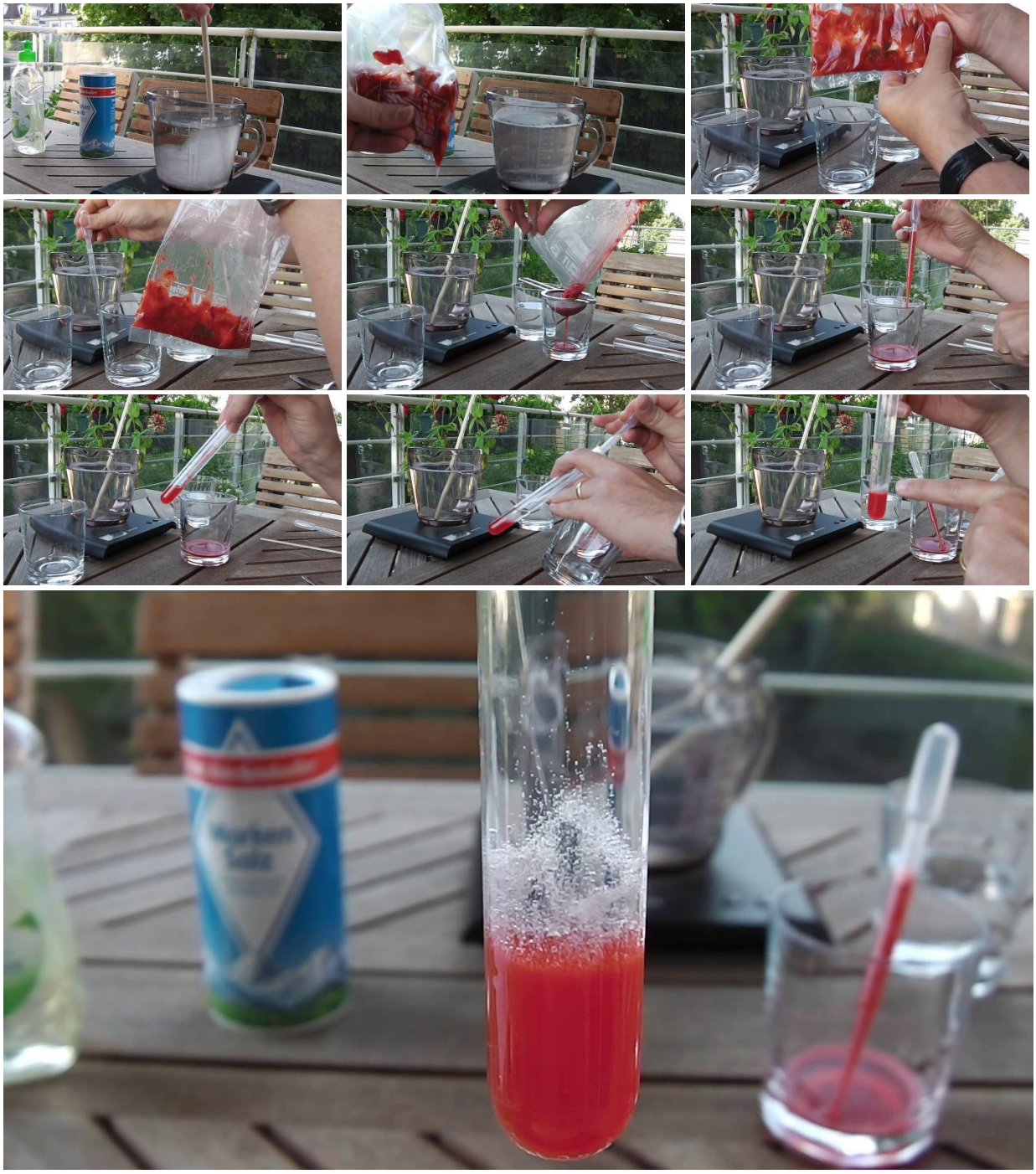
Likewise we included some basic free software (eg Adobe pdf reader, vlc media player) on the USB drive, since not all fellows had these available and would have found it difficult to download them locally.

We also included some general information about the B4FA project as well as about our funder, the John Templeton Foundation.

Games and practical exercises

DNA extraction

To demonstrate what DNA looks like, illustrate the similarity of DNA across different types of organism, and to give a small insight into the scientific process, all media fellows had the opportunity to **extract DNA** from fruit by means of a simple experiment carried out during the training workshop. Fruits selected were largely African (mango, avocado, papaya), though because it gives such clear results we did also use strawberry when the fruit was available.

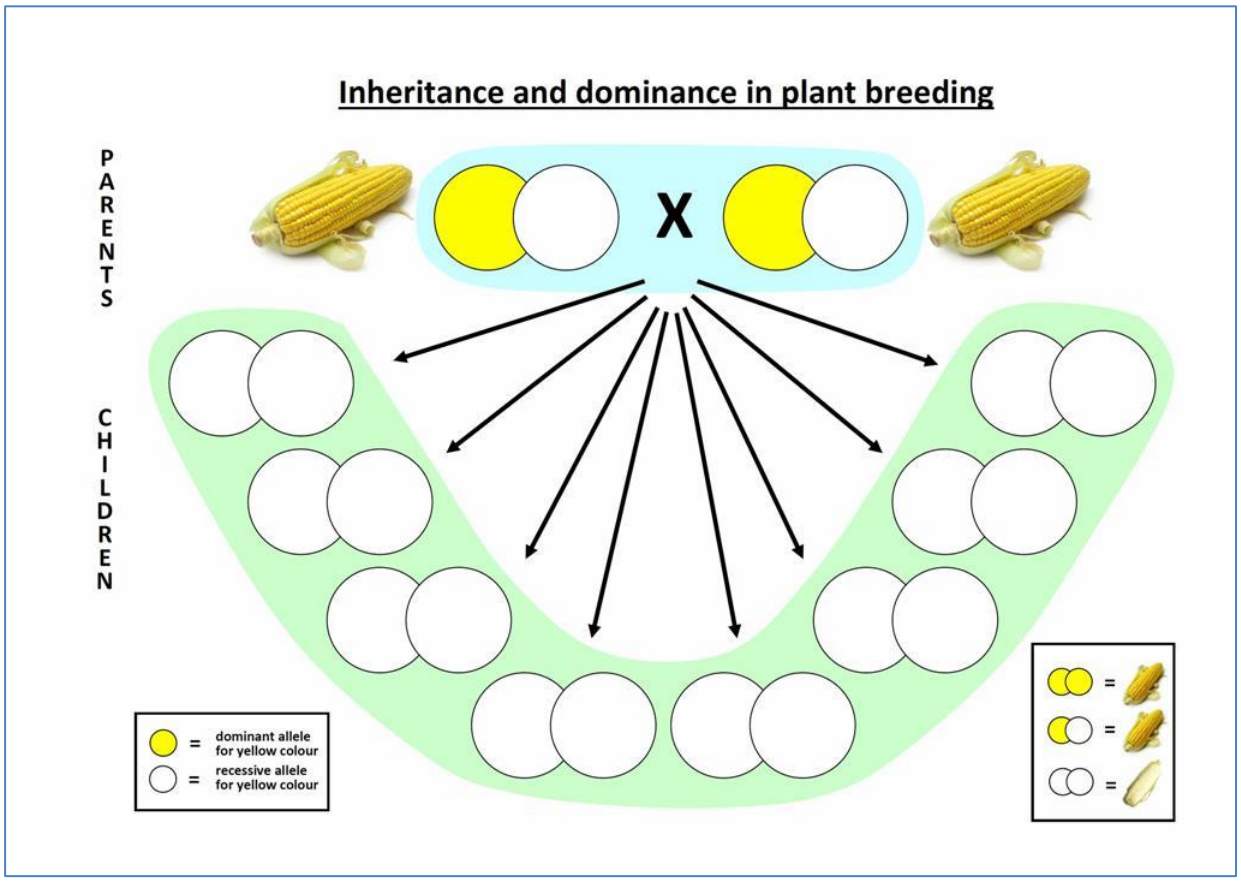


Following a simple experimental procedure (demonstrated beforehand through video – screenshots of which appear above) and mentored by B4FA staff and the research experts present, fellows prepared their chosen fruit, mixed it with the communally-prepared extraction buffer, added the ethanol and finally were able to collect the DNA they had extracted and transfer it into glass vials which they were able to keep.

Inheritance

In order to demonstrate **genetic traits**, and to enable fellows to really understand how traits are **inherited through dominant and recessive** alleles in living organisms, they were given the opportunity to work through the inheritance of a single trait in this worksheet – the trait in this example was colour in corn, which happens to be determined by a single gene, controlling for the expression of beta-carotene.

Beginning with two heterogeneous "parents", fellows were able to simulate the possibility of "offspring" inheriting alleles of either trait from each parent by drawing stickers from a bag and attaching these to the blank circles of the "offspring" generation. The bags contained a large enough sample of equal numbers of **yellow and** white stickers to ensure a near-random chance of either colour being drawn.



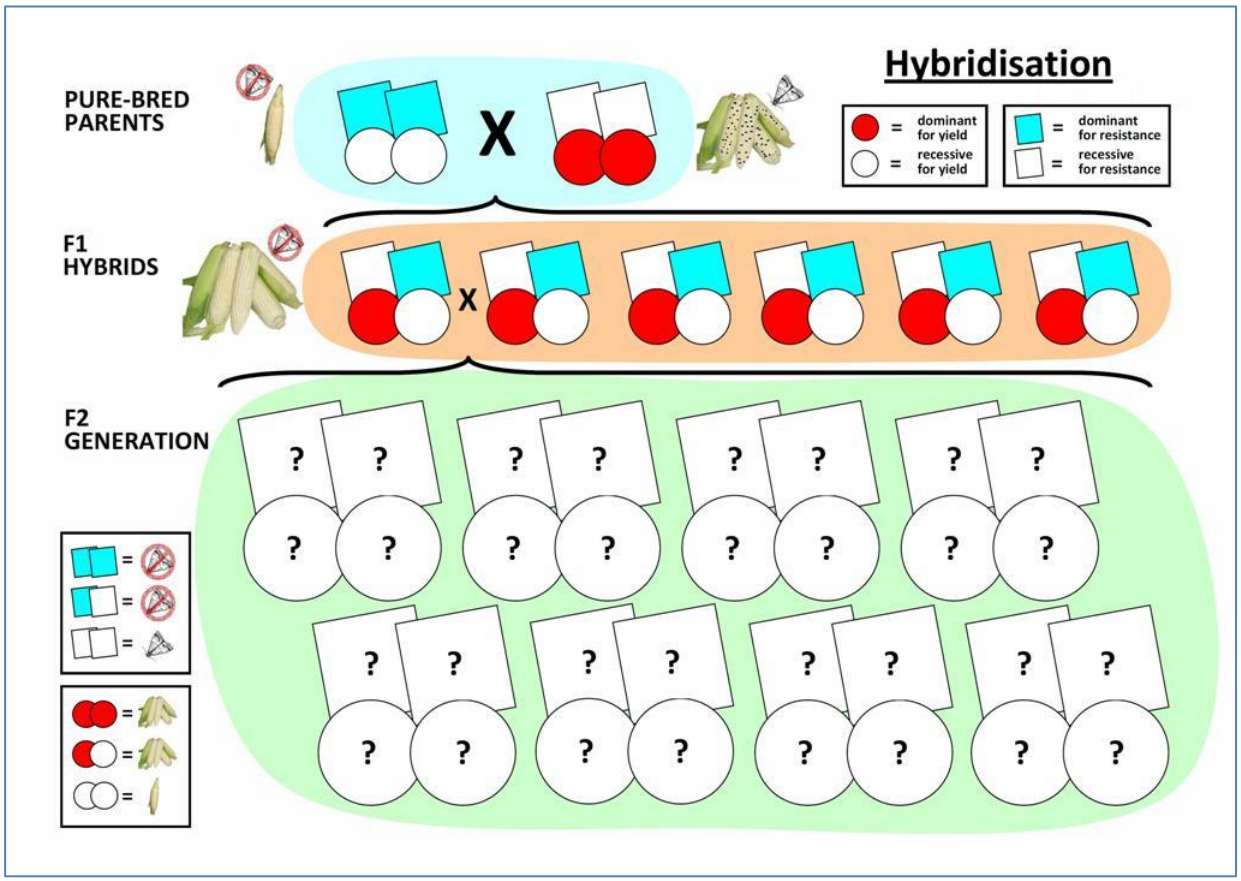
Once the worksheets had been populated with stickers, fellows were asked to identify how the colour trait would be expressed in each of the "offspring" individuals, and tot up how many of each colour there were. With B4FA and local expert mentors, they were then encouraged to compare their results with their neighbours', the expected ratio of 3:1 (and results were also totalled across the whole group to see how this compared to that ratio). Discussion was also encouraged of how these results would

seem to farmers and others who knew nothing of genetics, and might therefore be surprised to see that two yellow maize parents could have a white maize offspring.

F1 hybrid seed

In order to consolidate learning on how **dominant and recessive alleles are inherited**, and to demonstrate the genetic reasons **why saving and replanting seed from F1 hybrid plants** is not a good idea, fellows had the opportunity to work through the following F1 hybrid worksheet. Starting with the two purebred lines which are combined by breeders to produce the F1 hybrid seeds, the worksheets initially demonstrate how – through the genetics of inheritance – the F1 hybrid offspring end up with the dominant traits that breeders are trying to produce. The two traits used in this example were yield and insect-resistance, neither of which in reality is a simple trait controlled by just one gene.

The task for the fellows was then to simulate the characteristics of the F2 generation (the saved seed) that would result from crossing the F1 hybrids. Once again, the equal probability of each allele of the F2 generation inheriting either the dominant or recessive characteristic from the F1 generation was simulated by drawing stickers at random from bags containing equal numbers of each choice (one bag for each trait).

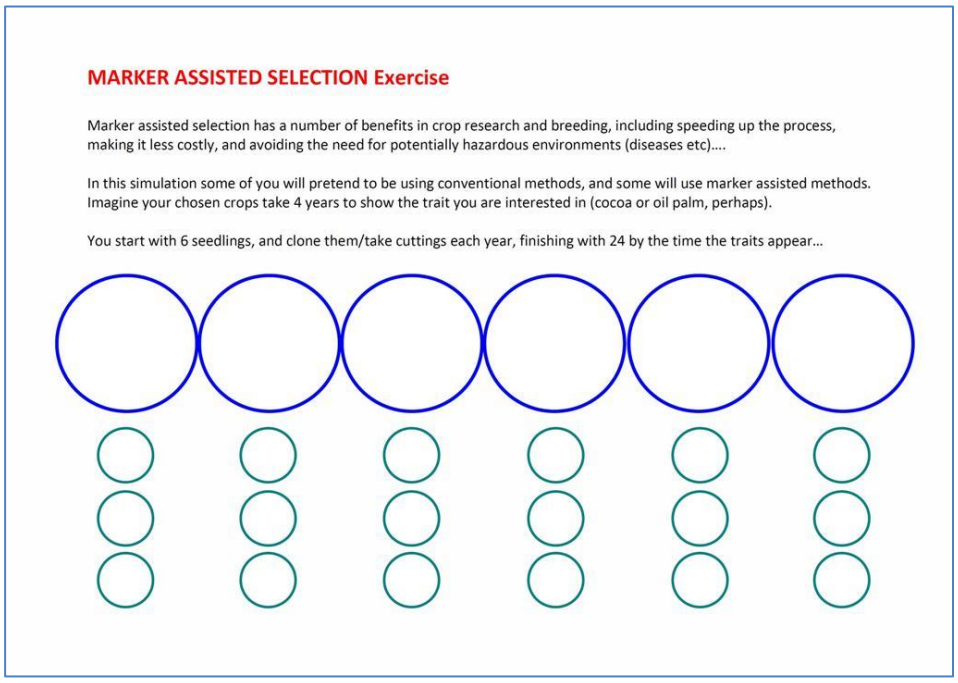


Once the worksheets had been populated with stickers, fellows were asked to identify how the yield and insect-resistance traits would be expressed in each of the F2 individuals, and tot up how many of each there were. With B4FA and local expert mentors, they were then encouraged to compare their results with their neighbours' and to reflect what this would mean to the crop productivity in the second year. Discussion was also encouraged of how these results would seem to farmers and others who knew nothing of genetics, and also to reflect on the fact that by saving seed, some of the resulting

plants will, because of the genetics of inheritance, have neither of the two traits that their F1 parents uniformly possessed.

Marker-assisted breeding

In order to demonstrate the value to plant breeders of **marker assisted selection**, fellows were given the opportunity to work through an interactive exercise to demonstrate the principles, in greatly simplified form. Given a scenario in which a crop takes four years to express the trait breeders are trying to produce (a fruiting tree species, for example), fellows were divided into two groups of "breeders". The seeds/crops were represented by small uninflated balloons containing a small sphere (the "DNA" for our simulation. Half the balloons contained a glass marble (trait missing) and half contained a steel ball bearing of the same size (trait present). One group – the conventional breeders – were asked to choose six specimens (balloons) to breed at random or visually; the other group – the marker assisted breeders – were given a marker test (a card into which a flat magnet had been glued) to help them select their six specimens. Each balloon was placed in a large circle on the worksheet. For each of the three subsequent "years" of the simulation they were asked to represent the effort, cost and time of raising the plants by sticking a small sticker of the same colour as the balloon in the next line below it.



After three repetitions, in the following growth year, fellows were told that the traits were expressed (in the fruit) so it would now become clear to the breeders what their results were. Candidates simulated this by removing the contents of the balloons and noting if they were glass or metal. Fellows were encouraged to share their results with their neighbours, and then publically to share their results with members of the other "team". Supported by B4FA and local expert mentors, they were then encouraged to reflect on how use of the marker techniques gave breeders confidence of productive results (simulated by 100% or near 100% results on the marker-assisted team) compared to the greater variation of results on the conventional breeding side (from 0% to 83%). They were further encouraged to consider what this variation in results meant in the context of the scarce funds and resources that had been used over the four years of the game, and the extent to which these had been wasted.

Public accepatability of GM

In a small group discussion environment, fellows were encouraged to discuss likely **attitudes of their fellow citizens towards GM products** in the context of the results of public opinion research carried out in Uganda in 2011.

The results below are from public opinion research carried out in Uganda in 2011. How would the public react to GM products at the market or supermarket in your country now? Why?

Table 2
Factor analysis loadings for consumers' Answers to perception and attitudinal statements.

No.	Statements were obtained using a five-point Likert scale ranging from strongly disagree to strongly agree	Agree or strongly agree (%)	Factor loadings for perceptions		
			Benefit	Food and envir. risk	Health risk
1	I would buy GM banana bunch if it was sold at the same price as a non-GM banana bunch, but was much more nutritious.	92	**0.73**	−0.16	−0.30
2	I would buy a GM banana bunch if it was sold at the same price as a non-GM banana bunch, but tasted better.	90	**0.70**	−0.17	−0.32
3	I would buy a GM banana bunch if it was sold at the same price as a non-GM banana bunch, but was produced with fewer pesticides.	78	**0.57**	−0.17	−0.29
4	I would buy a GM banana bunch if it was cheaper than a non-GM banana bunch.	79	**0.56**	−0.24	−0.31
5	If the majority of the Ugandan people are in favor of GM food, it should be legalized.	87	**0.49**	0.16	−0.13
6	I would buy a GM banana bunch if it were more expensive than a non-GM banana bunch	39	0.34	−0.21	−0.11
7	Information about food safety and nutrition on food labels can be trusted.	51	0.27	0.14	−0.15
8	The government effectively monitors the correct use of GM in the medical, agricultural, and other sectors.	69	0.24	−0.21	−0.05
9	I think the additives in food are not harmful to my health.	57	0.24	0.12	−0.07
10	The risks associated with GM food (if any) can be avoided.	82	0.18	0.10	−0.08
11	When humans interfere with nature, disastrous consequences result.	25	0.05	**0.61**	0.07
12	Among the risks we presently face, those impacting food safety are very important.	64	−0.03	**0.55**	−0.18
13	If something went wrong with GM food, it would be a global disaster.	92	0.00	**0.51**	0.22
14	The government should spend more money to increase food safety.	83	0.29	**0.50**	0.05
15	Humans are harshly abusing the environment.	54	0.02	**0.50**	0.17
16	Pesticides and fertilizers are dangerous to our environment.	74	−0.11	**0.40**	0.10
17	We can only eradicate the diseases and pests that attack crops using GM technology.	48	0.26	−0.32	0.02
18	Harmful environmental effects of GM crops are likely to appear in the distant future.	36	0.18	0.11	**0.66**
19	Harmful human health effects of GM foods are likely to appear in the distant future.	35	0.15	0.08	**0.62**
20	Even though GM food may have advantages, it is basically against nature.	36	−0.05	0.13	**0.41**
21	Eating GM food would harm me and my family.	26	−0.08	−0.07	**0.41**
22	GM technology should not be used even for medicinal purposes.	27	−0.11	−0.12	0.36
	Percent of variance explained (93 percent)		36	30	27
	Cronbach's alpha (α) coefficient		0.79	0.62	0.60

Note: Loadings in bold are values of 0.4 and above.

9. Conclusions and recommendations

The training workshop was successful.

Following the successful second round workshop model, while adding a few additional innovations, shows that the model can be targeted to respond to particular local needs and levels of sophistication.

There is a good balance now between the formal learning and interactive aspects, and while participants would always like more time, feedback shows that the format is achieving its goals. The new interactive training components, such as the targeted session on ethics, have proved to be successful at provoking discussion and encouraging understanding.

Having the alumni fellows participating in a second round of training also demonstrates the value of consolidating their learning through repetition.

Fellows expressed a desire to interact more with their colleagues in other African countries, and this will be built into the follow-up process.

It has been suggested that the fellows (possibly with the assistance of B4FA) produce a local lexicon of biosciences terms in local languages, for them to use. We will need them to take the lead on this if it goes ahead.

10. Presentations delivered in training course

Introduction

Dr Bernie Jones – B4FA Media Programme Director

Biosciences for Farming in Africa

Media Fellowship Programme
Round 2
Dialogue Workshop

Welcome

Professor Sir Brian Heap
B4FA Project Leader

B4FA – The Project

- 3 years long
- Encourage dialogue and understanding
  - Biosciences
  - Farming
  - Africa

Funders

- John Templeton Foundation
  - focus on the big questions of human purpose and ultimate reality. The Foundation takes a particular interest in how major advances in genetics might serve to empower individuals, leading to spiritually beneficial social and cultural changes.
- Malaysia Commonwealth Studies Centre
  - focuses on affordable education, affordable healthcare, sustainable development, food security, mitigating climate change, the promotion of electoral democracy and good governance.

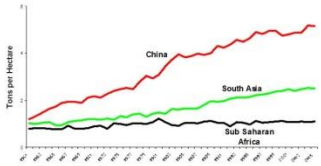
Sir John Templeton 1912 – 2008

- As a pioneer in both financial investment and philanthropy, the late Sir John Templeton spent a lifetime encouraging open-mindedness
- In 1999, *Money* magazine called him - "arguably the greatest global stock picker of the century"
- Sir John's passing was marked by *Nature*: Templeton was a deeply spiritual, although unorthodox, individual. He lived a life firmly rooted in the Christian traditions of modesty and charity. Yet he was also a great admirer of science....which led him to form his foundation in 1987

Project Rationale

- Philanthropic objectives of our funders
- Global factors
  - Population growth, climate change, food security
- National importance of agriculture in Africa
- Opportunity for socioeconomic development
- "Missed" green revolution

What green revolution?



What is happening on the ground in Africa?

- Lots of
  - research initiatives to improve local crops
  - international development projects on agric
- But
  - low/irregular funding, from donors and gvmts
  - little dialogue and public understanding in-country
  - disinformation

What does B4FA consist of ?

- *Insights*
- Media Development Fellowships
- Series of studies on agricultural extension services and innovation farms
- Finding synergies with others

Overview

Bernie Jones
Course Leader

Course Expectations

- Introduction to plant breeding, genetics, and agricultural biotechnologies
- Networking and dialogue with African experts and practitioners
- Discussion of the regulatory and commercial aspects of biotech and crop improvement
- Practical sessions and field trips
- Reminder of fundamentals of science journalism
- Opportunities to practice journalistic techniques and skills in mentored environment

Follow-up

- After this training course?
  - Fellowship is ongoing!
- Our expectations of you?
  - Engage in discussions, networking and other activities
  - Write/broadcast more about the issues, and let us know about it

Housekeeping

- Format of each day
- PLEASE no mobiles or emails in sessions
- Be on time – we cannot wait
- Attend all sessions
- Expenses settlement on final afternoon
- Prizes awarded at end of course
- Use free time for interviews, discussions etc

Introductions

Over to You!

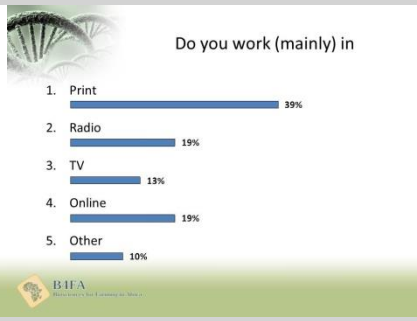
2013 fellows, 2012 alumni, experts, staff

Our interactive system

- Chance to poll our participants
- Get instant feedback
  (don't always show answers)
- Up to 5 options – identified by number

Let's practice...


In which capacity are you here?
1. 2013 Media Fellow
53%
2. 2012 Media Fellowship alumni
21%
3. Scientific Expert
15%
4. Mentor
9%
5. Workshop staff
3%
B4FA
36 / 50
Cross-tab label


Do you work (mainly) in
1. Print
39%
2. Radio
19%
3. TV
13%
4. Online
19%
5. Other
10%
B4FA


Coffee Break Exercise
• What are the biggest challenges in agriculture in this country
• What do you want to learn/develop from this workshop?
• Write your answers on a post-it and stick it up
B4FA

Plants and Agriculture – a history

Dr Bernie Jones – B4FA Media Programme Director

Plants and Agriculture – a history

Bernie Jones

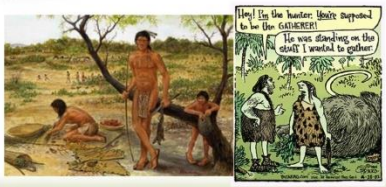
What do you know about farming?

1. I am a farmer — 26%
2. I grew up and/or have lived in a farming community — 54%
3. I am a city person, but members of my family farm — 3%
4. I have no experience of farming — 17%
5. What's a farm? — 0%

When did people start to farm?

1. People have always farmed — 45%
2. Around 10,000 years ago — 30%
3. Around 5,000 years ago — 15%
4. Around 2,000 years ago — 0%
5. Around 500 years ago — 9%

How did it start?



Early Farming

Domestication

When? Why? How?

9000BC Wheat/barley, Fertile Crescent
8000BC Potatoes, South America
7500BC Goats/sheep, Middle East
7000BC Rye, Europe
6000BC Chickens, South Asia
3500BC Horse, West Asia
3000BC Cotton, South America
2700BC Corn, North America

Diversity & Traits

Living things are variable

(This is genetics!)

Selection

Selection

- Early farmers discovered they could select better traits in their crops
- This becomes a continuous process

Selection

Crops already "genetically engineered" over 1000's of years…

Change: mutation & crossing

- Natural mutations and crosses
- Selection for desirable traits
- Deliberate crossing/hybridisation

Deliberate plant breeding

- Realisation that attributes of plants could be deliberately influenced
- Launched plant breeding as necessity (disease) and "pastime"
- Gradual realisation that there must be principles underlying this process
- Constant searches to find new plant material for cross-breeding

Breakthrough of "genetics"

- Could observe some underlying principles…
- Led to gradual understanding and discovery of genetics and inheritance. More of this in next session
- But allowed breeding, and breeding process, to become much more focussed and productive

Where are we today

- All our crops are "modified" in some way
- Plant breeding and selection have been basic way of life for farmers for millennia
- Techniques have developed over time
- Current technological options just part of this continuum
- Risks from traditional breeding?

Agricultural systems

- Crop rotation
- Sustainable agriculture
- Sustainable intensification
- Organic

But these are all potentially complementary techniques, not alternatives

B4FA

Colonisation, migration and agriculture

- Centres of origin vs most productive zones now

- Why are Africa's staple crops what they are?

B4FA

Which of these are "African" crops?

1. Cassava 15%
2. Maize 9%
3. Sorghum 47%
4. Banana 18%
5. Oil palm 12%

B4FA

Which of these are "African" crops?

1. Pearl Millet 65%
2. Mango 21%
3. Rice 0%
4. Sugarcane 9%
5. Cotton 6%

B4FA

Modern-day crops/foods

- Are often not indigenous
- Have (in the main) been significantly altered by humans over 1000s of years
- And are therefore "genetically modified" (but are NOT GMO's)

B4FA

Genetics/Breeding recap

- Natural (genetic) variety/diversity in crops
- Selection (natural, accidental, deliberate)
- Mutation (environmental, genetic)
- Crossing & hybridisation (natural, deliberate)

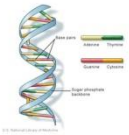
GENETICS!

B4FA

Recap

- Agric practices and environments complex
- Planting material/crops complex
  - "natural breeding"
  - deliberate and accidental breeding
  - constant process
- No silver bullets

B4FA



B4FA

Fundamentals of Genetics

Dr Moses Adebayo – Ladoke Akintola University of Science and Technology, Nigeria

Fundamentals of Plant Genetics

Moses Adebayo
LAUTECH, Ogbomoso, Nigeria
(adebayovam@yahoo.com)

RESEMBLANCE

Father

Mother

Facial look

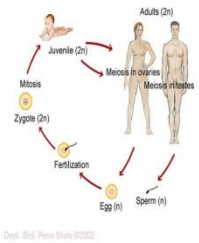
Complexion

Son

Son got "**something**" from father and from mother

INHERITANCE

- "Something" transmitted from me to son through sperm during sex
- Son equally received "something" from mother through egg
- Son mainly a product of "genetic" contributions from mother and father



Genetics

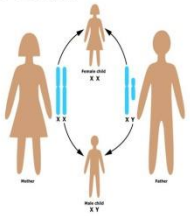
- Gene - unit of heredity (the "something").
- Genetics - the science of heredity (genes).
- Term coined at beginning of twentieth century (replaced previous studies of "generation", "inheritance", "heredity").
- In 1920's classical genetics was often referred to as "Mendelism" and was a relatively new (and controversial) area of biology.
- By 1950's genetics recognized as unifying principle at core of the life sciences.

Why study genetics?

- Understanding genetic processes is fundamental to comprehension of life itself. Genetic function - cellular function, external appearance, linkage between generations.
- Modern society depends on genetics. Breeding programs led to crops, livestock, Biotechnology produces drugs, etc.
- Genetics is a key component in medicine. Estimated at least 30% of pediatric hospital admissions have direct genetic component.

Girl, Girl, and Girl Again
The Blame Game!!!

- Many marriages have collapsed -"all girls, no boy"
- Wives often unjustly blamed, but never guilty
- Blame the husband, if not, blame genetics!!!
- The man's sex "contribution", either X or Y, determines the baby's sex



Genetics of gender in humans

Genetic Basis of Crop Evolution

Prehistoric farmers selected the genetic changes/characters that domesticated certain wild plants. Modern plant breeders have selected additional genetic improvements to produce the crop plants that we enjoy today.

teosinte / **corn** - cob size

Teosinte/corn photo compliments of J Doebley, Univ. Wisconsin

wild tomato / **modern** tomato - Fruit size

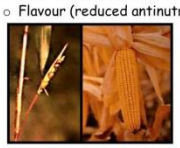
Tomato photo by Bruce Thomas, UC Davis

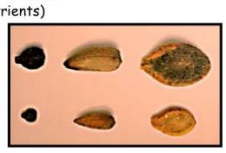
Variability, Traits, and Genes

- Variability/variation simply means difference - conditioned by genetics, environment, and their interaction
- Trait - any characteristic that can be passed from parent to offspring. Transmissible/heritable if genetic
- Genes acting singly or jointly are expressed as traits in organisms

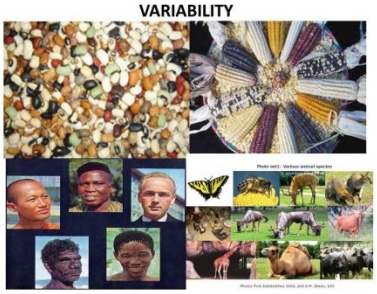
Traits associated with domestication:

- Seed size
- Seed abundance
- No shattering
- Thinner seed coats
- Uniformity (germination, ripening)
- Flavour (reduced antinutrients)





VARIABILITY



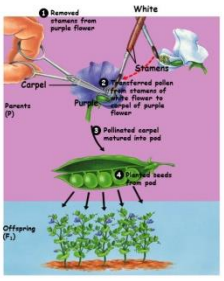
Genetics - How It All Started!

- Gregor Johann Mendel (Austrian Monk)
- Was the first person to analyze patterns of inheritance
- Deduced the fundamental principles of genetics
- Used physical appearances to deduce the genetic make-up

Gregor Mendel (1822-1884)

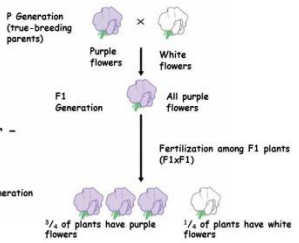
MENDELIAN GENETICS - LAWS OF INHERITANCE

- Mendel worked with Pea
- Carried out some **cross-fertilizations**
- Called heritable properties "**particles**"
- Refuted **blending inheritance**
- Created **hybrids**

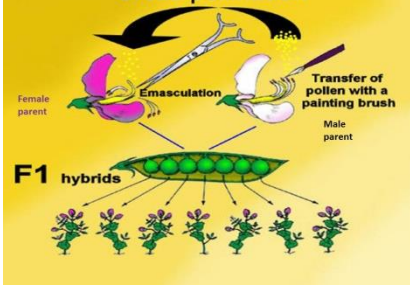


INHERITANCE OF ONE CHARACTER/TRAIT

- Parents differ in one character - flower color

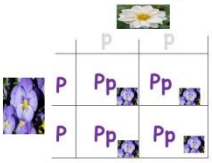


Cross pollination



Parental Cross

Trait: Flower color
Alleles: P - Purple, p - White
Cross: Purple flower x White flower
PP (female) x pp (male)



Genotype: Pp
Phenotype: Purple
Genotypic Ratio: All alike
Phenotypic Ratio: All alike

Genotype and Phenotype

- **Genotype (genetic make-up)** - gene combination for a trait (e.g. PP, Pp, pp)
- **Phenotype (physical appearance)** - the physical feature or appearance resulting from a genotype

purple flower

white flower

Where is the white flower???

Trait: Flower color

Alleles: P- Purple p- White

Cross: Purple flower x Purple flower (F1xF1)

Pp x Pp

	P	p
P	PP	Pp
p	Pp	pp

Genotypes: PP, Pp, pp

Phenotypes: Purple & white

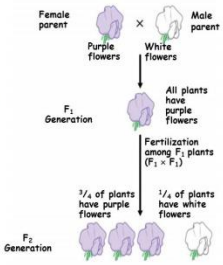
G.Ratio: 1:2:1

P.Ratio: 3:1

- **Alleles** (from allelomorphs) - two contrasting forms of a gene (dominant & recessive)
- **Dominant** - stronger of two genes that masks the other, expressed in the hybrid; represented by a capital letter (P)
- **Recessive** - gene that shows up less often in a cross; represented by a lowercase letter (p)

CONCEPTS OF DOMINANCE AND RECESSIVE ALLELES

- Two allelic genes for a trait, e.g. flower color
- Female parent carries purple allele
- Male parent carries white allele
- Purple allele masks or dominates (dominant) the white allele (recessive)



KINDS OF GENOTYPES

- Homozygous genotype: individual carrying similar alleles for a trait e.g. PP = homozygous dominant; pp = homozygous recessive
- Heterozygous genotype: individual carrying contrasting alleles for a trait e.g. Pp
- *Both PP and Pp have purple phenotype while pp has white phenotype*

CONCLUSIONS - Mendel's Laws of Inheritance

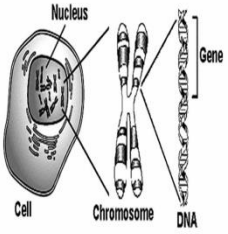
- Mendel's Law of Segregation: the two alleles of the gene controlling a character separate during formation of egg and sperm
- Mendel's Law of Independent Assortment: Each allele in a pair behaves independently

So far!!!!!

- Ample evidence that "genes" exist
- Genes are expressed in the physical appearances of individual organisms as "traits"
- Vital to locate the part of the living cell that "houses" the genes

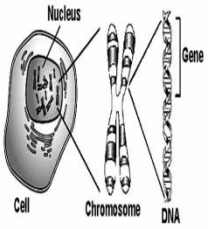
Where are the genes????

- The rediscovery of Mendel's work in early 20th century revealed what he didn't know - Chromosomes and DNA
- In 1842, Karl Wilhelm von Nageli detected Chromosomes under the microscope in plant cells
- Morgan's work of 1908 led to the discovery of chromosomal location of genes



Cell, Chromosome, DNA, Gene

- "A healthy plant is a community of cells built in a fortress-like fashion".....G. Agrios
- "Cells" to the body are "blocks" to a house
- Chromosome = DNA (deoxyribonucleic acid) + protein
- Genes form parts of the DNA

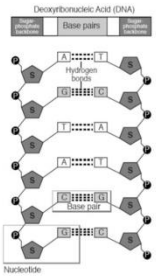


The Amazing Work - DNA!

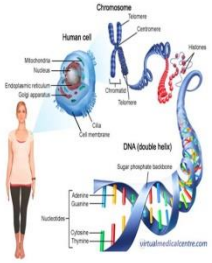
- Each cell has about 2 m long DNA.
- The average human has 75 trillion cells.
- The average human has enough DNA to go from the earth to the sun more than 400 times.
- *DNA is highly coiled (diameter=0.000000002 m).*

The earth is 150 billion m or 93 million miles from the sun.

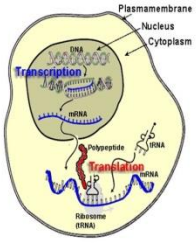
- DNA composed of four chemicals ⇒ Adenine (A), Guanine (G), Cytosine (C), and Thymine (T).
- Different arrangements of the chemicals make up the genes
- Genes that determine traits are parts of the genetic "codes"



- A. thaliana has 119 million bp; 26,300 genes - fully sequenced
- Maize has 250 million bp; ≈ 30,000 genes - fully sequenced
- A human cell has 6 billion bp, 20,000-25,000 genes
- Only 2% of human genome is genes, the rest is *junk DNA*



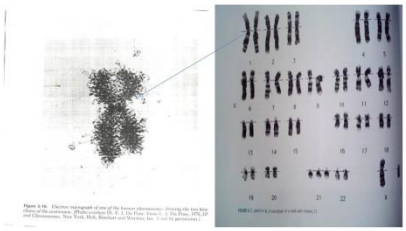
- Genes are genetic codes for active proteins that result in a phenotype or a biological process
- Gene codes from the DNA are made into active proteins
- Proteins guide all life processes - growth, reproduction, development, health, etc.

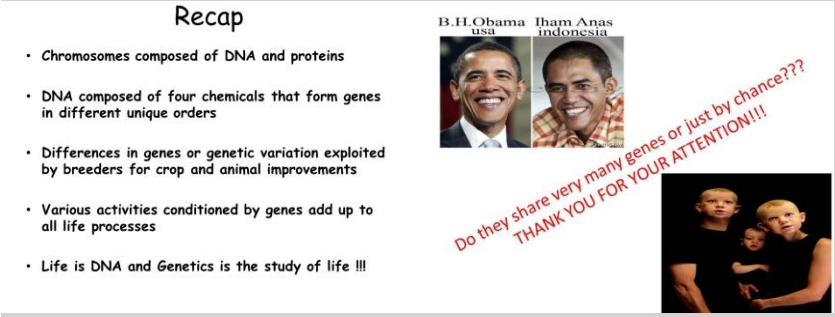


Gene Functions

- Genes determine the various characters transmitted from parent to offspring
- Genetic variations are being exploited for improvements of crops and other organisms
- Simple traits (flower or seed color) conditioned by one or a few genes - oligogenic inheritance
- Complex traits (grain yield, drought tolerance) determined by many minor genes - polygenic inheritance

Human genome




Recap
Chromosomes composed of DNA and proteins
DNA composed of four chemicals that form genes in different unique orders
Differences in genes or genetic variation exploited by breeders for crop and animal improvements
Various activities conditioned by genes add up to all life processes
Life is DNA and Genetics is the study of life !!!
B.H.Obama usa
Iham Anas indonesia
Do they share very many genes or just by chance???
THANK YOU FOR YOUR ATTENTION!!!

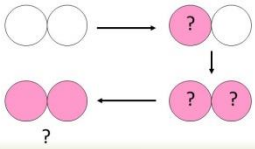
Genetics game & DNA extraction

Dr Bernie Jones – B4FA Media Programme Director

Genetics Simulation

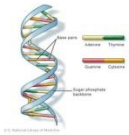
- Inheritance of traits (colour of corn)
- Dominant and recessive alleles

For every child/seed…



Results

- What traits do your seeds have?
- What is the ratio of yellow:white
- Is that what you expected?
- Why?



DNA Extraction

What you will do

- Some real science!
- Perform an experiment yourself right here to extract the DNA from fruit
  - You could use the same method on almost anything alive (including yourself) – but it works nicely with fruit, and hurts less!

Experimental Steps

- First, make the extraction solution ("buffer")
- Second, prepare (mash) the fruit
- Third, add the buffer to the fruit
- Fourth, extract the DNA with alcohol
- Fifth, try to pick up some DNA to keep!

What you will need

a plastic cup
a test tube
a pipette
some fruit
a plastic bag
a strainer (to share)

a glass phial to keep the DNA in

All clear?

Let's watch me trying it at home…

Making up the extraction solution (buffer)

Preparing the fruit

Adding the extraction buffer

Straining the solution

Extracting the DNA

Final result

Now
It's
Your
Turn!

B4FA

Well done!

- You've performed an experiment
- You have extracted DNA
- You have seen how DNA from different plants looks the same

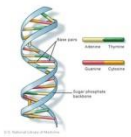
B4FA

...and now:

- Some quick feedback please
- We'll do this at the end of every session
- Results will NOT be displayed on screen, so please be honest and forthright
- Chance for written feedback at end of course

- We'll ask you about the History, Genetics and DNA Extraction sessions

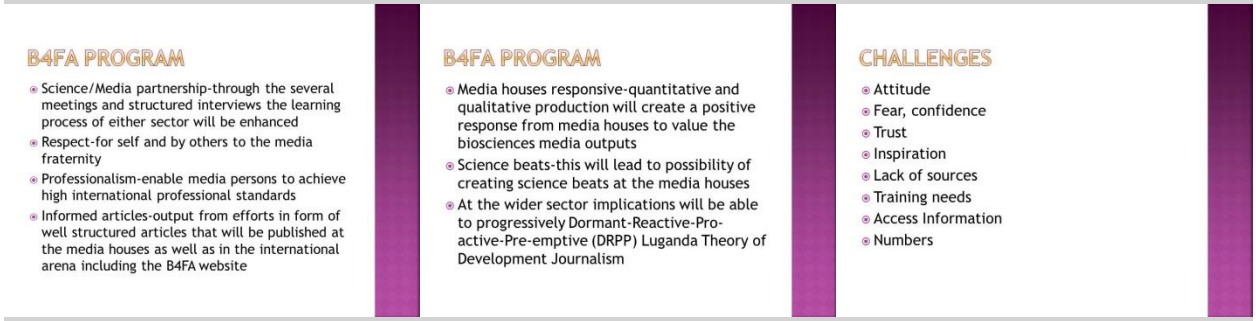
B4FA



B4FA

Science Journalism

Patrick Luganda – B4FA Media Mentor



F1 hybrid seeds

Dr Claudia Canales Holzeis – B4FA Technical Expert

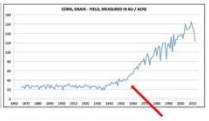
F1 Hybrids

Claudia Canales

The need for more food

U.S. population growth in the last 100 years

U.S. maize yields in the last 100 years

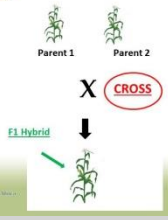


8-fold increase in maize yield thanks to:

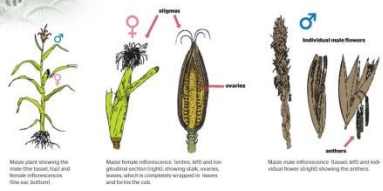
- F1 hybrids
- Fertilisers
- Mechanisation (tractors)

What is a maize F1 hybrid?

The first generation (F1) of a cross between from two uniform parent inbred lines



Maize reproduction



Controlled crosses

- Each kernel in a cob is a genetically unique individual
- Kernels in a cob have the same mother, but can different fathers

A maize cross protected by a bag.

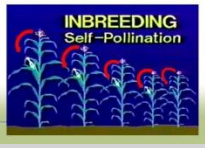
How do you make an F1 hybrid?

How do you make an F1 hybrid?

3 steps

1: Development of parental inbred lines

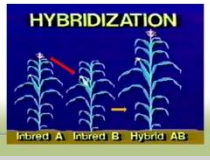
By self-pollinations until a good degree of uniformity is achieved. Selection for type and good parent potential is done as the lines are inbred.



Inbreeding depression

How do you make an F1 hybrid? Cont.

2: Test crossing: sets of two inbred lines are crossed (uniformly, with no selfing allowed)



Hybrid vigour

How do you make an F1 hybrid? Cont.

3: Production crossing: commercial production of F1 hybrid seed. Expensive and labour-intensive.

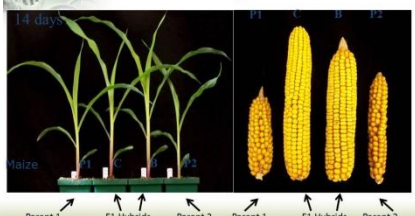
What are the advantages of F1 hybrids?

- It is uniform in appearance and behaviour:
  - enables farmer to treat and harvest crop at the same time uniformity
  - has marketing advantages when sold to buyers with strict quality standards)
- It has hybrid vigour (makes them more competitive with weeds)
- It is high yielding
- It is selected for improved grain quality
- A particular hybrid can be selected for specific pest and disease resistance or drought tolerance

What is hybrid vigour?

- F1 hybrids tend to have greater biomass, speed of development, and fertility than both parents
- Hybrid vigour is positively correlated with the degree of dissimilarity between the parents
- Why? Hypotheses:
  - masking of expression of undesirable (deleterious) recessive alleles (alternate forms of genes) from one parent
  - some combinations of alleles are especially advantageous when paired in a heterozygous individual.

Maize F1 hybrids



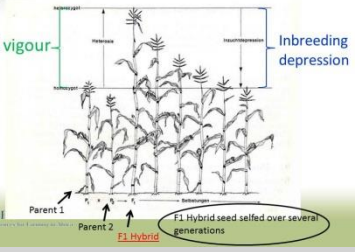
Game introduction

- F2 generation of hybrid seed – variability and consequences

What are the disadvantages of F1 hybrids?

- Hybrid seed is more expensive than open-pollinated maize seed
- Farmers situated in a low potential environment and who cannot afford extra inputs such as fertilizers may not recover the costs of the hybrid seed
- Fresh hybrid seed needs to be bought every planting season (farmers cannot replant grain as seed without major reductions in yield, which might be a decrease of 30 % or more)

What are the disadvantages of F1 hybrids? Cont.



F1 hybrid seeds vs landraces

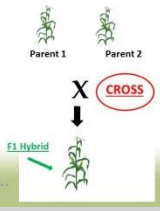
- Genetic uniformity can be a problem if the conditions are bad (such as extreme weather conditions, new pest or disease)
- Traditional landraces are genetically very variable, and hence more resilient, although yields are lower
- Landraces are invaluable sources of genetic diversity

Consequences of hybridisation

- Bought seed vs seed saving
- (Lack of) ability of individuals or government research institutions to produce in desired quantity and quality
- F1 hybrid production closely linked to the creation of private seed companies for commercial seed production (public versus private investment in plant breeding)

F1 hybrid seeds are not GM!!

Why? Because they are produced by crossing two non-GM plants.



F1 Hybrid Quiz!

- Three quick questions for you!

History of Breeding: Overall value of the session

1. Hybrid seeds are GM (genetically modified) — 6%
2. You cannot save seed for replanting because it is sterile — 19%
3. Hybrid seeds are always better than common farmers varieties (landraces) — 9%
4. Hybrid seeds are produced by crossing two conventionally bred maize lines — 66%

You cannot save seed of F1 hybrids for replanting because you lose the hybrid vigour, the uniformity of the crop, and potentially important characteristics

1. Yes — 73%
2. No — 27%

F1 hybrids are not GM plants because they have been generated by crossing

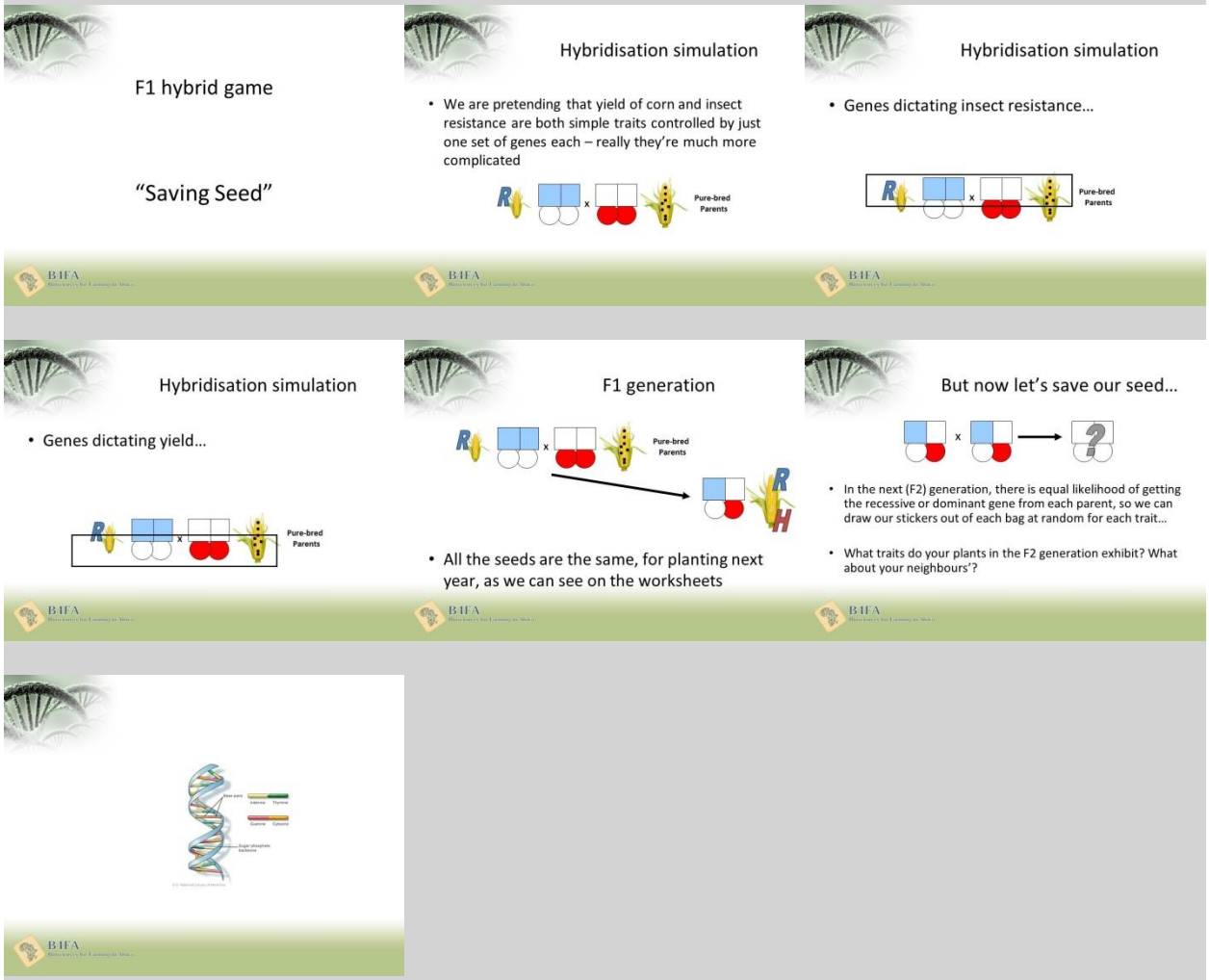
1. Yes — 88%
2. No — 12%

34 / 50

Cross-tab label

F1 hybrid seed game

Dr Bernie Jones – B4FA Media Programme Director



Gm Crops

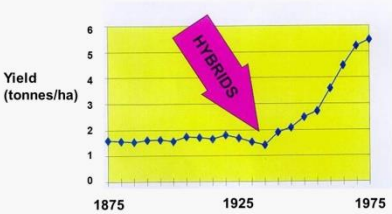
Prof Jim Dunwell – University of Reading

School of Agriculture, Policy and Development

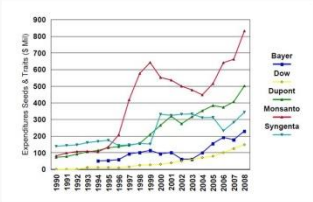
GM Crops: Production, Commercialisation and Regulation

Jim Dunwell

USA: Historic Maize Yields

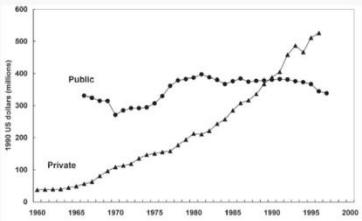


Expenditure on Seeds & Traits



Wilson & Dahl 2010

US Spending on Plant Breeding



Recap

- Ever more sophisticated techniques to introduce new/desired traits into plants
- But, what if:
  - The plants with the traits won't breed with each other
  - Your crops are sterile
  - The desired trait isn't available
  - You don't have time to follow a conventional breeding/back-crossing process
  - You want to do something new (make a vaccine etc)

Previous technologies

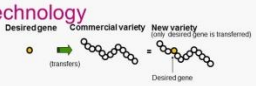
- All technologies and processes described so far are pretty non-specific, and can be time consuming
- Especially genetic variation aspect. You can want to introduce a single trait, but breeding "mixes everything up"
- Imagine you want to build a better car. You have a 4x4 which is good for getting around on your roads, but want it to go faster.
- Current technologies analogous to taking lots of 4x4s and lots of Porsches; rebuilding new cars from 50% of the pieces of each; and then seeing which ones work and which don't.
- When all you want to do is put the engine from one car into the body of the other one.

Traditional plant breeding

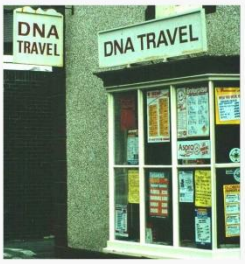
Traditional plant breeding combines many genes at once.

Plant biotechnology

Using plant biotechnology, a single gene may be added to the strand.



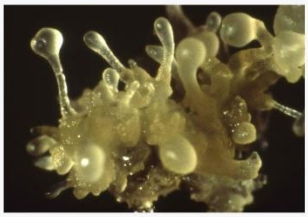
7



Ideal Transformation Method

- Can be applied to any genotype
- Produces fertile plants
- Has high efficiency
- Introduced gene is single copy
- Gene is stable and expressed over time/generations
- No background genetic change

Maize: Embryogenic Cultures

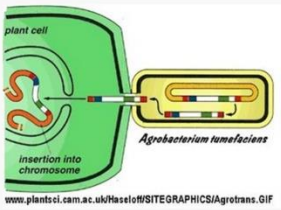


Indirect Methods

- Use of natural systems

Natural System for Gene Transfer

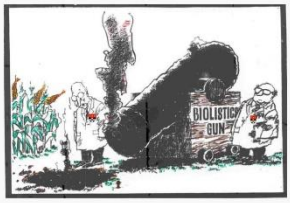
Agrobacterium Gene Transfer



Direct DNA Methods

- No need for bacteria

Particle Gun



"We won't know if it's worked until we find the plant"

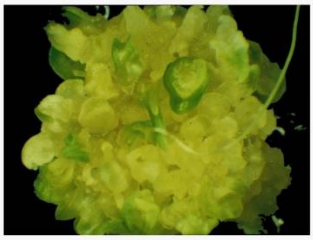
Biolistics

John Sanford

Particle Bombardment

Embryos after Particle Bombardment

Regenerating Wheat Embryo in Vitro



Regenerated Wheat Plants

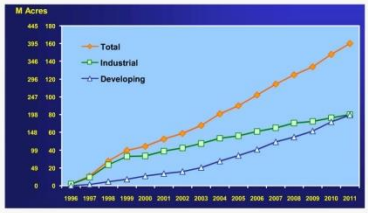
21

Jonathan Swift

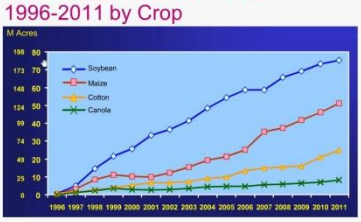
"And he gave it for his opinion, that whoever could make two ears of corn..to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country than the whole race of politicians put together" Jonathan Swift, 1726

Biotech Crop Countries and Mega-countries 2011

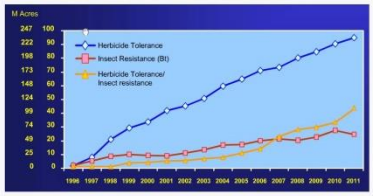
Global Areas of Biotech Crops 1996-2011



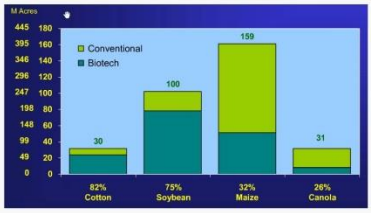
Global Area of Biotech Crops, 1996-2011 by Crop



Global Areas of Biotech Crops, 1996-2011 by Trait



Global Adoption Rates (%) Principal Biotech Crops 2011



28

GM Crops 2011

- Biotech crops reached 160 million hectares, up 12 million hectares on 8% growth, from 2010, as the global population reached a historical milestone of 7 billion on 31 October 2011.
- A 94-fold increase in hectarage from 1.7 million hectares in 1996 to 160 million hectares in 2011 makes biotech crops the fastest adopted crop technology in the history of modern agriculture.
- Of the 29 countries planting biotech crops in 2011, it is noteworthy that 19 were developing and 10 were industrial countries.

29

Approved GM Traits in US

Trait	Example
Herbicide tolerance	Bromoxynil, glufosinate, glyphosate, sulfonylurea
Insect resistance	Bt kurstaki, Bt tenebrionis
Virus resistance	Papaya ringspot, cucumber mosaic, zucchini yellow mosaic, watermelon mosaic, potato leaf roll, potato Y
Male sterility	Barnase/barstar
Modified ripening	ACC synthase, ACC deaminase SAM hydrolase, polygalacturonase
Modified oils	high lauric, myristic, oleic

30

Herbicide Tolerant Sugar Beet

Control GM

Herbicide Tolerant Sugar Beet

Advantages of Herbicide Tolerance

- Reduction of pre-emergent sprays
- Treatment can be left until weeds emerge
- No-tillage systems are possible
- Costs can be reduced
- Ease of agronomy

Brazil - Double Cropping without Irrigation

Harvesting Soybean, sowing Corn, with no tillage

Insect Resistance

35

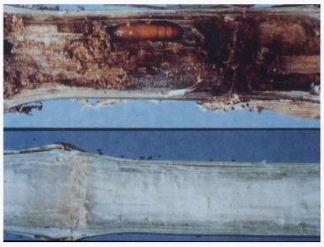
Bacillus thuringiensis (Bt) Toxin on Corn Borer

Control without toxin

Bt Toxin on Corn Borer

with toxin

Bt in Corn (maize)



Bt Corn

Insect Resistant Transgenic Rice with Bt against Stem Borer

Water Stress

Monsanto

Disease Resistance

1. Virus Resistance (approved products)

Transgenic Papaya Line with Resistance to PRSV

Deregulated in USA 1996

Now approved for sale in Japan, 27 May 2010

GM Control

GM Virus Resistant Papaya

45

"Input" and "Output" Traits

Input effects

- Crop protection (eg. insect, fungal control)
- Agronomic effects (eg. cold-tolerance, drought tolerance)

Output effects

- Higher yields
- High oil, modified starch, modified protein etc
- Modification of flavour and sweetness
- Post-harvest benefits eg. anti-sprouting, anti-bruising, ripening control
- Enhancement of beneficial components eg. vitamins

First GM Product in UK 1996

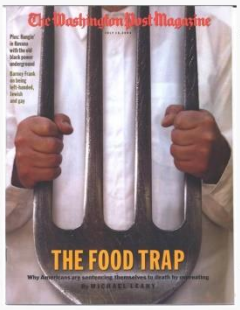
Reduced level of polygalacturonase enzyme

Commercialisation Pipeline

Output Traits

Why are fish oils important in human diet?

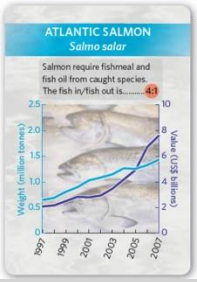
- Specific fatty acids found in fish oils are prevalent in specialised organs (such as the brain, eyes & testes). These are the n-3/omega-3 long chain polyunsaturates
- Mammals have a very limited ability to synthesise these fatty acids, so we need to obtain them from our diet
- Some human genetic disorders are directly linked to an inability to make these fatty acids. There is also some evidence of a reduced capacity to synthesise them in old age and/or diseased states.
- The fatty acids found in fish oils are NOT the same as those in vegetable oils
- Long chain Omega-3 fatty acids play a role in anti-inflammatory responses
- Long chain Omega-3 fatty acids have been shown to play a role in prevention of cardiovascular disease and re-occurance of infarction. They may also play a role in childhood IQ, depression and dispraxia.



Moderate consumption (0.5-2g/day) of omega-3 long chain polyunsaturated fatty acids found in fish oils can help reduce the risk of CVD and metabolic syndrome.

Unfortunately, wild fish stocks (the predominant source of these fatty acids) are in decline due to over-fishing and pollution of the marine environment. Also the demands of aquaculture

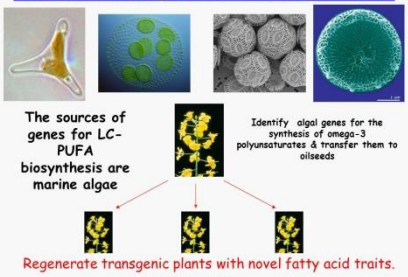
Fish farming is a net consumer of fish oils and is unsustainable..



Unfortunately, marine fish in aquaculture require dietary provision of omega-3 LC-PUFAs. Aquaculture is a massively expanding industry, already consuming a large % of wild capture fish oil & meal. Vegetable oils cannot substitute for the dietary fish oils.

Thus, there is a pressing need to find a sustainable source of fish oils for aquaculture.

The synthesis of omega-3 LC-PUFAs in transgenic plants



The sources of genes for LC-PUFA biosynthesis are marine algae

Identify algal genes for the synthesis of omega-3 polyunsaturates & transfer them to oilseeds

Regenerate transgenic plants with novel fatty acid traits.

Timeline – project started 1994 (!!)

Benefits of Omega-3 Fatty Acids

Algae naturally produce Omega-3 fatty acids that have health benefits for humans.

Humans don't typically eat algae, but fish do. Fish like salmon tend to have higher levels of Omega-3 fatty acids.

Goal: Develop a land-based source of oil with a nutritional profile similar to fish oil but an improved flavor

Monsanto

Establishing a novel oils platform in *Camelina sativa*.

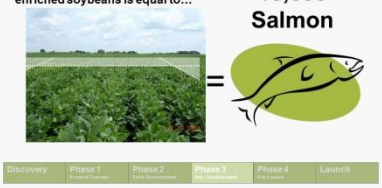
Most successful Arabidopsis-evaluated constructs will be introduced into Camelina sativa.

Camelina is a Brassicaceae and easily transformed. Oil profile is similar to Arabidopsis, so results should be equivalent or better to that observed in the model system. We have determined baseline datasets for lipid composition over seed development for Camelina

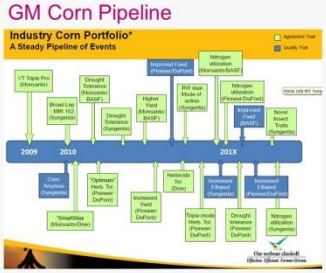
1 Acre of Omega-3 Soybeans: Comparison

- OMEGA-3 SOYBEANS

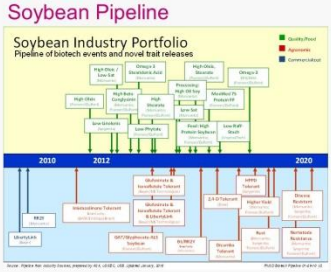
Just one acre of Omega-3, SDA-enriched soybeans is equal to…



GM Corn Pipeline



Soybean Pipeline



US Soybean Export Council

59

International Dimension

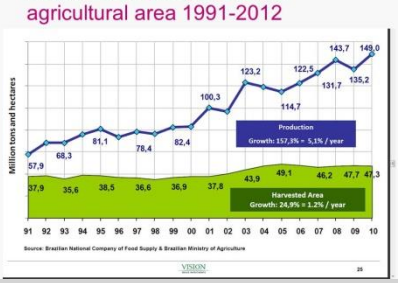
Potential to Reduce Yield Gap

All Crops	Yield Gap (%)
North America	33
West /Central Europe	36
Eastern Europe/Russia	63
South America	52
East Asia (China)	11
South Asia (India)	55
Sub Saharan Africa	76

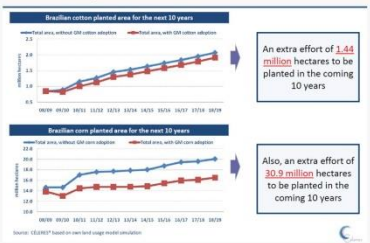
Source: Fischer, Hizsnyik, Prieler, Wiberg, 2010.

OECD Trade and Agriculture Directorate

Brazil: Grain production and agricultural area 1991-2012



GM Crops in Brazil

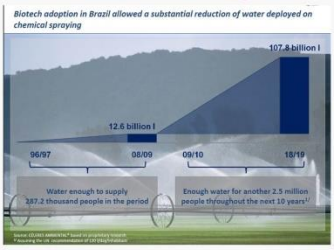


An extra effort of 1.44 million hectares to be planted in the coming 10 years

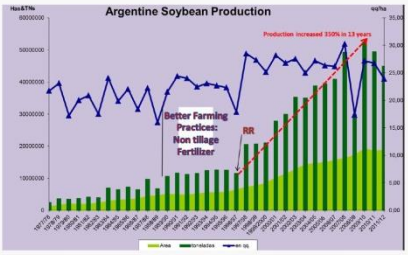
Also, an extra effort of 30.9 million hectares to be planted in the coming 10 years

Celeres 2010

GM in Brazil: Water Saving



Celeres 2010



[redacted]

66

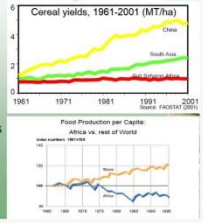
Bt Cotton in India

In the period, 2002 to 2008, Bt cotton generated economic benefits for farmers valued at $5.1 billion, halved insecticide requirements, contributed to the doubling of yield and transformed India from a cotton importer to the major exporter. In 2008 alone, the benefits accruing from Bt cotton in India was US$1.8 billion.

ISAAA 2010

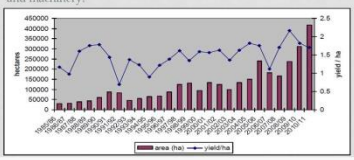
African Agriculture: Under-Performing

- Yields are stationary or declining
- Yet population has continued to increase
- Production per capita is declining



South African Experience: HT Soybeans 1

- Yields were relatively stagnant for the 15 years prior to introduction of HT soy beans .
- Introduction of HT soy bean had little if any impact on yield
- Farmers benefited mainly through saving on weed control chemicals, fuel and machinery.



South African Experience: HT Soybeans 2

- Soy bean farmers increased production (due to the ease of weed control management with HT.
- Demand for labour has increased.
- Increased employment opportunities also in the soybean processing sector (crushers, oil-cake, animal feed).
- Saving on foreign exchange

South African Experience: HT Maize 1

Insecticide saving impact of Bt
•Few smallholder farmers apply insecticides = little insecticide or labour saving
•Higher yields would mean more labour, but this was found to be minimal

Labour saving impact of HT maize
•A main benefit for HT adopting smallholder farmers is the labour saving impact
•A labour saving technology is not ideal for a country with a high unemployment rate but labour is a limiting factor for many subsistence farmers due to migration to urban areas and high prevalence of HIV/AIDS

South African Experience: HT Maize 1

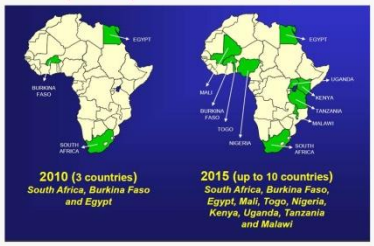
2006/07	Herbicide application	Manual weeding	Harvesting	Total
Conventional and Bt with manual weeding	0.0	21.0	10.1	44.5
HT (RR) with chemical weed control	4.0	0.0	13.9	39.4
2007/08				
Conventional and Bt with manual weeding	0.4	13.1	8.9	31.5
HT (RR+BR)	4.0	0.8	8.0	17.0

Transgenic Drought Tolerant Maize under water stress in CFT, Lutzville, RSA Mar 2011

Maruca Resistant- Cowpea

Developing high quality insect-resistant cowpea varieties for use by smallholder farmers

Implementation of appropriate regulation is a must to spur adoption of biotech crops in Africa



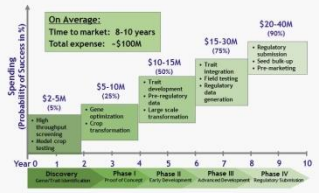
Policy on GM crops...

- Most parties engaged in product development find the operative policy environment on GM crops in Africa to contain highly precautionary overtones!

Courtesy, C. Juma, Harvard Univ.

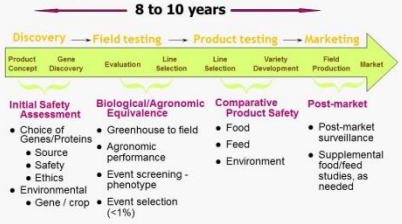
- An overly precautionary policy position is burdensome to product development and often turns away investments in GM technology

Ag Biotech has Lengthy Product Development Cycle and Large Investment Process



•Numbers (time duration, spending, and probability of success) are all estimates.
•The actual for individual projects could vary.

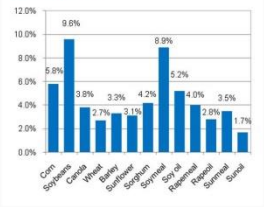
Safety Assessment Occurs Throughout the Development Process



Charles Darwin
(1809-1882)

"If the misery of the poor be caused not by the laws of nature, but by our institutions, great is our sin"

Increase in World Commodity Prices without Biotech



Brookes et al 2010

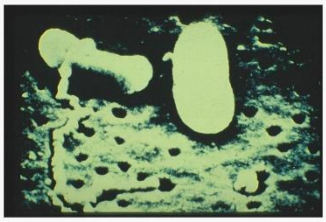
81

Future Prospects

- High value products
- Healthy food
- Biofuels
- Phytoremediation

High Value Products

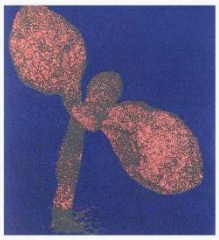
Polyhydroxybutyrate PHB



Plastics in Plants

Plastics in Plants

Plastics in Plants

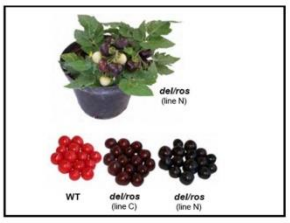


Healthy Food

Golden Rice: Increased Vitamin A

Golden Rice.org

Increased Anthocyanins in Tomato: Use of *Antirrhinum* Transcription Factor



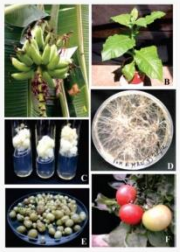
Protection against heart disease etc ? Martin et al 2008

Increased Anthocyanins in Tomato

	ug /gfwt	umol/gfwt
control	2.82	0.01
E8-Rosea1	9.74	0.03
E8-Rosea1 + E8-Delila Plant N	951.47	1.52
E8-Rosea1 + E8-Delila Plant Z	77.12	0.12

Pharming in Plants

Vaccines in Plants



Kumar et al. 2007

Conventional Field Crops

Maize
Rice
Barley

Novel or Non-food Field Crops

Other Crops

Tobacco - antibodies
Safflower - insulin
Alfalfa
Sugar Cane

Harvesting *Nicotiana*

Sterile F_1 Hybrids

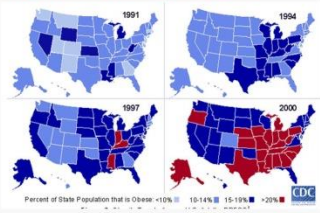
University Kentucky

First Pharma Product?

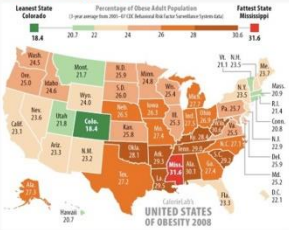
- Proinsulin from Safflower

Why Insulin?

Obesity Trends Among US Adults



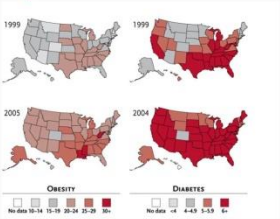
USA Obesity 2008



Increasing weight is associated with an overall increase in risk

- Overall mortality up to 2.5-fold in the 30-44 age group, less at older ages
- Cardiovascular mortality up to 4-fold in the 30-44 age group, less at older ages
- Diabetes up to 5-fold
- Hypertension
- Gall bladder disease

Obesity and Diabetes

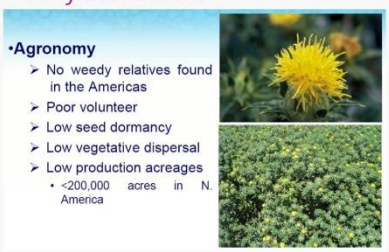


Insulin demand in USA

- In excess of US$7.1 billion today
- Predict US$15 billion in 2012

SemBioSys

Why Safflower?



- **Agronomy**
  - No weedy relatives found in the Americas
  - Poor volunteer
  - Low seed dormancy
  - Low vegetative dispersal
  - Low production acreages
    - <200,000 acres in N. America

SemBioSys

Why Safflower?

The biology of safflower makes it an excellent vehicle for PMP production.

- **Gene-flow**
  - Predominately self-pollinating (80-90%)
  - Virtually no wind transportation of pollen
  - Insects are biggest transport factors

SemBioSys

Safflower: Field Production

SemBioSys

Other Species used for Pharma Production

Arabidopsis	Pea
Banana	Pigeon pea
Carrot	Spinach
(flax)	Sunflower
Lotus corniculatus	Sweet potato
Lupin	Tomato
Papaya	White clover

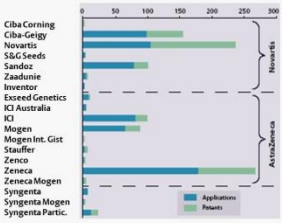
(also duckweeds, moss and algae)

Economic Perspective

IP and Industry Structure

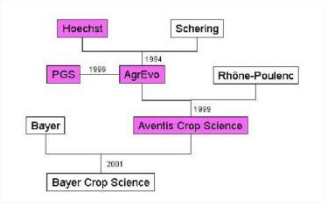
Five companies hold 75 percent of all ag-biotec patents

Syngenta Patent Portfolio



Graff et al 2003

AgBiotech Consolidation



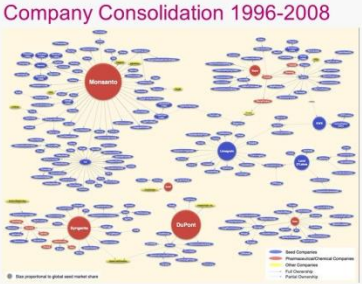
(CAMBIA)

The process of consolidation of IPR began in earnest in August 1996 with AgrEvo's purchase of Plant Genetic Systems (PGS) for $730 million, made when PGS's prior market capitalization was $30 million.

According to AgrEvo, $700 million of the purchase price was assigned to the valuation of the patent-protected trait technologies owned by PGS.

Pila 2008

Company Consolidation 1996-2008



Howard 2009

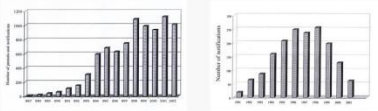
Public/Political Perspective

GM in Europe

Nature Biotechnology, April 2011

Effect of European Moratorium

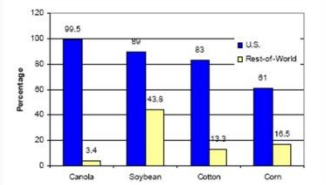
USA **Europe**



1995: USA 684, UK 37 (EU 213)
2008: USA 874, UK 2 (EU 83)
2009: USA 691, UK 2, (EU 104)

11

Intensity of Biotech Crops US vs Rest of World, 2006



Conclusion

- Global economic success
- Potential novel GM approaches
- International diversity of attitudes
- China ($3.5b), Brazil investment
- EU split
- US/EU asynchronous approval

Striga-resistant Sorghum case study

Dr Clet Wandui Masiga – ASARECA

ASARECA Transforming Agriculture for Improved Livelihoods

First products of DNA marker-assisted selection in sorghum released for cultivation by farmers in sub-Saharan Africa

PRESENTATION FOR **Initial Dialogue and Training Workshop on Plant Breeding, Genetics and Biosciences for Farming in Africa** 10 – 13 April 2013 Speke Resort and Conference Centre, Kampala

Abdalla Mohamed, Rasha Ali, Charles Mugoya, **Clet Wandui Masiga**, S. Deshpande, Folkertsma. R; D. Kiambi, O. Elhassan, A. Abu-Assar and C.T.Hash.

Clet Wandui MASIGA,
Conservation Biologist and Geneticist,
Agrobiodiversity and Biotechnology Programme (AGROBIO),
Association for Strengthening Agricultural Research in East and Central Africa (ASARECA),
P O Box 765, Entebbe, Plot 5 Mpigi Road, Entebbe, Uganda
Tel: +256 414 321885 Mobile: +256 772 457155
www.asareca.org/agrobio
Email: wmasiga@hotmail.com; c.masiga@asareca.org

ASARECA Transforming Agriculture for Improved Livelihoods

The production constraint

- Striga (*Striga hermonthica*) is a serious cereals production constraint leading up to 100% yield loss
- Resistance sources often low-yielding and poorly adapted
- Breeding progress often limited by poor knowledge on the genetics of resistance

About 17 million hectares of sorghum are infested with *Striga* in Africa every year, with yield losses of 6 to 7 million tons

Striga and sorghum

The parasite

Striga hermonthica (Del.) Benth.

- Family: *Scrophulariaceae, popular name: witchweed*
- Chlorophyllous, obligate hemi-parasitic plant
- Adaptive features:
  - high reproductive capacity
  - very small seeds, easy dispersal
  - long viability of seeds in soil

(Ejeta and Gressel 2007; Dörr 1997; Rodenburg 2005, and other sources)

Striga and sorghum

The Host

- Sorghum
  - Predominantly inbreeding
  - Outcrossing rates of 5-17% depending on variety
  - C4, 10 chromosomes (2n=20 1C=745 Mbp)
  - Fifth most important cereal
  - Main staple for 300 million people

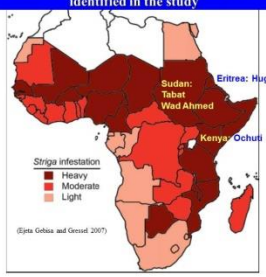
ASARECA Transforming Agriculture for Improved Livelihoods

Project background

Building upon the BMZ funded project with main objective

- *To develop Striga-resistant FPSVs, through a combination of MAB and farmer-participatory selection*

Farmer Preferred Sorghum Varieties (FPSVs) identified in the study



(Ejeta Gebisa and Gressel 2007)

ASARECA Transforming Agriculture for Improved Livelihoods

Objectives

- To use marker assisted breeding to enhance sorghum productivity in the *Striga* prone areas of the ECA. The specific objectives are:
  - To develop and map SSR and DART markers tightly linked to *Striga* resistance Quantitative Trait Loci (QTL)
  - To develop and evaluate farmer preferred *Striga* resistant sorghum lines
  - To develop capacity for marker assisted breeding in the ECA

ASARECA Transforming Agriculture for Improved Livelihoods

Outputs

- Output 1: Markers linked to *Striga* resistance QTLs identified and mapped
- Output 2: Farmer preferred *Striga* resistant sorghum varieties developed and evaluated
- Output 3: Capacity of NARS in marker assisted selection enhanced
- Output 4: Availability of information on *Striga* resistant sorghum enhanced

Historical Concept/Hypothesis: Case history of MARIS FREEMAN

- **Maris Freeman is a variety of wheat developed by PBI Cambridge for cultivation in the UK. It was developed during the 1970s and it revolutionized bread wheat production in the UK. The country became net exporter of bread wheat within a decade while previously it used to import most of the bread wheat from Europe and New Zealand.**
- **Maris Freeman was produced by PI method from cross between Maris Ranger, the most popular variety during the 1960s and Maris Widgeon which was an accession with desirable characteristics.**
- **Maris Ranger had high yield but poor bread making quality (high glutin %) and susceptibility to yellow rust. Seed suitable for animal feed.**
- **Maris Widgeon had low seed yield, resistance to yellow rust and good bread making quality (low glutin %)**

ASARECA Transforming Agriculture for Improved Livelihoods

Maris Freeman: Case history (1)

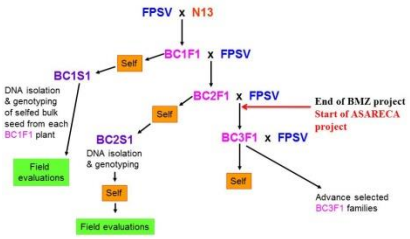
- 1962/3 Maris Ranger x Maris Widgeon
- F_1 (hand crossing, 20 plants in glasshouse, 4000 F2 seeds collected)
- ↓
- 1963 F2 (4000 F2 plants in field at 15x10cm, inoculated with yellow rust, visual selection for short-straw, high grain number and yellow rust. 500 heads (=plants) selected. Five grain from each head sall tested for bread quality 200 heads selected)
- ↓
- 1964 F3 (300 ear-rows grown at low density. Selection for short straw and grain number by eye, ……10 heads selected)
- ↓
- 1965 F4 (From 10 rows, the best row selected, seed of remaining 10 rows bulked for yield trial)
- ↓
- 1966 F5 (Selection carried out among F5 ear rows. Mini-trial of yield for the first time. Seed of rejected rows bulked for trial 2.)
- ↓
- 1967 F6 (Selection continued in the elite line. Rejected seed kept for trial. Mini trial-2)
- ↓
- Continued on next slide

ASARECA Transforming Agriculture for Improved Livelihoods

Maris Freeman: Case history (2)

- 1968 F7 (Selection continued, for uniformity. Rejected seed kept and given to National Institute of Botany, NIAB, for evaluation. Mini trial - 3)
- ↓
- 1969 F8 (Further purification of elite line. Rejected seed for NIAB Trial -1)
- ↓
- 1970 F9 (Ditto, NIAB Trial 2)
- ↓
- 1971 F10 (Ditto. NIAB Trial 3. Enough seed produced for the main trial by NIAB at different sights and elite seed given to NSDO for multiplication)
- ↓
- 1972 F11 (Purification, multiplication of seed by NSDO and NIAB Main Trial 1)
- ↓
- 1973 F12 (Purification, multiplication of seed by NSDO and NIAB Main Trial 2)
- 1974 NSDO seed multiplication and release of new cultivar Maris Freeman to the market.

Marker Assisted Backcrossing (MAB) scheme



ASARECA Transforming Agriculture for Improved Livelihoods

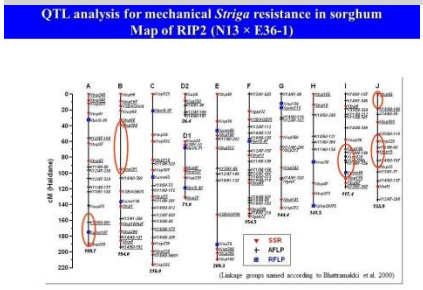
Methodology

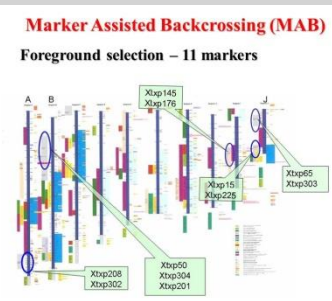
- Set of 600 simple sequence repeat (SSR) markers was developed by mining the expressed sequence tag (EST) database of sorghum.
- Primer pairs were designed and polymorphism detection ability was assessed using parental pairs of two existing sorghum mapping populations
- About 28% of these new markers detected polymorphism
- A subset of 55 polymorphic EST-derived SSR markers were mapped onto the existing skeleton map of a recombinant inbred population derived from cross N13 x E 36-1, which is segregating for *Striga* resistance
- These new EST-derived SSR markers mapped across all 10 sorghum linkage groups

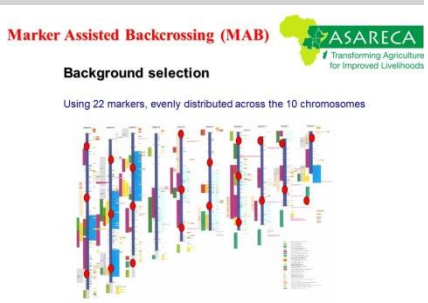
ASARECA Transforming Agriculture for Improved Livelihoods

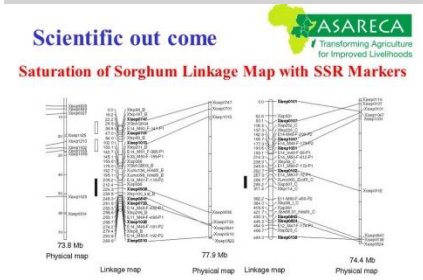
Methodology cont'd

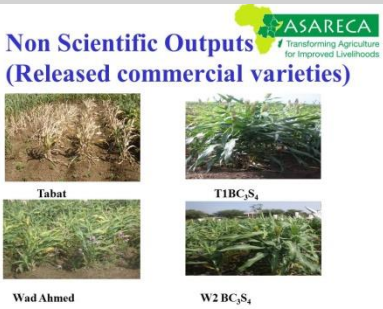
- DNA was extracted from the RIL population of N13 x E36-1
- A SSR marker-based skeleton linkage map transferred to a sorghum random inbred line (RIL) population of 219 F8 lines derived from N 13 x E36-1
- 65 SSR markers used to genotype 185 F8 lines and for linkage mapping
- 54 were mapped and 11 remained unlinked due to large flanking intervals
- 140 polymorphic primer pairs amplifying SSR markers flanking to target *Striga* resistance QTLs identified
- Markers used for genotyping and saturating the target QTL genomic regions harboring *Striga* resistance
- DarT markers screened and used to saturate genomic regions with *Striga* resistance


QTL analysis for mechanical *Striga* resistance in sorghum
Map of RIP2 (N13 × E36-1)
SSR
AFLP
RFLP
(Linkage groups named according to Bhattramakki et al. 2000)


Marker Assisted Backcrossing (MAB)
Foreground selection – 11 markers
Xtxp145
Xtxp176
Xtxp15
Xtxp225
Xtxp65
Xtxp303
Xtxp208
Xtxp302
Xtxp50
Xtxp304
Xtxp201


Marker Assisted Backcrossing (MAB)
ASARECA
Transforming Agriculture for Improved Livelihoods
Background selection
Using 22 markers, evenly distributed across the 10 chromosomes


Scientific out come
ASARECA
Transforming Agriculture for Improved Livelihoods
Saturation of Sorghum Linkage Map with SSR Markers
73.8 Mb
Physical map
Linkage map
77.9 Mb
Physical map
Linkage map
74.4 Mb
Physical map


Non Scientific Outputs
(Released commercial varieties)
ASARECA
Transforming Agriculture for Improved Livelihoods
Tabat
T1BC3S4
Wad Ahmed
W2 BC3S4


Non Scientific Outputs
(Released commercial varieties)
ASARECA
Transforming Agriculture for Improved Livelihoods
AG8
AG2 BC3S4
AG8
AG6 BC3S4


Thank you
Merci beaucoup

Hybrid banana case study

Reuben Tendo Ssali – NARL Kawanda

Multiplication, Evaluation and Promotion of East African Highland Banana Hybrids

Reuben Tendo SSALI
Banana Research Program,
National Agricultural Research laboratories, Kawanda.

Presentation outline

- Introduction
  - NARL
  - Banana
    - Importance
    - constraints
    - Genetic improvement
    - Dissemination process

NARL, Kawanda

- Public Agriculture Research Institutes (PARI) of NARO

Mission:
To generate and promote agricultural technologies that improve productivity, value addition, income and food security.

Mandate
- *Banana*
- *Soils, Agro-meteorology and Environment*
- *Food Biosciences and Agribusiness*
- *Biodiversity and Biotechnology*
- *Biosystems and Agricultural Engineering*
- *Agricultural Research Information Systems*

What makes bananas tick

- Banana is a major staple food in sub-Saharan Africa.
- Estimated per capita consumption of 207 kg/year
- Grown by about 75 % farmers on 1.3M ha
- High yielding staple food(up to 60ton/ha/yr = 8.4 t of dry carbohydrate /h/yr)
- Perennial crop fruits continuously ensures food security/income

Overview Banana Research-NARO

- Diagnostic survey (NARO & IITA) 1994
- Collecting Matooke cultivars in Uganda 1996
- Numerical taxonomy of EAHBs 1998
- Assembly & evaluation of banana germplasm collection 1998
- Screening matooke for male and female fertility 1999
- Conventional Breeding strategy for Nfuuka clone set 2000
- Genetic engineering of banana 2003

- Banana bacterial wilt reported in Uganda 2001
- Participatory on-farm trial banana hybrids 2005
- First evaluation transgenic banana plants Uganda 2007
- First Matooke hybrid release by NARO 2010
- Evaluation transgenic banana plants for pro Vit A and Iron 2010
- Evaluation of transgenic plants for BXW 2010
- Exante study on accepatbility of trangenic bananas 2012
- Relaese 2nd matooke Hybrid 2013

Banana production constraints
Diseases

1. Black Sigatoka — 30-50% yield loss
2. Fusarium wilt — Up to 100% yield loss susceptible varieties
3. Bacterial wilt — Up to 100% yield loss in affected fields
4. Banana streak virus (Badnavirus) — Up to 40%

Banana production constraints
Pests

5. Banana weevil (Cosmopolites sordidus) — Up to 60% yield loss in 4years
6. Nematodes — Up to 51% yield loss in 4 years

Banana Diversity in Uganda

Indigenous Matooke clone sets

Nakabululu clone set cv Bifusi
Nakitembe clone set cv Mbwazirume
Nfuuka clone set cv Enyeru
Musakala clone set cv Kisansa
Mbidde clone set cv Kabula

Banana Diversity contd: Introduced varieties

Sukali Ndizi (AAB)
FHIA 25(AAAA)
FHIA 17 (AAAA)
Kayinja (ABB)
Bogoya (AAA)
Red Bogoya (AAA)
Gonja Nakatansense (AAA)
Gonja manjaya (AAA)
Cavendish(AAA)

Cultivar distribution

Group	Type	1995	2005
AAA-EA	Highland banana	76%	77%
AAA	Gros Michel	2	2
AAB	Plantain	2	0.1
AAB	Ndiizi	8	5
AB	Kisubi	4	1
ABB	Kayinja	8	11

Priority traits identified for improvement

- Pest and disease resistance (black Sigatoka, weevil, nematodes, and bacterial wilt)
- Improved agronomic traits (Yield, Short maturity period)
- Improved plant architecture (corm and pseudo-stem hardiness, dwarfism)
- Enhanced nutrients (Vitamin A, iron)
- Delayed ripening

BANANA IMPROVEMENT IN UGANDA

- Conventional breeding
  - Development of improved Matooke hybrids (triploids)
  - Development of improved male parents (diploids)
- Genetic engineering
  - Resistance to nematodes, Weevils, Black Sigatoka, Bacterial wilt ,
  - improved fruit qualities(delayed ripening) and plant architecture.
  - Bio-fortification of bananas with iron and Vitamin A .

Conventional Breeding process

- Cross breeding
- Early Evaluation Trial
- Preliminary Yield Trial
- On-farm
- Promotion/release

CROSS-BREEDING HIGHLAND BANANAS (MATOOKE)

Triploid female parent
Diploid male parent Calcutta4. Resistance to Black Sigatoka
Banana hybrid seeds
Embryo
Embryo extraction
Germinating embryos
Budshoot formation
Rooted hybrids
Hardening at nursery
Early evaluation trial
Matooke parent
Improved male parent
Matooke hybrid (660K-1)
Early evaluation trial

1. Generating tetraploid hybrids (3x by 2x = 4X)

•16 tetraploids selected for use as female parents

2. Generating secondary triploids (4x by 2x = 3X)

12 (+ 6 IITA) hybrid lines selected for on-farm evaluation

3. EVALUATION OF AGRONOMIC PERFORMANCE OF TRIPLOID HYBRIDS (on-farm)

Genotype	Leaves at flowering	YLS	Leaves at harvest	Maturity period (days)	Bunch weight (kg.)
M9	13.00	10.33	5.33	521.00	27.00
M17	11.67	11.00	6.33	482.67	26.00
M2	9.67	9.00	7.33	457.67	24.33
M14	13.67	11.00	5.33	515.33	20.67
M19	9.00	6.67	1.67	507.33	15.83


local


M9


local


M2


local


M17

4. Consumer acceptability evaluation

Consumer preference for the Matooke hybrids

Hybrids	Appearance	Taste	Flavour	Texture	Acceptance
M9	5.10	4.90	4.83	5.00	5.5
M2	4.89	5.06	4.78	4.78	4.89
M14	4.52	4.55	3.76	4.88	4.73
M17	3.67	4.00	4.01	3.56	3.94
M10	5.00	3.17	4.83	2.72	2.89
M4	1.83	1.87	2.13	2.07	2.37
Local check	5.82	5.85	5.82	5.79	5.97

Bunch and Food of M9

Bunch and Food of M2

Dissemination

- Multiply the farmer selected hybrids for wider access to planting materials
  - Virus indexing the plants at Kawanda.
  - Mother Garden and Kawanda
- Rural hardening nurseries in Luwero,Masindi, Kyenjojo, Lira, Oyam and others areas
- Target areas: All areas where black Sigatoka is a big problem

Dissemination process

- Mobilize stakeholders (farmers , NGOs, CBOs, in the target zone (areas) national and regional workshops.
- Then together we develop an action plan to facilitate the farmer selection process to host demonstration plots.
- We transport our planting materials and guide the planting process.
- Disseminate information about the hybrids through field days, farmer training sessions in banana management at the demonstration sites and other communication channels.
- We Market test the potential performance of the hybrids on the local and regional markets.

Cotton Breeding case study

Dr Lastus Sserunjogi – Uganda Cotton Development Organisation

OBJECTIVES,TRENDS, SUCCESSES AND CHALLENGES IN THE IMPROVEMENT OF COTTON VARIETIES IN UGANDA USING CONVENTIONAL BREEEDING METHODS

BY

SERUNJOGI LASTUS KATENDE (PH.D)
PLANT BREEDER
P.O.BOX 801 ENTEBBE, UGANDA
MOB: +256772602553
E-MAIL:lastus2006@yahoo.com

1

BACKGROUND OF COTTON RESEARCH IN UGANDA

- Genesis of Agricultural Research 1898-Entebbe Botanical Gardens → Today's National Gene Bank (NARO).
- Cotton Introduced 1903; Missionaries and Traders (Egypt, Malawi, USA).
- Introductions up to 1915.
- Differences in climatic conditions, soils, regimes of pests and diseases led to need of Research.
- Cotton Research in 1930's

- Central + West: Kawanda → Bukalasa → Namulonge (1949)

-Nothern + Eastern: Serere 1919 (seed multiplication)

2

BACKGROUND OF COTTON RESEARCH IN UGANDA CONT'D

- Two cotton types of *Gossypium hirsutum*

-Bukalasa Pedigree Albar (BPA): West + Central at Namulonge

-Serere Pedigree Albar (SATU): N&E at Serere

- British Cotton Growing Empire staff 1940's- 1972
- 1994- NARO: Mandate on Cotton Research to SAARI now (NASARRI).
- 1994- Creation of CDO and Liberalisation of Cotton Industry
- 1997 phased out SATU vs varietal mixing

3

THE PARTS OF A COTTON PLANT

4

THE PARTS OF A COTTON PLANT

5

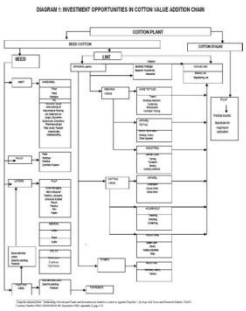
THE PARTS OF A COTTON PLANT

6

ECONOMIC COMPONENTS OF COTTON

Investment opportunities

7



8

OBJECTIVES OF COTTON BREEDING

- Breeding = the science of changing plants or animals genetically.
- **The General objectives**: meeting demands/ requirements of the stakeholders (client oriented Research).

-Farmers, Ginners, Traders/Exporters, Spinners& weavers

- **Specific objectives** of cotton Breeding are for improvement of cotton varieties for;

9

OBJECTIVES OF COTTON BREEDING CONT'D

- Increased yields of seed Cotton and Lint.

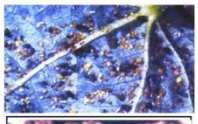
-High fiber quality (staple lenghth; fibre strength; fibre maturity and fineness) → strong + uniform yarns → even textiles

-Resistance to Insect and Nematodes pests.

-Resistance to Diseases

10

EXAMPLES OF COTTON PESTS AND DISEASES



Damage: Aphids suck sap from leaves and shoots. The young leaves droop and curl downwards. Plants stunt, particularly early in the season. However plants can fully recover from this kind of damage.

11

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

Damage: Jassids cause curling of edges of leaves which turn yellow or reddish, drying in severe cases. This 'hopper burn' can stunt plants.

12

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

- Damage: A serious pest in early/midseason, attacking both developing leaves and fruit buds. The leaf damage manifests itself in leaf tattering or 'shot-hole effect on expanded leaves this is a key pest in Kasese and Pallisa. Lygus also attacks squares, when the attack is severe the squares abort.

13

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

Damage: A serious pest, damages buds (squares), flowers, young and mature bolls. Larvae move from fruit to fruit, especially when fruits are small. They may damage 4-15 squares with an average of 9 squares per larva. Even large mature bolls may be entered into. This makes control at even quite low densities essential.

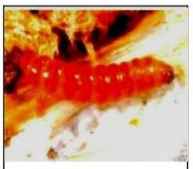
14

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

Damage: Spiny bollworms bore into shoot tips early in the season. This damage may stunt plants or force an unnatural growth pattern. Normally, however, the plant compensates well for early season damage by producing new shoots and no effect is realised on yield. Spiny bollworms also feed on flowers and young bolls.

15

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**



- Damage: Pink bollworm larvae bore into bolls. The larvae complete all their development in one fruit. The hole made as larvae emerge from the bolls is approximately 2mm diameter. The Pink bollworm is an internal (endocarpic) boll feeder and is less known to farmers as it is smaller and less visible.

16

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

- **Cotton Stainers**-*Dysdercus spp*
- Damage: Stainers pierce bolls, causing premature boll-splitting and allowing fungi, *Ashbya spp.* (Nematospora) to stain lint. Damaged young fruits shed from the plant. Slightly older fruits reduce in size and lint is stained.

17

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

- **Cotton Leaf Roller**-*Slyepta derogata*

18

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

Cotton white fly-*Bemisia tabaci*

19

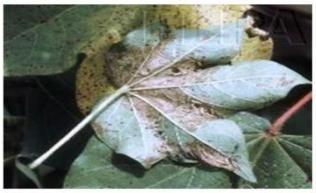
EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

- **Cotton seed bug**-*Oxycarenus spp.*

20

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

Cotton leaf worm



21

EXAMPLES OF COTTON PESTS AND DISEASES**CONT…**

Cotton thrips

22

EXAMPLES OF COTTON PESTS AND DISEASES **CONT…**

➢Cotton wilt disease

23

METHODS OF CONVENTIONAL COTTON BREEDING

- Collection of Germplasm for sources of New genes

24

METHODS OF CONVENTIONAL COTTON BREEDING CONT'D

- Making crosses and backcrosses ➞ genetic variability (1 year).
- Advancing Generations selfing/ in- breeding.

8 generations /years (pedigree systems)- screening for Resistance to Diseases.

- Comparative yield trials: RPR, Strain (on-station)- 2 years
- Multilocational line trials (2 years) + Breeder seed multiplication.
- Initial seed multiplication- Nucleus and Foundation seed -2 years.
- Variety Release (Total 14 years). Foundation seed ➞ CDO ➞ Registered seed ➞ Certified seed ➞ Commercial seed.

25

TRENDS OF IMPROVED VARIETIES RELEASED

- Each succeeding variety had a yield and quality advantage over the Predecessor

SATU TYPE	BPA TYPE
S47	BP52
SATU65	BPA68
SATU71	BPA 72
SATU 85	BPA 85
SATU 95	BPA 89
SATU 97	BPA 95
	BPA 97
	BPA 99
	BPA 2000
	BPA 2002

NB.the Numeric suffix denotes the year of first multiplication on main farm as "Foundation seed"

COTTON CONTRIBUTION TO NATIONAL ECONOMY AND FARMER'S INCOMES

- Production trends and earnings since liberalization of the cotton subsector

27

Table 1: PRODUCTION TRENDS AND EARNINGS SINCE LIBERALIZATION OF THE COTTON SUB-SECTOR

PERIOD/ SEASON	COTTON LINT PRODUCTION (Bales @ 185 Kg)	EARNINGS FROM LINT		EARNINGS BY FARMERS		SALES OF SEEDS BY GINNERS		
		Ave. FOB price ($/Kg of lint)	Value ($ million)	Ave Farmgate price (Sh./Kg of seed cotton)	Value (Sh. Billion)	Total quantity of seed produced (MT)	Ave. price per MT (Shs)	Total value of seed (Shs. Bn)
1	2	3	4	5	6	7	8	9
1994/95	33,000	2.10	12.82	400	7.39	12,000	100,000	1.20
1995/96	56,416	1.98	20.67	350	11.06	20,900	100,000	2.09
1996/97	110,700	1.86	38.09	320	19.84	40,900	100,000	4.09
1997/98	32,000	1.79	10.60	390	6.99	11,800	120,000	1.42
1998/99	82,000	1.68	25.49	400	18.37	30,300	130,000	3.94
1999/00	117,000	1.34	29.00	300	19.66	43,300	150,000	6.50
2000/01	100,000	1.50	27.75	420	23.52	34,700	150,000	5.21
2001/02	120,000	0.80	17.76	270	18.14	40,260	130,000	5.23
2002/03	110,000	1.20	24.42	500	30.80	38,460	170,000	6.54
2003/04	158,000	1.50	43.85	650	54.12	55,950	200,000	11.19
2004/05	254,000	0.80	37.59	350	45.78	91,030	110,000	10.01
2005/06	102,800	1.10	20.88	450	24.70	35,400	150,000	5.31
2006/07	134,000	1.10	27.27	470	32.50	46,500	180,000	8.37
2007/08	66,500	1.60	19.68	750	25.74	17,350	340,000	5.90
2008/09	125,310	1.06	24.57	650	48.49	42,731	350,000	14.96
2009/10	70,300	1.59	20.68	900	27.94	23,972	400,000	9.59
2010/11	146,894	3.88	105.44	2,300	179.06	50,091	700,000	35.06
2011/12*	245,000	1.02	46.23	1,100	142.84	83,545	500,000	41.77
TOTAL	**1,671,826**		**401.12**		**415.04**	**585,553**		**101.53**

CHALLENGES TO THE BREEDING EFFORTS

- Long time and high costs for variety development with conventional methods.
- Continuous acquisition of new Germplasm.
- Need Integration with Research on supplementary production Technology (Production Packages on).

-conventional Insect pests, diseases and weed managerial options/ seed dressing and spray pesticide/herbicide formulations.

-IPM techniques (scouting, biological control e.g with beneficial insects- Black ants(Enginingini), *Lepisiota SPP*).

29

CHALLENGES TO THE BREEDING EFFORTS CONT'D

-Soil fertility management (Rotations, N-fixing Legumes and Fertilizer Application – Organic + In-organic)- soil and foliar types.

- Pest Resistance to pesticides with prolonged use.
- Changes in virulence of Disease Pathogens.
- Droughts under climatic changes with no irrigation.
- Development of soil tillage and weeding ox-drawn implements
- Modern Research Equipment: screen houses cotton processing and spinning laboratory

30

WAY FORWARD FOR MITIGATION OF THE CHALLENGES

- Adoption of Biotechnology options including; Introgression of Uganda varieties with Novel Genes.

  -Reduced time for Desired Gene combinations.

  -Reduced use of Pesticides and hence pest resistance to the pesticides.

  -modern events with stacked, Genes to reduce pest resistance to the GM genes.

  -Multiple stacked Genes for Herbicide resistance to enable deployment of several herbicides

  Avoidance of "super weeds" (e.g. the Monsanto Triple herbicide resistant cotton event)

31

WAY FORWARD FOR MITIGATION OF THE CHALLENGES CONT'D

- The need to conclude the Bt and RR Biotech cotton trials in Uganda
- Biotech Research efforts needed on drought tolerance and organ specific traits e.g improvement of fiber quality.

32

MITIGATIONS AGAINST PESTS REQUIRING BIOTECH OPTIONS

➢American boll worm

33

CONCLUSION

- Breeding Research has contributed to advances in cotton variety perfomances.
- Modern Technology required for faster advances and returns from the cotton sector

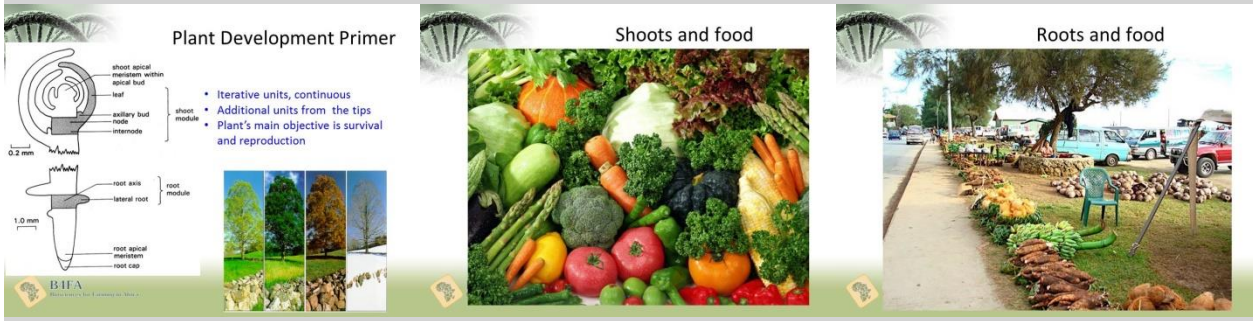
34

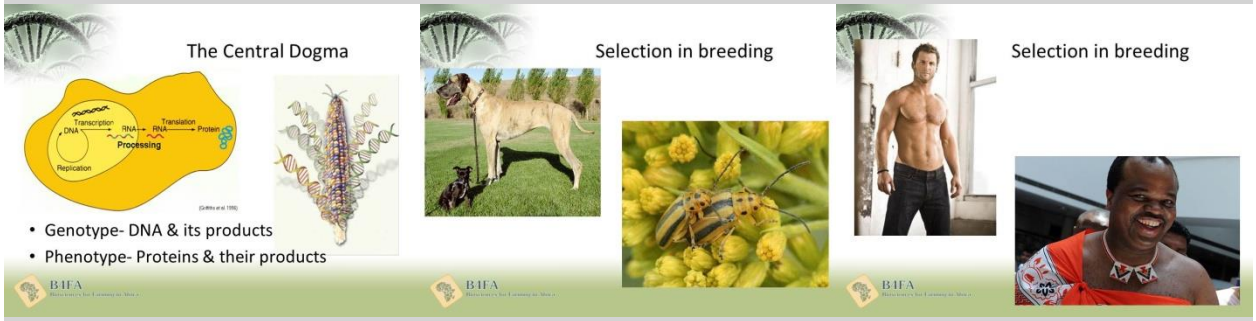
THANK YOU FOR LISTENING

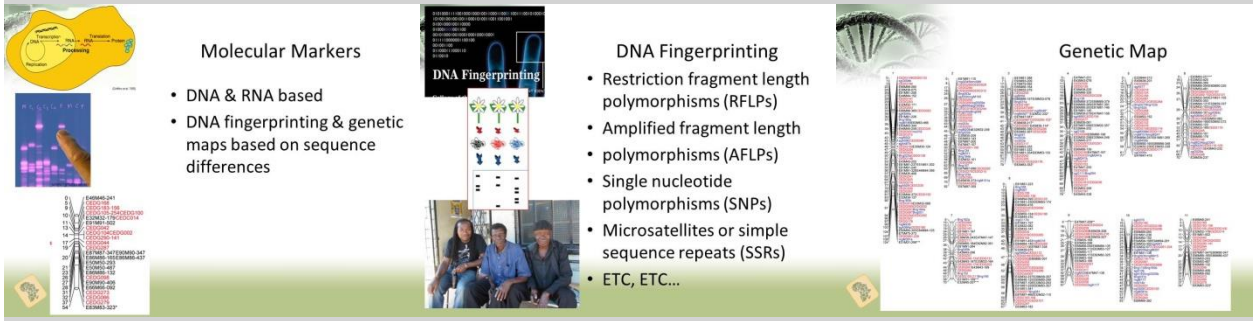
35

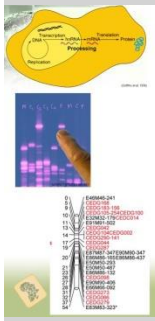
Marker-assisted Selection

Dr Tinashe Chiurugwi – National Institute for Agricultural Botany





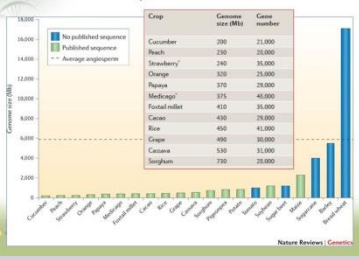




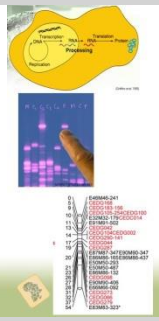
Molecular Markers

- DNA & RNA based
- DNA fingerprinting & genetic maps based on sequence differences
- Limited polymorphisms,
- Slow and expensive
- Not for polygenic traits

Why we needed markers



Crop	Genome size (Mb)	Gene number
Cucumber	200	21,000
Peach	230	28,000
Strawberry'	240	35,000
Orange	320	25,000
Papaya	370	29,000
Medicago'	375	46,000
Foxtail millet	410	35,000
Cacao	430	29,000
Rice	450	41,000
Grape	490	30,000
Cassava	530	31,000
Sorghum	730	28,000



Molecular Markers

- DNA & RNA based
- DNA fingerprinting & genetic maps based on sequence differences
- NEW: Genome-wide Selection (GWS)
  - High throughput sequencing
  - Real gene sequences: Perfect/Functional markers

DNA Markers & Breeding

- Selection from breeding lines/populations
  - Targeting selection for traits that are difficult to phenotype
- Marker-assisted backcrossing (MABC)
  - Transfer traits from donor into an elite genotype
- Marker-assisted recurrent selection (MARS)
- Pyramiding
  - Combining multiple genes/alleles in one line

B4FA

Example: Tomato Breeding

Example

Drought-tolerant Hybrid Maize case study

Dr Moses Adebayo – International Institute for Tropical Agriculture

Hybrid Maize Improvement for Drought Tolerance at WACCI/IITA

M.A. Adebayo[1,2], A. Menkir[1], E. Blay[2], V. Gracen[2,3], C. The[2], and E. Danquah[2]

1. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.
2. West Africa Centre for Crop Improvement (WACCI), Univ. of Ghana, Legon.
3. Cornell University, Ithaca, USA.

WACCI

Outline of Presentation

- Introduction
- Objectives
- Materials and Methods
- Results
- Research Findings

WACCI, Univ. of Ghana, Legon

- Inaugurated in 2008 to train plant breeders in West Africa
- Admitted 8 students in the First Cohort from Nigeria, Ghana, Mali, Burkina Faso, and Niger
- Now has the 6th Cohort of 8 students in-house

Meet WACCI First Cohort!!!

IITA, Ibadan, Nigeria

- A member of the CGIAR Consortium
- Founded in 1967 to fight hunger, malnutrition, and poverty
- Mandate crops - cowpea, soybean, plantain/banana, yam, cassava, and maize

IITA

CGIAR

Drought Stress

Drought Stress contd

- Drought limits maize productivity in sub-Saharan Africa (SSA)
- Drought at flowering could reduce maize yield by 80% or cause total devastation (Edmeades *et al.*, 1997)
- Breeding for drought tolerant hybrid maize can guarantee farmers' investments in SSA

Fig. 1: Effects of drought stress on maize at flowering and grain filling

Objectives

- To study the genetic variation existing among a set of drought-tolerant (DT) maize inbred lines developed at CIMMYT and IITA
- To develop and identify high-yielding hybrids under drought and non-drought conditions
- To identify "good" CIMMYT lines for improvement of IITA maize

Materials and Methods
A. Laboratory Analyses

- 48 DT maize inbred lines, 24 each from CIMMYT and IITA, were assayed with 81 SSR markers at Biosciences Lab, IITA
- *Maize inbred lines are the parents used in developing hybrid maize varieties, e.g. Obasuper 1 & 2*
- *Simple sequence repeats (SSRs) are parts of the genetic codes (DNA) that appear in tandem repeats throughout the entire maize genome*

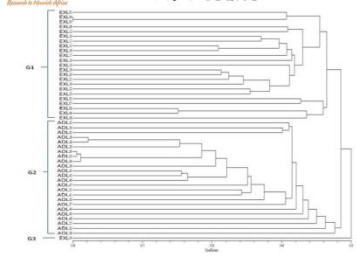
A. LABORATORY ANALYSES

Table 1

48 DIFFERENT MAIZE INBRED LINES USED

EXOTIC (CIMMYT)		ADAPTED (IITA)	
EXL01	EXL13	ADL25	ADL37
EXL02	EXL14	ADL26	ADL38
EXL03	EXL15	ADL27	ADL39
EXL04	EXL16	ADL28	ADL40
EXL05	EXL17	ADL29	ADL41
EXL06	EXL18	ADL30	ADL42
EXL07	EXL19	ADL31	ADL43
EXL08	EXL20	ADL32	ADL44
EXL09	EXL21	ADL33	ADL45
EXL10	EXL22	ADL34	ADL46
EXL11	EXL23	ADL35	ADL47
EXL12	EXL24	ADL36	ADL48

A. Results



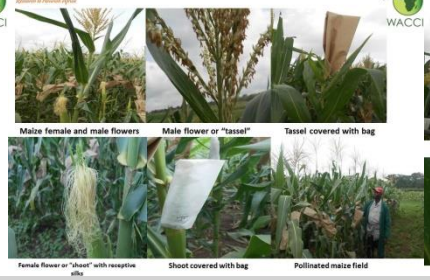
A. Results

- The molecular markers clearly delineated the inbred lines into 2 main groups – CIMMYT and IITA
- Sufficient genetic diversity exists among the germplasm
- Inter- and intra-group crosses may produce high-yielding hybrids

B. Field experiments

- 24 inbred lines, 12 each from IITA and CIMMYT, selected for making hybrid crosses
- 96 single-cross hybrids developed from 24 IITA and CIMMYT DT inbreds using NCD 2 mating scheme
- 96 hybrids plus 4 checks evaluated under two irrigation treatments in dry seasons of 2010 and 2011 at Ikenne, Nigeria
  - Block 1 – Watered throughout crop's life cycle (Well-watered or WW)
  - Block 2 – Water was shut off 28DAP (Drought stress or DS)

Maize Inbreds/Hybrids Development



Maize female and male flowers | Male flower or "tassel" | Tassel covered with bag

Female flower or "shoot" with receptive silks | Shoot covered with bag | Pollinated maize field

Maize Inbreds/Hybrids Development

Collection of pollen grains in bag | Pollination – dusting pollen grains on receptive silks

Pollinated shoot covered with bag | Paper bag stapled to hold in place

B. Field Experiments

Table 2: 24 SELECTED LINES

EXOTIC (CIMMYT)	ADAPTED (IITA)
EXL01	ADL34
EXL04	ADL35
EXL05	ADL36
EXL24	ADL39
EXL10	ADL31
EXL15	ADL41
EXL16	ADL33
EXL17	ADL47
EXL02	ADL27
EXL03	ADL32
EXL06	ADL37
EXL07	ADL38

B. Field Experiments

- Agronomic data: days to 50% anthesis (**DTA**), days to 50% silking (**DTS**), anthesis-silking-interval (**ASI**), number of ears per plant (**EPP**), grain yield (**GY**), etc
- Physiological data: normalized difference vegetation index (**NDVI**) recorded at 2 and 4 WAP with Greenseeker

Fig. 2: NDVI captured with Greenseeker 4WAP.

B. Field Experiments

- ANOVAs computed with PROC GLM in SAS using RANDOM statement with TEST option (*SAS Institute, 2009*)
- Pearson's correlation coefficients of GY with other traits calculated with PROC CORR in SAS (*SAS Institute, 2009*)
- Drought Tolerance Index

DTI (%) = $[(GY_{WW} - GY_{DS})/GY_{WW}]*100$

B. Results

- DTI (for GY) was ≈ 70%
- Mean grain yield under DS (1.9 t/ha) was 23% of yield under WW (6.1 t/ha)
- Drought stress increased ASI by 211% and reduced EPP by 30%
- Stress intensity sufficient for differential reactions of hybrids

B. Results

Drought stress Well-watered

B. Results

Effect of Drought Stress on Maize Yield

Drought-tolerant (Left) and drought-susceptible (Right) maize hybrids under drought-stress conditions

Table 3: Lines having positive and significant GCA effects

Line	Grain yield (Kg ha^{-1}) DS GCA_i	DS GCA_m	WW GCA_i	WW GCA_m
EXL04	136.82	-129.37	602.9*	554.7*
EXL05	16.8	236.0	706.2*	267
SE	*131.44*	*138.22*	*121.02*	*204.74*
EXL15	128.38	205.3*	324.2	319.7
SE	*138.22*	*103.63*	*204.74*	*188.41*
EXL02	228.9*	129.6	-565.62	-356.1
EXL03	177.6*	29.2	-73.07	128.7
EXL06	-487.3	-285.1	947.1*	931.3*
SE	*79.71*	*104*	*184.61*	*176.83*
ADL36	120.91	-68.1	171.4	446.0*
SE	*95.1*	*131.44*	*140.45*	*121.02*
ADL41	325.3*	-34.1	185.3	-358.3
ADL47	121.68	243.7*	332.23	797.0*
SE	*103.63*	*79.71*	*188.41*	*184.61*
ADL32	303.6*	82.6	912.2*	-211.5
ADL37	225.7*	71.01	-473.86	335.8*
ADL38	-37.0	457.6*	-484.8	802.8*
SE	*104*	*95.1*	*176.83*	*140.45*

Table 4: Means of GY (t/ha), DTI (%), ASI, and EPP of top 10 hybrids under drought and well-watered conditions

Drought stress Hybrid	GY_DS	GY_WW	DTI	ASI	EPP	Well-watered Hybrid	GY_WW	GY_DS	DTI	ASI	EPP
EXL10xEXL04	3.0	6.8	55.2	0.7	0.8	EXL06xADL47	8.9	1.1	87.3	1.7	1.0
ADL47xEXL10	3.0	6.9	57.5	3.0	0.8	ADL32xEXL06	8.2	2.2	72.9	1.0	1.0
ADL37xEXL03	2.8	6.0	54.0	1.5	0.8	ADL47xEXL16	8.1	2.0	75.3	0.2	1.0
ADL41xEXL17	2.7	6.1	54.7	0.8	0.8	ADL41xEXL15	7.9	2.6	66.5	0.5	1.1
EXL03xADL47	2.7	7.1	61.7	2.8	0.8	ADL33xEXL15	7.7	2.6	66.5	0.0	1.1
ADL47xEXL15	2.7	7.4	63.4	2.7	0.8	ADL47xEXL17	7.6	2.3	69.8	0.3	1.1
ADL41xEXL15	2.6	7.9	66.5	1.2	0.9	ADL41xEXL16	7.6	2.1	72.0	0.0	1.0
EXL17xEXL05	2.6	6.2	57.4	0.5	0.9	EXL15xEXL05	7.6	2.1	71.9	-1.0	1.0
EXL10xEXL01	2.6	5.6	53.9	1.2	0.8	EXL02xADL47	7.5	2.6	65.5	1.5	0.9
EXL02xADL47	2.6	7.5	65.5	2.7	0.8	ADL47xEXL15	7.5	2.7	63.4	1.2	1.1
Top 2 checks						*Top 2 checks*					
M1026-8	2.1	6.3	66.9	4.3	0.8	M1026-8	7.0	1.7	75.7	1.3	0.9
M1026-7	1.7	7.0	75.7	4.8	0.7	M1026-7	6.3	2.1	66.9	1.7	0.9
Statistics						*Statistics*					
Mean	1.9	6.1	69.5	2.8	0.7	Mean	6.1	1.9	69.5	0.9	1.0
$LSD_{0.05}$	0.9	1.4		2.3	0.2	$LSD_{0.05}$	1.4	0.9		0.1	0.1
P level	***	***		***	***	P level	***	***		***	***

Research Findings

- Additive genetic effects more important in controlling yield and drought tolerance
- Six CIMMYT lines, EXL02, EXL03, EXL04, EXL05, EXL06, EXL15 identified for improvement of adapted germplasm
- Three lines, EXL05, EXL15, and ADL47 combined attributes for high productivity and drought tolerance
- Three hybrids, ADL47xEXL15, ADL41xEXL15, and EXL02xADL47 identified as high-yielding and drought tolerant

Acknowledgements

AGRA Growing Africa's Agriculture
IITA Research to Nourish Africa
B4FA

Good harvest in season of drought!!!!!

Gm Crops – novel products

Prof Jim Dunwell – University of Reading

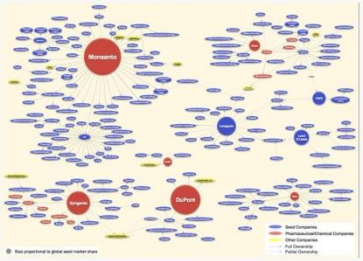
School of Agriculture, Policy and Development

GM Crops: Novel Products

Jim Dunwell

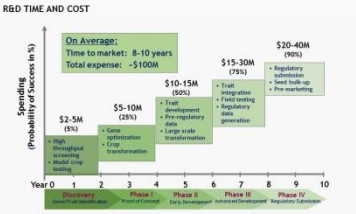
University of Reading

Company Consolidation 1996-2008



Howard 2009

Ag Biotech has Lengthy Product Development Cycle and Large Investment Process

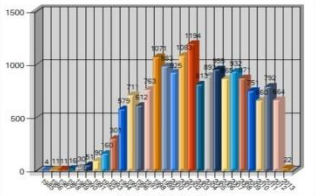


•Numbers (time duration, spending, and probability of success) are all estimates.

•The actual for individual projects could vary.

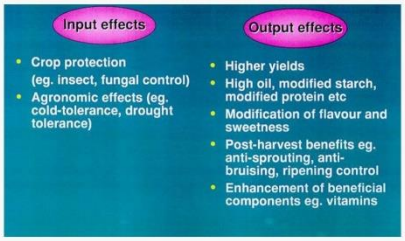
USA Field Trials

Total number permits and notifications



http://www.nbiap.vt.edu/

"Input" and "Output" Traits



Output Traits

First GM Product in UK 1996

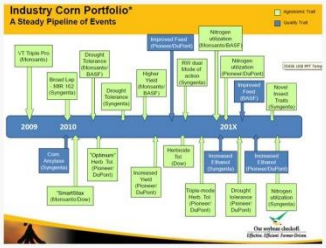
Reduced level of polygalacturonase enzyme

GM Carnations: Approved in Europe

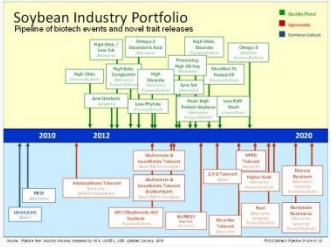
Deregulation pending

Florigene, now Suntory

GM Corn Pipeline



Soybean Pipeline



US Soybean Export Council

Future Prospects

- High value products
- Healthy food
- Biofuels
- (Phytoremediation)

High Value Products

Biofuels

Present status

Possibly the most advanced of the transgenic lines designed for bioethanol production is Syngenta corn Line 3272 (Enogen™).

This has been modified to contain corn amylase, which improves the fermentation of the corn starch to sugar in the bioprocessing stages of ethanol production.

Commercial Plans

- Syngenta hopes to make the necessary enzymes for cellulose-to-biofuels in green plants. The goal is to transplant naturally occurring genes for the required enzymes into the cells of these plants, which could then produce the desired enzymes in high yield. Plant-expressed enzymes, "can provide the lowest cost capability to make enzymes" for biofuels, compared with traditional production methods such as fermentation.

13

GM Trees for Biofuels

USDA/APHIS Environmental Assessment: Arborgen

Plants are a clone coded EH1 derived from a hybrid of *Eucalyptus grandis X Eucalyptus urophylla*. These have been genetically engineered with three different constructs. The primary purpose of the test is to test for the effects of two of the constructs which are intended to confer cold tolerance and to test the efficacy of a gene designed to reduce flower development, the exact nature of which is claimed as confidential business information (CBI).

[Federal Register: April 20, 2007 (Volume 72, Number 76)] Application (06-325-111r)

GM Trees for Biofuels

USDA/APHIS Environmental Assessment

Purpose: According to the applicant, genetically engineered cold tolerant *Eucalyptus* would enable the production of this hardwood species for pulping and for biofuel applications in managed plantation forests in the southeastern U.S.

[Federal Register: April 20, 2007 (Volume 72, Number 76)] Application (06-325-111r)

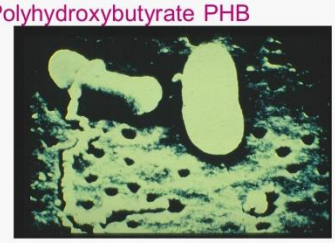
Other Tree Field Trials USA from 2008

ArborGen

- Hybrid pine
- Loblolly Pine (6)
- Pitch X Loblolly pine
- Eucalyptus (14) – lignin, cold tol.

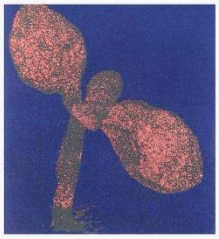
http://www.arborgen.com/

Biodegradable plastic Polyhydroxybutyrate PHB



Plastics in Plants

Plastics in Plants



Fruit Quality

22

Arctic™ Apple

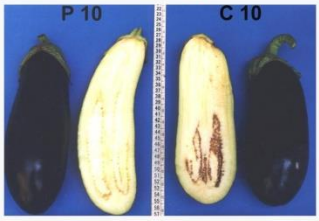
Reduced level of enzyme that causes browning
Okanagan Speciality Fruits, Canada

23

Apple: Fire Blight Resistance

Control GM

Seedless Aubergine



Acciarri et al 2002

Del Monte Rosé Pineapple

- GM pineapple with novel rose colour, and reduced precocious flowering
- Increased lycopene levels: gene from tangerine; reduced activity of pineapple genes
- Altered flowering: reduced level of activity of gene coding for ethylene production
- Result: new colour, better quality of fruit

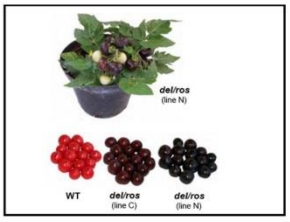
26

Healthy Food

Golden Rice: Increased Vitamin A

Golden Rice.org

Increased Anthocyanins in Tomato: Use of *Antirrhinum* Control Gene



Protection against heart disease etc ? (Martin et al 2008)

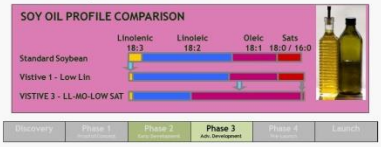
Increased Anthocyanins in Tomato

	ug /gfwt	umol/gfwt
control	2.82	0.01
E8-Rosea1	9.74	0.03
E8-Rosea1 + E8-Delila Plant N	951.47	1.52
E8-Rosea1 + E8-Delila Plant Z	77.12	0.12

Vistive™ III Compositional and Yield Targets

VISTIVE III SOYBEANS

- Vistive III is designed to lower linolenic and saturate content, while boosting oleic content for an oil profile similar to olive oil with processing and economic advantages
- 3 years of field data in the U.S. and Argentina indicates that yield is not statistically different from control



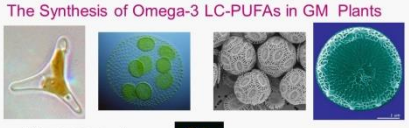
Discovery | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Launch

31

Why are Fish Oils Important in Human Diet?

- Specific fatty acids found in fish oils are prevalent in specialised organs (such as the brain, eyes & testes). These are the n-3/omega-3 long chain polyunsaturates
- Mammals have a very limited ability to synthesise these fatty acids, so we need to obtain them from our diet
- Some human genetic disorders are directly linked to an inability to make these fatty acids. There is also some evidence of a reduced capacity to synthesise them in old age and/or diseased states.
- The fatty acids found in fish oils are NOT the same as those in vegetable oils
- Long chain Omega-3 fatty acids play a role in anti-inflammatory responses
- Long chain Omega-3 fatty acids have been shown to play a role in prevention of cardiovascular disease and re-occurance of infarction. They may also play a role in childhood IQ, depression and dispraxia.

The Synthesis of Omega-3 LC-PUFAs in GM Plants



The sources of genes for LC-PUFA biosynthesis are marine algae

Identify algal genes for the synthesis of omega-3 polyunsaturates & transfer them to oilseeds

Regenerate transgenic plants with novel fatty acid traits.

Timeline – project started 1994 (!!)

Establishing a novel oils platform in *Camelina sativa*

Most successful Arabidopsis-evaluated constructs will be introduced into Camelina sativa.

Camelina is a Brassicaceae and easily transformed. Oil profile is similar to Arabidopsis, so results should be equivalent or better to that observed in the model system. We have determined baseline datasets for lipid composition over seed development for Camelina

1 Acre of Omega-3 Soybeans: Comparison

- OMEGA-3 SOYBEANS

Just one acre of Omega-3, SDA-enriched soybeans is equal to…

13,000 Salmon

Discovery | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Launch

Pharming in Plants

Human Collagen in Tobacco

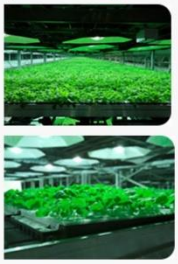
Collage™ : non-allergenic and non-immunogenic, with no risk of potential pathogens or animal-derived hazards

Collplant.com

Kentucky Bioprocessing

BIOMASS FACILITIES
Plant growth facilities include a 55,000 ft² fully contained indoor biomass production facility with 1.4 acres of multi-layered plant growth space.
A separate 26,000 ft² plant growth complex includes seeding, harvest and transfection space, along with five individual greenhouses at 2,000 ft² each.

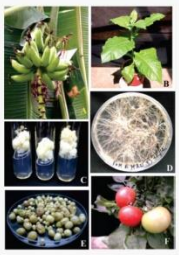
5th Oct 2012
To merge with Icon Genetics and Mapp Biopharmaceutical.



Greenhouse Production of Human Antibody in Tobacco Pharma-Planta

- Cultivation – transgenic tobacco plants cultivated for 45 days in greenhouse
- Harvesting – leaves chopped and shredded in 250-kg batches
- GMP – downstream processing using a custom process, >5 g of pure antibody
- Toxicology – product non toxic in rabbits
- Clinical trial – phase I trial in humans

Vaccines in Plants



Kumar et al. 2007

Producing Insulin in Plants

41

Safflower: Field Production

Human insulin: phase I/II trials

SemBioSys

Commercial reality

- Net loss for the three months ended March 31, 2012, was $1,352,301.
- Revenue for the three months ended March 31, 2012, was $207.
- Total short term debt was $8,395,347
- May 1. 2012: Company ceased trading
- June 22, 2012, MNP Ltd. appointed as receiver of the right, title and interest of SemBioSys Genetics Inc.
- 18th July 2012: All lab equipment auctioned

Duckweed: *Lemna* and *Spirodela*

2005: Lemnagene, acquired by Biolex.com

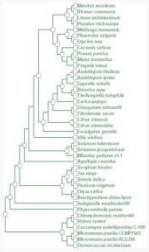
Glucocerebrosidase in Carrot Cells

ELELYSO™ (taliglucerase alfa), approved by the FDA on May 1, 2012 and is the first FDA-approved plant cell-based recombinant therapeutic protein.
Protalix.com

Value of Genome Sequences

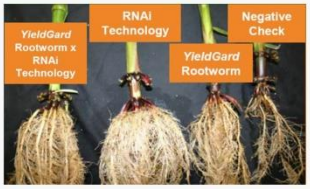
46

Plants with Sequenced Genomes



47

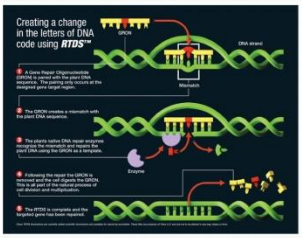
RNAi and Rootworm Tolerance



Bt + RNAi RNAi Bt

Monsanto

Directed Mutation



Rapid trait development system

Cibus

TRUST?

»	A lot	A little	Not at all
• Teachers	68	28	4
• Doctors	74	24	3
• Police	53	41	6
• Scientists	35	54	12
• Politicians	10	65	25
• Journalists	4	49	48

GM technology – ethical and moral dimensions

Prof Brian Heap – B4FA Project Leader

GM Technology
Ethical and moral dimensions

Brian Heap

Ethical issues

- First let's see what we all think…
- Answers will not display now, to avoid bias
- We'll ask the same questions at the end and compare…

Is GM technology "playing God"

1. Yes — 50%
2. No — 50%

Is GM technology safe?

1. Yes — 50%
2. No — 50%

Is GM technology fair?

1. Yes — 50%
2. No — 50%

Is GM technology natural?

1. Yes — 50%
2. No — 50%

Is GM technology needed?

1. Yes — 50%
2. No — 50%

Ethical issues

"Scientists are playing God"

- Is using science and biotechnology really "playing God"?

Playing God?

- No explicit instruction of prohibition in the sacred texts
  - Holy Bible
  - Holy Quran
  - Sacred texts of other religions

Playing God?

- Species boundaries derive from the view of Plato and Aristotle about eternal and ideal forms
- 'boundary-crossing' prohibited to keep things separate for reasons of health, purity or cleanliness
- Historical arguments about the fixity of species and fear of new varieties (eg potato not in Bible).
- What we have heard about how the genetics and form of almost all crops have been altered over the millennia

Playing God?

- Insights into humans as 'co-creators' with God
- Contributing to, rather than usurping the divine work of creation through new technology.

Classical questions

GM and biotechnology:

- Is it safe?
- Is it natural?
- Is it fair?
- Is it needed?

Is it safe?

- Questions of risks and risk assessment are notoriously hard to discuss rationally
- Individual perception of risk and benefit
  - Mobile phones
  - Surgery
  - Road travel
  - "Dangerous" sports
- Risks and benefits to wildlife and environment are no different from the introduction of any new plant variety or advanced hybrids derived from the well-established methods of conventional plant breeding

Some more about safety

Institution	Country	Year
Nuffield Council on Bioethics	UK	1999
Organisation of Economic Co-operation and Development	International	2000
European Research Directorate	European Commission	2001
French Academy of Science	France	2002
French Academy of Medicine	France	2002
Director General, World Health Organisation	International	2002
International Council for Science	International	2003
Royal Society	UK	2003
United Nations, Food and Agriculture Organisation	International	2004
British Medical Association	UK	2004
Union of German Academies of Science & Humanities	Germany	2004
The American, Brazilian, Chinese, Indian, and Mexican Academies of Science		

Is it natural?

- More like "hijacking" living processes and turning them to new ends
- Which is what humans have been doing for millennia
- But still troublesome
- How do we feel about:
  - in-vitro fertilisation
  - genetic testing during pregnancy
  - genetic technology to produce insulin, or vaccines

Is it fair?

- Public concerns expressed where they see science and its presentation shaped solely by commercial interests
- Commercial vs public benefit
- Developed world vs developing world benefit
- Regulation
- Intellectual property

B4FA

Is it needed?

- Food security requires that benefits outweigh the costs
- risks are likely to be dealt with by well-functioning markets
- market failure needs to be identified and appropriately targeted
- barriers may exist that prevent markets supplying resources and infrastructure to make food supply robust.

B4FA

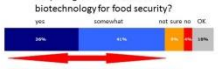
Power Politics (Porter, 2010)

EU Member States general attitudes to GM

Country	Vote
Germany	29
Poland	29
UK	22
Italy	20
Spain	27
[illegible]	[illegible]
Romania	14
Netherlands	13
[illegible]	[illegible]
Portugal	12
Belgium	12
Czech	12
[illegible]	[illegible]
[illegible]	[illegible]
Sweden	10
[illegible]	[illegible]
Bulgaria	10
Slovakia	7
Finland	7
Denmark	7
Ireland	7
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Latvia	4
Estonia	4
Malta	3

In Favour
Wavering
Against

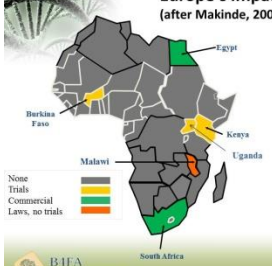
Do you agree or not with use of biotechnology for food security?



77% of EU citizens are in favour of taking advantage of biotechnology in agriculture

B4FA

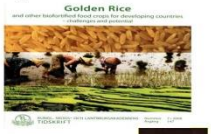
Europe's impact on Africa
(after Makinde, 2009)



- **Biotech commercial**
  South Africa -maize, cotton, soybean
  Egypt -maize
  Burkina Faso -cotton
- **Biotech on trial**
  Kenya – cotton
  Egypt – cotton
  Uganda- banana
  also Ghana, Tanzania

B4FA

Challenges of regulation



40 grams of Golden Rice a day will save life and sight

Vitamin A deficiency
Induced Xerophthalmia.
The leading cause
of childhood blindness
Bulletin WHO 2001 79 214

For I was hungry and you gave me nothing to eat.....

Matthew 25:42

B4FA

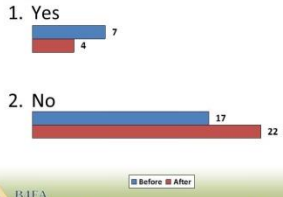
Europabio 2012 by permission

Ethical issues

- Discussion and comments
- Then lets see if our views have changed...

B4FA

Is GM technology "playing God"

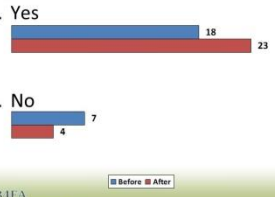


B4FA

Cross-tab label

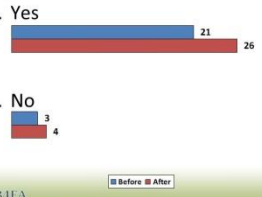
26 / 50

Is GM technology safe?



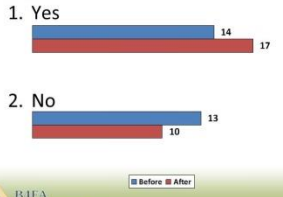
B4FA

Is GM technology fair?



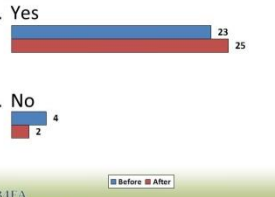
B4FA

Is GM technology natural?



B4FA

Is GM technology needed?



B4FA

Regulatory Environment for Agricultural Biotechnology

Arthur Makara – SCIFODE

Agricultural Biotechnology and the Regulatory Environment

Arthur M. Makara
Executive Director

Science Foundation for Livelihoods and Development (SCIFODE), Kampala, Uganda

SCIFODE—"Linking Science to Society"

- Scifode is a not-for-profit Organisation, registered in March 2007 under the laws of Ug
- Mission—to play a leading role in promotion of the application of science, technology and environment management practices for sustainable development
- Founded by scientists, media persons and environment experts and has membership from a wide array of stakeholders.

SCIFODE ACTIVITIES

- Biotechnology and Biosafety
  - policy dialogues.
  - Open Forum on Agricultural Biotechnology
  - Workshops and public lectures
  - Tissue culture technology
  - Scientific conferences
- Science Communication
  - The Science Times Magazine
  - Video Documentary Production
  - Strategic Communication Planning & Implementation for Projects and organisations
  - Science media capacity building/trainings

Regulation of Biotechnology

Responsibilities of Parties to CPB

- The Cartagena Protocol on Biosafety obligates state parties to put in place institutional, legal and other regulatory mechanisms for ensuring safe development, handling and transportation of GMOs referred to as LMOs in the protocol

Article 2 *"……Each Party shall take the necessary and appropriate legal, administrative and other measures to implement its obligations under this Protocol……"*

Chronology of Biotech Policy Dev'ts in Uganda

Time	Activity
1996	Establishment of the National Biosafety Committee
1997	GoU receives funding from GEF to develop the National Biosafety Framework (and Guidelines)
1998	Process of Development of the National Biosafety Framework (and Guidelines) starts
2000	National Biosafety Framework (and Guidelines) is finalised and adopted by Government
2000	GoU received additional funding to Implement the Biosafety Framework (including Public Consultations on key issues)
2000-2006	Consultations on National Biotechnology and Biosafety Policy and Bill
1999-2000	GoU participates in Consultations and negotiations of the Cartagena Protocol on Biosafety
2000	Uganda Signs the Cartagena Protocol on Biosafety

Chronology of Biotech Policy Dev'ts….

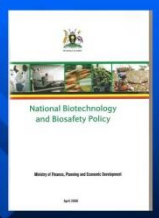
2001	Uganda Ratifies the Cartagena Protocol on Biosafety
2001	UNCST receives an application from Monsanto/NARO for Bt cotton trials
2001	GoU establishes an inter-ministerial Committee on GMOs: recommendation No. 1 was need to expedite the process of having a Biotech Policy and legal regime
Feb. 2003	GoU establishes a high-level task force chaired by Hon. Ayume (AG) to develop Uganda's position on GMOs. Key recommendations: 1. GMOs must be in milled form 2. The Policy and law should be expedited
2003-2007	Several Capacity Building and Training efforts by UNCST: to Inspectors, NBC Members, Journalists e.t.c
2006-2007	UNCST receives and Approves GM Banana trial. Planted at Kawanda
2004	High level delegation visits India's Biotech establishments
	Biotechnology and Biosafety Policy is approved by Gov't
2008-2011	Several other trials (more than 6) approved by NBC and implemented by NARO institutes.
May 2008	Final consultations on the bill; draft submitted to the Minister for presentation to Cabinet
2008-todate	Slow progress, requires concerted effort to lobby and get the bill on Government Agenda and subsequently it will move to Parliament

Biotech regulation in Uganda

- In the absence of an explicit government policy and legal regime on Biotech and Biosafety, efforts were made to provide for specific aspects of Biotech and Biosafety in the Uganda Biosafety Framework within which the various institutions and agencies involved in biotechnology research could operate.
- This came up as a result of Uganda's participation in the negotiations of the Protocol and subsequent signing (24th May 2000) and ratification (30th November 2001) of the Cartagena Protocol on Biosafety

Biotech and Biosafety Policy

- Given the broad nature of Biotech from Agric, to Human health, to environment, it was deemed necessary to have an explicit policy on Biotech but also that caters for Biosafety
- This explicit Policy was approved by Cabinet on 2nd April 2008



Importance of the Policy

- The Biotechnology and Biosafety Policy provides a framework for strengthening Uganda's research capacity and enhancing productivity for the health, agricultural and industrial sectors of the economy.
- The policy highlights a number of actions geared towards increasing agricultural productivity, industrial development, good health and increased household incomes.

Vision, Mission, Goal and Objectives of the Biotech Policy

- **Vision**: to make Uganda a country fully and safely utilising Biotechnology for national development
- **Mission**: The mission of the policy is to promote facilitate the development and judicious use of biotechnology for sustainable national development.
- **Goal**: to contribute to the achieving the national development objectives

Objectives of the Policy

1. Build and strengthen national capacity in biotechnology through research and development
2. Promote the utilisation of biotechnology products and processes as tools for national development
3. Provide a regulatory and institutional framework for biotechnology development and applications
4. Ensure public and environmental safety in biotechnology development and application
5. Provide for measures for biotechnology and biosafety monitoring and evaluation

Institutional Framework under the Policy

- The Government shall, establish and where already in existence, strengthen well-coordinated and sustainable mechanisms and structures for effective implementation, monitoring and periodic review of the policy

The National Focal Point

- Government shall enhance the capacity of the National Focal Point (NFP) for Biosafety in the Ministry responsible for Environment to take greater responsibility on behalf of Uganda in liasing with the CBD Secretariat in coordinating information flow and exchange

The Competent Authority

- Government shall strengthen the UNCST as the national competent authority to follow up, supervise and control the implementation of the policy

- **National Biosafety Committee**
  - Government shall strengthen the National Biosafety Committee already established within the Competent Authority to meet the standards of similar committees elsewhere in the world.
- **Other Lead Agencies**
  - The lead agencies comprise institutions within the National Research Systems, Sector Institutions, Sector ministries, Private Sector, Universities and organisations having a portfolio of biotechnology research and product development.
  - The Ministry responsible crop protection will specifically oversee inspection for compliance with the Phytosanitary and other terms and conditions of approval of researches and commercialisation involving agricultural biotechnology.

Financing and Legal Regime

- **Financing**
  - Government shall allocate adequate funding and make every effort to mobilise financial and other resources from the private sector and development partners, for biotechnology and biosafety research, development and application.
- **Legal and Regulatory Framework**
  - For the purposes of implementing this Policy, a National Biosafety Act will be enacted to regulate Biotechnology applications in Uganda.

Regulation of Lab and CFTs

- The Interim Legal Regime for GM research in Uganda is the UNCST Act Cap 209 that empowers the UNCST to regulate research in Uganda
- Under this regulatory regime to important Guidelines have been developed:
  - National Guidelines for Containment: For regulation of Laboratory Research involving GM organisms and microbes
  - National Guidelines for Confined Field Trials (CFTs) and
  - SOPs (Trial Managers' Handbook)

Highlights of the National Biotechnology and Biosafety Bill 2012

Scope and objectives

- **Scope**
  - Applies to research and general release of genetically modified organisms
  - Drugs excluded (Under National Drug Authority)
- **Objectives**
  - To provide a regulatory framework to ensure safety in the development and application of biotechnology
  - To facilitate safe use of biotech to address national development challenges
  - To strengthen consumer protection and public awareness in the use of biotech
  - Establish bio-ethical procedures in biotech research

Institutional arrangements

Review/approval procedure

- Depends on nature of activity
  - Lab research, contained research, confined research, Full safety assessment, general release, import/export/ transit
- Review at institutional, and national levels
- NBC main national body for biosafety matters – Under competent Authority = UNCST
- All relevant government agencies to have input into specific applications
- All approvals/denials based on sound, scientifically acceptable risk and safety assessment

Approval process for GM R&D

Stage / type of R&D	Approving Authority	Max. Review period (working days)	Remarks
Laboratory experiments	IBCs	21	Competent Authority is notified
Contained/testing	IBCs	28	Competent Authority is notified
Confined field testing	Competent Authority (UNCST)	90	IBC recommends
General release	Competent Authority (UNCST)	270	IBC recommends; Other government agencies & public are consulted; Gazette
Import, Export, transit	Competent Authority (UNCST)	28	Fulfill Cartagena PB W/A

Risk and safety assessment and management

- Bill emphasises safety in using biotechnology by providing for measures to be taken to minimise or avoid risk to human health and environment arising from actual or potential contact with a GMO
- Also provides for every application for research or general release to contain an emergency plan complete with safety measures for unintentional release of a GMO.

Restoration, cessation, inspections

- Competent Authority may:
  - Stop an activity when human health or environment is threatened as a result of a GMO activity
  - Stop unapproved activities
  - Issue restoration orders in the event of damage to human health and the environment
- Competent Authority may also:
  - Investigate any claims concerning GMO activities
  - Conduct inspections as appropriate

Status of bill in legislative process

- **First Reading:** Bill was committed to the relevant Committee of Parliament for consideration (S&T Committee) – Feb 05 2013
- Committee invited other stakeholders to state their views on the provisions of the Bill
- The committee held several hearings for the purpose.
- Bill still with Committee. Report expected by end of this month

Status of bill in legislative process

- The Committee will submit a report on the Bill to the plenary of Parliament;
- Parliament will consider the Bill at Second Reading which is a debate on the **principles** and **policies** of the Bill and **not on its details**.
- **Committee Stage** – Committee of whole house: Review bill clause by clause.
- Report of whole house
- **Third Reading** and **passage**

- When will the process be completed?

SCIFODE
Linking Science To Society

THANK YOU

Seed trade Environment in Uganda

Daniel Otunge – African Agricultural Technology Foundation

B4FA's Media Fellowship Programme,
UGANDA (April 10-13, 2013)

Seed Trade Environment in Uganda

By Daniel Otunge
OFAB Coordinator
d.otunge@aatf-africa.org

What is AATF?

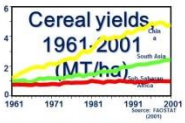
- The African Agricultural Technology Foundation (AATF) was set up in 2003 to facilitate access, adaptation and transfer of appropriate agricultural technologies to smallholder farmers in sub-Saharan Africa.

WHY AATF?

WHY AATF:

Need to access IP technologies to increase African agricultural productivity

- Yields are stationary or declining
- Production keeps up with population by expanding land under agriculture
- Productivity per capita is declining



- Support for public research is declining
- Private research is increasing → IPR regimes are increasingly an issue in tech access

Current AATF activities

1. ***Striga* control in maize**
   Applying *Striga*-killing herbicide, Imazapyr, to maize seeds that are bred to be herbicide resistant, increasing yields 300% on average
2. **Water Efficient Maize for Africa (WEMA)**
   Developing white hybrid maize varieties adapted to moderate drought conditions in SSA and insect resistant to increase yields 20-35%, through conventional, marker assisted breeding and transgenic technology
3. **Insect-resistant cowpea**
   Developing resistance to cowpea pest, *Maruca*, through transgenic technology; initial CFTs show little to no damage

Current AATF activities (con't)

4. **Protecting banana from bacterial wilt**
   Developing *Xanthomonas* wilt-resistant transgenic banana from East African germplasm, using two genes found in sweet pepper, namely *pflp and hrap*
5. **Biological control of Aflatoxin**
   Using bio-control product, Aflasafe, with holistic strategies to address aflatoxin problems in maize and peanuts
6. **Improving rice productivity**
   Developing rice varieties with Nitrogen-Use Efficiency, Water-Use Efficiency, and Salt Tolerant Traits (NEWEST); hybrid rice
7. **Cassava mechanisation**
   Brokering access to mechanisation and agro-processing equipment for development and use in Africa, accelerating harvesting and processing

Enabling Activities

- ***Trends monitoring***
  - R&D Priorities
  - Regulations for GM crops
  - Evolution of Seed Systems
  - IP policy and legislation
- **Public awareness: *Case of Open Forum on Agricultural Biotechnology (OFAB) in Africa***
  - enhances knowledge-sharing and awareness of biotechnology
  - contributes to building an enabling environment for decision making on agricultural biotechnology in Africa

About OFAB

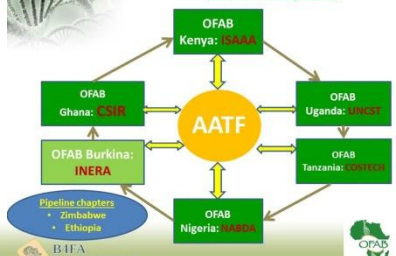
- **AIM - To enhance knowledge-sharing and awareness on biotechnology that will**
  - ✓ raise understanding and appreciation of agricultural biotechnology and
  - ✓ contribute to building an enabling environment for decision making
- OFAB is expected to ensure that **quality knowledge is disseminated to both policy makers and the larger public through provision of factual information**

OFAB – A Strategic Initiative

- AATF facilitated set up of OFAB as a platform that provides an opportunity for biotechnology stakeholders to:
  - ✓ network
  - ✓ share knowledge & experiences
  - ✓ explore new avenues for collaboration in bringing the benefits of biotechnology to all across Africa

The OFAB Platforms

OFAB Chapters



UGANDA SEED SYSTEMS

GENERAL OVERVIEW

- Both formal and informal seed systems are recognized in government policies and programs
- The government is the main regulator of the sector for quality assurance
- Country has 23 registered and active seed companies, trading in various seeds but mainly hybrid maize
- The country has over 2300 registered agro-dealers
- Several NGOs support farmer-saved and community-based seed. They train farmers on seed production and seed marketing.
- **Hence it is a distorted seed trade market**

Assessment of seed systems

Informal system:

- Farmers produce 90% of their seed themselves.
- They save part of their harvest as seed for the next planting season, and exchange communally
- They also buy grain at local markets for use as seed.
- Several governmental and nongovernmental organizations support farmers' groups in the production of standard seed.
- They also access quality foundation seed from public sector

Uganda Seed Schemes

Uganda is a member of the Organization Economic Co-operation and development OECD Seed Schemes as follows

Assessment of seed systems

Formal system

- 23 companies produce certified seed of hybrid and open pollinated varieties (OPVs) sourced from public research centers like NARO, Makerere etc
- They account for only about 10% of seed market
- International companies also import seed of hybrid maize, sunflower and exotic vegetables.
- State strongly supports production and access to crops like bananas, cotton, coffee and cocoa. These are mainly produced through private seed companies, laboratories and nurseries.

Key sources of quality seeds

- National Agricultural Research Organization (NARO). Its main institutes include:
  - ✓ National Crops Resources Research Institute (NACRRI)
  - ✓ National Semi-Arids Resources Research Institute (NASARRI)
  - ✓ National Forestry Resources Research Institute (NAFORRI)
  - ✓ 7 Zonal Agricultural Research Institutes (Abi, Mbarara, Ngetta, Buginyanya, Kachwekano, Corec, Tea)
- Universities e.g. Makerere's Departments of Crops Research and Biosciences

SEED SYSTEM LINKAGES & KEY PLAYERS

NARO: National Agric. Research Organisation
NBC: National Biosafety Committee
NSCS: National Seed Certification Scheme
NSB: National Seed Board
PIU: Phytosanitary Inspection Unit
NAES: National Agricultural Extension Service
NVRC: National Variety Release Committee
MAAIF: Ministry of agriculture, animal industry & fisheries
PGRC: Plant Genetic Resources Centre
UNADA: Uganda National Agro-input Dealers' Association

Biotech research in Uganda

The national research institutes are responsible for trials of various biotech crops such as:

- Banana (Bacteria, virus, nematode, bio-fortification)
- Maize (Drought tolerance & Insect resistance)
- Rice (NEWEST)
- Cassava (Mosaic & Brown Streak Viruses)
- Cotton (Insect resistance, herbicide tolerance)
- Sweet Potato (Virus & insect resistance)
- Groundnuts (Rosette Disease)

Issues that needs to be highlighted for the benefit of the public include industry readiness to take up to the technologies, capacity, status of biosafety law & regulations, public education efforts to address concerns.

• Seed production is an expensive undertaking

SEED REGULATORY ENVIRONMENT

Regulatory environment

Seed governance

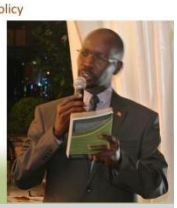
In Uganda, seed production& distribution are governed by a raft of laws, regulations, administrative and technical procedures, including:

- ✓ Draft National Agricultural Seed Policy (2011)
- ✓ The Seed and Plant Act (2006)
- ✓ The Seed and Plant Regulations (2009)
- ✓ The Plant Variety Protection Bill (2010)
- ✓ The National Agricultural Research Act, 2005
- ✓ The agricultural agrochemicals (control) Act of 2006
- ✓ The adulteration of Produce Act, Cap 27
- ✓ The Cotton Development Act, Cap 30
- ✓ The Export Promotion Board Statute, 1996
- ✓ The National Environment Act, Cap 153
- ✓ Uganda national Bureau of Standards Act, 1983

Biotech regulation

The following are the key regulatory documents for biotech in Uganda:

- ✓ National Biotechnology and Biosafety Policy (2008)
- ✓ Plant Variety Protection Bill 2010 (?)
- ✓ National Biosafety Bill (currently at the committee stage)



- Hon. Obua Denis Hamson (PM, Ajuri County) and Chair: S&T Committee

IPRs situation

- Currently no legislation on plant variety protection
- Plant Variety Protection Bill 2010 is stuck in parliament.
- Has Patents Act Chapter 216 but its is not explicit about breeder's rights and patenting of new plant varieties like the GM ones.
- **IPR protection is critical for increased investment in plant breeding and production of better seeds.**

International Instruments governing seed systems

International seed regulatory institutions

Seed Regulatory aspect	Description	Institutions responsible
Seed Certification (SC)	Quality assurance process. Inspection done by National Designated Authority (NDA), e.g. NSCS, to confirm DUS and VCU (Value for Cultivation and Use)	OECD: Organization for Economic Cooperation and Development. Has developed the seed schemes recognized internationally
Seed Testing (ST)	This is done to provide credible information on purity, germination, limits on moisture content and seed-borne diseases, size, weight, vigor, viability and varietal quality. Certificate of quality is issued if the NDA is satisfied.	ISTA: International Seed Testing Association. Provides uniform rules and guidelines for testing and also accredits of seed testing labs
Phytosanitary Measures (PMs)	These are rules governing importation and marketing of plant species. Aims to prevent spread of diseases, pests and invasive species	WTO: has provided sanitary and PMS(WTO-SPS) to guide movement of seeds across boarders. Allows countries to seed their own PMs based on science. IPPC: International Plant Protection Convention. The IPPC sets the standards and currently 177 countries are signatories.

International seed regulatory institutions

Seed Regulatory aspect	Description	Institutions responsible
Plant Variety Protection (PVP)	Breeders of new improved plant verities need protection of their intellectual property right so that they can exclusively benefit from it. IPRs are legal instruments used to protect creations of the mind which have commercial value, such as inventions. They grant exclusive rights to the creator to protect access to and use of their property from unauthorized use by third parties. ARIPO/OAPI (for Africa)	UPOV: International Union for the protection of new varieties of plants. The aim is to encourage breeding of new varieties for benefit of society. It is intergovernmental body. WTO-TRIPS: Trade Related Aspects of Intellectual Property Rights also obligates member-states to protect breeders-rights. Rights only given if a variety is new, distinct, uniform, stable and has VCU. PGRFA: International Treaty on Plant genetic resources for Food and Agriculture facilitates fair and equitable global benefit sharing.. In Ghana Plant Protection & Regulatory Services Department (PPRSD) of MOFA is responsible.
Capacity building Uganda has only about 9 PHds and 10Mses active breeders (as at 2011)	Developing and strengthening seed production capacity, regulation and policies are a priority areas for the international community GIPB: Global Partnership for Plant Breeding was set up by FAO to help poor countries to develop seed production and regulation capacities	FAO: Assists members in building capacities in the following ways: • National seed policy • Regional harmonization of seed regulations • Seed production and quality assurance • Quality Declared Seed (QDS)
Arbitration	This refers to the procedure for resolving seed trade disputes.	ISF: International Seed Federation has developed procedural rules for seed trade dispute settlement.

SEED MARKETING AND DISTRIBUTION

Key players

- Companies
- Farmers
- Government
- NGOs
- Churches
- Agro-dealers


Key tools used:
The mass media
ICTs
Farmer Groups
Exhibitions
Agric Extension Service (NAES)
B4FA
OFAB

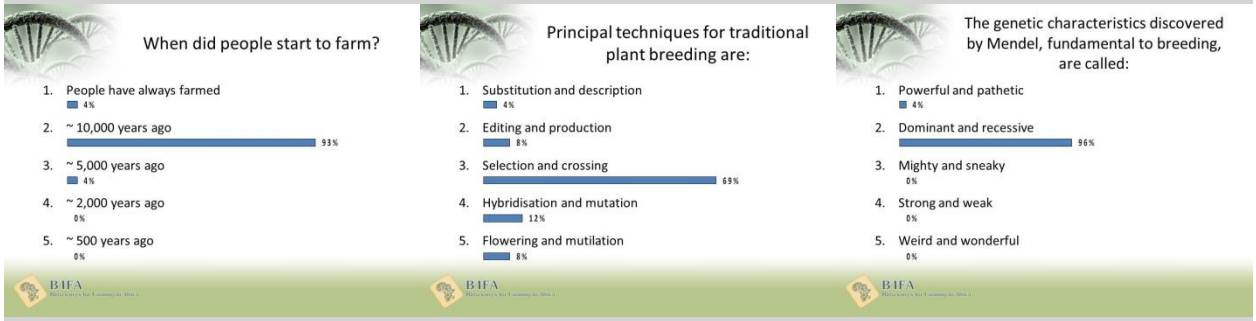

Role of extension service:
Government extension staff are responsible for agriculture extension
However, generally the extension service is:
Ineffective
inefficient
Underfunded
Understaffed
B4FA
OFAB

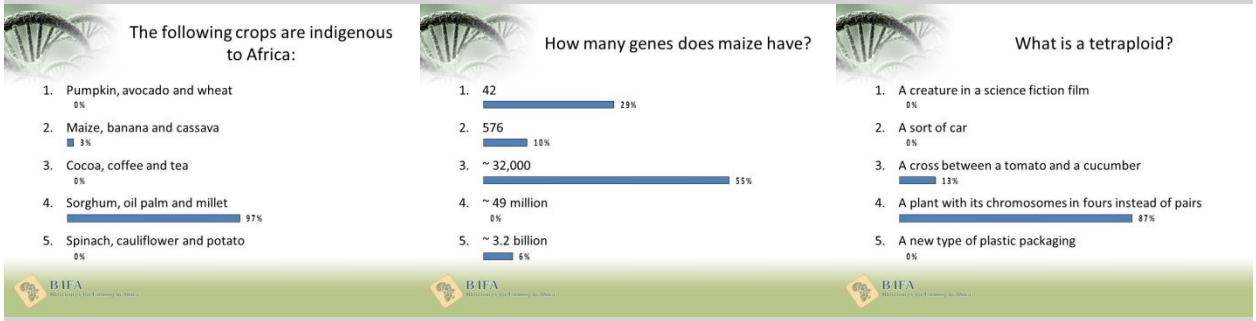

Challenges facing adoption of improved seeds
The following are some of the major challenges facing the seed systems in Uganda:
Counterfeiting
Low quality seeds
Lack of awareness of benefits
Negative attitudes towards new varieties (eg TC bananas)
Weak seed systems
Moribund extension service
Weak enforcement of regulations
Subsistence mentality
B4FA
OFAB


Give our scientists...
FREEDOM TO INNOVATE

Closing Session

Dr Bernie Jones – B4FA Media Programme Director





Which of these statements about GM do you think is the most accurate?

1. GM crops are only for the rich countries 0%
2. GM technology can solve all our agricultural problems 12%
3. GM crops look different to conventional ones 4%
4. GM is just one of many useful tools breeders can use 85%
5. GM crops are untested and unregulated 0%

If you had a query about a biotech story you were covering, would you:

1. Ask a local lobbying NGO 0%
2. Just rely on wikipedia 0%
3. Email Prof Jim in Reading 10%
4. Phone one of the Ugandan scientists you know 87%
5. Make it up 3%

Have you found the last 4 days interesting?

1. Yes 100%
2. No 0%

Have you found the last 4 days fun?

1. Yes 68%
2. No 32%

What now?

- Keep in touch
- Facebook group – B4FA Uganda
- Networking events
- Field trips (competitive)
- Prizes (competitive)
- Further training (competitive)

What we need from you!

- Engage in discussions online
- Participate in networking and other activities
- Write/broadcast more about the issues and how genetics and breeding are being applied

and let us know about it!

Feedback

- Comment forms distributed
- Please hand in to Eve
- Let us know any comments and thoughts at any time
- We need to learn from you!

Prizes

For best pieces produced on the course

Awards

Certificates for our participants

Thanks

- To our presenters
- To our scientists
- To our local project staff
- To YOU!

We look forward to seeing you all again soon!