Biosciences for Farming in Africa: Media Fellowship Programme

Fifth Workshop Report Round 2 – Ghana

Front cover photo: B4FA media fellows listening to a presentation of banana tissue culture by Prof Samuel Sackey of Biochemical Products Ghana Ltd, March 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.

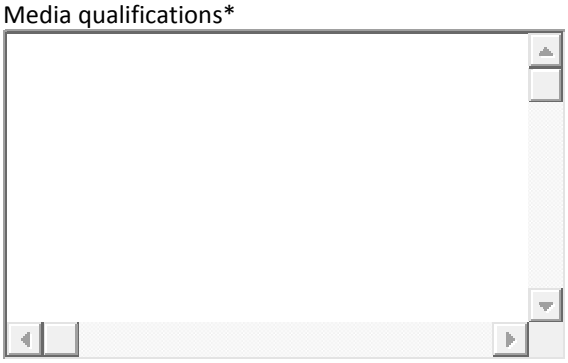
More details of the project and Fellowship can be found at b4fa.org

---

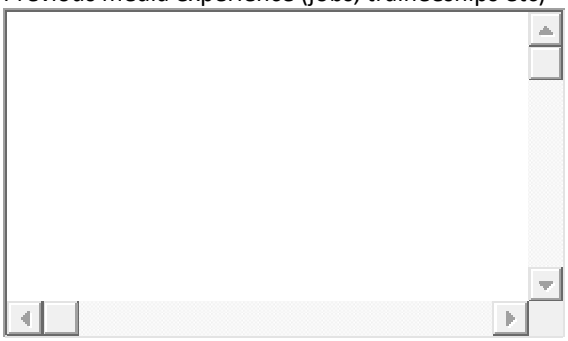
B4FA Media Fellowship - Online Application Form

- 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 *

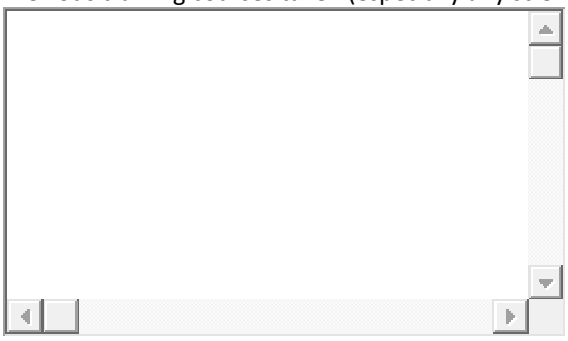
- Media qualifications*



- Previous media experience (jobs, traineeships etc)*

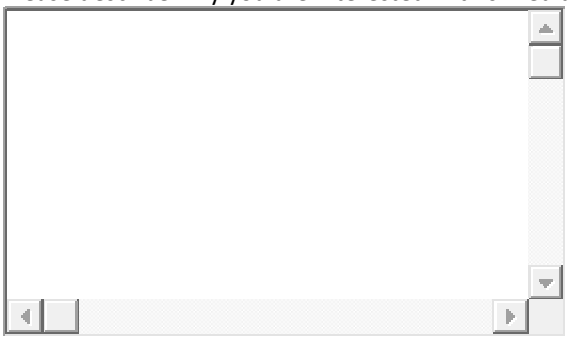


- Previous training courses taken (especially any science/ agricultural reporting courses)*

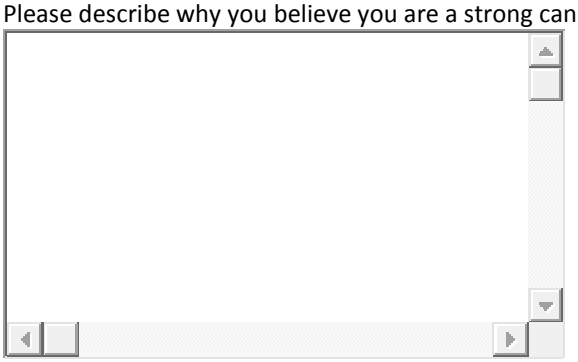


- List your current areas of interest in reporting*

- 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 Ghana we interviewed 32 print and broadcast journalists. Word of mouth had raised the profile of the fellowship, so there were some senior and experienced applicants, including the winner of the "journalist of the year" award.

As would befit a more senior population of applicants, the amount of misinformation they believed and reported was less, but there was still very little awareness of the underlying science, background and the opportunities of applying the new technologies.

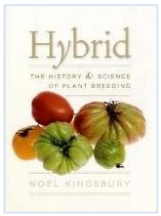
The ten most productive fellows from the first round were also asked to return as "alumni fellows" to act as mentors in their own right and also to consolidate their learning.

Prospective fellows selected from the interview round were:

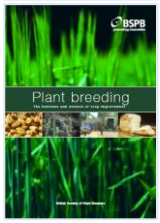
1. **Agustina Apik** Editor in Chief, GBC Radio
2. **Albert Sore** MultiTV, Bolgatanga
3. **Basiru Adam** Business and Financial Times
4. **Clement Boateng** Radio Bishara (Tamale)
5. **Charles Benoni Okine** Daily Graphic
6. **Cliff Ekuful** Ghanaian Times (Wa)
7. **Dansowaa Awuku** MultiTV
8. **Ebenezer Hanson** Assistant Editor, Public Agenda
9. **Edmund Gyebi** Chronicle (Tamale)
10. **Fati Shaibu Ali** Senior Editor, ETV
11. **Francis Ameyibor** GNA
12. **Frank Nyonator Worlanyo** Metro TV
13. **Fred Smith** ETV and Happy FM
14. **Isaac Nongya** Metro TV (Tamale)
15. **Linda Asante Agyei** GNA
16. **Manasseh Azuri** Finder
17. **Roland Walker** TV3
18. **Saeed Ali Yaqub** Luv FM (Kumasi) Editor
19. **Saminu Rafi Zambaga** Finder (Takoradi)
20. **Samuel Boadi** Editor, Daily Guide
21. **Samuel Duodu** Daily Graphic, Sunyani
22. **Shirley Asiedu-Addo** Daily Graphic, Cape Coast
23. **Zakaria Alhassan** Graphic (Tamale)

3. Pre-course reading material

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



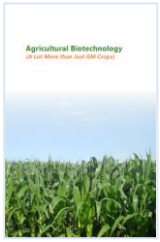
Noel Kingsbury: Hybrid – the history and science of plant breeding (Book)



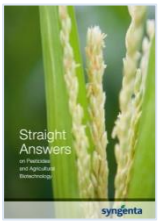
British Society of Plant Breeders – Handbook on Plant breeding

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

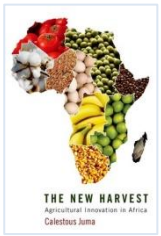
Sense About Science: I don't know what to believe – making sense of science stories



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

13 – 16 March 2013
Royal Richester Hotel, Legon, Accra

Please arrive at the hotel on Tuesday 12 March. Accommodation has been arranged.

Day 1 – Wednesday 13 March 2013

0900 **Welcome and Introductions**
Bernie Jones; B4FA Course Leader

1000 **Issue Brainstorming** – *tea/coffee*

1030 **History of Plant Breeding and Agriculture**
Bernie Jones

1100 **Fundamentals of Plant Genetics**
Eric Danquah; University of Ghana, Legon

Practical Exercise – Inheritance of Traits

1200 **Practical Experiment – DNA extraction**

1245 **Lunch**

1345 **Fundamentals of Science Journalism**
Alex Abutu; Desk Chief, AfricaSTI

1415 **F1 Hybridisation**
Claudia Canales; B4FA

Practical Exercise – F1 Hybrids and saving seed

1500 **Break** – *tea/coffee*

1530 **Fundamentals of Genetic Modification**
Chris Leaver; University of Oxford, UK

1615 **Video – Bad Science**

1645 **Journalism – Feedback**

Dinner

Day 2 – Thursday 14 March 2013

Breakfast

0900 **Local case-study 1 – Cocoa**
Abu Dadzie; Cocoa Research Institute of Ghana, New Tafo

Local case-study 2 – Cowpea
IDK Atokple; Savanna Agricultural Research Institute, Tamale

Local case-study 3 – Rice
Maxwell Darko; Crop Research Institute, Kumasi

1030 **Discussion** – *tea/coffee*

1100 **Round table discussion sessions**

- **Journalism – Story Ideas**
- **Bjorn Lomborg – Golden Rice**
- **Journalism – Crafting a "Top"**
- **Public attitudes to risk – why is GM so controversial?**
- **Why is agriculture not more popular with the media and public?**

Field Trip 1

1300 Depart – lunch on bus

West African Centre for Crop Improvement (WACCI)
University of Ghana, Legon

Return to International Press Centre tbc

1730 **Discussion and Journalism**

Launch of B4FA "Insights" booklet on biosciences in Africa

1800 **Launch Presentations**

Bernie Jones
Eric Danquah
tbc

Buffet reception

2000 Return to Royal Richester Hotel

Day 3 – Friday 15 March 2013

Breakfast

0900 **Local case-study 4 –**
Paul Agu Asare; Department of Crop Science, University of Cape Coast

Local case-study 5 – Pineapple tissue culture
Kenneth Danso; BNARI, Accra

Local case-study 6 – Cotton
Emmanuel Chamba; SARI

1030 **Discussion** – *tea/coffee*

1100 **Round table discussion sessions**

- **GM reality – from SeedFeedFood**
- **Practical Exercise – Marker assisted breeding**
- **Policy document: Regulation of GM in Africa**
- **What will give farmers faith in modern seeds?**
- **Will Ghanaians buy GM food?**

Field Trip 2

1300 Depart – lunch on bus

Private Tissue Culture Laboratory - Ningotech
New Ningo

Return to Hotel

1700 **Discussion and Journalism**

Dinner

Day 4 – Saturday 16 March 2013

	Breakfast
0900	**Practical Journalism**
1030	**Break** – tea/coffee
1100	**Agricultural biotechnology and the regulatory environment** *Josephine Nketsia Tabiri; Member of National Biosafety Committee, Ghana*
1145	**Agricultural biotechnology and industry** *Daniel Otunge; African Agricultural Technology Foundation, Nairobi*
	Discussion
1300	**Lunch**
1400	**Prize-giving and closing** Next steps and opportunities Announcement of prize-winners for best articles produced Award of Certificates
1500	**Official Close** – tea/coffee

5. List of participants and biographies

B4FA
Biosciences for Farming in Africa

Media Fellowships – Ghana
Second Round
List of Participants

B4FA Media Fellows

Agustina Apik	Editor in Chief, GBC Radio	
	tinapik@hotmail.com	0201-346643
Albert Sore	MultiTV, Bolgatanga	
	Albert.sore@hotmail.com	0209-716959
Basiru Adam	Business and Financial Times	
	daaraka2000@yahoo.com	0246-227377
Clement Boateng	Radio Bishara (Tamale)	
	spendiboat@yahoo.com	0244-415810/0205-546530
Charles Benoni Okine	Daily Graphic	
	cb.okine@yahoo.com	0242-615378

Charles is a senior financial correspondent on the Business and Financial Desk at the Graphic Communications Group Limited. He attended the Ghana Institute of Management and Public Administration (GIMPA) where he obtained his BSc in Marketing in 2006. He also holds a certificate in Management from GIMPA. Prior to the pursuit of his first degree, he attended the Ghana Institute of Journalism (GIJ), obtaining a Diploma in Journalism/Communications and winning GIJ awards for his economic reporting and performance on attachment. He also undertook a rigorous programme at the International Institute of Journalism (IIJ) of InWEnt Capacity Building International, Germany and obtained a certificate in Economic and Financial Journalism in 2004.

Cliff Ekuful	Ghanaian Times (Wa)	
	cliffff86@yahoo.com	0249-322628/0201-262150

Cliff is a journalist by profession and works with the New Times Corporation of Ghana as a senior reporter. He is currently based in the Upper West, where he serves as Regional Editor. Cliff holds a Diploma in Mass Communication from the Ghana Institute of Journalism, a BSc in Tourism from the University of Cape Coast and an MPhil in Development Management from the University for Development Studies.

Dansowaa Awuku	MultiTV	
	Dansowaa.awuku@myjoyonline.com	0208-148828
Ebenezer Hanson	Assistant Editor, Public Agenda	
	ekthanson@yahoo.co.uk	0540-660133
Edmund Gyebi	Chronicle (Tamale)	
	edmondopapa@yahoo.com	0243-081443/0206-105453

Fati Shaibu Ali	Senior Editor, ETV	
	fatishaibuali@yahoo.com	0268-806215
Frank Nyonator Worlanyo	Metro TV	
	nyanator@yahoo.com	0243-762003
Fred Smith	ETV and Happy FM	
	f.kuuku_smith@yahoo.ca	0266-230677

Fred Kuuku Smith is currently the news editor at e.TV Ghana and Ghana correspondent for e.news channel Africa. He has 16 years of diversified and progressive broadcast experience. A father of two, he is committed to trying to make a difference.

Isaac Nongya	Metro TV (Tamale)	
	ecomah@gmail.com	0246-711162
Manasseh Azuri	Finder	
	azureachebe2@yahoo.com	
Roland Walker	TV3	
	rowaghana@gmail.com	0202-849062
Saeed Ali Yaqub	Luv FM (Kumasi) Editor	
	saeed.yaqub@luvfmonline.com	0243-284111
Saminu Rafi Zambaga	Finder (Takoradi)	
	zambagarufai@yahoo.com	0200-215160
Samuel Boadi	Editor, Daily Guide	
	samuel10gh@yahoo.com	0244-026045

Samuel Boadi has worked with the Daily Guide newspaper for over 10 years now. He joined the newspaper after working for two years with Top Radio (103.1 fm), an Accra-based radio station as a news reporter. Currently the Business Editor of Daily Guide, he used to edit the BUSINESS GUIDE too. He has a BSc in Marketing from the University of Professional Studies (UPS), Legon.

Samuel Duodu	Daily Graphic, Sunyani	
	Duosam74@yahoo.com	0244-012151
Shirley Asiedu-Addo	Daily Graphic, Cape Coast	
	stquac@yahoo.com	0244-221751
Zakaria Alhassan	Graphic (Tamale)	
	gbangbahzak@yahoo.co.uk	0244-223511

B4FA Media Fellow alumni

Adelaide Arthur	Joynews Multitv, Accra	
	adelaide.arthur@myjoyonline.com	0243-843961

Adelaide Arthur is a practising broadcast journalist with Joy News on Multi TV. With four years' experience in Journalism she has worked as an intern with Ghana Television and GFA News. She holds a degree in Communication Studies from Ghana Institute of Journalism, GIJ.

Francis Balikawu Npong The Enquirer, Tamale
prinsfranco@yahoo.com 0209-336286

Francis is a communications consultant and journalist of 7 years' experience, with qualifications in journalism, climate change diplomacy, decentralized governance, marketing, human rights reporting, and digital photography. He is a blogger and national coordinator, Media Advocates for Sustainable Environment (MASE). He currently works with the Enquirer as Northern regional correspondent, and as a reporter for Thinkbrigade.com, an international online magazine run by the European Journalism Center. He has participated in many environmental and agriculture related workshops, and has won several awards in the field of journalism including the 2009 EPA environmental reporting award (print) and the 2010 European Journalism Center overall best climate change blogging award. He has particular interest in agriculture, environment, human rights, climate change, research and education. His hobbies are news reporting, travelling, cooking, and listening to speeches and lectures. He is married with a three old girl.

Kingsley Elijah Hope New Times, Kumasi
elikinhop77@yahoo.com 0208-158825

Noah Nash Hoenyefia Viasat, Tamale
nashmessiah@gmail.com 0277-814973

Hoenyefia Noah Nash has a Bachelors degree in Education (Mathematics) from the University of Cape Coast and Certificate in Script Writing (ScriptNet2000 / NAFIT). He worked as teaching and research assistant in the Department of Communication Studies for two years, and volunteered as a presenter and reporter at the UCC campus radio station for six years. He has worked with ChoiceFM in Accra as a reporter and later joined Nigerian production house PDR Media Services. He has traveled extensively in Africa and is a passionate activist for Education, Agriculture, Gender and Social issues. He is currently the Video Journalist for Viasat News in the Northern Region (Tamale).

Samuel Hinneh Daily Dispatch
hinnehgh@yahoo.com 0267-778788

Samuel Hinneh is a graduate of the African University College of Communications in Ghana with communication studies in 2008. He is currently working at Allied News Limited as full time journalist reporting on science, development and technology issues. He is also a freelancer for Science and Development Network (UK), and a contractor for Brooke Pattrick Publications (South Africa), which specialises in technical business-to-business publishing in the African continent. Samuel is also Ghana's representative for Group Africa Publishing Limited (Kenya), publishers of the Construction Review Magazine, African Mining Brief, and Agricultural Review Magazine, and also freelances for Modern Ghana Media Limited (www.modernghana.com), and Spy Ghana (www.spyghana.com), online media organisations in Ghana. Samuel is a member of the Institute of Financial and Economic Journalists (IFEJ) in Ghana and African Development Journalists Association (adja). He recently won the Africa Means Business Fellowship, managed by Thomson Media Foundation (UK) and sponsored by the Bill and Melinda Foundation.

Stella Danso Daily Guide, Accra
stardi2@yahoo.co.uk 0244-985016

Umaru Sanda Amadu Citi FM, Accra
umarusco@yahoo.com 0242-370554

Umaru Sanda Amadu is a 25 year old broadcast journalist with Accra based radio station Citi FM. He is a graduate of the Ghana Institute of Journalism where he obtained a Diploma in Communication Studies. He is currently a news producer, reporter and presenter. He has been nominated for several awards and recently won the ''Jury's Special Award'' in the 2012 Radio for Peace Building in Africa Competition. He has a background in agriculture; namely, cattle and crop production. He is an exciting fellow to work with.

Yakubu Abdul – Majeed New Times, Tamale
0208-389872 yakmas2@yahoo.com

Yakubu Abdul-Majeed is the Northern Regional correspondent for Ghanaian Times Newspaper. He hails from the Northern region and sees his work as a journalist as an opportunity to help improve on the lives of his people by highlighting the developmental challenges of the area for them to be addressed by policy makers and other relevant stakeholder. He holds a Degree in Public Administration from Ghana Institute of Management and Public Administration with a Diploma from Ghana Institute of Journalism.

B4FA Experts, Presenters & Mentors

Abu Mustapha Dadzie Cocoa Research Institute of Ghana, New Tafo
xmusto@yahoo.co.uk

Committed to a career helping improve Ghanaian agriculture through the application of genetics and plant breeding, Abu Dadzie holds a BSc from KNUST in Crop Science and Biotechnology, and an MPhil from the University of Ghana in Plant Breeding and Genetics. Member of several national and international scientific bodies, Abu is currently a research scientist at the Cocoa Research Institute of Ghana, where he has worked for 8 years. His focus is particularly on germplasm management and breeding of the cash crops of cocoa and cashew. He has a number of national and international peer reviewed publications, and has participated in high-level training courses in Wageningen, Netherlands, and Miami, Florida.

Alexander Augustine Abutu Africa Science, Technology and Innovation News
alexyabutu@gmail.com

Alex Abutu edits environment and agriculture stories for Daily Trust, one of Nigeria's national daily papers, and works for the News Agency of Nigeria covering science and related issues. A graduate of Benue State University with a degree in Mass Communication, Alex authored the most discussed story ever published by the Science for Development Network (SciDev.Net) and was honoured in London as one of the" journalists that changed the world".

Chris Leaver Emeritus Professor, University of Oxford
chris.leaver@plants.ox.ac.uk

Chris Leaver is Emeritus Professor of Plant Sciences at the University of Oxford. He was awarded the CBE for his distinguished contributions to science of plant development. He is a member of The European Molecular Biology Organisation, Fellow of The Royal Society, Humboldt Prize-winner, and

has had a longstanding record of engagement in informing the public understanding of the role modern plant breeding.

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.

Emmanuel Chamba CSIR Savanna Agricultural Research Institute, Tamale
echamba@gmail.com

Emmanuel Boache Chamba is currently a Research Scientist at CSIR-Savanna Agricultural Research Institute (CSIR-SARI) Tamale, Ghana. He has spent 10 years of his research career working on cotton, holding a BSc in Crop Science from KNUST, a Masters degree in Plant Breeding from Clemson University, South Carolina, USA and a PhD in Molecular Biology and Protein Biochemistry from Bristol University/Rothamsted Research, UK. In 2011 he also completed a full-time MSc Project Management Programme from Lancaster University, Lancaster, UK. Currently Emmanuel is the substantive plant breeder responsible for both cotton and yam improvement programmes at CSIR-SARI. His research effort in cotton breeding resulted in the release of two cotton varieties in Ghana in 2004.

Eric Danquah WACCI and University of Ghana
edanquah@wacci.edu.gh

Eric Yirenkyi Danquah is a Professor of Plant Molecular Genetics at the Department of Crop Science, University of Ghana. He also serves as the Director of WACCI, an institution established with funding from the Alliance for a Green Revolution in Africa (AGRA) in 2007 to train a new generation of plant breeders for the West and Central Africa sub-region. He graduated, M.Phil (Plant Breeding) and Ph.D (Genetics), from the University of Cambridge, UK in 1987 and 1993 respectively. He was a visiting scientist at the BBSRC Long Ashton Research Institute, UK from 2000 to 2001. Previous positions held in the University of Ghana include, Dean of International Programmes, Head of the Department of Crop Science and Senior Tutor of Legon Hall. In 2008, he was a member of the Sixth External Program and Management Review Panel of ICRISAT. He is a Fellow of the Cambridge Philosophical and Cambridge Commonwealth Societies. His research focuses on using the tools of genomics to facilitate crop improvement. He has several publications to his credit and has participated in over 70 international meetings the world over.

Ibrahim Atokple CSIR Savanna Agricultural Research Institute, Tamale
idkatokple@yahoo.com

Ibrahim Atokple is a senior Research Scientist at CSIR-SARI in Tamale. He holds a BSc in Agriculture and a DipEd from the University of Cape Coast, MSc and PhD degrees in Crop Breeding from Ahmadu Bello

University, Zaria, Nigeria. He was a postdoctoral research fellow with IITA in 1992 working on the genetics of *striga* in cowpea – a research breakthrough for the control of this parasitic weed. His 18 year research career at SARI has seen him working on sorghum, cowpea and rice, resulting in the release of several improved varieties of these crops, currently in commercial production around the country. Presently, IDK as he is fondly known by his colleagues is the substantive sorghum breeder and the PI for the Bt cowpea project sponsored by AATF.

Josephine Nketsia Tabiri University of Ghana, Legon
josephinetabiri@gmail.com

Professor Nketsia-Tabiri is a member of the National Biosafety Committee. She worked with the Ghana Atomic Energy Commission as a food technologist from 1981 until 2012. She was the Director of the Biotechnology and Nuclear Agriculture Research Institute from 2005 until her retirement in 2012. She has been involved in the activities of the National Biosafety Committee from 2005 to date, and also still teaches at the university of Ghana, Legon.

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.

Kenneth Danso Biotechnology and Nuclear Agriculture Research Institute
kaedanso@hotmail.com

Dr Danso attended University of Cape Coast in 1985 and graduated in 1989 majoring in Botany. He was employed in Ghana Atomic Energy Commission in 1992 as assistant Scientific Officer. While in GAEC he enrolled in University of Ghana for his MPhil in Botany in 1994 and graduated in 1998. In 2000 he was awarded a Commonwealth Scholarship tenable in the UK, at the School of Biosciences, University of Birmingham from which he graduated in 2003. He specialised in Plant Tissue Culture with emphasis on cryopreservation. Kenneth returned to GAEC to continue his work as Scientific Officer and Principal Scientific Officer from 2009. In January 2013 he was appointed as the Director of BNARI. His research focus has been developing protocols for mass propagation of food and medicinal plants. Kenneth also lectures at the School of Nuclear and Allied Sciences, University of Ghana, Atomic Campus where he teaches Plant Physiology and Tissue Culture.

Kofi Adu Domfeh Luv FM, Kumasi
adomfeh@yahoo.com

Kofi Adu Domfeh is a Broadcast and Online Journalist working with Multimedia Group Limited (in-charge of the Business Desk at Luv 99.5Fm). He is also the Ghana correspondent for UK-based WRENmedia (managers of Agfax Radio and New Agriculturist Magazine) and done several agricultural reports for CTA's Rural Radio Resource packs; covering assignments in Ghana, Nigeria, Kenya and South Africa.

Maryann Eyram Acolatse Joynews TV, Accra
maryann.acolatse@multitvworld.com

Maryann Eyram Acolatse is currently Managing News Editor and Channel Manager for the Joy News Channel of MultiTV – Ghana's first free to air digital television network. With wide experience in radio, television and online news media., she is locally and internationally recognised for her work in science and environment communication and election coverage. Maryann has a Master's Degree in Journalism Studies from Cardiff University, UK, and Executive Masters in Business Administration from University of Ghana Business School.

Maxwell Asante Darko CSIR Crop Research Institute, Kumasi
mdasante@gmail.com

Maxwell Asante Darko is a rice breeder at the CSIR Crop Research Institute. He has been involved in the release of four lowland rice varieties. His current passion is to develop rice varieties that have excellent grain quality. He believes that this will help domestic rice capture a large portion of the market, which is presently being controlled by imports from Asia and the USA. He obtained a BSc (Agric) from the University of Cape Coast in 1998 and an MSc in Plant Breeding from KNUST in 2004. He submitted his PhD thesis on "Genetic analysis of grain quality traits in rice" to WACCI, University of Ghana, and is waiting to be awarded. Maxwell is well travelled, having attended conferences, workshops and training programmes in more than 10 countries. He has carried out research at advanced institutions including Cornell and the USDA National Rice Research Centre in the US, and Kyoto University in Japan. He has published his work in national and international peer reviewed journals. He lives in Kumasi with his wife and three children.

Paul Agu Asare Department of Crop Science, University of Cape Coast
syasare@yahoo.com

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.

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 a hotel on the outskirts of Accra 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 West African Centre for Crop Improvement at the University of Ghana, Legon, and to an entrepreneurial private tissue culture facility in New Ningo – Biochemical Products Ghana Ltd. We also held the Ghana 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 remaining one was not permitted to attend at the last moment by her news organisation.

Programme

The new format for the workshops further revised the East African format, to include a specific session on the historical aspects of plant breeding and agriculture. Hybrids were also tackled in a separate lecture, and the fundamentals of genetics once more had a stand-alone session. A further game had been devised to demonstrate marker-assisted selection, and this was combined with sessions designed to encourage interactive debate between the fellows, challenging them to discuss issues of journalism and social acceptability of GM food in their country.

Fellows

Despite their seniority, the Ghana fellows still had some major challenges in relating to the agricultural concepts being discussed, as in the first round of training. But the new format went some way towards addressing those problems.

Having a separate presentation about hybrid seeds made a difference in the understanding of the fellows, and should therefore be retained.

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. We introduced a new game demonstrating marker-assisted selection, as well as some interactive debate sessions tackling journalism issues as well as social issues such as the public acceptability and uptake of Gm foods in their country.

The DNA extraction continued to be as popular as ever, with some of the alumni fellows bringing back their DNA samples that had been preserved in alcohol 6 months previously (and which were still going strong).

Local scientific participation

The local scientists who participated were uniformly excellent and reacted positively to the opportunity. Interestingly, those who had participated in the first round had kept up some of their relationships with the journalists, and were therefore able to relate well to the media needs and level of understanding.

Field trips

For the field trips, the group divided into two at each facility, which then toured separately.

At WACCI they had the chance to interact with some of the West African students present, visit the molecular biology laboratory adjacent to the facility, and see the field trial seed sorting room being used to analyse the harvest.

At BPG Ltd fellows had the opportunity to see how tissue culture worked as well as to appreciate the potential entrepreneurial value of the technology. Dr Sackey, the owner, led the tour and discussion and gave an insight into the technical and commercial aspects, as well as the benefits of the product for smallholder as well as commercial farmers.

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.

Will GM Cotton Save Ghana's Declining Cotton Industry?

Adelaide Arthur

Whether it is the clothes we wear, draperies beautifying our homes or dressing of our wounds at the hospitals, we use cotton everyday. Versatility, performance and natural comfort are known for this soft fibre that thrives in many tropical regions of the earth.

The plant is equally known for its susceptibility to a wide range of pests and diseases making farmers heavily dependent on chemicals.

The development of genetically modified (GM) cotton, known scientifically as Bt cotton, means farmers can now reduce their reliance on pesticides to fight insect pests. Bt, the abbreviation for '*Bacillus Thuringiensis'*, is a gene derived from soil bacterium which produces proteins toxic to caterpillars that feed on cotton.

The cotton industry in Ghana has been declining over the years as a result of low yields. According to statistics, cotton production hit its peak during the 1998/1999 season and since then yields have slowly decreased. At present, farmers record an average yield of less than 700kg per hectare.

Again, the three private companies with the authority to manage cotton production in the country, Wienco Cotton, Amajaro and Olam, could only produce 2,500 tons during the 2011/12 production year after cultivating on an area of 23,000 hectares. Research scientists say, yields of cotton in Ghana can be improved.

Just as cocoa is the lifeline to southern farmers, so is cotton to farmers in the three northern regions. For this reason, cotton scientists say there is the need to revitalise the industry to save farmers from losing their livelihoods and also make the country a net exporter of the cash crop.

Research scientists at the CSIR - Savannah Agriculture Research Institute (SARI) are currently awaiting approval from the National Biosafety Committee to conduct experiments on bt cotton.

The experiments seek to test the effectiveness of bt cotton against caterpillars that feed on cotton and by so doing allow for only two-time spraying.

According to cotton scientist at CSIR – SARI, Dr. Emmanuel Chamba, unlike GM rice, sweet potato and cowpea which will undergo on-station confined field trials sometime this year, evaluations of bt cotton will be conducted on farmers' field under strict supervision of scientists. This will be the first of its kind on the continent.

According to him, initial tests on all GM crops are usually done in on-station confined environment however, in Ghana bt cotton experiment will go straight to the farmers' fields for demonstrations because scientists will draw from experiences from Burkina Faso. He explained both countries "have similar environmental and weather conditions and since Burkina Faso have conducted the tests for several years and have now commercialised bt cotton, there is no need for Ghana to go through the same tests for about six years."

Dr. Chamba also indicated "cotton grown in both countries is the same variety. The only difference is that the Burkina variety has the bt gene and that of Ghana does not."

Scientists say the bt cotton contains two kinds of proteins that are toxic to bollworm, a key insect pest of cotton. The proteins are highly insect specific and in this instance, the proteins are targeting bollworm. This means the cotton plant will still attract other sucking pests such as Jassids, Aphids, and Cotton Stainer, which the bt proteins cannot control.

As such, pesticide spraying will still continue to keep these sucking pests at bay; except that farmers will only have to spray twice instead the current 6 times with insecticide application.

The challenge is that pesticides are expensive and insect can develop resistance to it. Farmers also have a nonchalance attitude towards its use. The laborious nature of the task makes farmers rush through spraying and usually, do not do it on time.

Dr. Emmanuel Chamba told Joy News information researchers have gathered from farmers in Burkina Faso indicate that they are comfortable planting bt cotton simply because it reduces the number of times spraying is done and saves time.

He added if approval is given by the NBC for the experiment to be conducted, bt cotton trials will be conducted on nine farmers' fields in all three zones of the northern part of the country. There will also be an on-station demonstration at SARI, which will be a replica of what is being done on the farmers' fields.

The bt cotton will be planted along side conventional varieties that farmers are currently growing to test how both perform under the same conditions.

Planting is expected to start in June and by December, researchers expect to harvest the first batch cotton. Scientist say the experiment will be conducted a second year in order to confirm results.

Dr. Chamba stressed, though demonstrations will be conducted in the open field, it is not for commercial purpose.

He added his outfit will only "recommend commercialisation of bt cotton when they are convinced the bt gene in cotton has diligently served its purpose which is to control bollworm as well as reduce the number of spraying.

Reuters reported in January that bt cotton production in Burkina Faso hit 630,000 tons exceeding the expected 532,000 tons during the 2012/2013 season up from 400,000 tons in 2011/2012.

This success story from Burkina Faso, one of the first countries in Africa to approve GMOs, is what cotton scientists in Ghana are seeking to achieve. Research scientists are hopeful bt cotton will do well in Ghana just as Burkina Faso.

Plant Breeding To Reduce The Plight Of Tomato Farmers

By *Albert Sore (Joy news Radio & TV)* ***Email:*** *albert.sore@hotmail.com*

Target: Policy Makers, Government and Farmers

Message: Tomato farmers of the Upper East Region can get their tomatoes to have the same quality that the Burkinabe tomatoes have through Plant Breeding.

Intro

Year in, year out, crates of tomatoes get rotten on farms in the Upper East Region. One reason known to account for this problem is that buyers of tomatoes in Ghana prefer tomatoes from neighboring Burkina Faso because they have a better quality. In times past, the financial implications of this problem were so severe that they drove some farmers into taking their own lives.

Plant breeding could be one sure way to reduce and perhaps end this problem.

Joy News' Upper East Regional Correspondent, Albert Sore is one of many Ghanaian journalists at a media fellowship who are currently learning from the Biosciences for Farming in Africa (B4FA) programme, specifically designed to encourage informed discussion about the potential application of biosciences and genetics for farming in Africa. He has listened to several lectures on Plant Breeding and has come through with the following report.

WIAT FOR CUE….

STORY LAY OUT

Background

CUE (Voices of farmers complaining about problems they face year in, year out)

Every year, farmers in the Upper East Region battle with problems of bumper harvests coupled with the lack of a ready market caused by the indefinite closure of the Tomato factory in Pwalugu. In the end, a lot of their tomatoes get rotten on their farms and in the local markets and many farmers lose a lot of money. In fact, several tomato farmers have committed suicide in the past because they had recorded severe post-harvest loses and did not know how to pay back loans they had taken to cultivate the tomatoes.

Governments over the years seem to lack the political will to find a solution to this problem. They could have at least, put the tomato factory back on track as a measure to reduce the plight of the farmers but instead, they make all kinds of promises which they never fulfill. As a matter of fact, promises by politicians to tomato farmers in the Upper East Region have almost become annual rituals.

Market women from mainly Accra and Kumasi are key determinants of the fate of tomato farmers in the Upper East Region. These women are traders who buy tomatoes in very large quantities and in

turn, sell it in parts of the country where there is a high demand for the commodity. If these women bought from the farmers in the Upper East Region, then they would have helped solve a part of the problem of the farmers. However, they do not buy tomatoes from the Upper East Region. They rather spend extra money, traveling into neighboring Burkina Faso to buy tomatoes from there. Only farmers who allow the market women to determine the prices of their tomatoes manage to catch the eyes of these women.

The market women do this for only one reason: tomatoes from Burkina Faso have the quality of lasting longer before they perish. Therefore if the women were unable to immediately sell what they bought, they are sure the tomatoes will not rot within a short period of time.

CUE (Market women explaining why they buy from B. Faso)

The Problem

Tomatoes from the Upper East Region lack this quality and that is why the market women do not buy it.

So why do Ghana tomatoes lack this one important quality that those from Burkina Faso have? This is the question I posed to some of the farmers.

CUE (farmers share what they know of Burkinabe tomato cultivation that gives produce the quality the market women are looking for. They do not relate it to quality of seedlings)

So again I ask the Upper East farmers to share with me, their own methods of cultivation. Donald Samani is President of the Upper East Regional Vegetable Farmers Association.

CUE (Samini explains how they select seedlings for cultivation and admits that they are still battling with getting seedlings with the quality they are looking for. He does not mention Plant Breeding)

The Solution

Plant Breeding can improve the quality, diversity and performance of just about any crop and help develop plants better suitable to human needs: Through scientific methods, a certain quality in one variety of a crop can be put into another variety of the same kind of crop. This is Maxwell Darko of the Crop Research Institute, Kumasi, explaining how the method is applied to different varieties of rice.

CUE (Maxwell Darko explaining how aroma and disease resistance qualities are infused into some varieties of rice that do not have those qualities)

At the Biosciences for Farming in Africa workshop, I learned from several lecturers that Plant Breeding can also be applied to Maize, Cowpea and Cocoa. So I said to myself: “if Plant Breeding can be applied to any kind of crop, then the tomato farmers of the Upper East Region can apply it to get their tomatoes to have the same quality that the Burkinabe tomatoes have”. To be 100% sure, I asked

Professor Eric Danquah of the West African Center for Crop Improvement (WACCI), University of Ghana, Legon.

CUE (Prof. Danquah confirms: "we can improve the quality of any crop including tomato through Plant breeding")

Conclusion

If we are still looking for a way to get Ghana tomato to have the one quality of Burkina Faso tomato that market women are looking for, then Plant Breeding is the way, as we heard from Prof. Danquah. So what are we waiting for?

Albert Sore, Joy News.

What I Did Not Know

Augustina Apik

Growing up as a child with my grandmother whom I lived with and helped on the" farm", I used to see grandma after the harvest select some of the well matured and good looking cobs of corn and fingers of millet, sorghum, groundnuts, beans and bambara beans and kept away. She explained that those were to serve as seed for the next planting season. So even though sometimes we would want to roast some of those good-looking corn and millet to chew as is the practice, we were restrained.

Little did we know that ,that simple act, of selection, what grandma and other farmers like her did, they were simply altering the genetic make up of the crops they planted or cultivated. As to whether in doing so , they considered the complex factors like faster growth, high yields, pest and disease resistance, and so on, I cannot tell.

I never asked how the traditional farmers came by the plants and crops they cultivated ; but I now know that they came from the wild, part of the free gift of God. The crops we now have and consume have gone through a series of crossing (hybridisation) to produce plants which give higher yield and in .some cases are resistant to pests and diseases. Now there is more knowledge about genetics and basic science which involves the use of new methods, including biotechnology, to improve some crops so that we get more food from a hectare of land. This process/technology is called genetic modification(GM) which is not accepted by everybody.

I have learnt that man originally just went into the wild and gathered plants and crops for food. As they began to build settlements , they then started to domesticate some of the plants and crops by planting them just around where they lived . The transformation of crops as the farmers selected seed and sowed every year took place through pollination, self or cross pollination .

Seed Improvement

As the years rolled by, I noticed the yield from our farms were diminishing,especially around the 1980s. Before then, there was always excess crops from the previous farming season at the next harvest time, but from the late 1970s to the early 80s the harvest was affected and there was never enough. This was due to soil exhaustion and sometimes lack of water. People labour for months and get very little. Any wonder that lands are being used for buildings instead farming. This is because farmers in the rural areas have not had the privilege of being introduced to improved seeds and innovative ways of farming.

There is a lot of talk and argument about GM foods in the cities. Many have demonized GMOs because all that is known about them is that you have to pay a little more for the seed each time to be able to get good yield. Also people do not know the differences between crossing plants (making hybrids and making GM seeds or crops. People's views about improved crops are that such products often look bigger than what we are used to. They easily get rotten and taste different from the traditional products.

When the current Minister of Agriculture Mr. Kofi Humado was asked at his vetting about his opinion on GMO being introduced into Ghana , he said there was a framework on how to regulate their use. As to whether he would recommend the cultivation of GM crops he said GM seeds demand higher use of fertilizer even though they are highly pest resistant. Large scale farmers can however be allowed to try them since they can manage the cost of fertilizers. Peasant farmers, according to him can be encouraged to use hybrids or CSIR improved seeds. This means that there is a difference between hybrid seeds and GMOs and this needs to be made clear when farmers are being introduced to improved seeds. This will help clear the misconception about improved seeds being developed by the country's Agricultural Scientists.

Scientific research institutions like the (CSIR), Centre for Scientific and Industrial Research should collaborate with traditional farmers and make their findings known to them as well involve them in the research work to make acceptance easier as farmers can claim to be part of the development. What ever be the case, several factors indicate that in order to have sufficient food for the ever growing population, steps must be taken to improve food production.

The question on my mind is whether grandma would appreciate many of the crops now being consumed if she was still alive. What is certain though is that her great, great grand children will be consuming food that is much much different from what she cultivated several decades ago.

Need to seriously focus on development of agric sector

Charles Benoni Okine

The acting Director of the Institute of Applied Science and Technology at the country's premier university, University of Ghana, Legon, Professor Sammy T. Sackey, has strongly advocated the need for the government to seriously focus its attention to the development of the agric sector in the country.

According to him, for the country to industrialize, solve the massive unemployment challenge and become food sufficient, there is the need to for first develop the agricultural sector, exploring all the various scientific techniques to boost food production in the country.

"Ghana has the capacity to quadruple its food production because we have acres of arable land across the country, we have the qualified crop scientists to breed high yielding and fast growing crops using bio scientific methods", he said.

Professor Sackey made the call when a group of journalists and scientists from Ghana visited his bio farm, Biochemical Products Ghana Limited at Nongo in Accra as part of a workshop under the auspices of Biosciences for Farming in Africa (B4FA).

The calls comes at time when budgetary support to the agricultural sector in the country is fast falling in spite of moves by governments to industrialize the country.

In this year's budget for instance, support for the agric sector dipped from 2.5 per cent of Gross Domestic Product (GDP) to 2.1 per cent.

The agric sector which grew at about eight per cent in 2006 has sharply declined to about 2.6 per cent.

By 1983 Ghana was self-sufficient in only one staple food crop—plantains. Food imports rose from 43,000 tons in 1973 to 152,000 tons in 1981.

However, the situation today has also changed drastically, as production levels has dropped and Ghana is now importing plantains and other vegetables from Cote d Ivoire and neighbouring Burkina Faso to supplement the production from the local farmers.

Crops scientists at the workshop have revealed that the government does not support crop research in the country, making it difficult for them o develop new yields that could push the drive to increase food production in the country.

According to them, the funds used in the development of new seeds comes solely from donor institutions such as ADRA and the Rockefeller Foundation among others and wondered what becomes of the country should those funds dry up or there is donor fatigue.

Savanna Agric Research Institute (SARI), is doing a fantastic job. They introduced the Obaatanpa maize variety.

They are studying more drought and flood resistant varieties, following the 2007 floods that hit the three northern regions.

Root & Tuber Improvement & Marketing Programme (RTIMP) is on going all with support from donors institutions.

The changeover from smooth cayenne pineapple to MD2 was with aggressive seed development with an initial $2 million facility from World Bank.

There are numerous lessons across the world which have made many continents and countries for that matter, food sufficient.

For instance according to a new book, Insights launched in Acrra by B4FA, the green revolution in Asia was based on improved crop varieties, particularly rice and wheat which together with expanded use of agrochemicals and irrigation, led to a dramatic yield increase. But in Africa the revolution has failed with modest increases in production over the last few decades.

Maize which is a major staple in Ghana has remained a seasonal crop, making its prizes shoot up during the dry seasons.

Meanwhile the book, with revelation from some farmers has recognized the need to have water efficiency ith maize because of the increasing incidences of drought which have resulted in frequent crop failures leading to hunger and poverty in sub-Saharan Africa.

"One of the most challenging problems in plant breeding today is tha of improving drought tolerance", the book revealed.

Recent reports according on the book show that the sites of poverty can be tackled by investment in the agricultural sector, with GDP growth in the sector contributing twice as uncheck to poverty reduction as any other sector.

From the global perspective, the combination of enhanced productivity nd efficiency generated by Genetically Modified (GM) technology already provides a major boosts to farmer income.

Between 1996 and 2009 for instance, it was said to be the equivalent of four per cent to the economic value of global production of the four main crops soya beans, corn and cotton and canola.

While there are arable land for production of rice in the country for instance, Ghana seems to be importing rice to the tune of US$700 million as at last year alone while rice production dipped by three to four per cent.

For instance, through the adoption of GM, Ghana's cotton industry is set to bounce back according to Dr Emmanuel Chamba, who is working in the northern part of the country to revive the cotton.

According to him, with funds purely from Monsanto, an international company specialized in Sed improvement, Ghana is set to begin pilot.

He said production of cotton in Ghana had dropped from about 38,000 tonnes in 1996 to about 2,500 2011.

The way forward "is BT cotton" he said for instance which he said ha been tried and tested in neighbouring Burkina Faso which shares the similar climatic and soil condition with Ghana."

BT cotton comes from a GM seed which is expected to kill bollworms (caterpillar) which destroys hundreds of hectares of cotton farms in the country

With BT cotton, The sucking pesticides has to be sprayed twice only by farmers as against six in the past.

So they reduce their spraying from six to two to save time and and cost of production.

"We are going straight to the farmers field because of a lot of information from Burkina which has the same soil type", he said, adding that "We need to act fast and that will be done".

He said here will be two rounds of experiment in 10 locations to be undertaken by three cotton companies and the Experiment starts in June this year.

It is expected that the farm yields will improve, farmers will be richer, it will provide avenues for employment of the mass of the youth and bring help increase foreign revenue for the government.

Dr Chamba said if Burnika Faso is now increasing yield from 480,000 to 630,000 in a year of using BT cotton, Ghana also stands a chance to catch up.

With these potentials, the scientists at the workshop were unanimous in their view that should the government support the development of biosciences to improve crop yield, Ghana will be better off to become self sufficient in food production and help generate employment for the mass of the people, boost its industrial drive and become a net exporter of food to the rest of the world.

Prospects of hybridisation in a changing climate

By Clement Boateng

Nowhere on this planet are people susceptible to the negative impacts of climate change than Africa. African countries are particularly vulnerable to climate change because of their dependence on rain-fed agriculture, high levels of poverty, low levels of human and physical capital, and poor infrastructure.

An increased body of evidence shows that climatic variability is adversely affecting Africa's natural resources such as land, water, forests and vegetation, as well as human capital.

Food security is under threat from unpredictable changes in rainfall and more frequent extreme weather.

Climate change is, therefore, expected to have significant impact on key resource-dependant sectors, such as agriculture and food production, and consequently on food security.

The negative effects of climate change on crop production are especially pronounced in Sub-Saharan Africa, as the agriculture sector accounts for a large share of GDP, export earnings, and employment in most African countries.

Mitigation and adaptation are key pathways to addressing adverse climatic change conditions. Adapting to climate change is vital in other to remain productive and competitive. Adaptation to climate change for food production activities require a shift to new and appropriate production methods and techniques, in order to counter the deleterious effects of adverse climatic conditions on land, water and human capital, which are key inputs in food production.

Many farmers in Africa, who are generally poor, are bearing the brunt of climate change as their crops perform poorly due to stresses like drought and pest invasion.

Dr. Maxwell Darko Asante, a Crop Breeder at CSIR-Crops Research Institutes believes hybridisation presents many prospects to the crop production sector in the wake of adverse effects of climate variability.

Dr Asante explained in an interview that through hybridisation crops could be improved not only for high yields but also to ensure they were drought and pest resistant.

If farmers are supported with high yielding improved crops limit the size of land a farmer needs to produce expected yield to feed themselves and earn extra incomes. When less land is tilled more carbon in the soil and tree will be trapped to reduce emissions. Hybridisation thus offers important pathway for reducing future emissions and for managing efficiently Africa's key limited resource, such as water, land and biodiversity.

Despite these enormous benefits biotechnology like hybridisation presents, African governments appears to be doing very little to support advancement of that area of study.

A recent call by the President of National Farmers and Fishermen's Award Winners Association, Mr Philip Abayori, at the launch of a published by Biosciences for Farming in Africa titled, 'Insights: Africa's future… can biosciences contribute?', on African governments to invest in Biotechnology to improve agriculture was very significant.

He believes investing in research to improve on crops in the continent is key to addressing food security issues and the challenges that climate change comes with.

Investing in Biotechnology for Food Production: A must for African governments

By Cliff Ekuful

The need for food self-sufficiency requires that Ghana and for that matter other sub-Saharan African countries invest in appropriate technologies, therefore governments must begin to channel resources into this area.

Research indicates that most of these countries risk losing out on the fight against diseases, hunger and poverty unless deliberate measures are put in place to improve food production within the next decade.

Challenges facing food production in most of these countries are neither the in availability of arable lands nor farmers but the lack of investments in the agricultural sector.

The increasing effects of climate change resulting in drought in most African countries are affecting crops production especially rice, maize and tuber which are major staples of most people.

Most African countries which are drought prone are worst hit by the effects of climate change because a vast majority of agriculture is rain-fed. It is important to emphasize that drought does not only lead to crop failure but also hunger and poverty.

It is estimated that between 1970 and 2004 more than ten drought events have reoccurred making farming risky for millions of smallholder farmers and their families who rely on annual rainfall to grow their crops.

To address these challenges will require the adoption of new and improved technologies such as biotechnology (bt) which includes hybridization, genetically modified crops and tissue culture.

Even though there is a strong opposition to the adoption and usage of bt products in Africa, very little or no scientific evidence have been adduced to prove the so called negative effects of the application of these technologies in food production.

The United States of America adopted the usage of genetically modified crops since 1996 and no scientific evidence have been put forward so far to support claims of negative side effect of these products.

The precarious situation which the continent of Africa finds itself makes it even more imperative to adopt biotechnology in its food production. Several researchers have come to the conclusion that GMO products hold key to the success in the fight against food insecurity on the continent.

Professor Eric Yirenkyi Danquah of the Department of Crop Sciences, University of Ghana, who also shares in this belief indicates that given the role of genetic improvement through plant breeding can play to provide vital inputs in boosting crop productivity, the need for a critical mass of scientists trained in plant breeding with conventional and molecular expertise develop superior varieties is urgent.

According to him, technology revolves around genetics and plant breeding, soil fertility solutions, crop protection, irrigation, labour-saving devices and connectivity.

He emphasized that even though the financial obligations of these technologies are enormous, the potential benefits to the present and future generations far outweigh the investments.

As a result governments are encouraged to reconsider levels of investments in the agricultural sector, Dr. Marco Ferroni; the Executive Director for Syngete Foundation for Sustainable Agriculture Basil Switzerland could not sum it up better than saying that governments have a big responsibility in Agriculture.

He therefore advocates the creation of supportive environments for farmers and related businesses on the continent.

Cutting back on rice imports

Dansowaa Awuku

RICE, a staple food yet - quest to make Ghana self sufficient eludes governments. Affordable, easy to cook, easy to bag, tasty, rice has become the preferred food of choice for those on the go. Miniature restaurants dot Accra's lively streets selling the staple. The rich eats it as much as the poor; cutting across the tribal divide. Sadly production has not matched demand - creating a huge deficit of over 500,000 metric tons. Effects of imported rice dominates Accra's bustling markets with bags of imported rice reaching to the ceiling in shops amidst huge billboards of brands such as Texas Rice, Sultana, Crown Jewel, Rice master, Chicago Stars and others. Meanwhile struggling for space are Ghanaian brands. It is on display though, but lost among all the imports. And to think Ghana has ever been rice sufficient makes that sight almost tragic. But as one rice breeder puts it "the population was small then and Acheampong was more committed". He adds: "irrigation projects across the country at his time also pushed his agenda of operation feed yourself". Despite governments' commitment over the years to cut down on the huge rice imports, population explosion in the country has not helped much. Annual consumption rate now stands at 700,000 metric tons, two thirds of that imported. When the NPP government came into office, it did all it could to resource Praire Rice, which when set up under Rawlings had a simple objective – to produce more rice to cater for the country. The first year of Mills' government, Ghanaians were assured they would eat only local rice with a campaign to achieve this. Years on, we still have a deficit of 550,000 metric tons as locally we are only able to produce just about 150,000 metric tons. Even those produced hardly sell, the quality of it has also been an issue. Furthermore, it is only available for six months – farm inputs a whole new topic. Sadly we have arable fields. So what are the issues here? Most Ghanaian farmers are subsistent farmers; two thirds of them too poor to dream of mechanizing their rice farms. Consequently, we are told science is there to make life easy. Whatever is developed through research must be translated to the ground. And this appears to have been done. According to Dr. Maxwell Darko Asante, a Rice Breeder at the CSIR-Crops Research Institute, his outfit has already worked to improve rice varieties. There are high yielding rice varieties on the ground which match up the quality of the imported ones but a general low level in investment in the sector means that domestic cannot compete with imported ones. "I can apply the best science and develop excellent rice varieties but if the other things along the value chain are absent, we will not see the impact on national scale" says Dr. Asante. He says only a value-chain approach to the issues can make Ghana rice self-sufficient and cut back on the dependence of imports. Farmers must be supported by government to develop their lands into proper paddy fields. Simple machines such as the power tiller can help the farmers' bound and level their fields for proper control of water and weeds. This together with the application of the recommended levels of fertilizers would at the least double average yields which presently stand at 2.4 metric tons per hectare. Production levels could thus increase very rapidly if farmers are supported with capital and technical support to grow the rice. But efforts to increase production must go with improved handling of the rice grain so that its quality will match those of imported rice. The mechanization of harvesting and threshing of the rice on smallholder farms is crucial for the maintenance of grain quality. The provision of infrastructure for drying of the rice prior to milling and good quality milling machines close to rice growing communities is also crucial in the struggle to improve grain quality of domestic rice. Then we need business people to brand and advertise domestic rice as aggressively as is done for the rice imported from Asia and the USA. Dr. Darko paints the picture graphically. "So I'll tell you, it is not only a production problem, it is also about quality and marketing". For us to succeed, we need to consider the whole value chain".

GM Crops, A Tool For Food Security Or Ploy To Perpetuate Neo-Colonial Agenda

By Ebenezer Tawiah Hanson

Among the subjects that have generated so much controversy within the spheres of Ghanaian intellectuals is whether or not our country and for that matter our farmers should embrace the use of Genetically Modified (GM) crops.

The debate is not borne out of the blues, for it is rooted in historical antecedents of colonialism and the belief held in certain circles that idea of GM crops is a ploy by Western countries to perpetuate their hegemony in the international community and hence consolidate their neo-colonial agenda in Africa.

The other leg of the argument is that, GM crops hold the magic wand to our food security needs and therefore why should we fret our souls on issues of hegemony and neo-colonialism. And whether Ghanaians like it or not, the Western nations are already in the saddle, hence why cry over spilt milk.

It is also worthy to note that it has been estimated that "by 2020, the world's population will rise to 9 billion. To satisfy the food requirements, the United Nation's Food and Agriculture Organization (FA O) has predicted that food production will need to increase by 79%."

Let us proceed in detail to critically dissect the two clashing views at issue. The challenge of food insecurity is a "clear and present danger" starring us in the face of Ghanaians. Our farms continue to turn out low yields in the face of a growing population of 2.5 per cent per annum, and with a current population of 25 million, the situation ahead becomes more precarious.

Besides, our farmers are in the main small scale farmers whose yields are nothing to write home about. To deal with the challenge, Ghana must embark on plantations and other pertinent farming systems.

Additionally, many of our cash crops, such as cocoa and cotton, are not disease resistant, and accordingly and it is imperative to have new varieties of these crops which possess traits which can withstand those diseases.

Similarly, with the gradual movement of labour away from agriculture to other sectors of the economy, we need to find measures to produce enough food within the constraints of the dwindling labour.

Last, but not least, with the discovery of oil, Ghana stands the risk of being caught by the enticing trap of the Dutch disease, a phenomenon in which all other sectors of the economy are neglected in favour of one or few booming ones, resulting in adverse unintended consequences for the country concerned. The Agriculture sector used to contribute the largest share to Ghana's GDP, but with the advent of the exportation of oil in 2010, the commodity is now the number one, contributing more than 50 per cent of the GDP.

The pro-GM crops group posits that all of these challenges can be fixed through the simple technique of employing GM methods. Thus Government and for that matter our farmers should be convinced to accept the technology and employ it to salvage the nation from the ensuing food insecurity.

But the anti-GM products movement sees the issue from a totally different perspective. It is convinced that the advanced countries are foisting the GM concept on Africa to maintain the 'centre-periphery ' status quo of relationship between the relatively few rich north and majority poor of the southern divide.

They contend that since many of the GM crops cannot reproduce themselves after about the fourth generation, African countries will have to constantly rely on the western countries for landrace for planting. That will indeed place African farmers at a disadvantageous position.

The ultimate result of this arrangement is the perpetuation of the dependency syndrome that has characterised post- colonial relationship between the rich north and the poor south, thus consolidating western hegemony.

Flowing from this arrangement is the unfavourable impact for Balance of Payments for African countries, which sometimes yield huge and unacceptable deficits and in the long-run unsustainable.

Many members of anti-GM crops group contend that proponents of GM products are always reluctant to state in unequivocal terms, the disadvantages of the GM crops if any, save to emphasise that many of the vaccinations we undertake and the use of insulin, among others, are GM products. And since nothing untoward has been identified with their usage why have Africans all of a sudden sgrown skeptical about GM crops.

The said evasive stance has rather confirmed the suspicions Africans and for that matter Ghanaians have about GM crops that the western countries, as usual, have something under their sleeves.

Whatever it is, time will be the best judge as to whether the idea of GM is a western ploy to continue with its neo-colonial agenda or a mechanism to ensure food security on the globe. Unfortunately, some of us may not be around to receive that verdict which will be delivered so truthfully and objectively by time, but posterity will surely be, and that will be fine with me.

Promoting Food Security in the Midst of Post-Harvest Losses

From: Edmond Gyebi, Tamale

Global food security is one of the most pressing societal issues of our time. It is presently estimated that more than one billion people, or one out of every seven people on the planet, is hungry or malnourished. Even more troubling is the fact that thousands die daily as a result of diseases from which they likely would have survived, had they received adequate food and nutrition. Meanwhile, it is estimated that between 30% and 50% representing 1.2 to 2 billion tonnes of food produced around the world go wasted due to several factors.

Currently, there are grave concerns about the coming global food crisis. According to Agricultural Scientists, global food production must increase by 70 to 100 percent by the year 2050 to adequately meet global food demand. So how is it to be done or achieved?

In order to avoid the unpleasant consequences of unprecedented widespread hunger and starvation in the years or decades ahead, there should be serious and unwavering commitment from political, educational, and religious leaders to ensure massive agricultural transformation or food production.

A report filed by John Sparrow, a reporter for Allafricaonline.com on 14th of March 2013 shows that, innocent children are wasting away in Southern Malawi. Mothers are distraught and beg for emergency feeding. The figures are soaring, already 50 per cent higher than those of a year ago due to the depletion of food stocks, the damage done to crops, seed supplies, livestock, the economic fabric and local markets.

Food Insecurity in Ghana

Statistics by the Agricultural Development Unit of the Ministry of Food and Agriculture (MoFA) and World Food Programme (WFP) have indicated that about 1.2 million people, representing five percent (5%) of Ghana's population, are food insecure. Thirty four percent (34%) of the population are in Upper West region, followed by Upper East with 15% and Northern region with 10%, amounting to approximately 453,000 people.

About 507,000 (40%) people are vulnerable of becoming food insecure in the rural areas of Upper West, Upper East and Northern regions. Up to 1.5 million people vulnerable to food insecurity live in the rural and urban areas of the remaining seven regions, with the largest share of them in Brong-Ahafo (11%), in Ashanti (10%), followed by Eastern (8%) and the Volta region (7%).

The Upper East Region is the worst affected as it experiences the longest food shortage period of 6 months annually. The Northern and Upper West regions record 5 months of food inadequacy. As indicated above, farmers are not able to produce enough to last throughout the year and also unable to store enough produce for home consumption throughout the year. The crucial question is: how are they able to survive?

The simple answer is that the farmers sustain their household food security by patronizing less expensive and less preferred foods, borrowing food or money to buy, purchasing food on credit, seeking assistance from friends and relatives and purchasing street food.

The Desire for Farming

Meanwhile, farmers in the three Northern Regions of Ghana are hard working and have natural love or passion for farming. Close to 75% of them are into small scale agricultural businesses as their main source of livelihood or survival.

The farmers usually cultivate maize, groundnut, soybean, millet, sorghum, rice and yam among other ancestral or traditional crops and they as well rear/raise other domestic animals such as cattle, sheep, goats, pigs, fowls and fishes.

Many areas of the Southern Ghana (comprising 7 different regions) which covers 60% of the country landmass enjoy two cropping each year whilst the Northern Ghana which covers up to 40% of the land area is mostly savannah where the dry season invariably affects productivity.

It has already been projected that high temperatures in Ghana will lead to low cereal yields throughout the country, especially maize and millet, which is a key staple crop in the north.

This fall or decline in cereal crop yield will mainly be due to a reduction in the growing period, and an increase in evaporation rates. Furthermore, roots and tubers such as cassava, yam and cocoyam – which are also key staples in the Ghanaian diet – will see a fall in its production as well.

According to researchers at the Ministry of Food and Agriculture (MoFA), production of cassava, for instance, is also expected to reduce by up to 53% by 2080, and cocoyam by 68%.

The north will be the region most severely affected, as it is the most vulnerable area in Ghana, in terms of agriculture, due to high climate conditions.

Some of the Northern farmers are not only being discouraged by the challenges confronting them but are also retiring from the farming business.

Acknowledging the Challenges of Northern Farmers

Apart from the erratic rainfall pattern which compels majority of them to crop only ones in a season, the unfertile nature of the lands, the ever growing desertification and the emergence of climate change and post harvest losses are also some of the major challenges facing most of the farmers in the three Northern Regions.

Other challenges such as the severe annual floods and droughts, low soil fertility, coupled with chieftaincy conflicts leading to burning of farm crops, have cumulatively heightened the already existing vulnerabilities or poverty situation among the farmers in these regions.

They loose chunk of their produce every year to wildfires, stray cattle and thieves. This is as a result of the lack of combine harvesters, proper storage facilities, transport services and poor road networks in the region. It is estimated that over 60 to 70% of the farmers do not have access to tractor services or safer place to store their produce after harvest leading to loss of over 40% of their crop. Most of them are therefore compelled to store the crops right on the farms at the mercies of bushfires, animals and sometimes the rainy weather.

Effects of Climate Change on Food Security

Over the past 10 years the Northern Region of Ghana has experienced a highly variable and unpredictable climate. Erosions are taking place on arable farm lands and in communities due to annual floods, strong winds and sand winning as well as illegal mining activities, which are posing serious threat to food productivity.

In the wake of inadequate trees, majority of the inhabitants are indiscriminately cutting down the few existing trees including shea nut trees for the purposes of charcoal burning and other domestic use.

The region has started experiencing the phenomenon of low agricultural productivity and if nothing is done about it, food security would seriously be affected and the problem of malnutrition would be exacerbated. In the Gushegu District of the Northern Region for instance, three out of every 10 children are said to be malnourished according to Ghana Health Service report. Most farmers are still hooked to the use of low yielding and poor nutritional crops.

Introduction of GM crops

Farmers in Ghana and especially those in the three Northern Regions have over the years experienced serious challenges in the course of feeding their households and the nation at large. The soils in the region have lost their nutrients or fertility long since and require the maximum use of fertilizers and other agrochemicals to produce results.

This comes at a high expensive cost to the farmers who are already classified as poor. That notwithstanding, the farmers are also compelled to look for alternative means of controlling weeds and pests to save their crops from going bad.

However, there seems to be some light at the end of the tunnel following the introduction of hybrid and genetically modified (GM) seeds into the system. Undeniably, the science of biotechnology, either through conventional breeding (often in conjunction with marker assisted selection) or genetic modification approaches has great potential to achieve biofortification for nutritional benefits in Ghana/Northern Region. There is an urgent need to solve the problem of micronutrient malnutrition that is prevalent among young children and women in Ghana and for that matter Northern Region. Genetically modified (GM) crops have great potential to resist drought, pests and diseases and also ensure high yields for maximum food security.

Given the prevalence of micronutrient malnutrition among young children and women, the development of foods with enhanced nutrients is crucial in Northern Region. The technology advancement in this era and subsequent adoption of innovative tools has the potential to pave the way for better crop productivity and higher quality food at lower cost in order to solve the micronutrient problem in this region.

In the advanced world, farmers are already growing thousands of hectares of GM crops including maize alongside conventional crops without any proven adverse effects. In the United States and parts of Europe, farmers are growing both the GM and the organic crops on the same land without any problems.

Africa's Climate and GM crops

A Science Lecturer at the Oxford University in the United Kingdom, Prof Chris Leaver says hybrid and GM crops are not automatically draught resistant and farmers could face challenges since draught is a major problem in Africa.

However, he says there are several genes scientists are evaluating to come out with other varieties that would probably tolerate the dry weather in Africa and other parts of the world.

Prof Leaver therefore encouraged government of Ghana to take bold steps to provide adequate irrigation facilities especially the dry areas so that farmers can grow the high yielding GM crops to ensure food security.

Mr. Saeed Ali Yakubu, an Editor at the Multimedia Group of Companies also appreciated the introduction of the GM crops but cautioned that the necessary facilities and support ought to be provided for farmers.

He entreated government to provide access roads, irrigation systems, storage facilities and ready market for the farmers as they move from the conventional to genetic modification crops.

Food Production through Science

FOOD-LEAD – Fati Shaibu Ali

Imagine a situation where you can find all you need from food; taste, size, quality and quantity. Great! Right? Well science has made this possible. Now you can choose what you really want.

((WAIT FOR CUE))

PACKAGE

The world is getting hungrier by the day, with land depletion, scarcity of water and changing weather conditions. But what is there is a way to curb the effects of these on our food production? Science has given the opportunity to explore alternative ways of improving food production. The opportunities are vast; from the use of hybrids, tissue culture, and genetic modification. Crop yields can improve and that means more money for farmers and satisfaction to the consumer. A professor at the University of Oxford in the United Kingdom speaks about one of the many ways the world can feed itself; the fundamentals in Genetic Modification, a scientific approach of utilizing genes to improve upon crop yields.

SOT: “We can change our future because science provides us with tremendous opportunities”. Plant breeding, which is popular in the developed world, if promoted adequately can support in transforming agriculture in Africa and ultimately support food security”

Ghana has already made some strides with scientific application in agriculture. Breeders have been able to produce improved varieties of rice, maize, cocoa and cowpea. What is left is the onward march towards the maximization of the full potential science output.

Food Security

14-03-13 FRED SMITH

Lead

Food scarcity – in proportions far bigger than what was experienced in 1983 - looms in Ghana and Africa. It will be no respecter of persons and would cause even the rich to go hungry and malnourished. Fred smith has been finding out when this could take place and whether it can be averted.

PACKAGE

[case study: family having dinner or a young average professional having a meal and talking about the daily routine]

All these foods could be a difficult thing to obtain soon.

The farmers who cultivate the food we rely on for survival are reducing in number, the land space on which crops are cultivated are also shrinking due to population growth and development.

Changes in the weather is also eating out the favorable weather conditions that enable our farmers grow food for us.

Davis Korboe is a renowned farmer in the Eastern Region of Ghana and laments low crop yields is gradually taking away his livelihood

Cue: DAVIS KORBOE – GHANA'S 2009 BEST FARMER (talking about dwindling farm produce)

More floods, drought and dry weather conditions would also destroy farms and reduce the amount of food produced by our farmers.

CUE: TSATSU SIAME – WEATHER FORCASTER (talking about climate change)

As a result, food production would significantly reduce, whilst the number of mouths that feed on it go up substantially.

The writing is already on the wall as food prices sky-rocket in the Markets, and who to better tell the story than market women themselves. Afia Adobea is a tomato seller at the Kaneshie Market in Accra and recounts how tomato scarcity has driven prices through the roofs.

Cue: Afia Adobea – tomato seller

Even the rich would struggle to get food – leaving millions of poor Ghanaians and Africans at the mercy of starvation.

CUE: KWADWO AFRIYIE - AGRONOMIST

Already, thousands in the Sahel regions of Africa have been killed by hunger, and many more are on the way to their graves if urgent steps are not taken to feed them.

But all hope is not lost.

Snd up…[farm ambience]

Technology could be the solution to the looming food crisis situation.

Many Ghanaian scientists are already researching into the problem and have come up with various solutions. Professor Eric Yirenky Danquah heads the West Africa Centre for crop improvement. They have been working on improving Maize and Cowpea yields.

CUE: PROFESSOR ERIC YIRENKYI DANQUAH – WEST AFRICA CENTRE FOR CROP IMPROVEMENT

Hybridization is one of many solutions available farmers as they strive to increase crop yields. Scientists are also modifying the genes of various crops for high yields, disease, pest and drought and flood resistance.

The Biosciences for Farming in Africa have been deep insights into farming technologies and are helping African Scientists to develop technology that can significantly improve crop yields. Bernie Jones a leading scientist there.

CUE: PROF. --- BERNIE JONES B4FA

Even for plants without seeds, some technology is available to develop high yielding crops such as bananas, plantain, cocoyam, yam and many others.

MOLECULAR BIOLOGIST – PRAMPRAM, Ghana

The Food And Agriculture Organisation of the UN anticipates that unless food production goes up by 70 percent within the next 40 years, many families would go hungry and may even die as a result.

[end case study: ***back to family to ask if they would welcome an agricultural technology such as GM if it provided the solution to the looming food crisis]***

The advances also provides hope for the continent as its leaders double efforts at achieving the targets set in the UN Millennium development Goals.

Looking At Food Security In Ghana.

Frank Nyonator Worlanyo

LEAD

When was the last time you ever stopped to observe that, eating attitudes in Ghana is changing and in fact changed in the last fifteen years? It is not strange to see all kinds foods westernized in style set on a dining table of a middle class nuclear family especially with rice dominating.

Frank Nyonator in this report tries to look at the issue of food security and the impact it may have on the country while raising questions the on food importations to Ghana.

PACKAGE

Ghana's economy for decades has been touted to rest on the shoulders of the agricultural sector but the question begging for answers over this period is how the sector has undergone reforms.

Currently, within the agric sector, the issue of food security has not only assumed a national one but also a global one that needs re-thinking in to the ways businesses are conducted in this area.

Others have in recent times been promoting the idea of GM foods (Genetically Modified) as one of the most effective means of making food available especially to the vulnerable in society. But in my estimation, food security is not just a problem of production, but also of distribution and access or purchasing power.

This stance is in response to the argument by scientists that GM crops will ensure higher yields and is therefore essential to ensure food security. This is part of food production and arguments being pushed by scientists. But as the scientists have rightly said, producing more food will per se not guarantee food security. There can be an abundance of food but if people can't access that food physically or economically increasing food production through higher yields or by adding new acreage of land will not result in a state of 'Food Security'.

The issue of food security is very complex and controversial one and there is no one blueprint that can be applied to all countries. In Ghana, the issue of self-sufficiency in order to create 'food security' has been a hotly debated one with reference especially to basic foodstuffs. The rice and poultry segments of the agric sectors.

The situation in Ghana is that, it has become heavily dependent on imports for about 70% of its rice and poultry demand. The intriguing challenge is why leadership in charge of the agric sector can't get their hands around the issue of cheap imports which has increased tremendously in the last four years. The agric ministry says it has made strides in investing in the local rice industry but how sustainable is this. The situation does not mean that Ghana is food insecure because the demand gap is currently being filled by imports.

Globally, there is consensus that if a country has the ability to become self-sufficient in most of its food requirements it must vigorously pursue that objective. In the case of Ghana it definitely has the ability to become self-sufficient especially in the areas of cereal and poultry production like the country did in the seventies when Ghana even exported rice. And it must be stressed that, right from southern Ghana to the north, rice can grow very well in all these parts, so why the huge imports of the same product.

To answer this question, a clear and objective assessment of why the huge demand –supply gap exists is required.

Let's explore the case of rice, first and important issue is quality. Ghanaians have become accustomed to high quality imported rice that they buy very cheaply at the same price as the local one. The local rice for some reasons is inferior quality most of the time. My take is that, as long as this situation is

quality against inferior exists producing more rice locally may in fact have negative consequences for the country.

In order to see this issue in perspective, one must look at the challenge at hand. Every Ghanaian will want to see the country self-sufficient particularly on food production and processing. But how quickly can this be done and how much it will cost us as a people and what the transition strategy of the government should be.

Of course producing more without taking the Ghanaian consumer in to consideration is surely not the way to go. The new head of the ministry of food and agriculture must surely have the support of the whole of Ghana to ensure food security as long as he plans and acts in line based on scientific evaluations with what food security is all about and that is not just about production.

Food security is also about consumer preference and his or her physical and economic accessibility to food.

And this where funding must be provided for research institutions like the CSIR, its allied bodies and the universities to come up with new yielding seeds. Again it is public knowledge that, governments over the years have paid lip service to research findings in to new ways of doing business in the agricultural sector.

The changing of the mind sets of farmers in Ghana is critical to the success of food security for this country. The media must be encouraged to delve in to these new fields of science improved agriculture so they intend can educate the farmers.

Another issue of concern is the huge dependence of ghana's agricultural budget on international donor funding. This dependence of the country's agricultural sector on external sources can however be detrimental to the growth of the sector given that the current global meltdown could trigger the inability of development partners to fulfill their financial commitments.

Critically is the question of whether Ghana is using an outdated food and agricultural sector development policy to allocate scarce resources to the sector.? Then, this is where a coordinated approach covering a broad spectrum of stakeholders including researchers, farmers, maybe district assemblies, input dealers, traders and NGO's can produce a draft report on the way forward to cabinet is possible.

The training of journalists in the fields of seed breeding and science related agriculture will allow professionals in journalism to write in simple and concise language while educating at the same time not forgetting setting the agenda for national discourse on what must be done in securing Ghana as a food sufficient country.

It must be stressed that, there is no one way of this.

WORLANYO FRANK NYONATOR(METRO T.V)

Availability of tomato hangs in balance.

Kwabena Ampratwum

"It won't be long there will be no tomatoes for anyone to buy. We are all looking for other jobs; unfortunately we are illiterates and its difficult finding any other job. Our children see no prospect in farming and are reluctant to even follow us to the farm let alone take over from us."

Fifty two year old Kwesi Mensah talks about what he sees as a bleak future for the cultivation of tomatoes at Akomadan in the Tano North District of the Ashanti region.

Mensah like the thousands of small holder farmers here have cultivated tomatoes for years and have depended on it for his livelihood.

However he takes a look at its prospects for the future and it puts a sad grin on his ageing face.

"Over two thousand young men in this town have abandoned farming and left to seek greener pastures in Libya because it is no more profitable"

He looks so pale and the toughened skin of his hands tells of the hard work and toil to produce tomatoes.

Tomato production is beset with huge challenges according to Mensah. Lack of technical knowhow and funding has resulted in a manual preparation of land instead of employing tractors.

Manually prepared Land Preparation at Akomadan

Mensah tells me it cost fifty cedis to plough an acre with a tractor compared to 20 cedis to get manual laborers to do the same job, albeit within a longer period than a tractor would.

Another major challenge he tells me is the availability of seeds to grow, they are purchased at high costs from Burkina Faso and Europe and sometimes are not suitable for the climatic conditions of Akomadan.

Tomato nursery at Akomadan

According to Dr Joseph Sarkodie Addo, Head of Department of the crop and soil science at Kwame Nkrumah University of Science and Technology a major setback to agriculture in Ghana is dependence on rainfall.

“We are doing what I term by God’s grace agriculture and when the heavens close the taps, we suffer the consequences”

His comment is manifest at Akomadam, 35 year old Yaw Obimpeh shares a boundary with Kwesi Mensah, I can see the fatigue in his eyes as he lowers to the ground a bucket full of water he fetched from a stream one kilometer away.

Obimpeh has to go through this routine over a five times a day with three hired laborers to get water for his four acre tomato farm because the rains have failed this season.

In spite of this laborious and tedious work, the farmers at Akomadam are still able to produce tomatoes in large quantities to feed the nation.

Ordinarily a bumper harvest should be a happy season for any farmer, it is however not so for Mensah, Obimpeh and the thousands of farmers at Akomadan.

Supply far outstrips demand when there is a bumper harvest and the farmers are at the mercy of middle men who purchase their produce at their own prices irrespective of whether the farmer makes profit or not.

Another farmer Fuseini tells me the variety of tomatoes they cultivate has so much water and perishes within three days of harvest, they are left with no choice than to give them to the buyers at low prices, often making great losses.

“they come with big boxes to buy the produce and give us little money, some farmers have committed suicide after they took bank loans and had huge losses over many seasons, all this wouldn’t happen if the government built the tomato factory they promised us twenty one years ago”

Fuseini’s words sums up the precarious situation of post harvest processing many farmers face in Ghana.

According to Dr Sarkodie although the country produces a lot of food, more than half is lost after harvest because there are no storage facilities and processing plants.

A very worrying problem is the unregulated use of pesticides by the farmers of Akomadan.

Tomato is susceptible to a host of diseases and the farmers have to apply pesticides throughout the cultivation period to get high yields.

Due to limited agric extension facilities at the district they mostly depend on their knowhow to apply these chemicals.

Unfortunately because most are illiterates or semi illiterate the chemical are largely wrongly applied, mostly in excess quantities leaving large residues in the fruits.

According to Mensah many farmers do not use protective gear and he speculates this has had a toll on the health of some farmers.

“It got to a time many of the men here complained of sexual weakness, a careful study by the farmers showed a new pesticide we were applying could be the cause, we stopped using that chemical and the problem has also stopped”

It is fair for the farmers of Akomadan and much other community to suffer these consequences to produce a commodity needed by all Ghanaians?

Dr Sarkodie believes the most important step to resolving these challenges is political will. He says government has over the years paid just lip service to investment in agriculture.

The lack of funding has stifled mechanization and research into new ways and products to resolve the problems.

For farmers at Akomadan one solution is the development of better tomato varieties by the research institution. They particularly want a variety with a better shelf life, less water and higher yield.

They are also pleading for the establishment of a tomato processing plant, according to Mensah this could reduce or stop the importation of tomato puree into Ghana, saving the nation hard earned foreign exchange and providing jobs for the youth

Director at West Africa Centre for Crop Improvement Professor Eric Danquah believes biotechnology is the key to combating the problems Akomadan tomato farmers.

He contends with the needed investment into agricultural biotechnology, Ghanaians scientist can come up with tomato varieties that are well suited for the climate of Akomadan, high yielding and with a longer shelf life.

Dr Danquah is also of the view development in biotechnology can result in crop varieties that are more resistant to diseases and draught tolerant, reducing the burden of fetching water over long distances by the farmers of Akomadan.

Until the Ghana puts our acts together and get serious with Biotechnology, crop production and investment in all parts of agriculture the nation undoubtedly face a bleak future.

Farmer at Akomadan Yaw Obimpeh says the time for action is now lest tomato production at Akomadan dwindles, migration sets in and the once prominent tomato production hub, becomes a ghost town.

Story by Kwabena Owusu-Ampratwum

Ghana and the Critical GM Question

By Manasseh Azure Awuni

The prime time news bulletin on the national television has no tickling political headlines today. So Mr Mensah, a middle aged banker, and his three middle-class friends have not been able to pick out topics from the bulletin for discussion. That ritual has eluded them tonight like the proverbial foot of the rainbow, for they look forward for the next story only for one "ordinary" story to follow another story. This is very unusual of them. They always talk about news items the same way they talk while watching football. But they would not end today without raising a discussion.

The commercials that play after the local news, however, contain an ad about Cowbell Milk. The ad contains a fat cow, which acts rather clumsily to end the ad's tag line: Cowbell, Our Milk!

"Why will children of today not behave like cattle, after being fed on this?" Kwame, a social worker breaks the silence and he is greeted with a chorus of laughter.

"I thought I was the only one who thinks this way," Manu says even before the laughter dies down completely. "I have always had qualms about what we call food today. We adulterate everything from the farm to the kitchen. Is there any wonder, then, that death continues to uproot us these days in our prime, in much the way a farmer in Gomoa would uproot his cassava?"

"Apart from the health dire health implications, every food item these days tastes funny in a strange way," Agana, the senior high school teacher, interposes. "I was born on a farm and can say for a fact that the real taste of every crop has changed for the worse: oranges, pineapples, banana and anything you can think of."

"Because of greed and profit motives farmers are only concerned about the size of their output and accept everything from scientists and don't care about the taste and the dangers such foods pose to our health," Kwame comes back. "They used to produce those once for export, but now they are in the local markets."

"Ah, that's why I still go to the village to buy food items. If you depend on these commercial farmers who plant today and harvest tomorrow with sizes bigger than the original crops, you will die leaving your children at the kindergarten," Agana reveals. "The size of an animal, for me, does not matter. What matters is the taste in its soup." His remark stokes another long laughter. The news bulletin is over. And they are leaving with nothing but what they have discussed.

The hypothetical conversation above is very typical of the ordinary Ghanaian's thinking about scientific interventions aimed at improving yields. The speakers would never quote any scientific research that points to the harmful effects of such foods but they are more believable than any scientist. This widespread misinformation and ignorance have conspired to conscript the general populace with fear and suspicion about hybridization and genetically modified foods.

This fear and suspicion was very much alive at a discussion session at the ongoing Bioscience for Farming in Africa Fellowship underway in Accra. The fellowship is being attended by some of Ghana's top journalists selected across the country. The fellowship has also brought together some of the finest brains on food science and crop research in the country and outside of Ghana.

In one of the groups, I witnessed a keen debate, when the critical question about whether Ghana would accept genetically modified (GM) foods was posed. The research scientists, had over the past few days, talked about some of the ground breaking interventions that do not only increase yields, but also fight pests in some of the commonest crops grown in the country.

With the critical question about whether or not Ghana would accept genetically modified foods, the discussion turned into a debate, with participants intermediately throwing the scientific findings overboard and clutching tightly to wild and widely-held notions about GM.

According to Dr Claudia Canales, GMs "are crops that have been modified by introducing a piece of DNA from the same or different individual that is wanted or required by the farmer for purposes such as to enhance pest resistance or to reduce the use of herbicides." She says genetic modification refers to the technology used to develop the crop, so it does not refer to the various characteristics of the final crop. In a lay person's language, a genetically modified soya bean may not taste differently from the non-GM soya bean.

Surprisingly, she said there are no genetically modified mangos yet. Many Ghanaians will not take this because of the widely-held notion that the hybrid mangos that appear bigger than the traditional mangoes are GM. This is not the only GM myth held by Ghanaians and other anti-GM products around the world.

One such dominant myth is the impression that GM foods are not healthy for consumption. But according to a EuropaBio Seedfeedfood publication, there is scientific evidence that GM foods are safe and no research has proved otherwise. The publication states that "an estimated two trillion means containing GM ingredients have been eaten around the world over the last thirteen years without a single substantiated case of ill-health." So where lies basis of the health concerns?

Around the world, GM foods have faced resistance for various reasons. In Ghana however, media discussions and public opinion suggest that the main reason for resistance is the unsubstantiated health concerns. This should be the theme of any campaign to dispel this fallacious notion. In Uganda, for instance, GM bananas have been introduced to help increase vitamin A in children, Dr Claudia Canales says. This runs counter to the concerns that GM foods have adverse effect on health of consumers.

A public opinion research carried out in Uganda by E.M Kikukwe et al shows some level of acceptance of GM in that country. According to that survey, 92% of respondents agreed or strong agreed that they would buy GM bunch of banana if it was sold at the same price as a non-GM banana bunch, but was more nutritious. Again, 90% agreed or strongly agreed that they would buy a GM bunch of banana if it was sold at the same price as a non-GM banana bunch, but tasted better. Some 78% of respondents would prefer GM to non-GM banana if the price was the same but with the GM, being produced with lower pesticides. The findings of show acceptance with a condition: if the benefits of the GM outweigh non-GM crops.

In Ghana, no such research has taken place but after the discussion, I decided to find out from some of the journalists how the workshop or the discussions had affected their perception about GM and how they would react if they were greeted with GM foods at the grocery store.

"I have learnt and understood much about GM, but I'm not convinced yet," Worlanyo Frank, a Broadcast Journalist with Metro TV said. "I'm still about 80% skeptical." He believed that the country must seriously consider adopting the scientific intervention such as GM if it should fight food insecurity in the near future. That notwithstanding, he would prefer a non-GM food to GM food any day.

Another journalist with *The Enquirer* newspaper, Mark Boye, described the fellowship as "enlightening and has demystified the perceptions about GMOs." But he will prefer non-GM crops to GM products.

For Bashiru Adam, a journalist with the *Business and Financial Times* newspaper, he sees nothing fundamentally wrong with GM crops but he is "yet to be convinced about the total safety of genetically modified food. He will not pick up a GM product at the grocery shop. "It is better to err on the side of caution," he says with a smile.

According to the motto of the Institute of Public Relations – Ghana, "Image is Everything!" It is evident that among people with some knowledge about GM, the perception is still stronger than the reality.

The scientific benefits of GM's far outweigh the feared and unsubstantiated consequences. Convincing Ghanaians to accept GM, as in Europe and other parts of the world will be a tall and thorny hurdle. It

ought to go beyond scientific evidence of the enormous benefits of GM to include economic, social, political, ethical and religious considerations.

In this part of the world where the debate is sometimes reduced to “whites trying to dump cheap and hazardous crops on Africa,” it takes much more effort to have the GM sermon accepted. Farmers also want to own their seeds, in Ghana and may resist crops whose seeds they would have to rely on someone else to plant.

But the battle is not lost yet. It may be true that the size of an animal does not matter; what matters is the taste in its soup. It is also true that taste is inconsequential to a person dying of starvation. These are the two main philosophies that may define the Ghanaian argument about the acceptance or rejection of GM in the near future. But with the growing level of food insecurity, the latter is bound to win and GM may be accepted in the end.

But now, it is still the battle between scientific research and emotional opinion when the critical question is posed. And the latter is winning.

Manasseh Azure Awuni is a broadcast journalist with Joy FM Email Address:

azureachebe2@yahoo.com

Demand For Biotech Mushroom Soars As CSIR Promotes Capacity Of Growers

By Mark Boye

For Pastor Joseph Mensah Agbesi, National Financial Secretary of the Mushroom Growers Association of Ghana, growing biotech mushrooms has been his major source of livelihood for a decade and half now.

According to him he has not regretted venturing into the cultivation of biotech mushrooms as his main occupation since it has been a lucrative business so far.

“For the past fifteen to sixteen years mushroom business has been my primary source of income I’m happy demand is high especially from the hotels, big shops and the restaurants”, he said.

Pastor Agbesi who employs four young workers at his mushroom farm says the industry has the potential to employ more unemployed youth.

He said demand is high but production is low noting that the association needs to grow the product all year round to increase production to serve the local as well as the international market. “We need advocacy, people who can champion our goals for the market to grow bigger”.

He noted for instance that, the association recently received a demand worth over $1million but could not supply due to low level of production.

Agbesi who said the association is made up of ninety three members nationwide, has been receiving support from the Council for Scientific and Industrial Research (CSIR) and the Comic Relief for growing techniques and logistical support respectively, but it needs more of such supports to expand.

The CSIR which uses process of tissue-culture, a tool of biotechnology to train the growers, however says it is determined to boosting biotechnology mushrooms in the country.

It said it is organizing series of training programs for the growers by improving their capacity and skills on the knowhow of mushroom growing to help promote the cultivation and consumption of the product.

The project is to serve as a part-time or full time job for interested people who want to take to mushroom growing on commercial basis and increase their incomes.

The Head of the Bio-Tech Mushroom Unit of the CSIR, Dr. Mary Obodai disclosed to The Enquirer that bio-tech mushroom production is on the increase due to its nutritional and medicinal uses as well as its high demand abroad.

“The biotech mushroom has a lot of uses and for export as well we need to establish our consumption inwardly or locally and then go onto the export market, so we need to educate the public as to the health benefit of mushroom and its nutritional properties and then encourage them to consume it”, she said.

According to her the process of producing bio-tech mushrooms is easy but needs technical knowhow on the part of the growers to be successful.

Dr. Obodai explained that the process is quite simple but entails some basic requirements that need to be followed, adding that it is basically the use of agriculture waste to grow the mushroom.

She said waste from agriculture products known as substrates, such as cassava peels and rice straw are decomposed and the roots of the mushroom put into the peels, whiles the root which given a medium to enable it to grow.

She noted that there are about 14,000 species of mushrooms classified as edible, medicinal and poisonous and out of these 7,000 are considered edible, 1,500 are for medicinal purpose and the rest are toxic.

“Mushrooms are one of the fastest growing vegetables in the world, it has the highest protein turnover, its turnover compared to the other crops is high, it grow on cheap agriculture waste such as the rice straw, maize, banana or plantain, cassava and sawdust”, Dr. Obodai noted.

The medicinal importance of mushrooms cannot be overemphasized as it can cure many chronic and terminal diseases, such as the cancers and hypertension.

According to Dr. Obodai mushrooms are rich in protein, low in fat, rich in carbohydrates, has high fiber content and rich in the minerals and vitamins such as vitamin B, B1, B5, B7, and vitamin 12.

“The Ganoderma species contain various triterpenoids and has polysaccharides that are used to cure insomnia and asthma”, she said.

She noted that the prospect of mushroom farming in the country is high and it needs to be promoted; adding that it is against this backdrop that the CSIR is continuously organizes such training programs for the growers to adopt the best practices.

“CSIR is constantly researching for better spawns or seeds that would give us better yield and we are doing this with the growers association”, she added.

It is estimated that in 2010-2011 season value of sales of biotech mushrooms was over $1.02 billion worldwide, with much of the share going to the United States, Europe and Asia.

'The Savanna farmer feeds city dwellers and covers their nakedness"'

Feature by: Nelson Nyadror Adanuti

Cue: *Salif Keita's music* **'***Anamang***' [fade in]**

Announcer: Challenges of globalization and World Trade may be meaningless to most children growing in developing countries like Hafisa Yakubu, who is from the North of Ghana, but the realities lay in the telling effects of the impact on her home, school and community.

Cue sound effects [kids in a classroom with teacher] @ the background of the narration

Her dreams of remaining in school to secure her a brighter life is in the hands of her cotton farmer parents whose yields are dwindling. The growing disparities between food crops and income securities are a part of the missing link to accessing quality education especially by children raised small holder farm families.

Hafisa's mother, who has six other children with her polygamous Muslim husband, shares her frustrations with Diamond FM's Nelson Nyadror Adanuti.

Cue [Hafisa's mum voice over in Dagbani mother tongue]: *"life has never been easy lately, this seeming dangers and the virtual collapse of our livelihoods is a real danger to us…we pray that the devil will not create an avenue for our children who wallow around to either become pregnant or got caught in crime..Worse of our predicament will be for them to migrate away without any experience."*

Announcer: Although Northern Ghana occupy's a third of Ghana's landmarks, living conditions here are so harsh. According to the poverty index, seven out of 10 people in the savanna region are poor.

Of course, the global trade policy imbalances, the new world order and other challenges such as lack of know-how, low capital investments, and the removal of agricultural subsidies have denied or limited opportunities for local farmers in to compete fairly in livelihoods and income openings that will bring sustainable accelerated development.

An edition of the BBC's World agenda magazine, quoted an economist, Pietra Rivoli, as saying "if you are a single mother with four children, then the ethical thing is to clothe them as cheaply as possible."

Just like food and shelter, clothing is another essential need of humans. But to clothe cheaper depends largely on the availability of a raw material like cotton, otherwise referred to as 'white gold' that is cultivated by over 18,000 small holder farmers' small holder and cotton companies in northern Ghana and their counterparts elsewhere.

With declining yields in producing countries in West Africa such as Ghana, Cote D'Ivoire, Togo and Benin due to environmental and agronomical factors that militate against cotton production, Burkina Faso has braved the storm and leads in BT cotton production after successfully undertaking Confine Field Trails (CFT) of the application of modern biotechnology as an effective way of addressing pests that destroys the cotton crop.

Dr. Emmanuel Chamba, specializes in cotton at the Savanna Agricultural Research Institute near Tamale;

Cue Dr. Chamba: *"…Ghana, through the National Bio-safety Committee is taking steps to introduce 'Bacillus Truringiences' BT cotton, which is a genetic engineering technique that injects protein into the pulp which automatically kills pest that feed on the cotton under cultivation."*

He explained *that* the revitalization of the cotton industry by the government in 2010 was not only relieved to farmers, but the adoption of modern biotechnology would enable farmers cut down production costs associated with the use of pesticides and weed management.

"When we begin BT cotton production, hopefully soon, we are not only looking at yields per hectare that has dropped drastically from 38,000, tons in the 90s to the current 2,500 hectares, but we also will be looking at quality of the produce…Ghana has realized the need to improve on its competiveness hence the new way of cotton production is being adopted and we are going to do that under strict supervision."

Seidu Nindow, a cotton farmer from Tolon in the Northern Region, is among a farmers group and researchers from Ghana that visited their Sahel neighbors in Bobo-Delaso, Burkina Faso. Seidu tells me; *'the savanna farmer is not only feeding city dwellers, but clothing the nation,'* as such, more help must come from government to back activities of SARI and that of the hardworking farmers.

Cue Nindow: "*I was impressed with what I saw in Bobo-Delaso. The company, Sofitex has a demonstration farm that produces and sells viable BT cotton seeds to its farmers….I really believed that it was a priority of the Burkinabe government that is why they are faring well in cotton production. Currently, we are growing conventional, but if SARI gets the needed assistance, it will be better for us with the switch to BT which needs only twice of spraying and saving money. For us in the north, we have nothing and cotton is a cash crop for us."*

Announcer: This new information may come as a relieve to cotton farmers and others within the cotton value chain such as farmers, transporters, the ginneries, textile manufacturing companies and distributors, dressmakers and of course buyers, who want it the final product at a reasonable cost.

According to the World Bank, Africa has about 60 percent of the World's uncultivated land. With emerging biotechnologies, sweeping mechanization programmes may also be needed to replace traditional low yield methods used to grow crops such as rice, corn, soya and cotton which remain livewires of many people in the north and the continent at large.

Cue sound effects [kids riding bicycles and honk their horn]

Announcer: For now, the UN Children's fund (UNICEF) has been gracious with the supply of bicycles and food ration to girls in deprive communities in Northern Ghana. That include Hafisa and her peers; to remain in school, yet these are not enough. Foreign Aid may last for a while, but her illiterate peasant cotton farmers must survive the storm to keep them going.

Cue: Salif Keita's music [fade out]

End.

Rice Breeding for Ghana

Noah Nash

Noah Rice Farmin B4FS 13.mp4

A research Scientist in Rice Breeding at the CSIR-Crop Research Institute, Mr. Maxwell Darko Asante has noted that for ghana to sustain and improve its high yielding rice varieties, government must critically intervene in the development of rice fields for farmers. He noted that rice fields are very expensive ventures that cant be left to farmers. He made the called at the second edition of Bioscience for Farming in African fellowship in Accra.

VO

According to the Ministry of Food and Agriculture over 70% of the rice consumed in ghana are imported using scare foreign exchange, as it has become an important staple for both rural and urban dwellers and is gradually taking over from traditional crops such as root and cereal crops.

The cost of rice production is high and uncompetitive in the domestic market due to relatively cheaper imported rice. Due to the limited resources of most of our local farmers they are unable to develop their rice fields at the lowland areas where it is easy to trap water to improve yields but expensive to develop.

To address the problem, a rice Breeder at CSIR-Crop Research Institute, Mr. Maxwell Asante noted that for the country to sustain and improve its high yielding rice varieties with superior cooking and eating qualities, government must critically intervene in the development of rice fields for farmers. He noted the intervention would increases yields and improve the livelihoods of farmers since there are local varieties that can march the qualities and taste for most imported rice.

SOT 1: Mr. Maxwell Darko Asante, Rice Breeder, CSIR Crop Research Institute

“if we want to have a serious rice industry it will be based mainly on production from the lowland which includes the inland valleys and the few irrigation facilities that we have so see the more reason since the farmers are poor more reason why we have to support them to develop their lands, otherwise they don't get any good yield out of their lands and they get frustrated. all over the world, USA, Japan and everywhere government support farmers so mine suggestion is that government should support the farmers to a least develop it is there you only go during the season and rotavan it and plant again because the bonds and leveling and if want to grow rice at a very productive level very important curiously we help the farmers to develop the lands”.

VO

Mr. Asante further noted that if processing and packaging facilities are improved the local varieties could march the imported varieties in the system.

SOT 2: Mr. Maxwell Darko Asante, Rice Breeder, CSIR Crop Research Institute

"We have to improve on our processing facilities. The rice mills for instance and the post harvest handling in general. Once we do that we are able to package it and brand it and market it very well we have varieties that can march the import and in the pipeline we are even trying to make those varieties better to improve their quality and their yields. So there is no reason why we should be importing up to 70% of the rice we use in Ghana. we actually have varieties now that can match even the import".

VO

An Emeritus Professor of Plant Science, Prof. Christopher Leaver in an interview with Viasat one news called on scientists in the country to adapt conventional breeding technics to reduce the various challenges associated with diseases and pest. And further called for proper evaluation and regulation of Genetic modified products in Ghana. For Viasat one news Noah Nash reporting.

Can Bio Science Technology help create a Vibrant Agriculture Sector in Africa?

Article: Npong B. Francis

By 2050 the world's population is expected to reach 9 billion. This demand for an increase in food production and conservation of water bodies to meet the food and water needs of the population. This increased human population will mean that nations' ability to feed its people depended on a number of factors including available land, water and technology to produce more to meet the population pressures.

In some poor countries, attempts to increase food production and consumption are undermined by rapid population growth, availability of farmlands, poverty and lack of effective technology.

The UN Food and Agriculture Organization (FAO) has envisaged that food production would need to increase by at least 70 per cent to be able to feed the world by 2050. However, land and water resources are increasingly suffering human population pressures, which have grave implications for developing countries, in particular in Africa whose agriculture has remained stagnant for decades.

These challenges therefore would mean that Africa must take drastic action by investing hugely in agriculture, develop farmers' expertise, and deplore new technologies in agricultural science to meet its food needs.

"There is the need for Africa governments to spend close to 45% of their annual budgets on agriculture, finding new technologies through research as the only means to helping improve food production," said Thomas Ayamga, a retired crop scientist.

Ayamga suggested a replica of "green revolution" in Africa, the method used by industrialized countries after the Second World War to achieve food sufficiency and agricultural industrialization, as the only option to achieving the needed food supply to cope with the increasing population in Africa.

A Rice Breeder Maxwell Darko from the Crop Research Institute, Kumasi, said there is a need for new techniques to support conventional crop breeding system to enhance traits of seeds crops. This will support crops to be able to withstand the changing climate, diseases, and insects.

CSIR Ghana, like other crop science institutions in Africa, are currently using conventional crop breeding technology which still has not improved crops nutrition and yield leaving Ghana and the rest of Africa in food in-secured position.

CSIR Ghana however, has established a confined field trial for Genetically Modified Organism (GMO) crops and is currently testing the crops for possible introduction into Ghanaian agriculture sector for adoption in their bid to improve food production, according to a lead crop scientist, Dr. Kwasi Atopkle. Dr. Atokple however, indicated that Ghana was far away from releasing GM crops into the food supply chain.

Prof. Chris Leaver, University of Oxford, UK said that, unlike the conventional crop breeding system that allows natural modification, the genetic modification procedure uses laboratory techniques to change the genes or characteristics of crops. "The genes or traits may be from any source depending on the desired traits," he said. Genetic engineering gives original organism new characteristics such as resistance to disease and insects. The most common GMO crops released into food supply chain are maize, soy, rice, potato, and cotton.

However, the use of bio science technology to alter genes of plants is raising a lot of questions and creates many controversies over the safety of GMO products. In the US, the UK and other industrialized countries as well as in Africa, some groups – religious bodies among them – are against the introduction of GMO crops because of alleged health hazards. This, Prof. Leaver said is untrue that GM products have health risks association. Infact, GM technique he explained is used in manufacturing of vaccines and medicines yet people will go for vaccinations against diseases but will not consume GM products.

“Genetic Engineering allows DNA from one species to be injected into another species in a laboratory, creating a combination of plant, animal, bacteria, and viral genes that do not occur naturally or through traditional conventional breeding systems”, he explained.

The use of GMO in foods was recently banned in Europe when a research conducted by the Committee for Research and Independent Information on Genetic Engineering (CRIIGEN) allegedly found that when the GMO products were fed to rats, females developed tumors while male rats died from severe hepatorenal chronic deficiencies. These findings heightened speculation about safety risks related to GMO.

In a video massage, Sir Brain Heap, project leader, plant breeding, genetic and bioscience for farming in Africa, said science had kept global famine at bay over the centuries in spite of population growth. He said the introduction of bioscience for farming in Africa is aimed to help transfer the knowledge of science and new farming to improve food production to meet the demand of the increasing population

Can bioscience technology help create a vibrant agriculture sector to keep pace with the increasing population in Africa? How about the safety of food produce for Africans through bioscience technology? The controversies of GM are still raging on and depending on the urgent need for increased food production will inform the choices of techniques in Africa to double food production.

Prof. Chris Laver disagrees with the assertion that GMOs are dangerous products to human health. He said that like any other product, GMOs have both negative and positive aspects however, the specific bad aspect of GMO are yet to be determined. He observed that the conventional crop breeding system which, existed for decade now have failed to improve food production because of the emergence of new diseases hence the need for new methods to deal with that problem. Citing Bt cotton as an example, Prof. Leaver said genetically engineered crops can resist diseases and insects.

Government urged to Commit More resources to research dissemination

By Yakubu Abdul-Majeed

The country can only become self-sufficient in rice production, if government and policy makers devote much attention and resources towards funding and disseminating of research findings by local researchers, says Dr. Maxwell Darko Asante, a researcher at the Crops Research Institute (CRI) of the Council for Scientific and Industrial Research (CSIR)

Currently the country continues to import nearly 70 per cent of rice consumed locally due to the lower levels of rice production by farmers, which he attributed to lack of adequate funding for the dissemination of research findings.

Addressing a group of science journalists at the second dialogue and training workshop of the Biosciences for Farming in Africa (B4FA) media fellowship programme over the weekend, Mr. Asante said the country had the capacity to produce more than enough rice to feed itself.

He said some of the bottle necks which must be addressed immediately if the country was to make any headway beyond the rhetoric's would include developing inland valleys and irrigation dams for farmers to take advantage of.

Mr. Asante explained that it was important for government to invest in these areas because they are capital intensive and individual farmers in the country could not own up to it.

He said the country's largest potential lied in the inland valley areas and all the necessary measures must be put in place to ensure its full development.

Mr. Asante added that beyond putting in place the needed infrastructure, a proper value chain system must be put in place for the rice sector to enable rice farmers in the country take advantage of the huge potential that exist.

He said a proper value chain system would have to look at backward linkages where issues of post-harvest losses, branding and marketing are addressed.

He noted that Ghanaians consumed more than 500,000metric tons of rice annually and it is estimated that the figure would continue to go up in the coming years owing to the increasing change in life styles and eating habits.

Mr. Asante said agricultural scientists in the country had developed different and improved varieties of rice which could compete with other varieties from other parts of the world.

He said government must show commitment by putting its money where its mouth is when it comes to developing the agricultural sector, adding that "This country can reduce its rice importation by more than half if government will show commitment by supporting the development of the basic infrastructure."

He said with government's commitment, the private sector would be interested to take advantage of the huge potential in the sector to create meaningful employment for the theming masses of unemployed youth in the country.

Dr. Yakubu Alhassan Chairman of the Parliamentary select committee on Agriculture who corroborated this position said several researchers had come out with various high yielding crops varieties but have not been adopted by farmers.

He thereby challenged all particularly media practitioners to impress upon government to support farmers to get certified seeds for production.

Dr. Alhassan said the country would remain where it is if we continued to relegate scientists and their findings to the background, stressing that “no country has ever developed without the full application of the sciences.”

END

The 'Mystery' Of Food Availability In Ghana---The Role Of Research.

Saeed Ali Yaqub

Just last week, an argument (or was it lamentation?) ensued over the fate of the Ghanaian farmer, and how they are able to feed over 24 million people, with only occasional and short-lived shortages.

Despite the challenges farmers face about land, weather, financing, mechanization, seed availability, post-harvest losses, processing and storage, transportation et cetera, food shortages in Ghana have, over the years, come about largely due to weather failure.

For instance, it is estimated the average famer, who is predominantly subsistent, stores between 20 % and 30 % of their produce (harvest) as seed for replanting. Even with this, the safety of the planting materials cannot be guaranteed due to a number of factors; the seeds are not free from pest attack, in times of severe drought, fire can sweep through the storage facility or, in the event of communal violence, the 'fortune' could become target of attack and destruction. The whole stuff could be lost eventually, and the poor farmer is back to square one. That is the reality confronting the cutlass and hoe farmer who ensures we sit at table, at least, three daily to fill our tummies for energy and all the nutrients we need to keep us going in our daily lives.

So in the midst of these obstacles, my colleagues and I concluded in our discussion that God does something mysterious that Ghanaians are unaware of so we get supplement from an unknown source.

The question that kept agitating my mind, with the conclusion we drew was ''So what is the source of God's 'food'? I definitely did not have any idea, apart from going with my colleague proponents of this 'theory' of what I have decided to describe as God's Buffer Stock.

My confusion and mystery were solved when I had the opportunity to participate in a media fellowship workshop, organized in Accra by the Biosciences for Farming in Africa. The four-day session was an overwhelming revelation, and I wished all my colleagues who engaged in the conversation, ei, sorry, lamentation over the fate of the Ghanaian farmer, were part of the exercise to explore a whole 'new world'.

The work of scientists, researchers and especially plant breeders had completely been lost on us in our discussion! The reality however is that these groups of people have held, and continue to hold the key to our food security as they work sleeplessly to come out of improved variety of food and cash crops for cultivation.

From history of plant breeding and agriculture, plant genetics(natural characteristics), hybrids (high-yielding) to fundamentals of genetic modification, experts emphasized crop breeding is a continuous process.

The primary objective of crop breeders is to come out with varieties of higher yielding, more pest and drought resistant and, above all, higher nutrition value than existing varieties. And this never happens overnight. Dr. Maxwell Darko of the Crop Research Institute in Kumasi indicates it could take as long as five years to complete breeding process for rice.

Dr. Emmanuel Chamba of the Sahara Agricultural Research Institute , says Ghana's cotton industry has prospects with the introduction of a new variety called Booguard II. Trials have already been done in land-locked and drought-prone Burkina Faso where production went over 630,000 tons in 2012/2013 crop season. Unlike an existing variety spraying, with the attendant health risk has reduced from six times to two from cultivation to harvest.

It is worth noting that as scientist struggle to work towards food security, society, that is, government, the private sector and individual farmers must be prepared to invest in research to enable the experts continue their work.

Government urged to provide adequate funding for research institutions.

Story: Samuel Duodu

Crop research scientists at a four-day media training workshop in Accra for both print and broadcast journalists selected from across Ghana have called for adequate funding from the government to enable them and their respective research institutions to make their findings public to benefit farmers who are the end users of their work to enhance agriculture production to ensure food security in the country.

They also urged the government to attached much importance to science and technology in Agriculture if the country is to achieve food sufficiency and security as well as an improvement in the income of farmers and generate employment.

The media fellowship programme which is the second in a series, organised and sponsored by Biosciences for Farming in Africa (B4FA) is to better understanding and dialogue on developments in agriculture and bioscience throughout Africa with specific emphasis on activities and research taken place in the focus countries of the programme of which Ghana is a beneficiary.

Most research findings by crops scientists had remained on the "shelves" and do not get to farmers on the ground as a result of lack of funding to disseminate the findings to them to enhance their work.

Another nagging problem is that most farmers, especially small holder farmers could not afford the newly improved varieties of crops and therefore the government must step in to get this varieties to farmers for planting to increase food production and make farming easier and not laborious.

According to agriculture experts, Africa and for that matter Ghana needed to embrace science and technology in farming to feed its increasing population, save foreign exchange for food import and also address issues on climate change which has had adverse effect on food production in the country as " we still practice rain fed agriculture "

Dr. Maxwell Darko of the Crop Research Institute (CRI) in Kumasi in the Ashanti Region and a Rice breeder said the institute has developed about seven new varieties of rice including aromatic ones (those with good fragrance) for rice farmers for planting to help reduce the importation of "perfume" rice into the country.

He noted that it was their duty to come out with such new varieties but it was the responsibility of the Ministry of Food and Agriculture to do the dissemination and appealed to the government to also support rice farmers in the country to develop our paddy lands (low lands) for rice cultivation and high yields.

He appealed to media practitioners to help in the dissemination of research findings to the public, especially farmers for enable them to embrace the newly improved varieties that have been developed for higher yields and short gestation period to enhance food production.

Prof. Eric Y. Danquah, Director of the West Africa Centre for Crop Improvement (WACCI) who was also a resource person in an interview also called for funding from the central government to assist research institutions to develop more improve crop varieties for farmers for planting.

He said the media also has a critical role to play in the dissemination of new varieties developed by scientists to farmers to enable them to accept such high yielding, drought and disease resistant crops for planting to ensure food security.

The scientists also urged media practitioners to help break the myth and misconception associated with Genetically Modified (GM) crops to enable the public, especially farmers to accept and patronize GM products.

Does DNA Testing Play any Role In Food Security

By Stella Danso Addai

Mr. Kofi Badu is a subsistence Farmer at Agogo in the Ashanti Region, and farming has been his source of livelihood, although he claims the business is unprofitable.

According to him, he does not understand why scientists are wasting time and resources on projects that do not in any way have links to food security in the country.

Mr. Badu in an interview noted that he wants to hear pragmatic steps being taken by Government and scientists towards the improvement of agricultural productivity and not funds in support of scientists to conduct research that would bring about improve crop varieties.

"What has research got to do with farmers and how does such activities improve upon our farm produce and profitability", he quizzed.

According to Mr Badu, to him, poor quality planting material and depleted soils have kept Ghanaian farmers' yields very low and therefore wanted government to come out with measures that would increase the yield of farmers, but nothing else.

Like Mr. Badu, most Ghanaian farmers do not acknowledge that researching into the quality of the seeds play a major part in the increasing farmers' yield, hence co-operation with scientists are necessary in finding appropriate scientific approaches to increase farm produce in Ghana.

But scientists in Ghana are working tirelessly to solve most of the challenges encountered by farmers in the country.

Scientists have noted through research that just by applying existing and available agricultural devices and technologies, the productivity of African agriculture could double or triple.

Abu Dadzie, of the Cocoa Research Institute of Ghana, New Tafo made it clear in his presentation in Accra during a four-day workshop on plant breeding being offered by the Cambridge UK-run Biosciences for Farming in Africa (B4FA) project.

He says through biotechnology, scientists have come out with cocoa seeds that are resistant to draught and diseases.

Scientists such as Abu Dadzie are of the view that the issue at stake is all about people becoming more enlightened and knowledgeable about the technology and how it works.

Professor Christopher John Chris Leaver of the department of plant sciences, University of Oxford in a presentation at a workshop in Ghana explained that DNA is one of the modern techniques to help ensure food security in Africa.

He was of the view that DNA will pave the way to produce a new breed of seeds that can respond better to drought, pests, or climatic changes.

However like Mr. Badu most Ghanaians do not understand the essence of the DNA in agriculture. One would then ask what is DNA testing and what is its impact in food security?

Dr. Paul Agu Asare a lecturer at the Department of Crop Science, University of Cape Coast in an interview noted that when it comes to scientific research, DNA has enabled scientists to find groundbreaking discoveries that make the scientist better understand the evolution of life on planet Earth.

He stressed that DNA studies have provided scientist with explanations on what makes the different or what makes the similarity to other living organisms, and how the ancestors have adjusted to make survival possible as Earth went through its own evolution.

In the medical field, scientists have explained that DNA testing has greatly helped in pushing forward studies related to life-threatening illnesses.

The most widely known use of DNA perhaps is its application in solving police crimes and body identification as popularized by television and the movies.

According to scientists, paternity DNA is especially helpful in settling legal disputes such as child support and custody, inheritance, and immigration issues that depend much on proving family relationships.

With time and with advancements in technology, DNA studies have also been useful in helping us slowly fill the gaps and piece together in the puzzle of our long genetic history.

Increasing agricultural productivity in Ghana has currently been a major issue as Government in collaboration with NGOs has adopted several measures to boost the agricultural production.

However scientists think that issues such as DNA must not only be a laboratory activity, but must be demystified and society at large enlightened on it's benefits.

Scientists in Ghana Not Asleep – Professors remind policy makers

Saminu Rafi Zambaga

MARRYING research work, science and technology propels industrialization. This model of development has helped countries around the world to grow. The reality in Africa and particularly in Ghana however is that, the practice has not been fully embraced by policy makers.

Policy makers in Ghana are more and more mandated by law to make complex decisions on issues of development. In this context, the adoption and promotion of science and technology as the best model required to advance national development has become crucial. They (policy makers) are however confused in doing that because they are often confronted with undue pressures from either partisanship inclinations thwarting their effort or engaged in self-centeredness.

Under this circumstance, they are still compelled by law (The 1992 Constitution) to make critical decisions with the principles of state policy in mind to influence activities for national development. In the face of this, most of them (past and present) policy makers have turned to put the blame of under industrialization on scientists for not adequately researching into the problems facing the nation.

But, professors in the country have strongly opposed this assertion, juxtaposing the position that they are not asleep as being propagated by policymakers. They exhibited their research findings including bioscience technologies they have developed for selected journalists in the country to catch a glimpse at and pointed out that they could not be blamed for the poor science application in national development. According to them, funding to promote and commercialize their research findings has been the major challenge confronting them which obviously is also affecting the industrialization process of Ghana.

They presented their position on the matter regarding industrialization in Ghana when they interacted with a cross section of journalists drawn from the ten regions of the country at a four day workshop organized by Bioscience for Farmers in Africa (B4FA) in Accra. Activities of the workshop included field trips to some of the research centers, bioscience farms currently being managed by some of the scientists themselves.

Speaking one after the other on bioscience technological development and application, the professors catalogued a number of challenges working against their research findings in Ghana. They stated that though work done in various fields could be used as the yardstick to drive the industrialization pole, funding of such findings to make that happen has always been the challenge. Unstable power situation, water crisis and lack of basic infrastructure among other utilities continue to hamper activities. In addition, they mentioned the lack of ready market for some of their findings, lack of cooperation and effective collaboration with farmers as other disturbing occurrences.

Professor Sammy T. Sackey of the Department of Biochemistry at the University of Ghana Legon whilst interacting with the journalists at the site of his Biochemical Products Ghana Limited at Ningo a suburb of Accra, reminded policy makers that they should not allow the hard work of scientists in the country to go waste.

He expressed regret that much of the work of policy makers in Ghana has been centered on talking instead of assisting researchers to actualize their findings in support of industrialization and development of the country "I am fed up explaining the importance of our findings to policy makers. They come here to see things themselves and when they go, the matter ends there" he sounded frustrated.

Professor Eric Danquah of the University of Ghana Legon, one of Ghana's bio-scientists in schooling the selected journalists on the impact of science, its application and understanding in Ghana's development process earlier made same assertion.

He however stressed that the situation could improve tremendously with effective collaboration, stating that the application of science must be supported by all stakeholders especially policy makers on one hand and scientists on the other and ultimately simplified to the ordinary Ghanaian by the Ghanaian media.

He explained that constant engagement of the science stakeholders in Ghana by the media has the potential of drawing scientists closer to policy makers. It will also reduce to bare bones the technicalities involved in science communication. “The use of terminologies, jargons could be simplified further to the ordinary Ghanaian if the media truly understand the ideas behind science application, discoveries and findings by scientists, he noted, adding “What you say, can change the world”

Professor Danquah who heads the West African Center for Crop Improvement (WCCI) which is training PhD students of West Africa on Bioscience used the platform to school the over 25 journalists attending the workshop for over one hour on fundamentals of plant genetics, noting that genetics affect ones world view. According to him, modern society, including Ghana’s development depends on genetics.

He cited products such as dresses, made from beautiful garments woven from cotton, a plant which has been cultivated by farmers as one of the wonders of science. “This is genetic in nature”. In addition, he said sophisticated crimes such as rape, robbery are committed in the dark, and yet are being detected through revelations of DNA and genetic application among other important mile stones chalked in science advancement.

Beyond that, he said genetics also form part of the crucial components of medicine which is used primarily to address health problems. “A large proportion of human ill health has genetic basis” he added. Professor Danquah however indicated that what an organism becomes depends on its genotype and also the sequence of environment; despite the fact that “Genes make us who we are” he added.

Professor Josephine Nketsia Tabiri, Member of National Biosafety Committee of Ghana at a separate function with the media also charged policy makers to appreciate the work of scientists in Ghana. “We say that Ghana is an agrarian country and we import everything. I am getting confused, what is this science going to do for us as a country?” she asked rhetorically

She however tasked policy makers in the country to stop talking and embrace the work of scientists in order to change the face of the agricultural sector which is responsible for food security “We must embrace all technology that has the capacity to improve the agricultural sector” Professor Josephine Nketsia Tabiri counseled.

Prize winners

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

Edmond Gyebi – “Promoting Food Security in the Midst of Post-Harvest Losses”

Albert Sore – “Plant breeding to reduce the plight of Tomato Farmers”

Prizes were also awarded to the following Alumni media fellows for the quality of pieces produced during the workshop:

Noah Nash – “Rice Breeding for Ghana”

Kwabena Ampratwum – “Availability of tomato hangs in balance”

Nelson Nyadror Adanuti – “The Savanna Farmer feeds city dwellers and covers their nakedness”

A further prize was awarded to media fellow Shirley Asiedu for her piece, but it was not possible to obtain a copy of the material for inclusion in this section of the report.

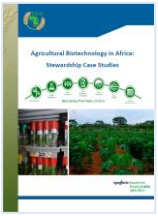
8. Material supplied to Fellows during training courses

Material distributed during courses on USB stick

AGRA: The African Seed Company Toolbox

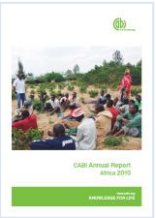
AGRA: Seeds

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



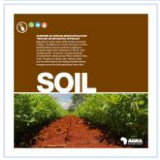
CABI Annual Report

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

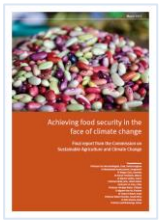
Collard & Mackill; IRRI: Marker-assisted breeding for Rice Improvement



AGRA: Soil brochure

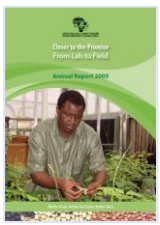
IITA: Annual Report 2011

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

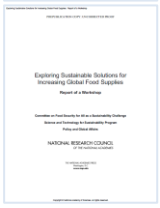
AGRA: Markets brochure

ATDF Journal: Orphan Crops issue

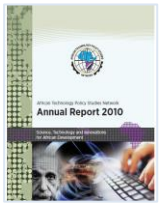
Calestous Juma; Nature, Nov 2011: Preventing Hunger – Biotechnology is key

AGRA brochure: Africa's Green Revolution

Science Africa: Volume 17

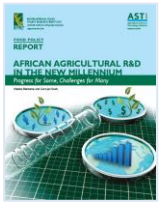


National Academies of Sciences/National Research Council: Exploring sustainable solutions for improving global food supplies



Africa Technology Policy Studies Network: Annual Report 2010

William Kerr: Food Sovereignty – Old Protectionism



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

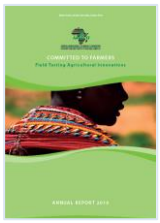
FARA Report: Inventory of Innovative Farmer Advisory Services using ICT

IITA: Research for Development Review

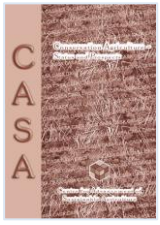
IFPRI Report: Country R&D Facts

Science Africa: Volume 15

AGRA Review 2011



AATF Annual Report 2010

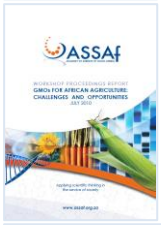


Centre for the Advancement of Sustainable Agriculture: Conservation Agriculture – Status and Prospects

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.

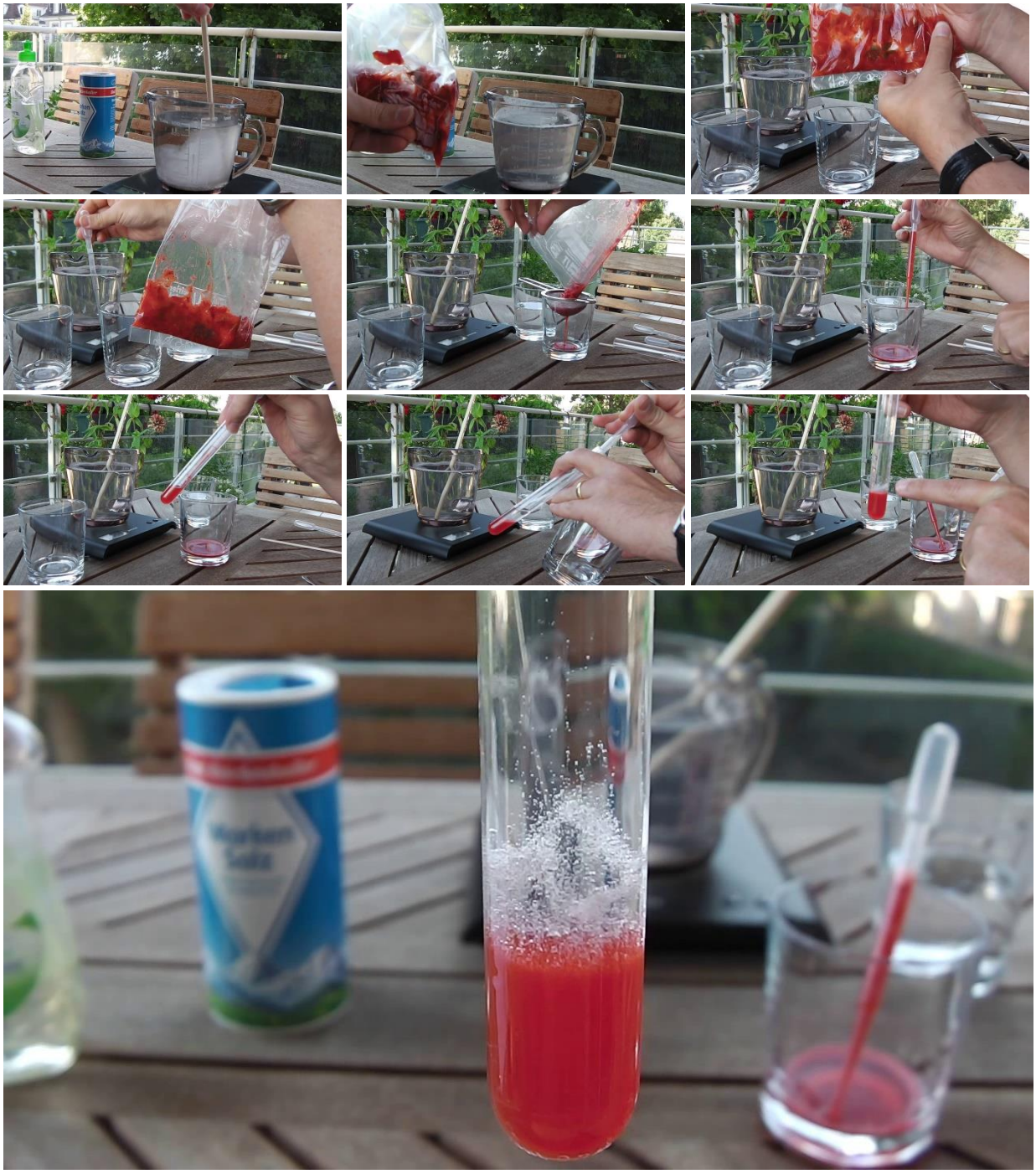
Likewise we included some basic free software (eg Adobe pdf reader, vlc media player) on the USB drive, since not all fellows had these available and would have found it difficult to download them locally.

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.

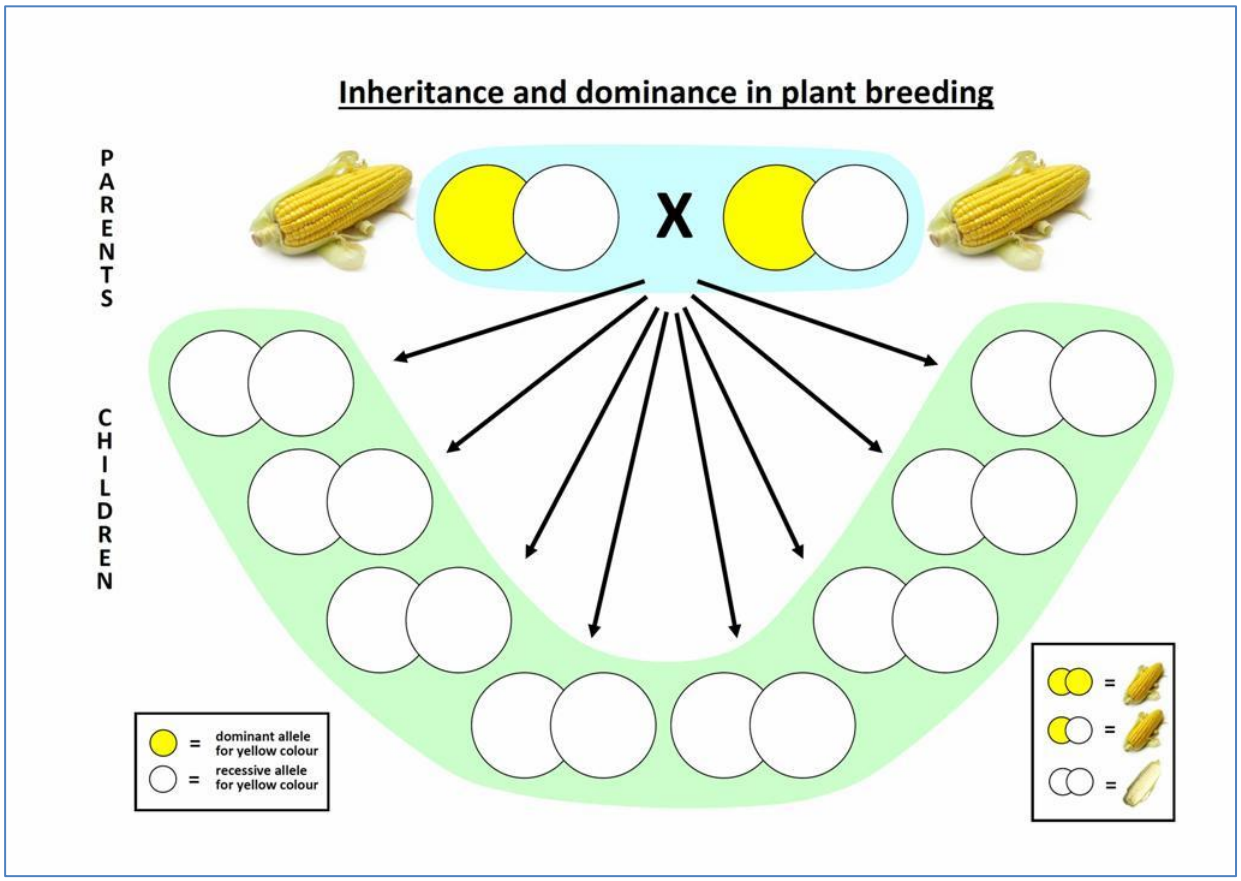


Following a simple experimental procedure (demonstrated beforehand through video – screenshots of which appear above) and mentored by B4FA staff and the research experts present, fellows prepared their chosen fruit, mixed it with the communally-prepared extraction buffer, added the ethanol and finally 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.



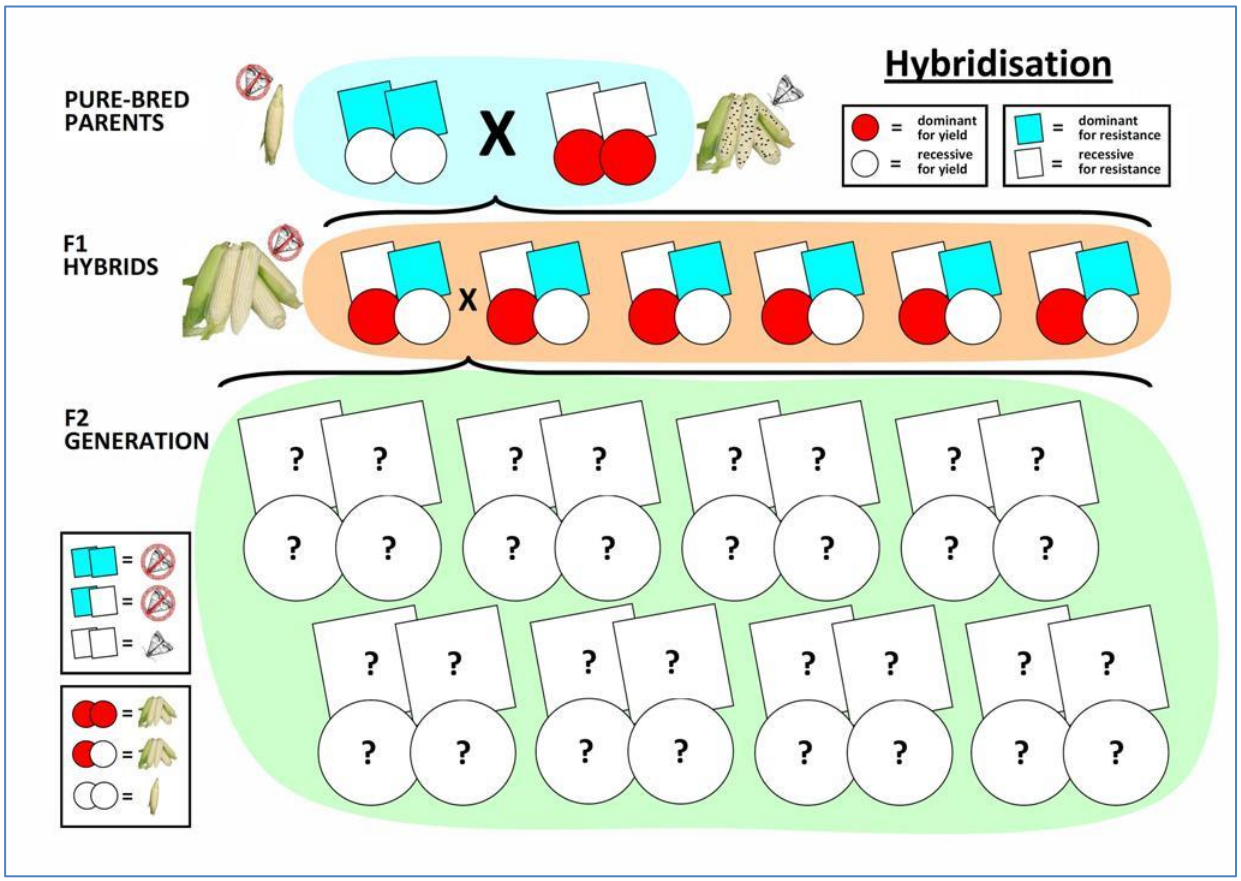
Once the worksheets had been populated with stickers, fellows were asked to identify how the colour trait would be expressed in each of the "offspring" individuals, and tot up how many of each colour there were. With B4FA and local expert mentors, they were then encouraged to compare their results with 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).

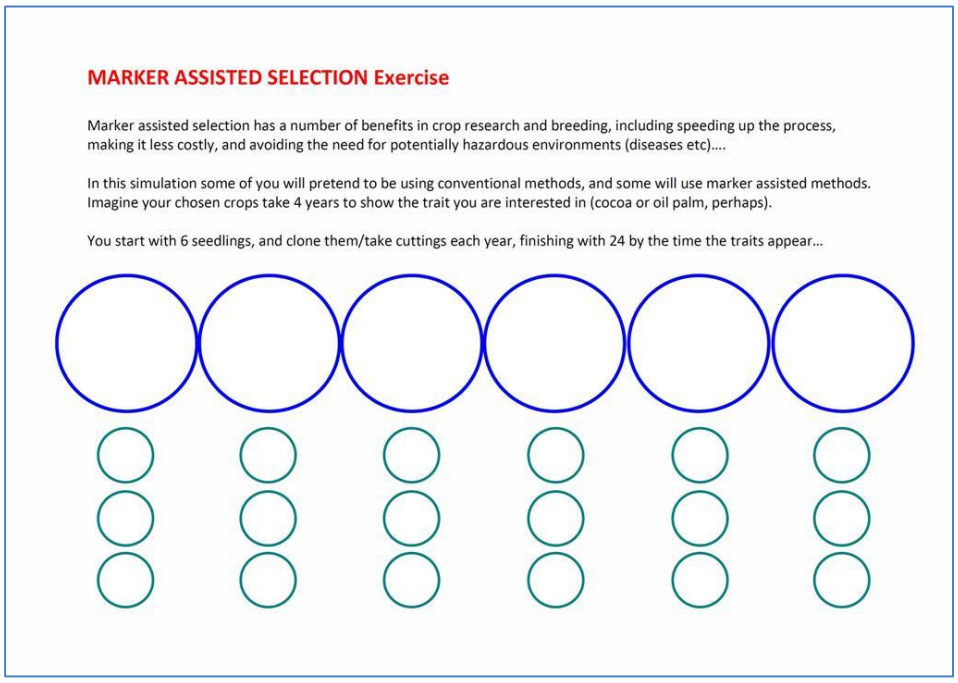


Once the worksheets had been populated with stickers, fellows were asked to identify how the yield and insect-resistance traits would be expressed in each of the F2 individuals, and tot up how many of each there were. With B4FA and local expert mentors, they were then encouraged to compare their results 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 represented a productive start to the second round of the programme.

Retaining the most successful aspects of the first round workshops, and adding in targeted training and engagement activities to meet specific learning needs, has resulted in a successful model that we shall apply to each of the future workshops we run.

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 training components, such as the targeted session on hybrids, have proved to be successful at addressing those specific misunderstandings.

Having the alumni fellows participating in a second round of training also demonstrates the value of consolidating their learning through repetition. It was striking the degree to which after just six months the alumni fellows were prepared and equipped to mentor their colleagues in the second round intake.

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

10. Presentations delivered in training course

Introduction

Dr Bernie Jones – B4FA Media Programme Director

Biosciences for Farming in Africa

Media Fellowship Programme
Round 2
Training Course Outline

Welcome

Dr Bernie Jones
B4FA Project Director

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

But first...

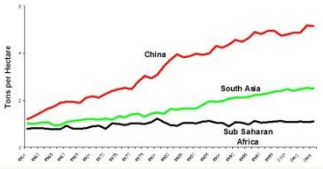
A welcome from the leader of our project...

Professor Sir Brian Heap FRS

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's happening on the ground?

- Lots of
  - Research Initiatives
  - Development Projects
- But
  - Low/irregular funding
  - Little dialogue and public understanding
  - Disinformation

B4FA

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

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

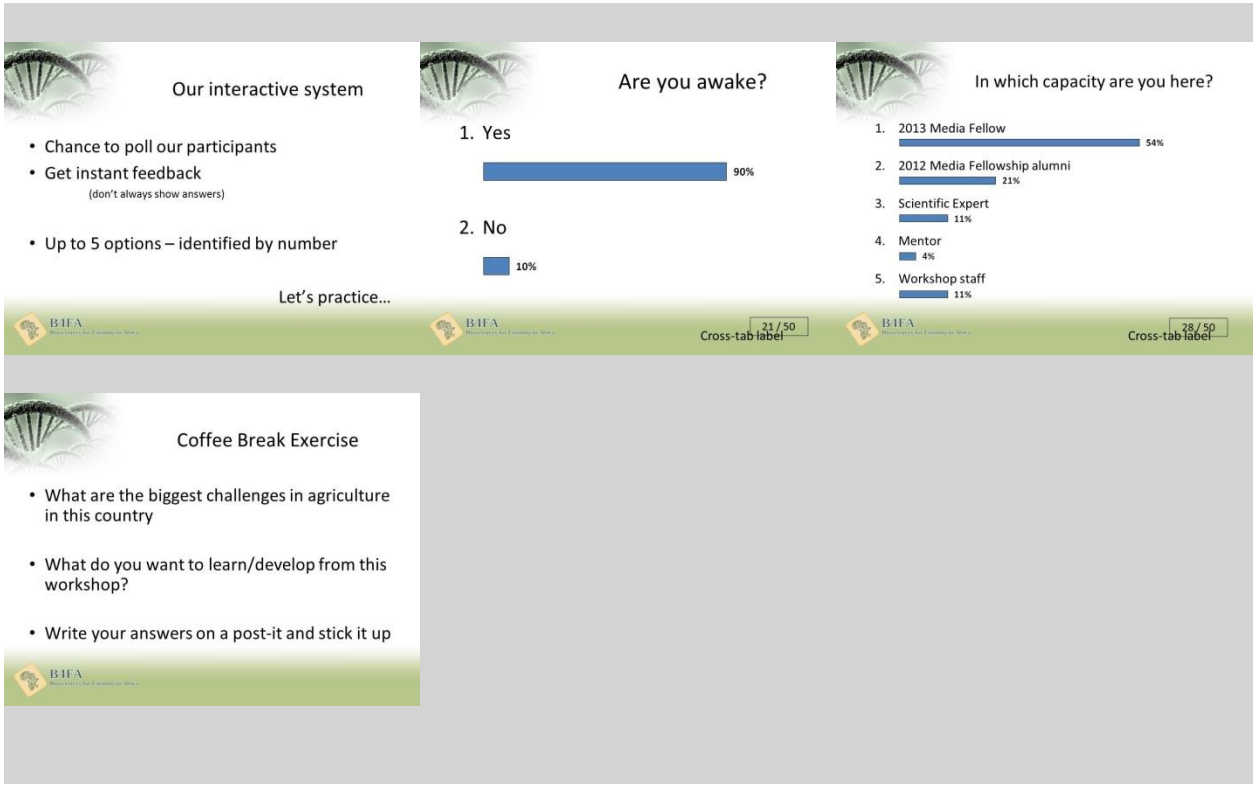
Housekeeping

- 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...
Are you awake?
1. Yes
90%
2. No
10%
21 / 50
Cross-tab label
In which capacity are you here?
1. 2013 Media Fellow 54%
2. 2012 Media Fellowship alumni 21%
3. Scientific Expert 11%
4. Mentor 4%
5. Workshop staff 11%
28 / 50
Cross-tab label
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

Plants and Agriculture – a history

Dr Bernie Jones – B4FA Media Programme Director

Plants and Agriculture – a history

Bernie Jones

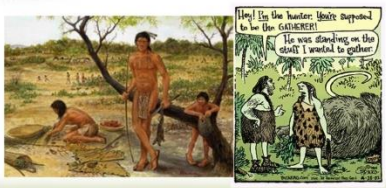
What do you know about farming?

1. I am a farmer — 1
2. I grew up and/or have lived in a farming community — 14
3. I am a city person, but members of my family farm — 4
4. I have no experience of farming — 1
5. What's a farm? — 3

When did people start to farm?

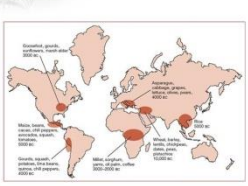
1. People have always farmed — 55%
2. Around 10,000 years ago — 27%
3. Around 5,000 years ago — 9%
4. Around 2,000 years ago — 5%
5. Around 500 years ago — 5%

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?

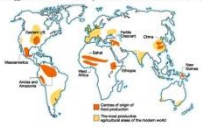
Agricultural systems

- Crop rotation
- Sustainable agriculture
- Sustainable intensification
- Organic

But these are all potentially complementary techniques, not alternatives

Colonisation, migration and agriculture

- Centres of origin vs most productive zones now



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

Which of these are "African" crops?

1. Cassava 12
2. Maize 1
3. Sorghum 3
4. Cocoa 2
5. Oil palm 8

Which of these are "African" crops?

1. Pearl Millet 52%
2. Mango 20%
3. Rice 12%
4. Sugarcane 4%
5. Cotton 12%

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)

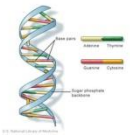
Genetics/Breeding recap

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

GENETICS!

Recap

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



Basic Genetics

Prof Eric Danquah – West African Centre for Crop Improvement, University of Ghana at Legon

Basic Genetics

Eric. Y. Danquah
West Africa Centre for Crop Improvement (WACCI)
University of Ghana
edanquah@wacci.edu.gh

Media Fellowships Programme Round 2, Biosciences for Farming in Africa
Accra, Ghana, March 13 - 16, 2013
Royal Richester Hotel, Legon, Accra

Outline

- Genetics and the Organism - Heredity and Variation
- Mendelian Genetics
- Cells, Chromosomes, DNA, and Genes
- Backcrossing
- Take-home message

What do you understand by the word genetics?

First, we need to define what genetics is

- Study of heredity?
  - ancient discipline (domestication of plants and animals)
  - inheritance of individuality in humans (why children resemble their parents; how various diseases run in families)
- Definition incorrect; ancient people not geneticists. **Genetics comes from the word genes and genes provide the focus for the subject.**

Genetics and human affairs

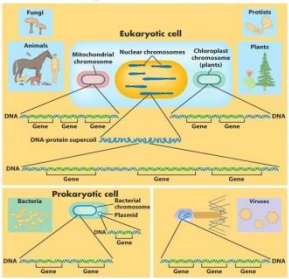
First, modern society depends on genetics

Second, genetics is a crucial component of medicine

A large proportion of human ill health has a genetic basis

- Inherited genetic diseases (Phenylketonuria)
- somatic genetic diseases (Cancer)
- chromosomal aberrations (Down syndrome)

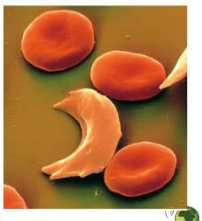
Third, genetics affects one's world view



Genetics and the environment

Model I: Genetic determination

- Compare a maize plant to say a cowpea plant
- The case of **sickle cell anaemia** (caused by a variant of **haemoglobin**, the oxygen-transporting protein molecule found in red blood cells)
  - Normal people have a type of haemoglobin called *haemoglobin A*.
  - Replacement of glutamic acid for valine in the β **globin chain** results in the production of a slightly changed haemoglobin, termed *haemoglobin S*.



Hybrid vrs Open pollinated maize

On the left, a local landrace variety

On the right a new, hybrid maize variety developed by CIMMYT with PASS funding.

Model II: Environmental determination

Above are monozygotic twins raised in the same home but, consider the case of monozygotic twins separated at birth from peasant parents and adopted by foster parents from two culturally diverse backgrounds

Model III Genotype-environment interaction

- What an organism becomes depends on its genotype and the sequence of environments to which it has been exposed

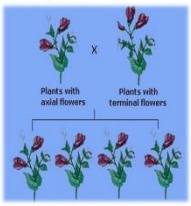
The Beauty of Diversity: A Result of Genes - Environment Interaction

Two of the biggest mysteries in biology answered by Genetics

- What makes a species what it is?
- What causes variation within a species?

Heredity

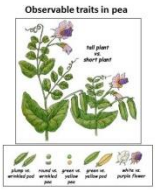
- Heredity is the passing of **traits** to offspring (from its parent or ancestors).



Offspring resemble their parents more than they resemble unrelated individuals (why is this so?)

What is a trait?

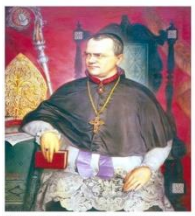
- A **peculiar quality** or **characteristic** exhibited by an individual organism.



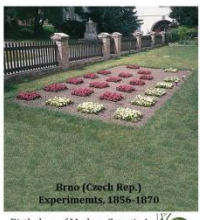
Variability

- Variability is the differences among individuals within any population

Gregor Johann Mendel, (b. 22 July 1822; d. 6 January 1884) Moravia, Austro-Hungarian Empire



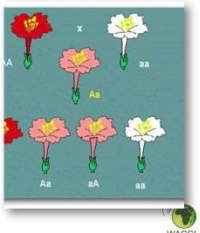
Originator of the concept of the gene (autosomal inheritance)



Birthplace of Modern Genetic Analysis
Augustinian monastry garden, St. Thomas
Brünn, Austria

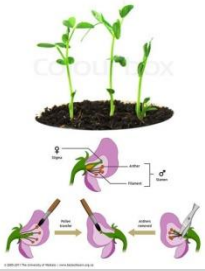
The idea of blending inheritance

- Spermatozoon and egg contained essences from various parts of the body; at conception, these essences somehow blended to form a pattern for the new individual

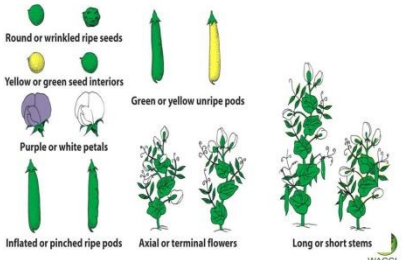


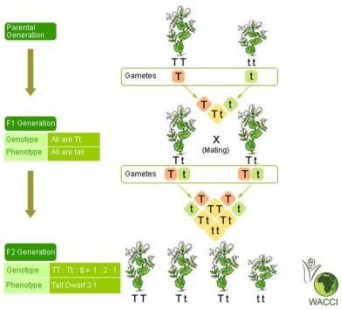
Reasons for choosing to study garden pea

- **No morals involved**
- Can be grown in a small area
- Produce lots of offspring
- Easily identifiable traits
- Produce **true-to-type** when allowed to **self- pollinate** over several generations
- Can be artificially **cross-pollinated**



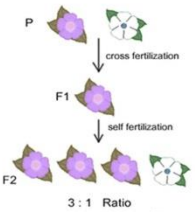
The seven character differences studied by Mendel



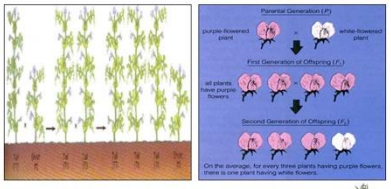


Summary and conclusions of Mendel's experiments

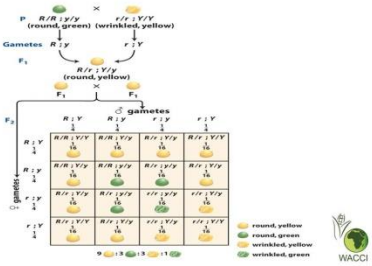
- After crossing pure parental strains, the F1 produced 100% of one character.
- After self-pollinating the F1, both characters showed up in a 3:1 ratio.
- Because the same types of ratio kept coming up, Mendel believed that there must be some mathematical formula or explanation for the observed data
- The first assumption made by Mendel was that there must be a "pair of factors" that controls the trait in pea plant. This "pair of factors" idea helped him formulate his principles



Dominant and recessive traits



Punnet square of the predicted genotypic and phenotypic constitution of the F_2 generation from a dihybrid cross

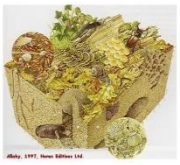


Mendel's Laws

- **Law of equal segregation (First Law)**
  - The two members of a gene pair segregate from each other into the gametes; so that half the gametes carry one member of the pair and the other half of the gametes carry the other member of the pair.
- **Law of Independent Assortment (Second Law)**
  - different gene pairs assort independently during gamete formation

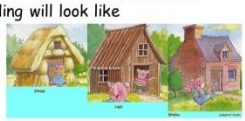
Organisms

- An organism is any living thing:
  - microbes
  - plants
  - insects
  - birds
  - mammals
  - us



Cells

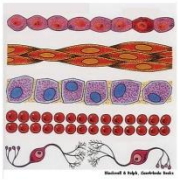
- Cells are the building blocks of organisms
- Think of bricks making a building
- The type of brick determines what the building will look like



Cells, cont.

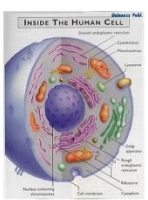
- in the same way, the type of cell determines the type of organ
- and, the type of organ determines the type of organism

Each time we scratch our skin we scrape off millions of cells



Cells, cont.

- Each cell is like a city
- It has a:
  - transport system
  - waste disposal system
  - food delivery system
  - water delivery system
  - disease control system
  - management centre

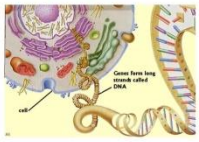


Cell management centres

- Cell management centres contain all the information needed to keep the cell running
- They also contain all the information needed to make the **whole** organism
  - a 'blueprint'

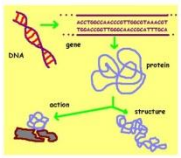
Cell blueprints

- The information is a code held on long strands called DNA



Genes (Every organism carries inside itself what are known as genes)

- The code on the DNA is divided into sections called genes.
- Each gene codes for a protein
- Each protein has a function
  - an action
  - building block



DNA - the code for life

- The DNA code consists of just 4 building blocks:
  - A, C, T and G.
- Whether we are bacteria, fungi earthworms, mushrooms or humans our DNA has the same building blocks, just in a different order.

Genes, cont.

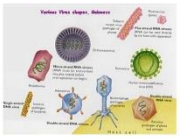
Similarly,

- Sunflowers have genes for yellow petals and
- Petunias have genes for purple petals

Genes, cont.

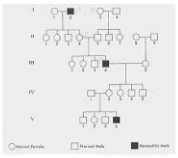
and ...

- HIV has genes that cause AIDS, while
- Chickenpox virus has genes that cause chicken pox or shingles



Genes (The genes are codes or messages. They carry information. The information they carry is used to tell the organism what chemicals it needs to make in order to survive, grow or reproduce)

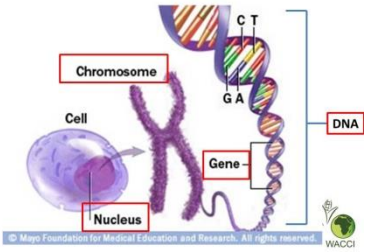
- Genes make us who we are
- We receive our genes from our parents
- The same is true for all animals, plants and microbes

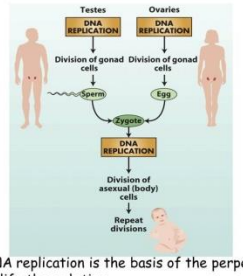


The Cell

Cells are the basic functional unit of all life forms they hold all of the biological equipment necessary to keep an organism alive Earth

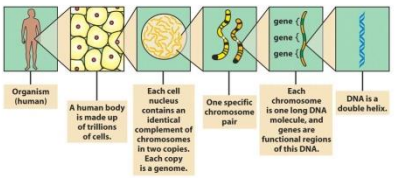
Inside the Nucleus of a Cell

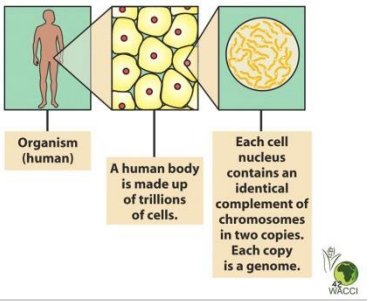


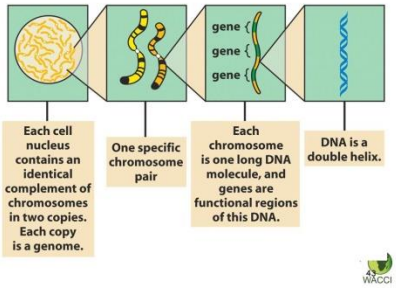


DNA replication is the basis of the perpetuation of life through time

The genetic material in sharper focus following successive enlargements



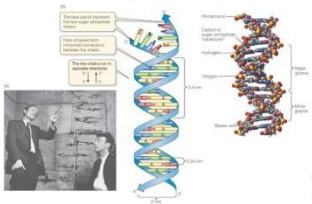




Background to discovery of DNA

James Watson & Francis Crick – accurate model of DNA

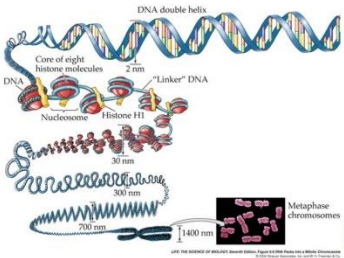
Chargaff's realization that A = T and C = G, combined with the X-ray crystallography work by Rosalind Franklin and Maurice Wilkins, contributed to Watson and Crick's derivation of the three-dimensional, **double-helical model** for the structure of DNA.



http://www.nature.com/scitable/topicpage/discovery-of-dna-structure-and-function-watson-397

DNA- **d**eoxyribo**n**ucleic **a**cid...

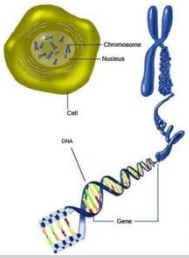
How complex is DNA?



Information Flow

What is a gene?

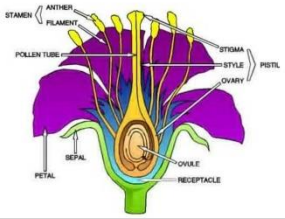
- A hereditary unit that occupies a certain position on a chromosome/DNA in the nucleus of a cell. This unit that has one or more specific effects on the physical appearance of an organism.



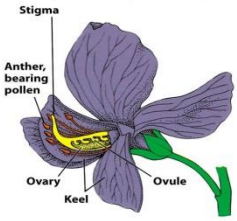
Significance of Mendel's work

- advances in plant and animal breeding

Sexual reproduction in plants

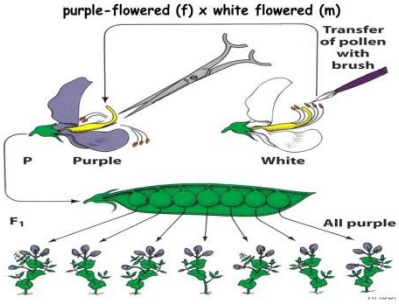


A pea flower with the keel cut and opened to expose the reproductive parts

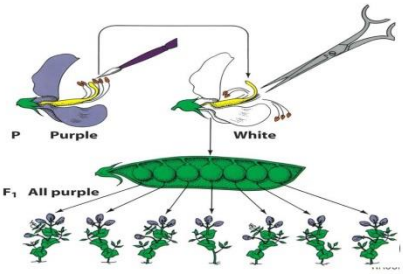


Artificial cross pollination

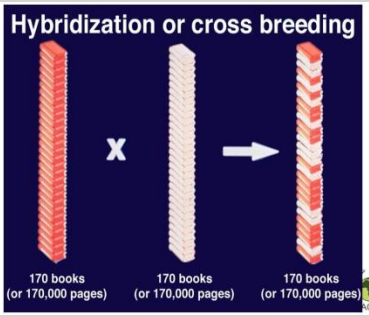
purple-flowered (f) x white flowered (m)



purple flowered (m) x white-flowered (f)



Hybridization or cross breeding



Backcrossing

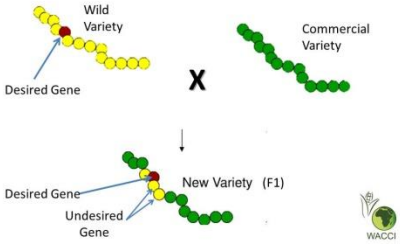
- Backcrossing is done with the main objective of incorporating a **desired gene**, either **dominant** or **recessive**, from a **wild** or **non commercial variety** to a highly productive, commercially successful variety which lacks that specific gene.

http://theagricos.com/plant-breeding/backcross-method/

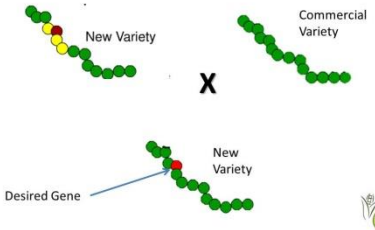
Backcrossing..... cont'd

- This is a type of repeated selection where a specific gene can be incorporated into otherwise superior cultivars.
- One of the parental varieties is highly productive and commercially successful but lacks a specific gene (e.g. disease resistance). This trait is usually present in the other parental variety.
- After each back cross, hybrid plants are identified with the gene under consideration and are back crossed again with the recurrent parent.
- The rate at which undesired traits from the donor parent are eliminated depends upon linkage with the desired gene.

Backcross Breeding Illustrated



Backcross Breeding Illustrated...



Take-home message

- Sexual reproduction and random mutations have been used to change the characteristics of individuals from time immemorial- **this is imprecise and more of an art than a science; it also take a long time to develop plants of choice and only sexually compatible species can be crossed**
- Genes govern the characteristics that are passed on from parents to offspring
- If we can isolate specific genes and use them to direct the evolution of plants and animals to our benefit, **why should we put the world at risk by not taking advantage of science and technology**


Thank you
WACCI

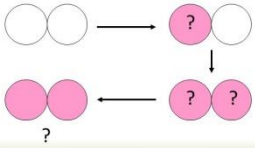
Inheritance of Traits Game; DNA extraction

Dr Charles Amadi – National Root Crops Research Institute, Umudike, Nigeria

Genetics Simulation

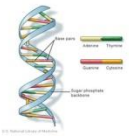
- Inheritance of traits (colour of corn)
- Dominant and recessive alleles

For every child/seed…



Results

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



DNA Extraction

What you will do

- Some real science!
- Perform a experiment yourself out by the poolside 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!

Well done!

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

...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 Introductory, History, Genetics, Game and DNA Extraction sessions

Which was your favourite part?

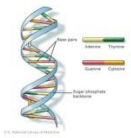
1. Introduction 0%
2. History of plant breeding 31%
3. Principles of genetics 27%
4. Yellow/white maize game 4%
5. DNA extraction 38%

Which was your least favourite part?

1. Introduction 100%
2. History of plant breeding 0%
3. Principles of genetics 0%
4. Yellow/white maize game 0%
5. DNA extraction 0%

I would like some lunch!

1. Yes 0%
2. No 0%



Fundamentals of Science Journalism

Alex Abutu – Africa STI

Fundamentals of Science Journalism

Alex Abutu
Editor,
Environment & Agric Page, Daily Trust Newspaper.

Why Science journalism?

The need to improve the understanding of science, medicine and technology.

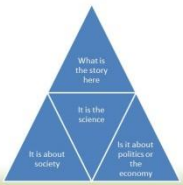
How to find a story

- **Sources of information and inspiration**
- News conferences
- Press releases
- Peer reviewed Journals
- Research institutes, etc

What makes a good science story?

There are three components to the perfect science story. The first is the intellectual leap or excitement that a particular piece of research brings. Second, the practical implications – how will this research change our lives? The third is the human story

Is it a story?



Sources of information

- A good science story depends to a large extend who or what the source is, so it is very important that the source of our information be credible and possibly an authority in the field.

Sources:

Scientists | Organisations | NGOs | Government | Journals or other publications

Who do you trust?

- Not all sources are valid
- Science and 'balance'
- Research vs opinion
- Published work
- Where and who by?
- Peer review

Interviewing a scientist

Interviewing a scientist

- Three quick tips on how to get the best out of an interview.
- Be smart (Read about the subject)
- Prepare your questions
- Establish the rules

Interviewing a scientist

- Scientists' reactions to journalists
- How to get the best from scientists
- Building a relationship
- How do you write the story for your reader to understand?
- Translating science-speak without dumbing down

Interviewing a lobbyist

- Relationships with lobbyists
- How to get the truth from a lobbyist
- Investigative interviewing techniques

How do scientists react to the media?

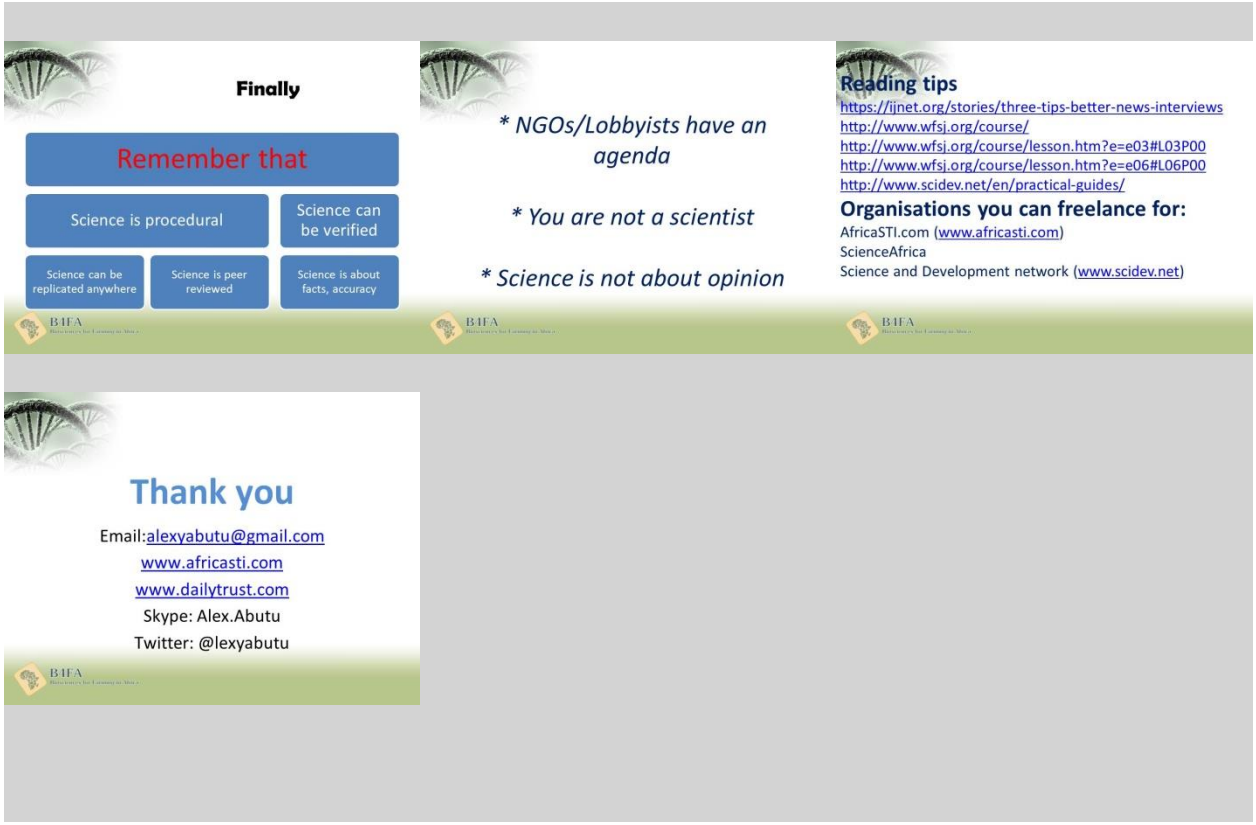
- What do scientists think of us?
- Misquote, misrepresentation, inability to understand common scientific jargon
- What can you do about that?
- Befriend them, win their trust, cross check copy, make them understand you a journalist
- Building the relationship?

How do journalists react to scientists?

- How do you typically react to scientists?
- Mr think he knows everything, Jargon man,
- What can you do about that?
- Try to understand him, read more about his work
- What can scientists do?
- Be more accessible, be willing to explain
- How can you help them achieve this

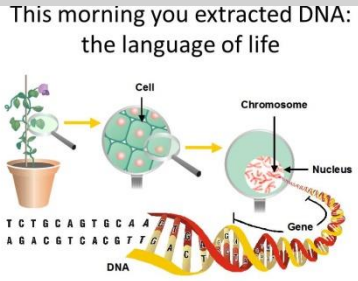
Selling it to your editor/producer

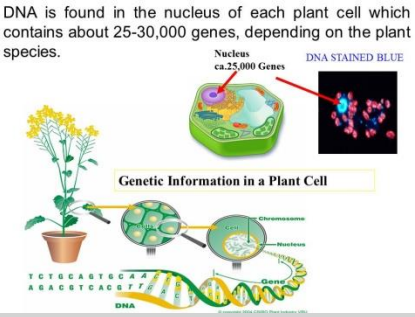
- Why should this be published?
- Impact on society, economy, health, etc
- Selling the story to your editor
- Must be well written, draw out benefits/implications of the discovery as it relate to food security, vision 202020 etc

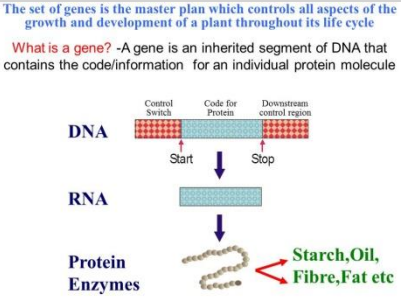

Finally
Remember that
Science is procedural
Science can be verified
Science can be replicated anywhere
Science is peer reviewed
Science is about facts, accuracy
* NGOs/Lobbyists have an agenda
* You are not a scientist
* Science is not about opinion
Reading tips
https://ijnet.org/stories/three-tips-better-news-interviews
http://www.wfsj.org/course/
http://www.wfsj.org/course/lesson.htm?e=e03#L03P00
http://www.wfsj.org/course/lesson.htm?e=e06#L06P00
http://www.scidev.net/en/practical-guides/
Organisations you can freelance for:
AfricaSTI.com (www.africasti.com)
ScienceAfrica
Science and Development network (www.scidev.net)
Thank you
Email:alexyabutu@gmail.com
www.africasti.com
www.dailytrust.com
Skype: Alex.Abutu
Twitter: @lexyabutu

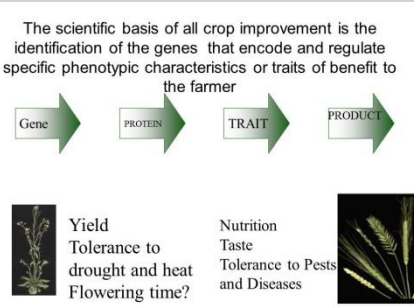
Genetic Modification

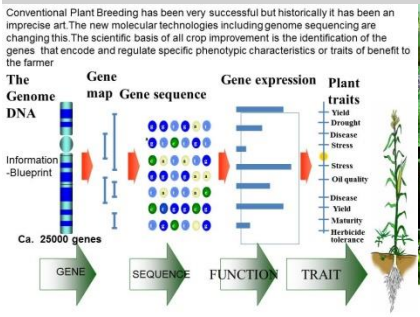
Prof Chris Leaver – University of Oxford, United Kingdom

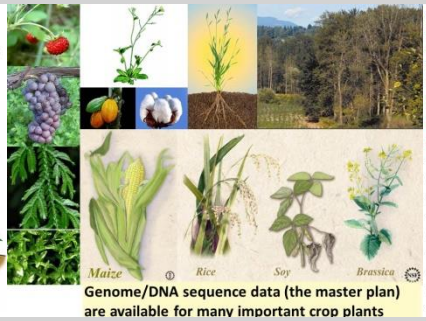


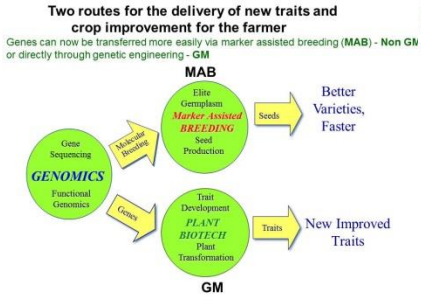


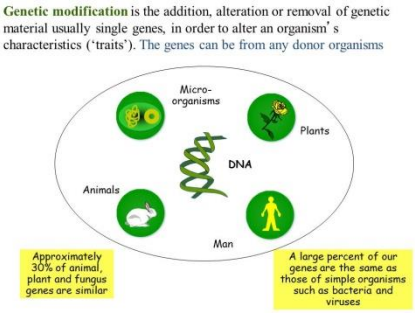


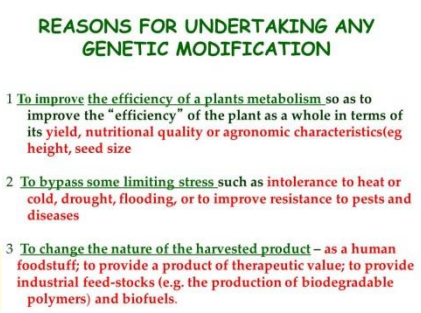


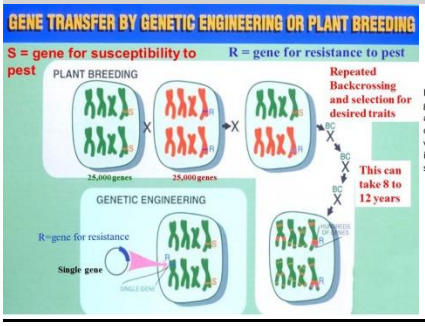


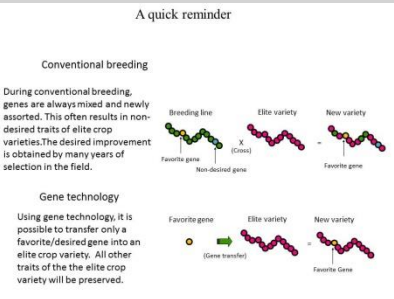


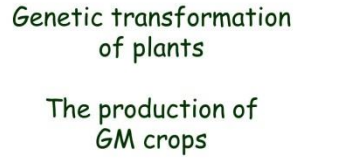












Isolate the Gene by standard techniques of molecular biology

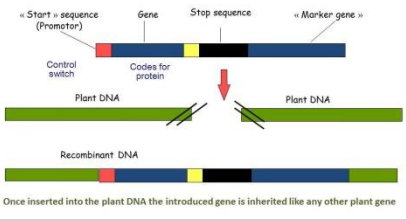
The first step is to isolate DNA like you did today.

Then cut the DNA into gene size pieces with special enzymes- 'molecular scissors'.

Separate the genes from each other and identify the genes and what they code for- ie. the protein which controls the trait or characteristic which you may be interested in.

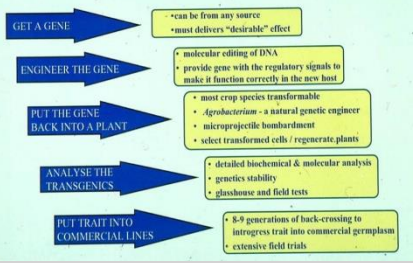
Combine the gene with control sequences and make many copies of the gene by cloning.

How does the genetic modification work?



Once inserted into the plant DNA the introduced gene is inherited like any other plant gene

A quick guide to transgenic plants



Specificity of Genetic Modification

Identification and isolation of specific genes with defined and understood function

Insertion of specific genes into a crop species to promote desirable characters

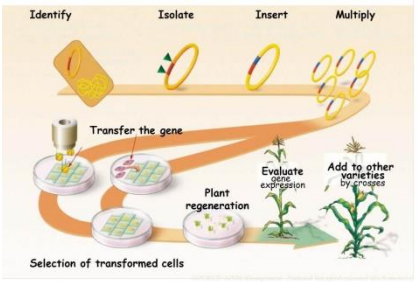
GM progeny/plants can be selected for the product or activity of specific genes with a defined function

There are no "surprises" from unknown genes transferred along with the planned cross as is the case with conventional plant breeding

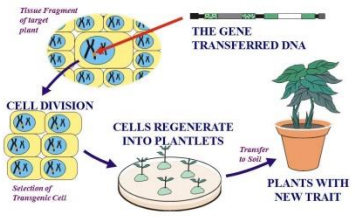
Ideal Gene Transformation Method

- Can be applied to any genotype
- Produces fertile plants
- Has high efficiency
- Introduces genes in single copy
- Gene is stable and expressed over time /generations:that is inherited in a Mendelian manner
- No background genetic changes

The steps involved in genetic modification



Getting genes into plants



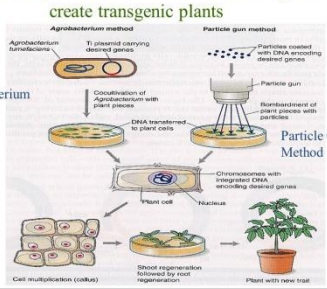
How is a gene transferred to a plant?

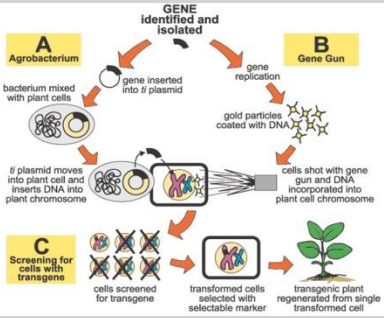
Two major methods:

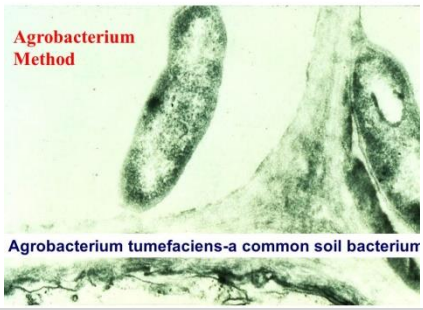
1. *Agrobacterium tumefaciens*; a bacterium that acts as a "natural" genetic engineer

2. Biolistics; using DNA-coated metal particles

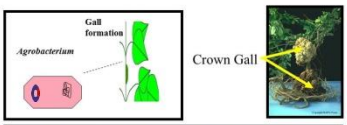
Schematic representation of the two main ways to create transgenic plants





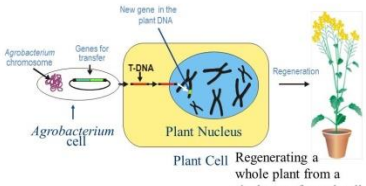


Nature's original genetic engineer



The soil bacterium *Agrobacterium* is able to infect plants and make them produce the food it needs to live on. The bacterium does this by inserting a small piece of its own DNA into the genome (DNA) of the plant. Scientist have modified this naturally occur process to make genetically modified plants.

DNA delivery to plant cells: *Agrobacterium*



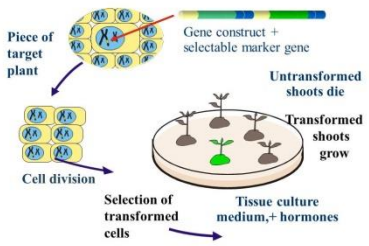
Regenerating a whole plant from a single transformed cell with a new gene in it.

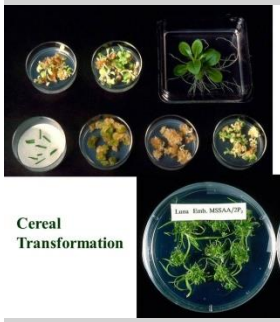
The next step

What happens after the cell has taken up the DNA?

1. Whole plants must be regenerated from that cell
2. Cells that take up DNA (transformed cells) must be differentiated from those that did not take up DNA
   - use of selectable marker gene
   - usually antibiotic resistance

Selection of transformed plants

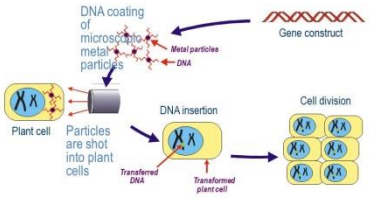


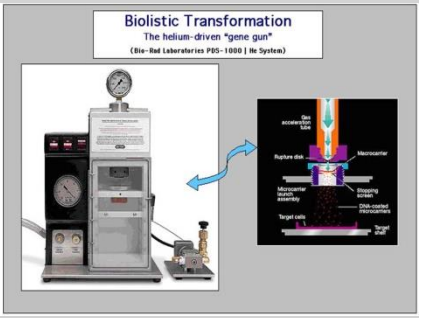


Broad Leaved Crops

Cereal Transformation

DNA delivery to plant cells:
Particle Bombardment (also called Biolistics)





Advantages of Particle Bombardment

- Simple procedure
- Broad application range (relies on physical rather than genetic parameters; thus often genotype-independent)
- Transformation restricted only by competence of plant tissue to take up DNA and regenerate
- Can be used to transform organized tissues e.g. plant embryos
- Multiple genes can be introduced simultaneously
- No plasmid backbone sequences are required (clean transgene integration)

Crop Transformation

- **High efficiency transformation protocol**
- **Output > 25,000 transformed plants per year**

From laboratory to commercialisation

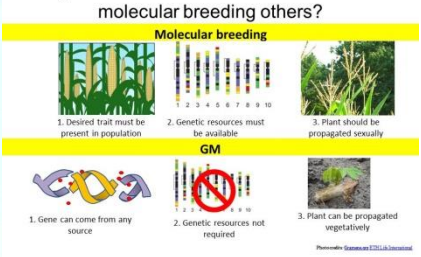
specific gene transfer in the lab. followed by subsequent testing in the field

this is the only plant breeding technology which requires regulatory approval (and, in some countries, labelling of all the food products derived from modified plants):

- **testing for food toxicity, nutritional value, composition and allergenicity – includes animal feeding trials**
- **characterisation of the transferred gene as well as its effects on the host genome**
- **an environmental audit as well**

Development of Products of Gene Technology

Why are GM methods used sometimes and molecular breeding others?



TEN CROPS THAT FEED THE WORLD

Crop Source: www.businessinsider.com 2008 data	Annual Production million tonnes	Average yield tonnes/ hectare	GM status	Commercial GM Products
1. Corn	822.7	5.1	Yes	Yes
2. Wheat	689.9	3.1	Yes	No
3. Rice	685.0	4.3	Yes	Yes?
4. Potato	314.1	17.2	Yes	No
5. Cassava	232.9	12.5	Yes	No
6. Soybean	231.0	2.4	Yes	Yes
7. Sweet potato	110.1	13.5	Yes	No
8. Sorghum	65.5	1.5	Yes	No
9. Yams	51.7	10.5	Yes	No
10. Plantain	34.3	6.3	Yes	No

Genetically Modified Crops in Agriculture Today

- **Input traits** of obvious benefits to producers (agrochemical companies and farmers) but not yet obvious to the consumer
- Including resistance to **herbicides, insects** and viral disease

Genetically Modified Crops in Agriculture Today

The first generation of GM traits were designed to complement the use of agrichemicals and provide better insect and weed control

These input traits were of obvious benefits to producers (agrochemical companies and farmers) but not obvious to the consumer. These traits are now being introduced together (stacked) in Corn ,Soybean,Cotton,Canola and now Rice and other crops-----

Input traits

Corn
- Glyphosate tolerance
- Foliar insect control
- Corn root worm

Cotton and Soybean:
- Insect resistance
- Glyphosate tolerance

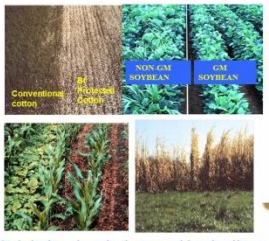
How many more traits in one crop?

Virus control

Papaya

Canola (Oil Seed Rape)
Sugar Beet
- Glyphosate tolerance

The first generation of GM traits were designed to complement the use of agrichemicals and provide better pest and weed control and involved the transfer of a single gene from a bacterium. One conferred resistance to a herbicide (ESPS-Glyphosate-Roundup) the other to specific classes of boring insect pests(Bt-Bacillus thuriengsis).



Now being introduced into a wider range of crops including rice, sugarcane

Stacked GM traits in the Field

- Triple Stacked traits protection against:

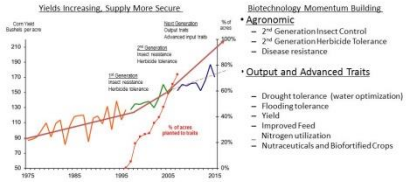
Corn borer-above ground

Glyphosate tolerance

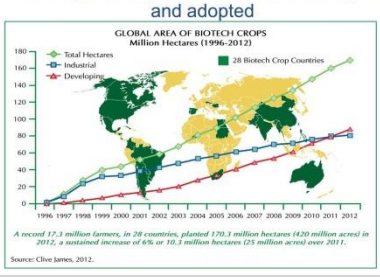
Root worm-below ground

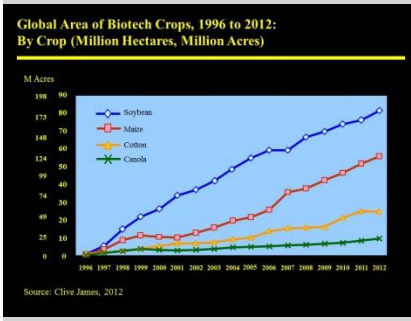
Stacked traits are becoming the norm and introduced into range of crops including rice

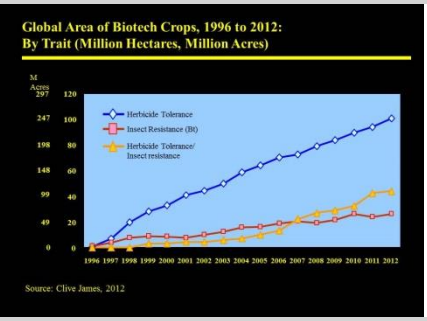
Traits benefit growers & value chain



Transgenic crops continue to be developed and adopted







Traits of interest in the pipeline

- **Farmer-oriented traits** (pest resistance - insects, diseases, weeds;nutrient use efficiency)
- **Stress resistance-** (frost, drought, salinity; and growth/performance-earliness, yield);
- **Consumer-oriented traits** (flavour, nutritional quality –vitamin A, vitamin E and protein and postharvest storage).
- **Processing traits** (altered oil, carbohydrates, protein).

Traits of Interest with particular relevance to Africa

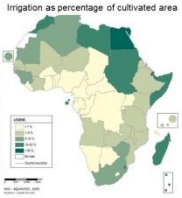
- *Drought Tolerance Crops*
- *Nutrient Enhanced Crops* (***Bio-fortified sorghum*** **with enhanced vitamin A and lysine content;** ***Biocassava Plus*** **- cassava plants with 30 X beta-carotene, 4X iron, and4 X protein as traditional cassava).**
- *Cassava Mosaic Disease*
- *Maruca-resistant Cowpea*
- *Insect and Virus Resistant Sweet Potato*
- *Insect Resistant Bt Potato*
- *Disease and Insect Resistant Banana.*

Plant breeding can support African agriculture

African farmers need access to high yielding, drought tolerant, disease resistant plants. Most food is grown by small-scale farmers with little mechanization. Cassava, cowpea and banana are important crops and the focus of intensive breeding programs.

Maize is a staple crop in Africa but very sensitive to drought damage

Less than 10% of crop land in sub-Saharan Africa is irrigated, making agriculture production highly susceptible to drought



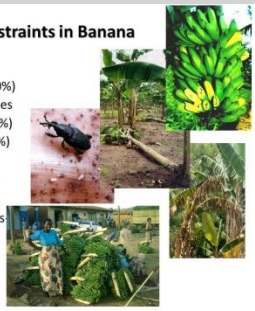
Water Efficient Maize for Africa was developed through a public-private partnership

Water-efficient maize optimized for growth in sub-Saharan Africa has been developed through a combination of breeding and GM methods

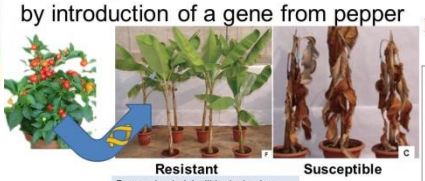
WEMA is being developed as a public-private partnership that includes international and regional plant breeding institutes, philanthropic groups and Monsanto

Productivity Constraints in Banana

- Pest and disease
  - Banana weevil (40%)
  - Parasitic nematodes
  - Black sigatoka (50%)
  - Bacterial Wilt (90%)
  - Fusarium Wilt
- Plant architecture
  - Long growth cycle
  - Post harvest losses ripening

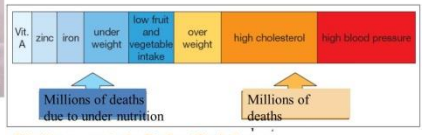


GM Example: Disease resistant banana by introduction of a gene from pepper



Banana bacterial wilt is destroying plants in eastern Africa. Transgenic plants carrying a resistance gene from pepper are resistant to the disease

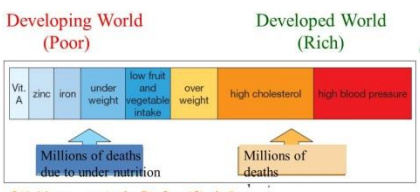
The Link Between Diet and Health



GM Nutraceuticals:Biofortified Crops-

Many of our common food crops are not perfect with respect to the nutritional requirements of humans or animals.
Protein, starch, and oil composition and content as well as vitamin and micronutrient content can all be improved to make foods more

The Link Between Diet and Health

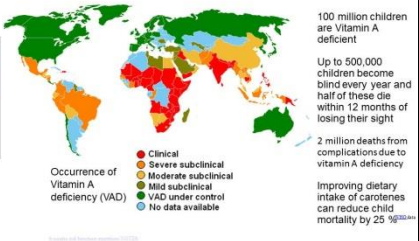


GM Nutraceuticals:Biofortified Crops-

Many of our common food crops are not perfect with respect to the nutritional requirements of humans or animals.
Protein, starch, and oil composition and content as well as vitamin and micronutrient content can all be improved to make foods more

Vitamin A deficiency is a leading cause of blindness

Breeding plants for β-carotene (pro-vitamin A) enrichment



100 million children are Vitamin A deficient

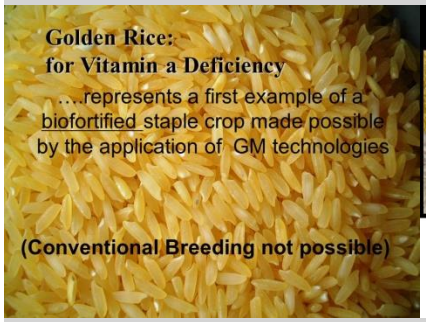
Up to 500,000 children become blind every year and half of these die within 12 months of losing their sight

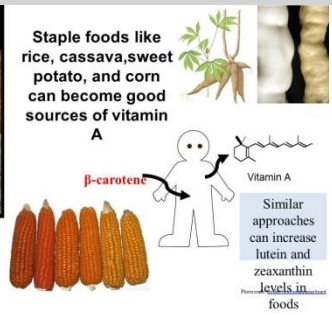
2 million deaths from complications due to vitamin A deficiency

Improving dietary intake of carotenes can reduce child mortality by 25 %

Global population mortality 2010

Cause	Annual mortality (millions)
Vitamin A deficiency	1.9 – 2.8
HIV/Aids	1.8
Tuberculosis	1.4
Malaria	0.7





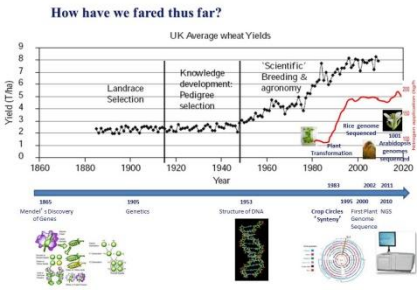
Key Messages

- Global food and nutrition security is under immense pressure
- Technology has vast potential to meet not only global demands for food and nutrition but also address emerging issues of sustainable energy and environment
- Cost of bringing new technologies to the market continues to escalate
- Genetics is expanding the paradigm of crop nutrition and pest protection to include stress alleviation, land and natural resource use efficiency, consistency and crop quality
- A science-based, transparent, globally harmonized regulatory and trade policies are central for realizing the potential of the sector

Can Genetic Improvement of Crops Help Feed the world?

- No single solution will solve this problem but the new genetic technologies of plant breeding developed during the last few years can help- **they are but one tool in the toolbox.**
- They can increase agricultural efficiencies in a sustainable manner. Genomics, marker-assisted screening, phenotype analysis, computer modeling, and genetic modification (GM) when required, have greatly improved and accelerated the breeding process.

GM is not a Silver Bullet!



Cocoa Black Pod Disease Case Study

Abu Dadzie – Cocoa Research Institute of Ghana (CRIG)

Cocoa Research Institute of Ghana

Breeding for black pod disease resistance cocoa in Ghana

By

Abu M. Dadzie and GeorgeA.Ameyaw

Cocoa Research Institute of Ghana

Outline of Presentation

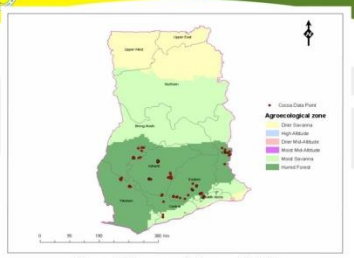
- Cocoa production and some challenges affecting it.
- Cocoa introduction
- Black pod disease of cocoa
- Germplasm and hybridization
- Developed Hybrids
- Use of MAS in cocoa breeding
- Achievments

Cocoa Research Institute of Ghana

Introduction

- West Africa produces 70% of the world's cocoa
- About 2,000,000 small holder farms in West Africa contributes the entire production
- Ghana –produces 14% of the entire beans in the world
- Western region of Ghana produces 55% of total cocoa beans from Ghana

Cocoa Research Institute of Ghana



Map of Ghana and Cocoa Districts

Cocoa Research Institute of Ghana

Challenges associated with cocoa cultivation

- Low yields: between 250 - 350kg/ha with unimproved materials whiles improved materials gives between 500 – 1500 kg/ha
- Small-scale farmers (1-6 ha): unstable low income
- Cocoa Swollen Shoot Virus Disease
- Black pod caused by *Phytophthora palmivora* and *megakarya*
- In *megakarya* endemic areas: 80 - 100% losses are recorded

Cocoa Research Institute of Ghana

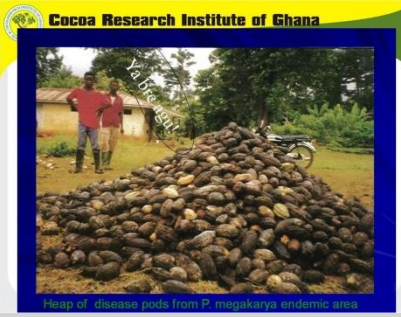
Early cocoa introductions / Planting materials

- Amelonado cocoa types which produce small pods with good flavour was introduced from Fernando – po (Equatorial Guinea) where it was cultivated to Ghana by Tetteh Quarshie in 1878.
- This introduction succumbed to both Black pod and CSSVD.

Cocoa Research Institute of Ghana

Infected pods Healthy pods

Cocoa Research Institute of Ghana



Heap of disease pods from P. megakarya endemic area

Cocoa Research Institute of Ghana

How can we address the black pod menace ?

- Develop improved cocoa varieties for farmers
- Application of good agronomic practices such as :
  - Regular removal and burying of infected pods
  - Good shade management
  - Adhering to recommended plant spacing
  - Regular pruning of chupons etc

Cocoa Research Institute of Ghana

How can we achieve our goal?

- Through:
  - Training of research personnel
  - Access to well characterized germplasm
  - Merging conventional and molecular breeding techniques and tools
  - Application of Suitable technological Package
    - Improved seed garden output
    - Use of improved seeds by farmers

Cocoa Research Institute of Ghana

Further introductions made into the gene bank with black pod resistance attribute

- Upper and Lower Amazon materials (Foresteros)
- Trinitarios (Foresterios x Criollos)

Cocoa Research Institute of Ghana

Germplasm

- Sources:
  - Ex-situ collections
    - Amazon collections
    - Local collections
- Characteristics:
  - Resistance to pests and diseases
  - High yield
  - Bean quality
  - Tree architecture

Cocoa Research Institute of Ghana

Variation in germplasm collections

Cocoa Research Institute of Ghana

Comencement of Breeding by utilizing Germplasm materials

Hybridization (crossing) of various germplasm materials to raise progenies with specific traits such as

Disease resistance, Moderate vigor, Large bean size, Reduced gestation etc.

Local Trinitario X Upper Amazon

Cocoa Research Institute of Ghana

Established trials to address Black pod disease

- Progeny trials (Upper Amazon) Gestation Prd
  - x Amazon (2 – 4yrs)
  - x Trinitarios (3 – 4yrs)
  - x Amelonado (6 – 8yrs)
- Clonal trials (local Trinitarios and international clones)
- Combining ability trials (varied males x females).

Cocoa Research Institute of Ghana

Early hybrids developed

- Series i
- Series ii
- Series iii

General Purpose

- Series iv
- Series v
- Series vi

Specific Purpose

iv – cssvd, v- black pod and vi- drought issues, some hybrids were released in 1986 and are performing very well in farmers' farms

Variety development may last longer than 20yrs therefore the need to employ molecular markers or marker assisted selection in breeding

Cocoa Research Institute of Ghana

Further breeding work done to improve resistance

Include:

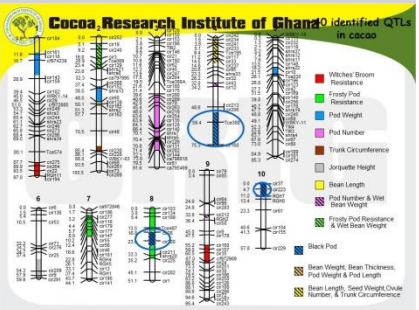
Introduction of marker assisted selection (MAS) technique

where two main maker types are considered to hasten breeding time. The markers are mainly used for,

- For (genetic finger printing) identification of planting materials
- For mapping or Identification of genes associated with black pod resistance or other trait..

Cocoa Research Institute of Ghana

10 identified QTLs in cacao



Cocoa Research Institute of Ghana

Identifying favourable alleles using SSRs

PRIMER	37		61		168		200		222	
SELECTION	Allele 1	Allele 2	Allele 1	Allele 2	Allele 1	Allele 2	Allele 1	Allele 2	Allele 1	Allele 2
Pound 7	139	146	196	206	174	174	238	240	218	220
PA 7	139	144	196	196	176	180	240	240	220	224
P 30	164	164	197	197	174	174	240	240	216	216
Pound 7 x P30	139	146	196	206	174	174	238	240	218	220
	164	164	197	197	174	174	240	240	216	216
PA7 x P30	139	144	196	196	176	180	240	240	220	224
	164	164	197	197	174	174	240	240	216	216

Cocoa Research Institute of Ghana

SNP Markers used for similar purpose

	field label	genotype	sample code	EST 47(CT)	W17s169(CT)	est0003(CT)	W3s463(CG)	W3s259(AG)	W8s119(CT)	W8s131(CT)	W8s204(CT)	TH 8s339(AC)	W7s104(AT)	W6s286(AG)	W3s41(GT)	W11s867(CT)
2																
3	std 15 r 3	pound 7 xp3(	TC11565	H	H	C	G	G	H	H	H	C	A	G	G	C
4	std 16 r 3	pound 7 xp3(	TC11566	H	T	C	H	H	H	H	H	C	A	G	G	T
5	std 19 r 3	pound 7 xp3(	TC11567	T	H	C	G	Ud	C	T	C	Ud	A	G	G	C
6	std 22 r 4	pound 7 xp3(	TC11571	T	H	C	G	G	H	H	H	C	A	G	G	C
7	std 21 r 4	pound 7 xp3(	TC11572	T	T	C	H	H	H	H	H	C	T	G	T	H
8	std 20 r 4	pound 7 xp3(	TC11573	H	H	C	H	H	H	H	H	C	A	G	G	C
9	std 19 r 4	pound 7 xp3(	TC11574	T	H	C	H	H	H	H	H	C	A	G	G	T
10	std 12 r 4	pound 7 xp3(	TC11580	H	H	C	G	G	H	H	H	C	A	G	G	C
11	std 11 r 4	pound 7 xp3(	TC11581	H	H	C	C	H	C	T	C	C	A	G	G	C
12	std 10 r 4	pound 7 xp3(	TC11582	H	T	C	G	G	H	H	H	C	A	G	G	T
13	std 8 r 4	pound 7 xp3(	TC11583	T	H	H	Ud	H	H	H	H	Ud	A	G	Ud	C
14	std 7 r 4	pound 7 xp3(	TC11584	H	H	H	H	H	H	H	H	C	A	G	G	C
15	std 5 r 5	pound 7 xp3(	TC11590	T	H	C	H	H	H	H	H	C	A	G	G	T
16	std 18 r 5	pound 7 xp3(	TC11767	T	H	C	H	H	H	H	H	C	A	G	G	T
17	std 22 r 6	pound 7 xp3(	TC11606	H	H	C	G	G	H	H	H	C	A	G	G	T
18																
19																
20	maternal	pound 7	TC11729	H	H	H	H	H	C	T	C	C	A	G	H	H
21	paternal	p 30	TC11738	T	T	C	G	G	T	C	T	C	A	G	G	C

Cocoa Research Institute of Ghana

Achievements

Certifed parents have been identified and are being used in further breeding trials or recommended for Seed Production Unit for multiplication and supply of improved planting materials to farmers.

Presently new potential male and female parents have been identified and will be released to the SPU to increase the number of existing parents or replace some parents

At the institute some potential parents for black pod disease resistance have been identified and crossed to most promising genotype tolerant to CSSVD to raise population for further molecular studies. It is expected that new hybrids that combine both Black pod and CSSVD tolerance traits will made available soon

Cocoa Research Institute of Ghana

About 10 female clones and four good male clones have been supplied to various seed gardens across Ghana for multiplication and distribution to farmers based on the need of the community

Parents supplied to various seed gardens may vary depending on the need of the community farmers.

Cocoa Research Institute of Ghana

Thank you

Maruca-resistant Cowpea Case Study

Dr IDK Atokple – Savanna Agricultural Research Institute (SARI), Ghana

Status of Maruca-Resistant Cowpea Project in Ghana

By

IDK Atokple

Presentation at the Second Workshop on Training the Media organized by B4FA , Accra, 13-16 March 2013

Maruca vitrata and its devastating effects

Importance of Maruca-resistant cowpea

- Minimizes yield losses (Yield loss due to Maruca is 30-80%)
- Reduces reliance on hazardous chemical - pesticides – (health and environment)
- Improves the nutritional value of the grains
- Overall cost of production reduced – increased profit margin.

Historical Perspectives

- IITA and NARS in West Africa dedicated over 30 years to cowpea research and development.
- Breeding for pest, disease and abiotic stresses
- Insect pests: Aphids, flower thrips, pod borers, pod -sucking bugs, bruchids.

Successful Genetic transformation – of Cowpea line (IT86D 1010) from Nigeria

Successful lines being hardened in the Screenhouse

Proof of Concept: Preliminary efficacy tests show that Bt cowpea protected from *Helicoverpa armigera*

Preparations of CSIR-SARI towards CFT of Pod-borer -Resistant Cowpea in Ghana

Legal Framework

- The passage of the Legislative instrument, LI 1887 and the Biosafety Act 831 of 2011 – has given the legal support for any research and subsequent release of GMOs in Ghana.

The proposed CFT has the following Objectives:

- To evaluate the efficacy of tested transgenic lines expressing the Bt (Cry1Ab) protein against *Maruca vitrata*.
- To evaluate the agronomic performance (e.g. germination rate, phenotype, grain yield etc.) of the transgenic cowpea lines vs. the non-transgenic lines.

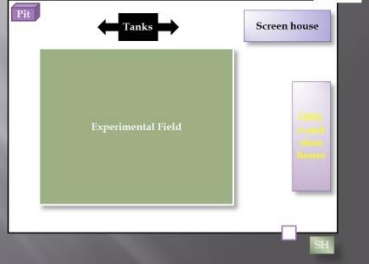
Objectives cont'd

- To initiate collection of preliminary data relevant to an environmental risk assessment that would be submitted to regulatory authorities as part of an application for field release.
- To transfer the resistant gene into the commercial cowpea lines for subsequent on-farm evaluations and release.
- No release is intended at this stage!!!!!!!!

Capacity Building of CSIR-SARI

- CSIR-SARI has completed the major constructions at the Confined field trial (CFT) site to the satisfaction of the NBC.
- Her research team and Institutional Biosafety Committee (IBC) are in place
- The research team and the IBC members have undergone some trainings organized by AATF, ABNE, FARA and ICBEG covering CFT management, biosafety regulations, stewardship and communications strategies of biotechnology research

Layout of the CFT site at SARI



Front view of Confined Field Trial Site, CSIR-SARI

SHIPPING AND STORAGE PRACTICES FOR GM COWPEA SEED

Packaging

Goal: **Prevention of accidental release and loss of material confinement**

- Primary container
- Secondary container
- Tertiary container
  - All independently sealable (preferably waterproof)

Packaging

Primary:
Metal cans, Plastic bottles, Plastic bags

Secondary:
Plastic or metal cans or boxes

Tertiary:
Any of the 2° or wooden boxes or crates

- Seeds of different varieties may be separated in sub-containers
- Preferable to ship non-GM seed separate from GM seed

Labeling

Labeling with sufficient information for:

- Identification of contents
- Contact details of official contact person

'Genetically Modified Plant Material for Research Purposes Only. Do Not Use for Food or Feed'

'Do Not Eat' Symbol

Retention of Packaging

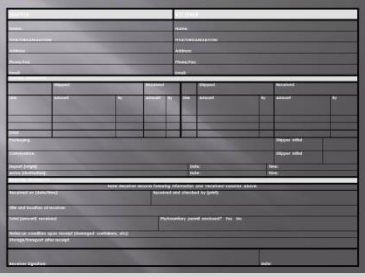
- Primary container and the labeling is used for storage of plant material
- Can be retained through the duration of the authorization period
- Disposal: incineration

Disposal of Packaging Materials

- Cleaning of primary container with sterilizing agent depending on container
- Disposal by burying, incineration, etc.
- Any breach of primary container requires destruction of secondary and tertiary packaging materials

Shipment and Receipt

Example of a Shipping Form



Shipment and Receipt

- Shipping form is record of transport and chain-of-custody documentation
- Additional inventory lists may be attached
- Recipient shall retain a copy of completed Shipping Form (and import permits, phytosanitary certificates, etc.)
- Copies of all documents should be retained in a file at the trial site and made available to regulatory authorities upon request

Receipt

- Complete recipient information on Shipping Form
- Verify that packaging is intact. Note any damage to containers in Shipping Form
- Verify that all listed items have been received
- If release of GM material suspected, the lead scientist and the trial manager should be notified immediately

Storage

- To preserve identity, security and integrity of GM plant materials
- To prevent consumption by humans or livestock
- To prevent unwanted release in the environment

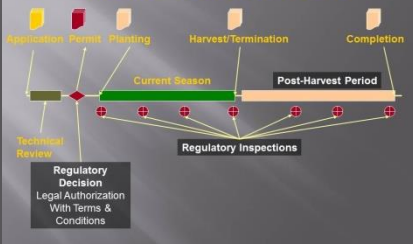
Storage Facility

- Restricted access to authorized personnel
- Sign-posted with 'GM Plant Material – Not for Use in Food or Feed'
- GM material to be kept separate from non-GM in the same facility
- GM material must be clearly marked or labeled to prevent misidentification
- Storage Inventory: Maintained and available for inspection by National Biosafety Office personnel

CFT Application and Seed Importation

- The CFT application to the National Biosafety Committe has been approved by the NBC in Nov 2012.
- The required corrections of the CFT Application have being effected for re-submission to the NBC.
- Need for import permit for CSIRO. Modalities are being finalized with the NBC and the PPRSD.

Confined trial process



3 critical control points for field trials

Aim to:

- Prevent dissemination of new genes into the environment (*i.e.,* prevent pollen flow)
- Prevent the persistence in the environment of the experimental biotech plants and progeny (*i.e.,* contain seed and planting material)
- Prevent introduction of the experimental material into livestock feed or human food pathways

Striga and Aphid Resistant Lines – Parentals for Introgression

Communications and Awareness Creation

- Workshops have been planned with AATF for awareness creation.
- The NBC is also planning joint awareness creation workshops with the project team specifically in the community where CFT will be carried out.
- Planting is anticipated in July/August, 2013.

THANK YOU FOR THE ATTENTION

RIce Breeding Case Study

Dr Maxwell Darko Asante – CSIR Crop Research Institute, Kumasi, Ghana

Breeding rice varieties in Ghana

Maxwell Darko Asante
CSIR-Crops Research Institute
mdasante@gmail.com

Outline

- Road to becoming a plant breeder
- What does plant breeding entail
- Rice breeding at CSIR-CRI
- My present work
- Concluding remarks
- Acknowledgement

My background

- "O" level @ Okuapemman school: 1985-1990
  - Best student in Agriculture
- "A" @ Presec-Legon:1990-1992
- BSc Agriculture @ UCC: 1993-1998
- Work @ CSIR-Crops Research Institute: 1998 to date
- MSc Plant breeding @KNUST: 2002-2004
- PhD Plant breeding @WACCI, UG: 2008-2012

Plant breeding

- Selecting a desired plant from a population
- The breeder will usually have to create the desired plant by combining valuable characters from two or more plants
- A group of diverse plants (germplasm) showing variation for various characters is therefore the greatest resource of the breeder

Genetic diversity

Without genetic diversity within a species, breeding becomes seriously handicapped

Different kinds of rice grains

Genetic diversity of sorghum (left) and millet (right)

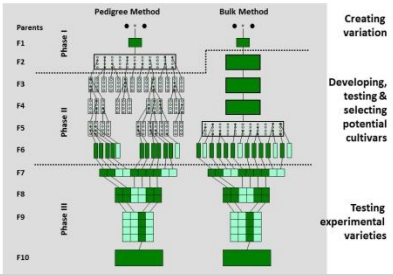
Making crosses

Two parents are crossed to combine the desired characters of both plants into one plant

Cutting flower open

Removing male portion of flowers

Pedigree Selection vs. Bulk Selection



Rice breeding@ CSIR-Crops Research Institute

Rice Varieties Released by CRI

Variety	Year of Release	Ecology
CRI-Amankwatia	2010	lowland
Wakatsuki	2010	lowland
Bodia	2010	lowland
Sakai	2010	lowland
Emo teaa	2009	Upland
Otoo mmo	2009	Upland
Sikamo	1997	Lowland/ Upland

CRI-Amankwatia

- Species: *Oryza sativa*
- Varietal type: Indica
- Year released: 2010
- Growing ecology: Lowland
- Days to 50% flowering: 80 – 85
- Maturity: 115 – 120 days
- Potential yield: 8.0 t/ha
- Resistance to blast: Tolerant
- Resistance to lodging: Good
- Grain shape: Long and slender
- Caryopsis color: White
- Milling yield (% White rice) : 70.4%
- Cooking quality: Good
- Aroma: Present

Wakatsuki

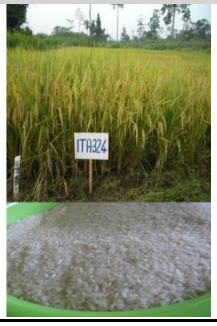
- Species: *Oryza sativa*
- Varietal type: Indica
- Year release: 2010
- Growing ecology: Lowland
- Days to 50% following: 93-98
- Maturity: 125 – 130 days
- Potential yield: 8.0 t/ha
- Resistance to leaf blast: Tolerant
- Resistance to lodging: Good
- Grain shape: Long and slender
- Caryopsis color: White
- Milling yield (%White rice): 66%
- Cooking quality: Good
- Aroma: Absent

Bodia

- Species: *Oryza sativa*
- Varietal type: Indica
- Year released: 2010
- Growing ecology: Lowland
- Days to 50% flowering: 90 – 95
- Maturity: 120 – 125 days
- Potential yield: 8.0 t/ha
- Resistance to leaf blast: Tolerant
- Resistance to lodging: Good
- Grain shape: long and bold
- Caryopsis color: White
- Milling yield (%White rice): 66%
- Cooking quality: Good
- Aroma: Absent

Sakai

Species: *Oryza sativa*
Varietal type: Indica
Growing ecology: Lowland
Year released: 2010
Days to 50% flowering: 95 – 100
Maturity: 135 – 140 days
Potential yield: 8 t/ha
Resistance to leaf blast: Tolerant
Resistance to lodging: Good
Grain shape: Long and slender
Caryopsis color: White
Milling yield (%White rice): 66%
Cooking quality: Good
Aroma: Absent



Otoo mmo

- Species: Oryza sativa
- Varietal type: Japonica
- Year released: 2009
- Growing ecology: Upland
- Days to 50% flowering: 80 – 85
- Maturity: 115 – 120 days
- Potential yield: 5.6 t/ha
- Resistance to blast: Resistant
- Resistance to lodging: Good
- Grain shape: Long and slender
- Caryopsis color: White
- Milling yield (%white rice): 66%
- Cooking quality: Good
- Aroma: Absent

Emo teaa

- Species: Oryza sativa
- Varietal type: Japonica
- Year released: 2009
- Growing ecology: Upland
- Days to 50% flowering: 75-80
- Maturity: 110 – 115
- Potential yield: 4.8 t/ha
- Resistance to blast: Resistant
- Resistance to lodging: Good
- Grain shape: Long and slender
- Caryopsis color: White
- Milling yield (%white rice): 65.6 %
- Cooking quality: Good
- Aroma: Absent

Sikamo

- Species: *Oryza sativa*
- Varietal type: Indica
- Year released: 1997
- Growing ecology: Lowland / Upland
- Days to 50% heading: 90 – 95
- Maturity: 120 – 125 days
- Potential yield: 6.0 t/ha
- Resistance to blast: Tolerant
- Response to drought: Tolerant
- Nitrogen use: High N use efficiency
- Grain shape: Long and slender
- Milling yield (white rice%): 68.4%
- Cooking quality: Good, high expansion ratio

My work@ CSIR-Crops Research Institute

Interactions with farmers' on varietal preference

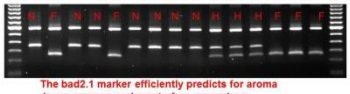
Maintaining and studying different rice types (germplasm)

Various rice types (accessions) growing in the field

Diversity within rice populations at CRI: Indica (green), tropical japonica (red), aromatics (yellow) and aus (blue)

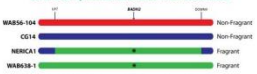
Research on aroma

Allele specific marker(bad2.1) for aroma segregating in an F2 population



The bad2.1 marker efficiently predicts for aroma in my crosses and most of my germplasm

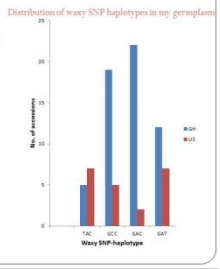
Aroma in Nerica 1 originates from WAB638-1 and not from its original parents, (WAB56-104 and CG14) which are both non-aromatic



Asante *et al.* (2010). *Molecular Breeding, 26, 419-424.*

Research on cooking quality

- Cooking quality of rice is controlled by starch properties
- Starch properties are influenced by the waxy gene
- Functional SNPs found in the waxy gene
  - In 1 G→T
  - Ex 6 A→C
  - Ex 10 C→T
- Four waxy SNP haplotypes:
  - TAC- low amylose(AC)
  - GCC- intermediate AC
  - GAC-high AC
  - GAT-high AC & RVA



Combining stress tolerance of Digang (RYMV, blast) with grain quality of Jasmine(aroma,taste)

Digang X Jasmine 85

Digang X F1

60 BC1F1

480 BC1F2

used SNPs to select for the background of Digang

Parents and F1

BC1F2 population

Selection of individuals from BC1F2 population

- Grain quality loci (aroma & AC) of Jasmine 85 selected using starch properties and marker data
- Seven plants selected based on the criteria:
  - >70% Digang background
  - presence of aroma (bad 2.1 allele)
  - amylose content 16-22%
- Selected plants will be backcrossed to Digang 2X

Development of varieties thro' Single Seed Descent and pedigree selection

- Crosses
  - Sikamo/Jasmine85
  - Digang/ IR70445-146-3-3(5)
  - IR71137-184-3-2-3-3(7)/ Sikamo
  - Bouake 189/ IR71137-184-3-2-3-3(7)
  - IET 6279 /IR70445-146-3-3(5)
  - Viowonor short/Jasmine 85

Conclusions

- Rice has become very important in the last two decades and consumption is overtaking more tradition crops
- The research at CRI is aimed at releasing high yielding rice varieties that are tolerant to the stresses in our environment and also have the preferred grain quality
- Modern molecular tools are being applied to improve the efficiency of breeding

Acknowledgements

CRI Rice Team
Mr. Ralph Bam
Mr. Henry Doku
Mr. George Acheampong
Dr. Kofi Dartey
Dr. E. Annan-Afful
Collaborators @ Cornell University
Dr. Susan McCouch
Jennifer Spindel
Financial support
AGRA/ WACCI

B4FA

F1 Hybrids

Dr Claudia Canales-Holzeis – Biosciences for Farming in Africa

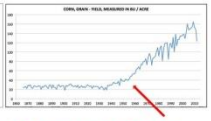
F1 Hybrids

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

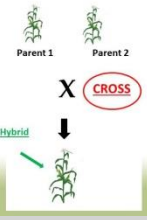


8-fold increase in maize yield thanks to:

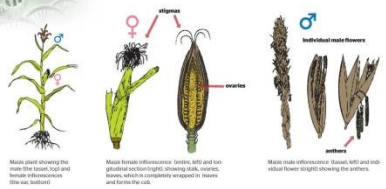
- F1 hybrids
- Fertilisers
- Mechanisation (tractors)

What is a maize F1 hybrid?

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



Maize reproduction



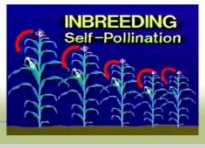
Each kernel is a genetically unique individual

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

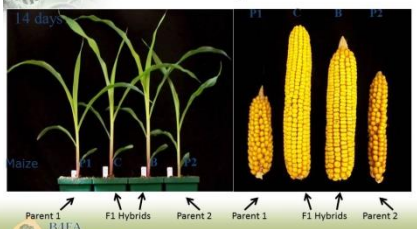
How do you make an F1 hybrid? Cont.

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

Maize F1 hybrids



Game introduction

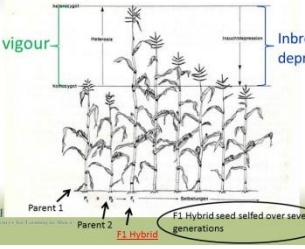
- F2 generation of hybrid seed – variability and consequences

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 fertilizer 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.

Hybrid vigour



Inbreeding depression

Parent 1

Parent 2

F1 Hybrid

F1 Hybrid seed selfed over several generations

F1 hybrid seeds vs landraces

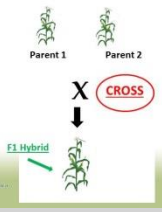
- Genetic uniformity can be a problem if the conditions are bad (such as extreme weather conditions, new pest or disease)
- Traditional landraces are genetically very variable, and hence more resilient, although yields are lower
- Landraces are invaluable sources of genetic diversity

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 seed game

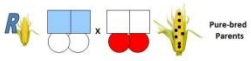
Dr IDK Atokple – CSIR Savannah Agricultural Research Centre, Tamale, Ghana

F1 hybrid game

"Saving Seed"

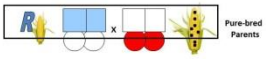
Hybridisation simulation

- We are pretending that yield of corn and insect resistance are both simple traits controlled by just one set of genes each – really they're much more complicated



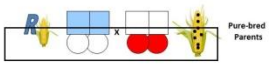
Hybridisation simulation

- Genes dictating insect resistance…

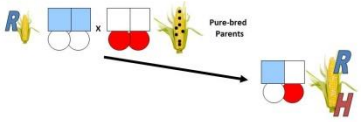


Hybridisation simulation

- Genes dictating yield…

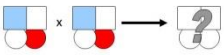


F1 generation

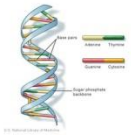


- All the seeds are the same, for planting next year, as we can see on the worksheets

But now let's save our seed…



- In the next (F2) generation, there is equal likelihood of getting the recessive or dominant gene from each parent, so we can draw our stickers out of each bag at random for each trait…
- What traits do your plants in the F2 generation exhibit? What about your neighbours'?



Journalism Skills – crafting a "top"

Sharon Schmickle – Journalist Mentor, USA

Genes: Out of the laboratory, into the news.

Sharon Schmickle
Media Fellowship Program
Biosciences for Farming in Africa
March-April 2013

Opening by connecting

"Shopping for food: we all do it, whether at the supermarket, or from traditional neighborhood shops, or in a market. It's the modern equivalent of what our ancestors would have done in long-gone hunter-gatherer days."

--Noel Kingsbury, opening lines in the introduction of *Hybrid: The History and Science of Plant Breeding*

Please come with me

- Open a door
- Extend a hand
- Lead the way

Speak to your audience

A story about crops might speak to:

- Farmers
- Policy makers
- Business leaders
- Consumers
- All of the above

Typical journal article

Tomato (*Solanum lycopersicum*) is a major crop plant and a model system for fruit development. *Solanum* is one of the largest angiosperm genera and includes annual and perennial plants from diverse habitats. Here we present a high-quality genome sequence of domesticated tomato, a draft sequence of its closest wild relative, *Solanumpimpinellifolium*, and compare them to each other and to the potato genome (*Solanumtuberosum*). The two tomato genomes show only 0.6% nucleotide divergence and signs of recent admixture, but show more than 8% divergence from potato, with nine large and several smaller inversions.

--Nature, 31 May 2012

Translation

What is your idea of a dream tomato? Women selling the juicy globes in the markets, no doubt, would wish for a slow-spoiling variety so that today's leftovers would sell tomorrow. Buyers, of course, would want luscious flavor. Growers would hope for fortification against yield-stealing pests.

The day when all of those wishes could come true has been advanced by news published online in the journal Nature: tomato's genome has been decoded. Now that scientists have the full genetic code of a common tomato, they have an unprecedented view of some 35,000 genes that make the tomato what it is.

-- Sharon Schmickle, B4FA web site

From technical jargon to common touch

Paul Karaimu covered a technical presentation at an "AgKnowledge Africa" fair in Ethiopia. Here is how he started his story:

Imagine using your mobile phone to connect to a voice site on the internet, to listen to your favourite blog or to search for information. According to IBM, this might be one of the ways we use the internet in the near future.

No, it will not replace the current technology that involves using a browser on your computer to search for what you need online, but the company is banking on a new voice-enabled internet platform that can provide information and services to millions over the phone, especially in the developing world's rural areas, where many people do not read and write and have no access to the internet.

-- From Science in Africa

Another approach: tell a story

RUSSIA'S greatest plant scientists died of starvation rather than eat their collection. . . . By 1941, the Soviet Union had established an enormous gene bank of plants containing 187,000 varieties at the Institute of Plant Industry in Leningrad (now St Petersburg). When the city was blockaded by the Germans, so important was the collection some of the scientists gave their lives to save it.

By January and February of 1942, temperatures had fallen to record lows of minus 36-40 degrees. Workers, numb with cold and emaciated from hunger, struggled to save the collection while bombs pounded nearby. And as the citizens of Leningrad began to starve, so did the plant scientists. . . . Around them were collections of peas, rice, corn and wheat.

--The Economist, 6 August 2010

Try extending your own hand

- Identify the audience for your article
- Craft beginning paragraphs that speak to the audience
- Share your creation

Now what?

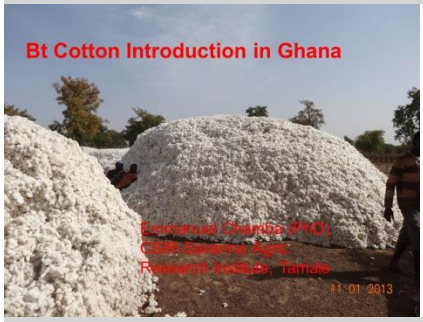
Your invitation was accepted.
Now you must deliver the full story with

- Accuracy
- Clarity
- Fairness

Thank You

Bt Cotton Case Study

Dr Emmanuel Chamba – CSIR Savanna Agricultural Research Institute (SARI), Tamale, Ghana



Presentation Outline

- General Introduction
- Objectives of presentation
- Major Cotton Insect Pests and control
- Bt Cotton
- Bt introduction consultations
- Bt Cotton Experimentation in Ghana

General Introduction

- Cotton *(Gossypium hirsutum)* is an important cash crop in northern Ghana
- Additional source of income
- Employment to farmers and their families.
- Farmers have the added benefit of using residual fertilizer for the production of maize and striga (witch weed) control in a rotation regime.

- Despite the importance of cotton in Ghana, seed cotton yield remains very low
- Less than 700 kg/ha

Ghana Seed cotton production 1995 – 2010

Company/year	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	03-04	05-06	06-07	07/08	08/09	09-10
GCCL	11.113	15.070	20.249	24.100	22.379	18.985	8.410	6.764	7.295	12.756	20.627	12.700	12.600	7.900	
PDL	3.419	4.505	6.499	8.414	5.652	2.394	2.109	1.165	719	1.954	1.992	NA	NA		
NWJJV	1.670	2.150	3.085	1.800	4.050	4.210	1.340	1.949	1.592	1.901	2.205	NA	NA		
OTHERS	1.321	2.950	3.950	4.970	4.374	5.535	2.112	1.806	1.220	1.659	651	NA	NA		
TOTAL	17.723	24.705	33.803	39.300	36.455	31.016	13.979	13.627	10.834	18.312	25.679	12.700	12.600	7.900	2.500

Source: Diagnostic Study of the Cotton Sector in Ghana SOFRECO GLG Consultants

Current Situation

- GOG having recognized the fact that Ghana's production potential, took a bold decision to adopt a revival strategy in November 2010,
- GOG entered into transitional concession contract with three companies

Seed cotton production 2010 - 2011

Company name	Area sown (Ha)	Expected Yield (kg/Ha)	Expected volume of Seed cotton(Mt)
Wienco Cotton	7,000	900	6 300
Olam Gh Ltd	10,000	900	9 000
ARMAJARO Ghana Ltd	6000	700	4 200
Total	23,000	2,500	19,500

Source: cotton companies

Objectives of Presentation

- Why the need for Bt cotton in Ghana
- The consultations to get bt cotton in Ghana
- The type of experimentation

Cotton and Insect Pests

- Crop damage caused by insect pests has become a major issue confronting the West Africa cotton sector, which has been a contributing factor to the stagnation and recent cotton yield declines in the region

- The larva of *Helicoverpa armigera* (cotton bollworm, is the main cotton pest in Burkina Faso and throughout West Africa
- On unprotected fields, Burkina Faso researchers claim that insect pests can damage up to 90% of the cotton crop

- Insects have traditionally been a threat to sustaining cotton production
- Insects attack cotton throughout the growth stages
- They may attack the leaves, soft stems, squares (flower buds), bolls and the seed inside bolls
- Control of these insects is necessary to obtain improved yield and income

Major Insect pests of cotton

- For purposes of this presentation , the major pests will be as classified as
  - ✓Sucking pests
  - ✓Bollworm complex

Sucking Insect Pests

- Sucking insects
  - ✓Jassids (Leafhoppers)
  - ✓Aphids
- Boll-sucking Insects
  - ✓Cotton stainer
  - ✓Other bugs

Jassids (Leafhoppers)

- **Both nymphs and adults feed on the plant sap**
- **Attack cotton seedlings and new shoots but prefer to feed on the upper surface of mature leaves from flowering onwards causing stippling effect on leaves**
- **Heavy feeding results in "hopper burn" which is caused by the toxic effect of the insect saliva**

Aphids

- Aphids are slow-moving, soft-bodied sucking insects.
- Found on the undersides of leaves or feeding on the terminals and other parts of cotton plants.
- Significant damage may occur during dry weather
- Are easily washed off during rainy periods

Cotton stainer, *Dysdercus* spp.

- Both the nymphs and adults piece the seeds and their excreta also stain the lint

Bollworm complex

- Bollworm complex comprise such as
  - ✓Spiny bollworm
  - ✓Red bollworm
  - ✓Pink bollworm
  - ✓American bollworm

Spiny bollworm, *Earias* spp.

- The caterpillar is greyish with black dots and spines
- It bores into tender shoots, flower buds and fruits causing the shoots to break or dry while flower buds & fruits drop prematurely

The Red bollworm, *Diparopsis* spp.

- This worm characteristically attach the flower bud on which they are feeding by a silken thread

Damaged square

Flared square

American bollworm *Helicoverpa armigera*

Pink bollworm, *Pectinophora gossypiella*

- Larvae bore into green bolls feeding internally and to a lesser extent into squares and flowers
- This results in damaged lint due to feeding and the entry of boll-rotting fungi

General Management Practices

- Control of cotton insect pests in Ghana relies solely on insecticides
- Varied cocktails of insecticides are used
- **TIHAN, POLYTRIN C, THUNDER, CALIPHOS 720 EC, KD 415 EC, Armaphos, CONQUEST C 88 EC, Chemaprid**

Problems with Insecticide Use

- Continuous cotton cultivation leads to pest build up and consequently high pest pressure
- An average of 6-8 sprays in a season
- Pest resistance to insecticides

- Insecticides are expensive and detrimental to the farmer and the environment
- Farmers attitude towards insecticide use(spraying, protection and containers)
- Decrease in seed cotton yield

Bt Cotton

- Bt is *Bacillus thuringiences*- bacteria in the soil
- Genetic engineering techniques were used to insert genes into cotton that encode and promote the production, within the plant, of proteins toxic to certain lepidopteran insect pests of cotton, esp. the bollworm complex
- Genes originate from bacterium *Bacillus thuringiensis (Bt)*

Bollguard II (BG II)

- In BG II (seed for Ghana), contains the proteins, Cry1Ac and Cry2Ab2, .
- Once ingested, the Cry proteins bind to specific molecular receptors on the lining of the caterpillar's gut, create holes in the gut, and quickly cause death

- Individual Bt Cry proteins are highly specific to some insects and do not target other insects unlike conventional pesticides, many of which kill across a wide spectrum of both targeted and non-targeted (sometimes beneficial) insects.
- Sucking are sprayed (2x) when BG II is grown

Merits of Bt Cotton

- ❖Reduction in the number of sprays(6 to 2)
  - Herbicide injury – 75% inhalation and 12% spillage on the body (Burkina)
- ❖Time savings
- ❖Incremental yield (21.3% mean of 6 yrs of on-station/farm research)

2012/13 target 532,000 tons seed cotton

Yield realised 630, 000 tons seed cotton

Burkina Faso cotton output soars 57.5 pct due to GMOs -producers

OUAGADOUGOU | Thu Jan 31, 2013 12:00pm EST

Jan 31 (Reuters) - Cotton production in Burkina Faso, one of the first countries in Africa to approve genetically modified cotton, jumped 57.5 percent in 2012-2013 due to an increase in GMO crops, the producers' association said.

Output for the year to end-January 2013 rose to 630,000 tonnes from 400,000 tonnes in 2011/2012 and exceeded the association's expectations for 532,000 tonnes, the Burkina National Cotton Producers' Union (UNPCB) said on Thursday. Burkina Faso, which relies on cotton as one of its major exports, approved the planting of Monsanto's Bt cotton GMO variety in 2008.

"Genetically modified cotton production is experiencing growth every year," said Karim Traore, UNPCB president.

Bollguard II Commercial Production

- ❖USA since 2003
- ❖South Africa since 2004
- ❖Australia since 2006
- ❖Burkina Faso 2008

BG II introduction in Ghana- Meetings

- UNIDO in cooperation with (GoG): (MOTI), (MOFA), (MESTI) organised an expert group meeting on "Improving the competitiveness of cotton in Ghana".
- To create public awareness on suitable options to increase cotton productivity including the benefits of biotechnology derived insect tolerant and herbicide tolerant cotton
- To assist the GoG in making an informed decision whether or not to adopt insect/herbicide tolerant cotton, based on the current scientific facts, as well as an exposé on the benefits, lessons learned and experiences of farmers from countries already producing Bt-cotton. (June 11-12, 2012 at Alisa Hotel Accra)

- UNIDO Bt consultant cotton stalk holder consultations in the three northern regions (June 24 –July 6, 2012)
- Cotton Scientist interaction with Burkina counterpart (INERA) in Burkina Faso, January 6-16, 2013
- Cotton scientist interaction with Monsanto staff in Burkina (February 14, 2013

Confined Field Trials (CFT)

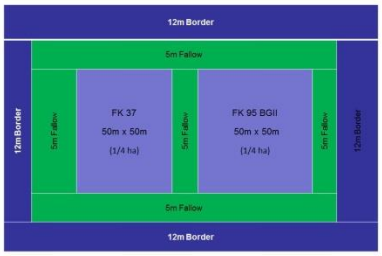
- No on-Station CFT for BGII in Ghana (1st)
- Similar cotton growing environment with Burkina Faso. Rely on Burkina data.
- About 80% of cotton grown in Ghana are from BF and convention version of BGII
- Farmers along the BF border with Ghana
- Demonstrations on farmers field under the strict supervision of SARI cotton scientists

Experiments

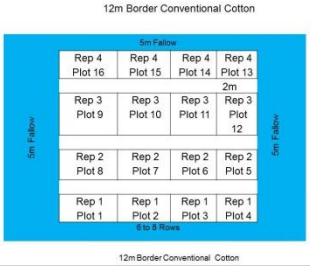
Two types of experiments:

- Determine the efficacy of BGII in Ghana under farmer management. On the farmer's field at 10 locations in the three cotton zones
- Determine the effectiveness of the BGII insect control system (replicated experiment at one site –SARI)

Experimental design for demonstration trials



Experimental design for insect control trial



Spraying regimes for insect control trial

TREATMENT NO:	VARIETY	INSECTICIDE APPLICATIONS
1	FK 95 BGII	Sprayed bollworms Spray sucking pest
2	FK 95 BGII	Unsprayed bollworms Spray sucking pest
3	FK 37 (Near Isogenic version)	Spray bollworms Spray sucking pest
4	FK 37 (Near Isogenic version)	Unspray bollworms Spray sucking pest

Data to collect

- Weekly scouting for insect pests (all types)
- Gene flow studies
- Seed cotton yield
- Fibre characteristics

Also,

Socioeconomic data before trials and after commercialisation (if accepted)

Cotton Producing Companies Role

- The three cotton producing companies are in favour of the demonstrations
- Each company to selection three testing locations/farmer from their zone
- SARI will conduct one demonstration at Nyankpala. Ten locations in total
- SARI will also conduct one replicated experiment

Preparations for Experiments

- Application for permit to conduct Bt cotton approved by the Institute Biosafety Committee (IBC)
- Will be submitted for by approval by the National Biosafety Committee (NBC) at 12.00 noon today
- Other arrangements in place pending NBA approval

Other Activities

- Training – biosafety requirements
  - Field staff – SARI and Cotton companies
- Field Days
  - All stake holders in cotton industry, Politicians
  - and Journalist

Cassava Mosaic Disease Case Study

Dr Paul Asare – Department of Crop Science, University of Cape Coast, Ghana

Characterization and screening for Cassava mosaic disease (CMD)resistance

Paul. A. Asare (Ph.D)
Department of Crop Science
U. C. C

Outline of presentation

- Introduction
- Objective
- Materials and method
- Results
- Conclusion
- Some breeding work at UCC

Introduction

- Cassava (*Manihot esculenta*)
  - Is one of the world's most important tropical plants
  - The fifth source of carbohydrate in the tropics
- Contributes 22% of the total Agriculture Gross Domestic Product (AgGDP) (Parkes 2009)
- It is also a source of income for most rural dwellers.

Objectives of the study

- The objectives of the study were:
  - to characterize the various accessions using morphological descriptors and molecular markers.
  - to screen for mosaic resistant accessions.

Materials and methods

- Forty three (43) different cassava plants (accessions) were used
- Land preparation
  - A portion of land, at the School of Agriculture Teaching and Research farm, was cleared, ploughed and harrowed
- Planting of cassava accessions
  - Single row planting method of 1m x 1m length was used.
  - Ten cuttings for each accession.

Morphological Characterization

- The accessions were first characterized base on morphological descriptors (IITA, 1990).
- Both qualitative and quantitative data were taken on shoot and root morphology
- Data collection started six weeks after planting through to 12 months after planting (MAP).

Molecular Characterization

- DNA extraction was done using the CTAB protocol I (Murray and Thompson 1990).
- DNA quality and quantitation was done using spectrophotometer.
- DNA was stored at -20°C.

Molecular Characterization cont'd

- PCR Amplification
  - PCR amplification was carried out using 36 pairs of cassava SSR primers
  - hPAGE was used
  - Documentation
  - 20 SSR primers that produced clear bands were used for the analysis

Results

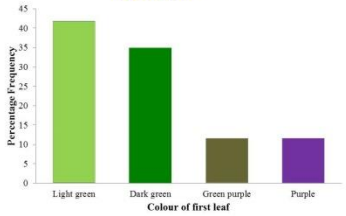


Fig. 1 Distribution of first leaf colour in cassava germplasm

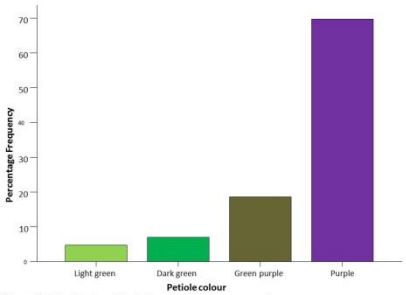


Figure 2: Distribution of petiole colour in cassava germplasm

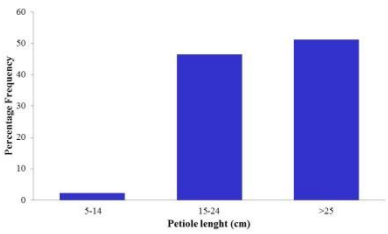


Figure 3: Distribution of petiole length in cassava germplasm.

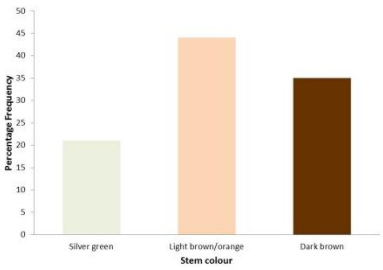


Figure 4: Distribution of stem colour in cassava germplasm.

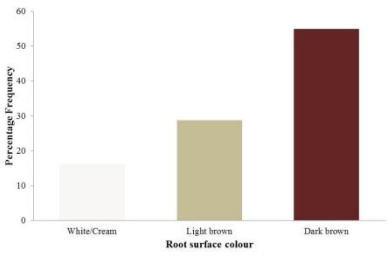


Figure 5: Distribution of root surface colour in cassava germplasm.

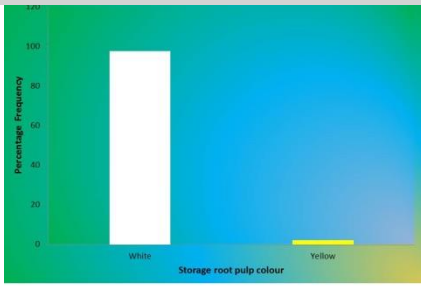


Figure 6: Distribution of storage root pulp colour in cassava germplasm.

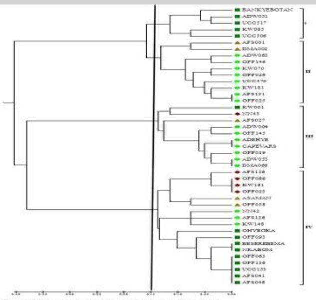


Figure 7: Dendrogram of cassava accessions based on morphological data

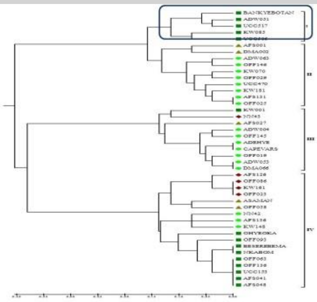


Figure 7: Dendrogram of cassava accessions based on morphological data

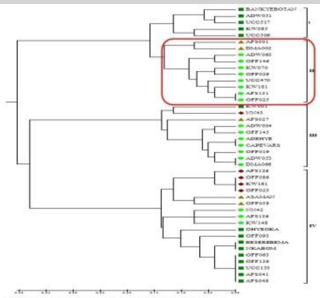


Figure 7: Dendrogram of cassava accessions based on morphological data

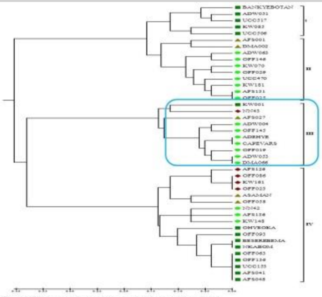


Figure 7: Dendrogram of cassava accessions based on morphological data

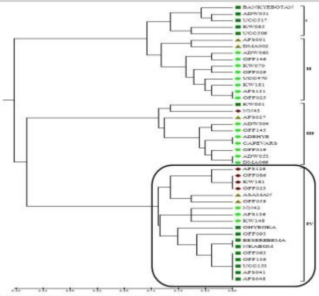


Figure 7: Dendrogram of cassava accessions based on morphological data

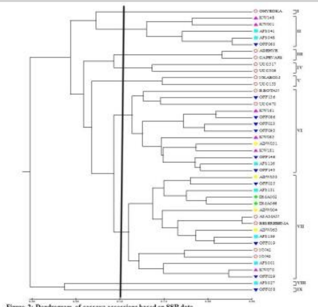


Figure 2: Dendrogram of cassava accessions based on SSR data

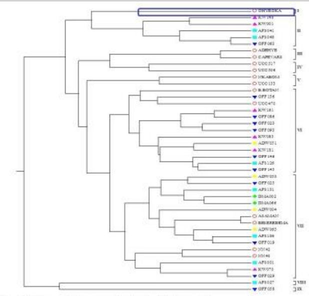


Figure 2: Dendrogram of cassava accessions based on SSR data

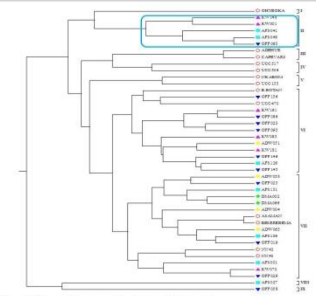


Figure 2: Dendrogram of cassava accessions based on SSR data

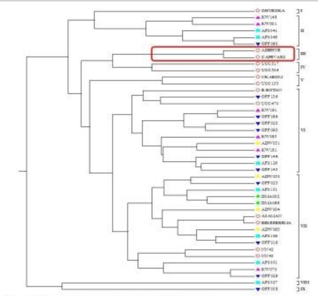


Figure 2: Dendrogram of cassava accessions based on SSR data

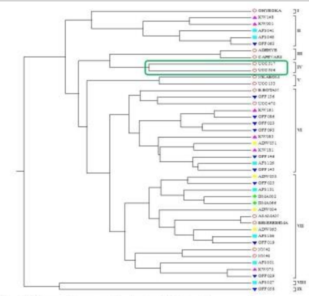


Figure 2: Dendrogram of cassava accessions based on SSR data

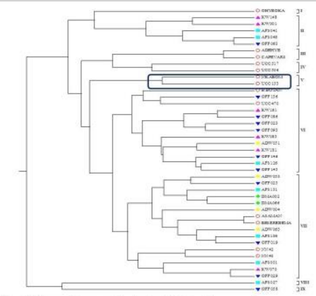


Figure 2: Dendrogram of cassava accessions based on SSR data

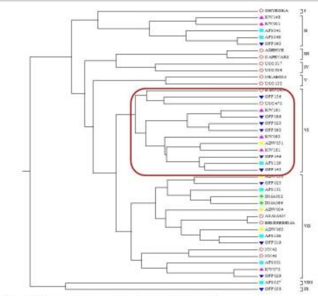


Figure 2: Dendrogram of cassava accessions based on SSR data

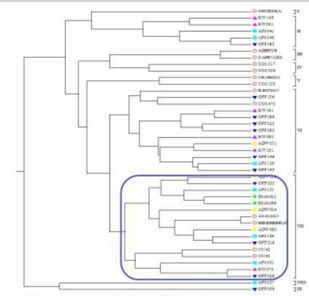


Figure 2: Dendrogram of cassava accessions based on SSR data

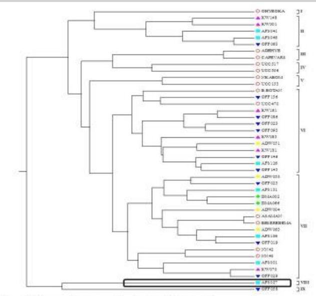


Figure 2: Dendrogram of cassava accessions based on SSR data

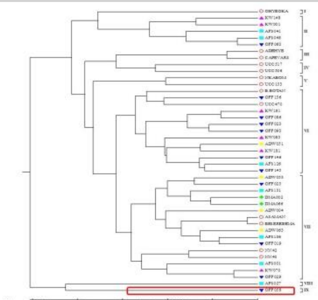
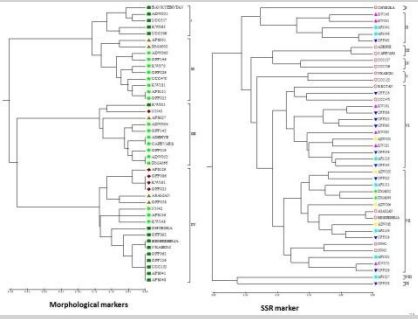


Figure 2: Dendrogram of cassava accessions based on SSR data



Marker Assisted Selection

- Laboratory screening.
  - Six (6) pairs of CMD diagnostic primers were used to check for the various strains of the virus
  - Four (4) pairs of primers associated with resistant (*CMD2* gene) to the virus were used.

Lab. Screening…cont'd

- PCR amplification

Table 2: *Nucleotide sequences of DNA primers used in polymerase chain reaction for the detection of cassava mosaic begomovirus*

Virus	Name of primer		Sequence (5' to 3')
ACMV	ACMV-F1	(P_1)	TTC AGT TAT CAG GGC TCG TAA
	ACMV-R1		GAG TG AAG TTG ACT CAT GA
	ACMV-F2	(P_2)	GTG AGA AAG ACA TTC TTG GC
	ACMV-R2		CCT GCA ATT ATA TAG TGG CC
	ACMV-AL1F	(P_3)	GCG GAA TCC CTA ACA TAA TC
	ACMV-ARO.R		GCT CGT ATG TAT CCT CTA AGG CCT
	ACMV-1	(P_5)	GCTC AAC TGG AGA CAC ACT TG
	ACMV-2		CCT GCA ACA TAC TTA CGC TT
EACMV/EACMV	UV-AL1F	(P_4)	TAC ACA TGC CTC RAA TCC TG
	UV-AL1F1		CTC CGC CAC AAA CTT ACG TT
EACMV-Ug	UV-AL1F1	(P_6)	TGT CTT CTG GGA CTT GTG TG
	ACMV-CPR3		TGC CTC CTG ATG ATT ATA TGTC

Harrison et al. (1997) and that of Zhou et al. (1997)

CMD2 markers were SSRY28, NS156, NS169 and RME1 *(Akano et al., 2002; Fregene et al., 2001)*

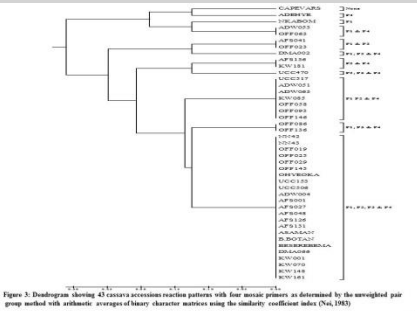


Figure 3: Dendrogram showing 43 cassava accessions reaction patterns with four mosaic primers as determined by the unweighted pair group method with arithmetic averages of binary character matrices using the similarity coefficient index (Nei, 1983)

Conclusion

- The 43 cassava accessions used were genetically variable and clustered into groups not necessarily based on the source of collection.
- Molecular markers were more efficient in distinguishing the 43 accessions into 9 clusters, compared to morphological markers, which grouped them into 4 clusters
- The only CMG strain responsible for the disease symptoms in the study area was ACMV.

Conclusion cont'd

This study identified only one genotype (Capevars) as resistant to the cassava mosaic disease CMD.

Some plant breeding work at UCC

- Cassava germplasm collection – Central & Western Regions
  - 516 accessions from 23 districts
  - Through conventional breeding 2 varieties were released to farmers
- Characterization of water yam accessions using both morphological and molecular techniques.
- Molecular characterization of Ghanaian Avocado pear
- Screening work
  - Striga resistance in cowpea
  - Drought resistance in cowpea
  - Drought resistance and 'stay green' trait in sorghum
  - Blight tolerance/resistance in taro

Pineapple Tissue Culture Case Study

Dr Kenneth Danso – Biotechnology and Nuclear Agricultural Research Institute (BNARI), Ghana

Pineapple Tissue Culture

K.E. Danso
Biotechnology and Nuclear Agriculture Research Institute,
P. O. Box LG 80, Legon, Accra
Ghana
kaedanso@hotmail.com

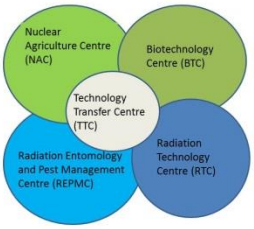
BNARI'S BIOTECHNOLOGY EXPERIENCE

Mission
BNARI exists to carry out research and development activities on safe applications of biotechnology and nuclear science and transfer these technologies to end-users in order to enhance agricultural productivity, health delivery and industrialization.

Vision
Leading public institution that providing solutions to challenges in agriculture, health and industry through scientific knowledge in biotechnology and nuclear science.

Biotechnology and Nuclear Agriculture Research Institute

Research Centres



Research activities

- Mutation induction
- Conventional hybridisation
- Genetic transformation
- Improving regeneration efficiency in food, tree and medicinal plants
- Water use efficiency
- Soil management studies
- Medical sterilisation
- Food preservation and extension of shelve life
- Control of pest and diseases using SIT

Other activities

- Training of students
- Farmers

TRAINING OF STUDENTS AND INTERNATIONAL FELLOWS

Scientists from Africa at a practical section

Focused crops

Food crops
- Cassava
- Plantain/
- Banana
- Yam
- Sweetpotato

Tree crops
- Shea tree
- Bamboo

Medicinal Plants
- *Phyllantus*
- *Cryptolepis*
- *Afromomum*

Limitations of conventional propagation

- Pineapple (*Ananas comosus* L. Merr.) is vegetatively propagated
- Have long propagation cycle about 18 months
- Unexpected or sporadic natural flowering
- Seeds cannot be used for propagation
- Often associated with systemic viral, fungal and bacterial diseases
- Mature at different times because they are not uniform

Why pineapple tissue culture?

- Rapid multiplication
- All year round production
- Disease elimination
- Production of uniform planting materials
- Germplasm conservation and exchange of plant genetic resources
- Prerequisite for genetic modification
- Enhance improvement of the crop

Methodology

Explants for culture

- slips,
- suckers,
- crowns
- ratoons
- leaves

***Crowns* are the preferred planting material since they have the potential to develop better root systems in some countries. For tissue culture slips are the most preferred**

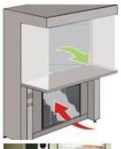
Explant Selection

The planting (explant) to be cultured is usually taken from a healthy and vigorously growing ideally from the glasshouse.

- suckers or buds at the base of the leaves
- slips found at the base of the fruit.

Caution:

Buds must not be opened at the time of collection due to high microbial load on the explant.

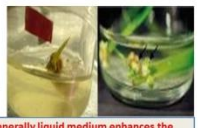


Sterilization of explants

Explants
↓
Running tap water
↓
Trim explants
↓
Transfer to Flow chamber
↓
Wash with sterile distilled water
↓
Immerse with sodium hypochlorite Or 0.1% mercuric chloride
↓
Rinse three times in SDW
↓
Initiate on a pineapple culture medium

Culture medium

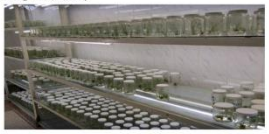
- Murashige and Skoog (1962) basal salt
- 30 g/l sucrose
- 100 mg/l myo-inositol
- 4.5 mg/l BAP
- 0.75 mg/l NAA
- Gamborg B5 vitamins
- pH 5.8
- autoclave 3.5 mg/l phytagel
- autoclaving at 121ºC for 15 minutes



Culture medium may be solid or liquid. Generally liquid medium enhances the production of more plantlets than solid but liable to contamination.

Incubation conditions

- Photoperiod: 16/8 hours day/light
- Temperature: 25-28ºC
- Light intensity 3,500-4,500 lux
- High humidity



Subculture

- Splitting them into two equal halves
- Each half is transferred onto fresh MS medium supplemented with BAP and NAA but at slightly lower concentrations than he initiation medium.
- Well developed shoots without roots are transferred onto the same medium for proliferation

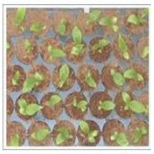
Rooting

- MS medium with lower concentration of BAP
- relatively higher concentration of NAA or IBA or a combination of NAA and IBA.
- Root development occurs within 4-8 weeks depending on the auxin in the culture medium.

16

Acclimatisation

- **Shoots with roots are transferred to the greenhouse or the plant barn**
- **Gently remove plantlets from the culture vessels**
- **Washed off any phytagel adhering to roots**
- **Transfer to loamy soil mixed with cow dung or coconut husk (vermiculite or jeffy peat pellets can be used)**
- **Water of MS solution**
- **Cover with Watson module/plastic cup to create high humidity.**
- **Plastic cups are removed after four**



17

Acclimatisation

18

Field transfer

- **Successfully weaned plantlets are transplanted on the field**
- **Plantlets will do well depending proper agronomic practices**

20

BNARI'S Role in the pineapple Industry

- Significant role in the change over from growing smoot cayene and sugar loaf to MD2 at the international market
- Supplying of planting materials to individual farmers
- And some companies outside Ghana

Thank you

21

Agricultural Biotechnology and the Regulatory Environment

Prof Josephine Nketsia-Tabiri – National Biosafety Committee, Ghana

AGRICULTURAL BIOTECHNOLOGY AND THE REGULATORY ENVIRONMENT

Prof. Josephine NKETSIA-TABIRI

Member, National Biosafety Committee

B4FA 13-16/3/2013 RR 1

Outline of Presentation

- Introduction
- Convention on Biological Diversity and the Cartagena Protocol on Biosafety
- National Policy on Biotechnology /Biosafety
- Regulation of Modern Biotechnology in Ghana
  - Development of National Biosafety Frameworks
  - L.I. 1887 Biotechnology Regulation 2007
  - Biosafety Law 831:2011
- Conclusions

B4FA 13-16/3/2013 RR 2

Introduction

- Convention on Biological Diversity (CBD) 29 Dec 1993
- International Instrument for addressing biological diversity issues.
- provides a comprehensive approach to the conservation of biological diversity, the sustainable use of natural resources and the fair and equitable sharing of benefits deriving from the use of genetic resources.
- Recognizes the need for appropriate procedures to enhance the safe exploitation of biotechnology.

B4FA 13-16/3/2013 RR 3

Introduction

- Cartagena Protocol on Biosafety to the CBD - Ghana ratified 30 May 2003
- A legally binding international protocol for the transboundary movement of products of modern biotechnology.

- National Biosafety Committee set up and mandated to develop guidelines for safe application of modern biotechnology in Ghana.

B4FA 13-16/3/2013 RR 4

Introduction

- A **National Policy on Biotechnology /Biosafety**

National Science, Technology & Innovation Policy (2010): *On Increasing Agricultural productivity*
".....promote the research and application of new technologies including safe biotechnology, which hold potential for increasing productivity"

Guided by Ghana's 1992 Constitutional obligation to promote agriculture and industry and at the same time ensure protection of the environment and our natural resources [Art. 36 (9), 41 (k)].

B4FA 13-16/3/2013 RR 5

Regulation of Agric Biotechnology in Ghana

- **Development of National Biosafety Framework**
- A National Policy on Biotechnology/Biosafety
- A regulatory system to address safety in the field of modern biotechnology (incl. Biosafety Act, Reg.)
- An administrative system to handle requests for permits (lab work, field releases of LMOs & products)
- A decision making system that includes Risk Assessment and Management of LMO releases
- Mechanisms for public participation and information sharing

B4FA 13-16/3/2013 RR 6

Regulation of Agric Biotechnology in Ghana

- **Development of National Biosafety Framework**
- Surveys/Information gathering **(need new Law etc?)**
- National Stakeholders workshops
- Nationwide Awareness Creation Workshops (general public, farmers, industrialists, students, parliamentarians, policy implementors, researchers, radio discussions etc)
- Technical Consultations
- Preparation of National Biosafety Framework Docs

B4FA 13-16/3/2013 RR 7

Regulation of Agric Biotechnology in Ghana

- **Development of National Biosafety Framework**

References (2003)

1. Survey Report on Programmes for Safe Use of Biotechnology/Biosafety and Existing Status of Biotechnology and LMOs in Ghana.
2. Survey Report on Existing Legislation and Legal Instruments Related to Biotechnology in Ghana.
3. Regional Mechanisms for Harmonization of Biosafety Activities – A Survey Report.
4. National Biosafety Framework for Ghana - Administrative guidelines

B4FA 13-16/3/2013 RR 8

Regulation of Agric Biotechnology in Ghana

- **Development of National Biosafety Framework**

5. **National Biosafety Guidelines. Part I, II & III**
   Part I Introduction to Biosafety Guidelines
6. **Part II Guidelines for Laboratory & Field Work**
7. **Part III Movement of Regulated Materials & Commercial Releases**
8. **Guidelines on Public Participation, Information Sharing and Access to Justice with Respect to GMOs.**
9. **National Biosafety Framework for Ghana**
10. **Biosafety Bill**

B4FA 13-16/3/2013 RR 9

Regulation of Agric Biotechnology in Ghana Biosafety References (2003)

B4FA 13-16/3/2013 RR 10

Regulation of Agric Biotechnology in Ghana

- **L.I. 1887**
- Legislative Instrument, LI 1887 was passed on 30 Nov 2007

Biosafety (Management of Biotechnology) Regulation

- Permit contained and confined field trials
- Does not cover commercial releases

B4FA 13-16/3/2013 RR 11

Regulation of Agric Biotechnology in Ghana

- **Biosafety Law 831**

Biosafety Law 831 came into force on 31 Dec 2011

- Provisions of Act 831
- Section 40 (2) Until Regulations are made under .....the Biosafety (Management of Biotechnology) Regulations, 2007 (L.I. 1887) shall continue in force as if made under this Act.
- L.I. 1887 Biosafety Regulations currently being revised to address all the provisions under Act 831.

B4FA 13-16/3/2013 RR 12

Regulation of Agric Biotechnology in Ghana

- **Biosafety Law 831**
- Scope, Objectives and Establishment (art. 1 – 5)
- Administration (art. 6- 10)
- Handling of Requests for Approvals (art. 11 - 23)
- Reviews and Approvals (art. 24 - 26)
- Technical Advisory Committee (art. 27 - 30)
- Regulatory agencies (art. 31 -32)
- Inspections (art. 33 – 34)
- Finance (art. 35 – 39)
- Miscellaneous (art. 40 – 44)

B4FA 13-16/3/2013 RR 13

Regulation of Agric Biotechnology in Ghana

- **Biosafety Law**
- **Scope**
- regulates all biotechnology activities including contained and confined use, releases into the environment and placement in the market, export, import and transit of GMOs.

- Not applicable to GMOs that are pharmaceuticals for human use.

B4FA 13-16/3/2013 RR 14

Regulation Agric Biotechnology in Ghana

- **Biosafety Law 831**

Objectives

(1) Ensure adequate level of protection in the field of safe development, transfer, handling and use of GMOs resulting from biotechnology that may have adverse effect on health and the environment.

(2) To establish a transparent and predictable process to review and make decisions on GMOs specified under the scope of the Act and related matters

B4FA 13-16/3/2013 RR 15

Regulation Agric Biotechnology in Ghana

❑ **Establishment of the National Biosafety Authority**

Functions

- To receive, process, respond to and to make decisions on applications under and in conformity with this Act.
- To establish administrative mechanisms to ensure the appropriate handling and storage of documents and data in connection with the processing of applications and any other matter covered by this Act
- To promote public awareness, participation and education concerning the activities of the Authority.

Regulation Agric Biotechnology in Ghana

❑**Governing Body**

experts in biotechnology and related sciences incl. biosafety

- Chairperson of TAC
- One rep Ministry responsible for Science
- One rep AGI
- One legal practitioner
- One rep NGOs
- Two rep from Academia
- One rep CSIR
- One rep MOFA
- One rep MoH
- One rep Customs-GRA
- Chief executive officer

Regulation Agric Biotechnology in Ghana

❑**Handling of requests for approval -**

- ❖Application for Contained or Confined use (art. 11)
- ❖Introduction into the environment (art. 12)
- ❖Import or place on the market (art. 13)
- ❖Export (art. 14) - Advance Informed Agreement
- ❖GMOs in Transit (art. 15)
- ❖*Gazette* publication (art 18) and also avail portions of application to persons on request
- ❖Risk assessment and Risk management (art. 19)

Regulation Agric Biotechnology in Ghana

❖**Determination of the application (art.21)**

- ✓information submitted by applicant
- ✓Risk assessment report
- ✓Relevant comments submitted by the public
- ✓Socio-economic considerations arising from impact of the proposed activity and the GMO on the environment. (Clear definition and application)

Regulation Agric Biotechnology in Ghana

❖**Communication of decision (art. 22)**

- ✓ not later 180 days after receipt of *complete* application.
- ✓ approval shall set out clearly the specific conditions related to the approval
- ✓approval shall be specific and limited to the activity authorized as set out in the decision document.

Regulation Agric Biotechnology in Ghana

❑**Review of approvals**

- applicant or regulatory agency
- Significant new scientific information that approved GMO or the approved activity may have adverse effect on human, plant, animal health or the environment
- If the Appeals Board is satisfied that a change in decision is warranted a revised decision will be issued.

Regulation Agric Biotechnology in Ghana

❖**Withholding information (art. 25)**

- ✓Information obtained by applicant after approval
- ✓Which could change the evaluation of the risk posed by the intended activity
- ✓information not disclosed with the application
- ✓Attracts a fine (2,500 – 5,000 penalty units) or imprisonment (5 – 10 years) or both

Regulation Agric Biotechnology in Ghana

❖**Appeals tribunal (art. 26)**

A person aggrieved by

- ✓Refusal to grant approval
- ✓Conditions of the approval
- ✓Revocation, suspension or revision of an approval
- ✓Refusal to treat an application as confidential

Regulation Agric Biotechnology in Ghana

❑**Technical Advisory Committee (art. 27)**

Membership and tenure defined

CSIR rep, GAEC rep, socio-economists (2), ecologists / experts in GMO development and release (2)), Regulatory agents

- act as the national advisory body on matters related to GMOs and
- carry out risk assessment
- audit applications at the request of Board
- Submit proposals for regulations and guidelines

Regulation Agric Biotechnology in Ghana

❑ **Regulatory agencies (art. 31)**

Monitor applicants activities for compliance

- Customs Division-GRA
- Food and Drugs Authority
- Environmental Protection Agency
- Plant Protection & Regulatory Services Directorate
- Veterinary Services Directorate
- District, Metropolitan, Municipal Assemblies and other local government authority.

Regulation Agric Biotechnology in Ghana

❑ **Inspections (art. 33)**

- Biosafety inspectors
- Enter any premises, vessel or property, which the inspector has reason to believe it is necessary to enter, in order to ascertain compliance with provisions of this Act including approvals.

Regulation Agric Biotechnology in Ghana

❑**Public awareness and participation (art.42)**

- ✓ NBA shall promote public awareness, participation and education concerning biosafety matters
- ✓ publication of this Act and regulations in local languages
- ✓public lectures, seminars and workshops
- ✓Publish notices of final decisions in the *Gazette* as well as in electronic and print media.

Regulation Agric Biotechnology in Ghana

❖**Civil liability and redress (art. 43)**

- ✓ Liability or redress for a damage that occurs as a result of an activity under this Act is subject to the applicable laws

eg· Pesticides Control & Management Act, 1996 (Act 528)

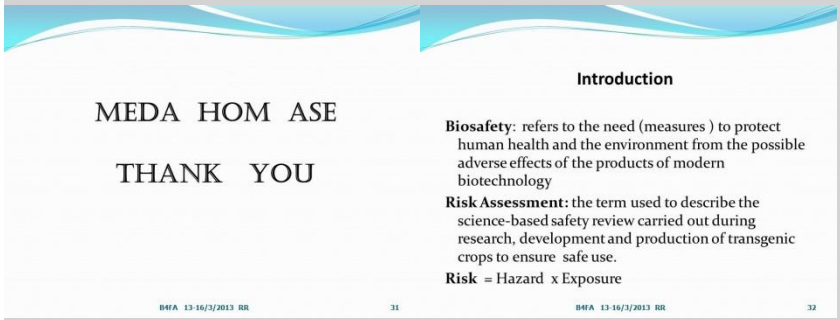
Liability and redress and THE COMPACT (2010)

To provide a united framework for addressing potential claims, the leading agric biotech provider companies – BASF, Bayer CropScience, Dow AgroSciences, DuPont, Monsanto and Syngenta- agreed t establish a binding contract for international arbitration to offer United Nations Member States a legally binding mechanism for seeking redress from a responsible party if the release of an LMO by that party causes damage to biological diversity.

The COMPACT complements domestic and intnl laws incl. Supplementary Protocol on Liability and Redress

Conclusions

- ➢Certified Institutional Biosafety Committees (IBCs)
- ➢Inspected and Certified Laboratories and containment facilities.
- ➢Constituted Technical Advisory Committees
- ➢Evaluated and Approved 3 Applications for Confined Field Trials (CFT).
- Nitrogen efficient, water efficient, salt tolerant Rice
- High protein Sweet Potato
- Insect (*Maruca*) resistant Cowpea
- Development of Regulations for Act 831 on going.


MEDA HOM ASE
THANK YOU
B4FA 13-16/3/2013 RR 31
Introduction
Biosafety: refers to the need (measures) to protect human health and the environment from the possible adverse effects of the products of modern biotechnology
Risk Assessment: the term used to describe the science-based safety review carried out during research, development and production of transgenic crops to ensure safe use.
Risk = Hazard x Exposure
B4FA 13-16/3/2013 RR 32

Commercial Dimensions of Agricultural Biotechnology

Daniel Otunge – African Agricultural Technology Foundation, Nairobi

B4FA Media Fellowship Programme
(March 13-16, 2013)

Seed Trade Environment in Ghana

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

What is AATF?

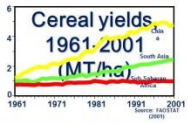
- The African Agricultural Technology Foundation (AATF) was set up in 2003 to facilitate access, adaptation and transfer of appropriate agricultural technologies to smallholder farmers in sub-Saharan Africa.

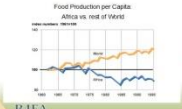
WHY AATF?

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

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 banana 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 Efficency, Water-Use Efficiency, and Salt Tolerant Traits; 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

- **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
- ***Trends monitoring***
  - R&D Priorities
  - Regulations for GM crops
  - Evolution of Seed Systems
  - IP policy and legislation

About OFAB

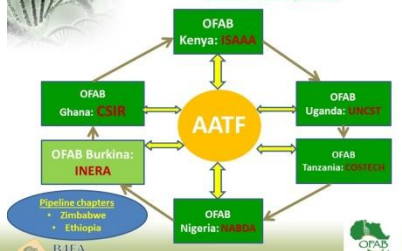
- **AIM - To enhance knowledge-sharing and awareness on biotechnology that will**
  - ✓ raise understanding and appreciation of agricultural biotechnology and
  - ✓ contribute to building an enabling environment for decision making
- OFAB is expected to ensure that **quality knowledge is disseminated 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



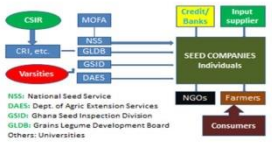
Planning OFAB BF launch, Oct 22, 2012

Meeting with UoZ DVC

SEED TRADE IN GHANA

Ghana seed system

- Linkages between institutions involved in the Ghana Seed Sector



- NSS: National Seed Service
- DAES: Dept. of Agric Extension Services
- GSID: Ghana Seed Inspection Division
- GLDB: Grains Legume Development Board
- Others: Universities

Ghana Seed Schemes

The Role of farmers

- Informal seed sector dominates seed industry in Ghana
- About 80% of seeds planted are farmer-saved grains
- Recognized by government
- Registered individual seed growers/merchants
- Distorted market system

Role of national institutes

- The Council for Scientific and Industrial Research (CSIR) institutions produce most of breeder's seed
  - ❑ Established in 1957
  - ❑ Under the Ministry of Environment, Science & Technology
  - ❑ 13 (14th for Hort. already approved) Research Institutes
  - ❑ 600 research scientists

Role of research institutes

- **Breeder/pre-basic seed is given to GLDB to produce Foundation/Basic for seed companies and other players to produce certified and standard seeds**
- **Challenges include:** Inadequate funding; brain drain; ill equipped laboratories; inadequate training; poor project supervision, dependency on donor funding, etc.

Role of Universities

Role of varsities…

- To fulfill both training and commercial purposes, public and private universities in Africa play significant roles in production of breeder/pre-basic and foundation/basic seed
- **For instance,** the University of Ghana's
  - Institute of Agricultural Research (IAR) and
  - Biotech Center, etc

Role of Seed Companies

Role of Seed Co…

- Ghana has about 30 registered companies
- The local companies play small role in production of certified seeds, including OPVs
- The multinationals like **Monsanto, Pioneer, Bayer, Syngenta, Pannar, SeedCo, Viba Seed,** etc., can produce their own seeds breeder, foundation and certified seeds
- Most Ghanaian companies can't
- There is fear of control of seed supply by multinationals

Role of Seed Companies

- With shrinking public investment in agric. research, giant companies play crucial roles in plant breeding.
- Seed production process is very expensive and takes over 10 years to complete
- **It is worse with biotech due to elaborate risk assessment.** It costs upwards of $100 m

Role of CGIAR

- The Consultative Group on International Agricultural Research (CGIAR) also plays important roles in plant breeding in Ghana: Most relevant ones include:
  - ✓ International Maize and Wheat Research Center (CIMMYT)
  - ✓ International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
  - ✓ Africa Rice Center (WARDA)
  - ✓ International Rice Research Institute (IRRI) and
  - ✓ International Potato Center (CIP)
  - ✓ International Institute for Tropical Agriculture (IITA)

Role of regional organizations

- NEPAD: New Partnership for Agric. Development
- FARA : Forum for Agricultural Research in Africa)
- CORAF/WECARD: West & Central African Council for Agricultural Research & Development)
- RECS :Regional Economic Communities like ECOWAS
- AGRA: Alliance for the Green revolution in Africa
- AATF: African Agricultural technology Foundation

SEED REGULATORY ENVIRONMENT

Seed regulatory environment

The Ghana has the following laws/regulations that affect seed:

- **Seeds (certification and Standards) Decree of 1972**
- **Seed and fertilizer Act Law**
- **Biosafety Act 2011 and Biosafety Regulations**
- **Cartagena Protocol under the CBD**

Over regulations!

IPRs in Ghana

- Ghana has a draft legislation on protection of plant variety to be tabled in Parliament.
- Currently, despite the fact that the country has Patent Act, 2003, Act 657, section 2(e)- (g) of the Act excludes **patentability of plant or animal varieties** or essentially biological processes and the products of such processes.
- **The weaknesses in IP legislation and reluctance to grant patents for plant variety protection are some of the reasons for slow investment in the seed subsector in Ghana.**
- **To overcome some of the challenges Ghana needs to adopt international standards governing seed trade**

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. GSID, 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 protect varieties of plants. The aim is to encourag of new varieties for benefit of society. It is intergovernmental body. WTO-TRIPS: Trade Related Aspects of Intel Property Rights also obligates member-st protect breeders-rights. Rights only given i is new, distinct, uniform, stable and has V PGRFA: International Treaty on Plant gene resources for Food and Agriculture facilita equitable global benefit sharing.. In Ghana Plant Protection & Regulatory Se Department (PPRSD) of MOFA is responsil
Capacity building	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 capacitie following ways: • National seed policy • Regional harmonization of seed regula • Seed production and quality assuranc • Quality Declared Seed (QDS)
Arbitration	This refers to the procedure for resolving seed trade disputes.	ISF: International Seed Federation has dev procedural rules for seed trade dispute se

SEED Marketing

Seed marketing

Seeds reach farmers through:

- ❑ Agro-dealers/seed companies
- ❑ Researchers
- ❑ Government Extension service (DAES/REFLCs)
- ❑ Sales and promotion (including use of ICT, e.g. eSOKO)
- ❑ NGOs
- ❑ Media
- ❑ Farmer field days
- ❑ Farmer Federation
- ❑ Exhibitions
- ❑ Industry association (SEEDPAG)

Challenges facing seed sub-sector

The following are some of the major challenges facing the seed systems in Africa:

- Unstable government policy
- Weak seed market systems
- Low seed adoption rate
- Lack of up to date data on seed
- Inadequate capacity building
- High production costs
- Inadequate distribution channels
- Poor extension service
- Poor storage facilities

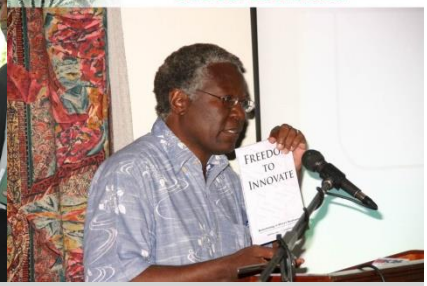
Challenges facing seed sub-sector

- Lack of harmonized regional seed policies and regulations
- Unavailability of seeds in commercial quantities
- Lack of awareness of new varieties
- High relative price of seeds
- Lack of insurance system for agriculture industry
- Insufficient supply of good quality breeder/pre-basic seeds
- Underinvestment in seed diffusion/extension services
- Poor agro-dealer network
- Weak national seed trade/grower associations

Challenges facing seed sub-sector

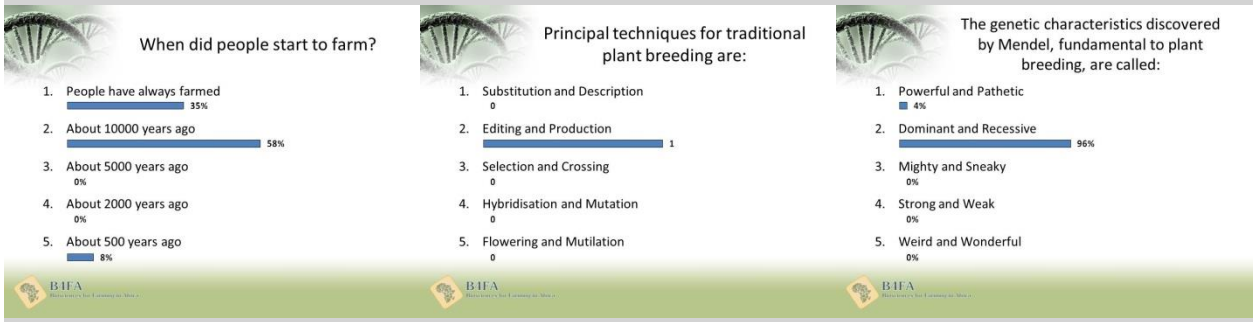
- Poor policy implementation
- Inadequate enforcement of seed laws and regulations
- Poor funding of research for seed development
- Counterfeiting and adulteration of seeds
- Underdeveloped irrigation systems
- Inadequate land for seed production
- Lengthy variety release process
- Expensive credit facilities

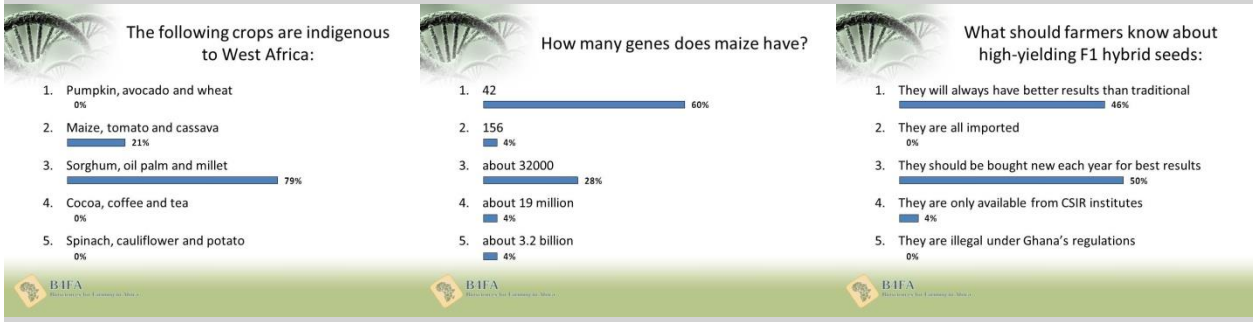
Give our scientists...

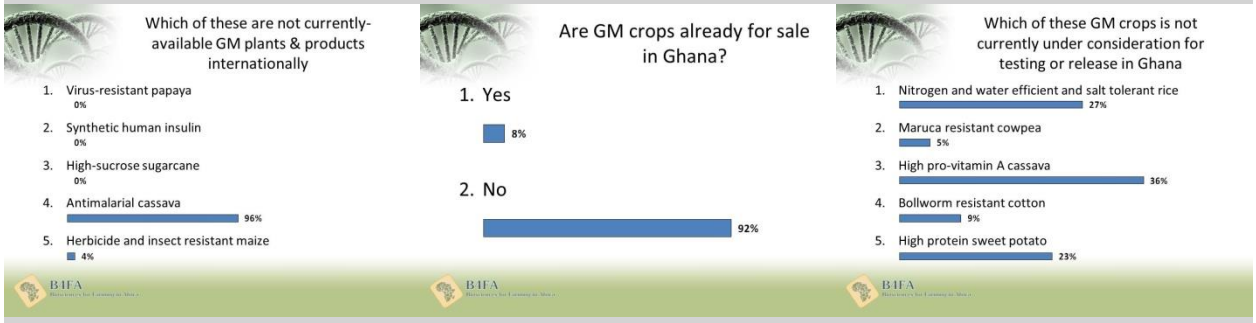


Closing Session

Dr Bernie Jones – Chair of Parliamentary Agriculture Committee, Ghana







Have you found the last 4 days fun?

1. Yes

2. No

What now?

- Keep in touch
- Facebook group – B4FA Ghana
- 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 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!