Biosciences for Farming in Africa: Media Fellowship Programme

First Workshop Report Round 1 – Ghana

Front cover photo: B4FA media fellow Samuel Hinneh of the Daily Dispatch with maize cobs at West Africa Centre for Crop Improvement Sept 2012 – photo by Claudia Canales-Holzeis

Table of Contents

1. Fellowship advertisement and application form

Professional Development Opportunity
B4FA Media Fellowship – Ghana
Application for participation

The Cambridge, UK-run ***Biosciences for Farming in Africa (B4FA)*** project, funded by the philanthropic John Templeton Foundation, is offering a Pan-African Professional Development programme over a six month period to media professionals (including journalists, editors, broadcasters and producers) in our focus countries in sub-Saharan Africa, including Ghana.

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 genetics, 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 form below in as much detail as possible, and submit it to ghana@b4fa.org by 30 June 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 strongly encourage you to submit a letter of support from your editor, producer, managing editor etc.

We will be carrying out face-to-face interviews in Accra after shortlisting in late July and early August. Proposed training dates for this year are September 19th – 22nd. Please ensure you will be available on these dates before applying.

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

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B4FA Media Fellowship – Ghana
Application Form

	Details	**Answers**
1.	Name of applicant	
2.	Address of applicant	
3.	Date of birth	
4.	Gender	male/female
5.	Office and/or mobile telephone number (please indicate preferred contact)	
6.	Email address	
7.	Name of media organisation for which you work (if any)	
8.	Job title (Reporter, editor, freelance etc)	
9.	Please describe you role, and how long you have worked in it for	
10.	Media qualifications	
11.	Previous media experience (jobs, traineeships etc)	
12.	Previous training courses taken (especially any science/ agricultural reporting courses)	

13.	List your current areas of interest in reporting	
14.	Please describe why you are interested in this Media Fellowship	
15.	Please describe why you believe you are a strong candidate for this Media Fellowship	
16.	Do you have the approval of your editor/producer etc to participate in this Fellowship for 6 months? Are you attaching a letter of support?	Approval: yes/no/not applicable Name and position of approver: Letter attached: yes/no
17.	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, 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. Titles of pieces submitted: 1. 2. 3.
18.	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	
19.	Commitment	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/no

Please submit to ghana@b4fa.org by 30 June 2012

2. Interview findings and candidates selected

In Ghana we interviewed 43 print and broadcast journalists. Few had had any exposure to science or to scientists, but although few had rural experience, most were able to give a credible set of answers to the question of what issues farmers in Ghana faced.

Reflecting the fact that science journalism is in its infancy in Ghana, few were able to give good answers to questions around how science might be effectively presented to a lay readership, though those with excellent general journalism skills were able to give credible answers.

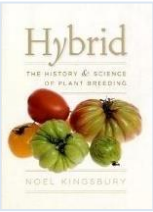
It was also clear that there was a huge amount of misinformation in circulation about agricultural biotechnology and GM in particular. Few, if any, of the fellows could give any positive answers to questions about what they knew of the subject. The answers that were given most consistently were that GM food contained dangerous chemicals, that it caused infertility, and (most bizarrely) that it could easily be recognised in the market because GM fruits and vegetables were larger than conventional varieties. Most journalists were clearly of the belief that GM foods were already growing and available in their country.

The findings in the interview stage were actually rather encouraging, as they gave us confidence that the programme was needed! Prospective fellows selected from the interview round were:

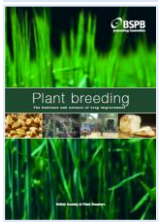
1.	**Adelaide Arthur**	Joynews Multitv, Accra
2.	**Anny Osabutey Joshua**	Joy FM, Accra
3.	**Audrey Dekalu**	GNA, Accra
4.	**Dela Russel Ocloo**	Daily Graphic, Accra
5.	**Francis Balikawu Npong**	The Enquirer, Tamale
6.	**Kingsley Hope**	New Times, Kumasi
7.	**Kofi Adoma**	Adom FM, Tema
8.	**Kwabena Ampratwum**	Luv FM, Kumasi
9.	**Malik Abass Daabu**	myjoyonline, Accra
10.	**Mark Boye**	The Enquirer, Accra
11.	**Mohammed Sulemana**	Public Agenda, Accra
12.	**Nana Konadu Ofe –Brobey**	Metro TV, Accra
13.	**Noah Nash Hoenyefia**	Viasat, Tamale
14.	**Nyadror Nelson Adanuti**	Diamond FM, Tamale
15.	**Odelia Ofori**	TV3, Accra
16.	**Samuel Hinneh**	Daily Dispatch
17.	**Stella Abudu**	GTV, Accra
18.	**Stella Danso**	Daily Guide, Accra
19.	**Umaru Sanda Amadu**	Citi FM, Accra
20.	**Wilfred Otoo**	Daily Searchlight, Accra
21.	**William Evans Nkum**	TV3, Kumasi
22.	**Yakubu Abdul – Majeed**	New Times, Tamale

3. Pre-course reading material

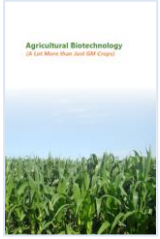
Material distributed on USB stick and physically (book) before training workshops took place.



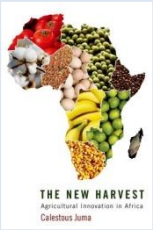
Noel Kingsbury: Hybrid – the history and science of plant breeding (Book)



British Society of Plant Breeders – Handbook on Plant breeding



ISAAA guide to Agricultural Biotechnology



Calestous Juma: The New Harvest – Agricultural Innovation in Africa

4. Workshop programme

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

PROGRAMME

19 – 22 September 2012
Oak Plaza Hotel, East Airport, Accra

Day 1 – Wednesday 19 September 2012

Please arrive at the hotel for 9am

0930 **Welcome and Introductions**
Bernie Jones; Course Leader

Break – *tea/coffee*

SESSION 1 - Background

Julia Vitullo-Martin – facilitator

1045 **Plant Breeding and Agriculture**
Wayne Powell; University of Aberystwyth, UK

Discussion

1215 **Science Journalism**
Alexander Abutu Augustine; Africa Science Technology & Innovation News

1300 **Lunch**

1400 **Principles of Genetics**
Eric Danquah; West Africa Centre for Crop Improvement, University of Ghana

Discussion – *tea/coffee*

SESSION 2 – Practical Science

Kofi Adu Domfeh – facilitator

1630 **Practical Experiment – DNA extraction**
Bernie Jones

1730 **Video Presentation: TED – Ben Goldacre – "Battling Bad Science"**

Dinner

Day 2 – Thursday 20 September 2012

Breakfast

SESSION 3 – Biotech for Agriculture I

Alex Abutu – facilitator

0900 **Biotech, Genetics and Plant Improvement**
F1 Hybridisation, Tissue Culture and Seed/Gene Banks
Jasper Rees; Agricultural Research Council of South Africa

Discussion – *tea/coffee*

1030 **Local case-study 1**
Manfred Ewool; CSIR Crop Research Institute, Kumasi

1100 **Local case-study 2**
George Ameyaw; Cocoa Research Institute of Ghana

1130 **Local case-study 3**
Ibrahim Atokple; CSIR Savannah Agricultural Research Institute, Tamale

Discussion

FIELD TRIPS

1230 **Biotechnology and Nuclear Agricultural Research Institute, Accra and West African Centre for Crop Improvement, Accra**

Packed lunch on the bus

SESSION 4 – Professional Journalism I

Maryann Eyram Acolatse – facilitator

1700 **First journalism piece - background**
Preparation and discussion of story ideas, angles, sources, interview Questions. Feedback on pre-course work – *tea/coffee*

1930 **Dinner**

Day 3 – Friday 21 September 2012

Breakfast

SESSION 5 – Professional Journalism II

Kofi Adu Domfeh – facilitator

0900 **First journalism piece - production**
Production and feedback on first piece

tea/coffee

SESSION 6 - Biotech for Agriculture II

Julia Vitullo-Martin – facilitator

1030 **Genetic Modification**
Jim Dunwell; University of Reading, UK

Discussion

Brief on post-dinner "game"
Bernie Jones

1300 **Lunch**

1400 **Local case study 4**
Emmanuel Chamba, CSIR Savannah Agricultural Research Institute, Tamale

1430 **Commentary**
Ibrahim Atokple, CSIR Savannah Agricultural Research Institute, Tamale

1500 **Local case study 5**
Lawrence Aboagye, CSIR Plant Genetic Resources Research Institute, Bunso

Discussion – *tea/coffee*

SESSION 7 – Professional Journalism III

Maryann Eyram Acolatse – facilitator

1600 **Second journalism piece - background**
Preparation and discussion of story ideas, angles, sources, interview Questions. Feedback on pre-course work

Dinner

2030 **Post-dinner game: "Genes on air"**
Role playing talk shows on GM and biotech issues
Bernie Jones - facilitator

Day 4 – Saturday 22 September 2012

Breakfast

SESSION 8 – Regulatory and Commercial considerations

Alex Abutu – facilitator

0830 **Agricultural biotechnology and the regulatory environment**
Eric Okoree, Ministry of Environment, Science and Technology, Ghana

0915 **Agricultural biotechnology and industry**
Daniel Otunge, African Agricultural Technology Foundation, Nairobi

Discussion – *tea/coffee*

SESSION 9 – Professional Journalism IV

Julia Vitullo Martin – facilitator

1030 **Second journalism piece - production**
Production and feedback on second piece

1200 **Lunch**

SESSION 10 – Biotechnology and the future for African agriculture

Bernie Jones; Course Leader

1300 **Keynote addresses: Biotechnology for Agriculture in Ghana**
Dr Ahmed Alhassan MP, Chair Agriculture Committee
Dr George Essegbey, CSIR STEPRI

1430 **Prize-giving and closing**
Next steps and establishment of follow-up network
Opportunities for participation in future courses
Announcement of prize-winners for best articles produced

1500 **Official Close**

5. List of participants and biographies

B4FA Media Fellows

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

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.

Audrey Dekalu GNA, Accra
0277-185884 audreydekalu@yahoo.co.uk

Audrey Dekalu is a journalist who has worked with the Ghana News Agency (GNA) over the past 12 years. Mrs Dekalu, who is a Chief Reporter, has acquired rich experience as a Health and Science Reporter.
She holds a Bachelor's degree in Communication Studies from the Ghana Institute of Journalism, the premier journalism training school in Ghana. She has attended many international and local workshops and seminars on health and science that have improved her knowledge on the subject. She has to her credit several feature articles and news stories on health, science and other social issues.
She has been awarded certificates from the American Cancer Society, World Bank, Ghana AIDS Commission and other international organizations and NGOs. She now has additional responsibility for selecting and editing stories from major foreign news agencies for GNA's foreign news subscribers.
Mrs Dekalu is an excellent team player, assertive, result oriented, resourceful, confident, disciplined and articulate. She is affable and has excellent interpersonal skills. She is analytical, has exceptional ability to work independently and under pressure and effective oral and communication skills in English. Mrs Dekalu, who is married with two daughters, has a great sense of humour and loves cooking.

Dela Russel Ocloo Daily Graphic, Accra
0244-144720 delarussel@gmail.com

She holds a Diploma in Communications Studies, Journalism option from the African University College of Communications and has been working with the Daily Graphic for the past four years. I am currently pursuing a Bachelor's Degree in Communications Studies, Journalism option at the Ghana Institute of Journalism.

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

Npong Francis Balikawu (Francis Npong as-pen name) is 29 years old. As a Climate Change Communications Consultant he holds a Diploma in Journalism, Climate Change Diplomacy certificate, Certificate in Decentralized Governance, Diploma in Marketing, certificate in Human Rights Reporting and Journalism, Certificate in Digital Photography, blogger and National Coordinator, Media Advocates for Sustainable Environment (MASE).

He has about 7 years working experience as a journalist. He currently works with ***the Enquirer*** as Northern Regional Correspondent, and a reporter for Thinkbrigade.com, (www.thinkbrigade.com) , an international online magazine run by European Journalism Center focusing on global environmental, climate change, human rights, development and democratic issues.
He has participated in many environmental and agriculture related workshops. He has won several awards in the field of journalism including the 2009 EPA environmental reporting award (print), 2010 European Journalism Center Overall best climate change blogging award etc.
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 Hope New Times, Kumasi
0208-158825 elikinhop77@yahoo.com

Kofi Adoma Adom FM, Tema
0246-177100 hikofi@yahoo.com

Stephen Kofi Adoma comes from Berekum in the Brong Ahafo Region of Ghana where he obtained his basic and secondary Education . He is a teacher by profession but has worked as a journalist for close to nine years. He began work as a Journalist with no particular qualification or training in Journalism but has come this far as a result of hardwork and his passion for the Job.
He began his career at Shalom Radio in Berekum then moved to GBC radio in Ho in the Volta Region, then to Fox Fm in Kumasi. He later moved to Hot FM in Accra and finally to Adom Fm in Accra where he works as a news anchor and talk show host. He also a sit in host for the station's morning show He is also the Host of a popular weekly tv show ''Yesee Yese'' aired on Multitv. He loves to see things done the well.

Kwabena Ampratwum Luv FM, Kumasi
0244-784920 ampress1@gmail.com

Kwabena Owusu Ampratwum began work in the media after completing Senior Secondary School at Presbyterian boys' Secondary school, PRESEC, LEGON. He was associated with the Luv fm Newsroom as an intern for six months whilst waiting for his results and continued to work at Luv fm newsroom during vacations. He also had stints with Joy fm in Accra during his School days.
He is a graduate of the University of Ghana with a BSC. Agric, Crop science option, He did his national service at the Ministry of Food and Agriculture in Obuasi. He later joined MTN Ghana, a giant telecommunications Company in Ghana where he worked in the customer care department till April 2010, after which he returned to mainstream media. He is currently a news anchor and producer at Luv Fm in Kumasi where he resides.

Malik Abass Daabu myjoyonline, Accra
0243-150805 malikdaabu@gmail.com

Malik Abass Daabu holds a Bachelor's degree in Communication Studies from the Ghana Institute of Journalism and edits Myjoyonline.com, Ghana's comprehensive news portal. He has been working there for the past four-and-a-half years. Malik has also worked with the State-owned Daily Graphic newspaper and enjoyed court reporting probably because of his special interest in law.
Prior to going to the Ghana Institute of Journalism, Malik had three year's experience as a teacher, having taught in two different schools after completing college in 2001. He is currently pursuing a Bachelor of Laws programme at the University of London External Programmes.

Mark Boye The Enquirer, Accra
0243-977354 boyemark@yahoo.com

Mohammed Sulemana Public Agenda, Accra
0244-443222 Sulemanm72@yahoo.com

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

Hoenyefia Noah Nash is a dynamic individual with a diverse range of experiences in Administrative Procedures, Research and Security, and Reporting. He has Bachelor degree in Education (Mathematics) from the University of Cape Coast and Certificate in Script Writing (ScriptNet2000 / NAFIT).
He worked as Teaching Assistant / Research Assistant in the Department of Communication Studies for two years. He has work with the University of cape coast campus based radio station as a volunteer for six years as a presenter and Reporter.
He has also worked with Choice Fm in Accra as a Reporter and later joined a Nigeria Production house called PDR Media Services as Administrative (PA) and Market Researcher on part-time. He has traveled extensively in Africa.
He's a passionate activist about Education, Agriculture, Gender and Social issues. He is currently the Video Journalist for Viasat News in the Northern Region (Tamale).

Nyadror Nelson Adanuti Diamond FM, Tamale
0243-383659 Nyadanel_2007@yahoo.co.uk

Nelson Nyadror Adanuti, reports for Diamond FM, Tamale in the 'challenging northern region.' He works to expose injustices that have led to poverty, underdevelopment and malnutrition among others by bringing various actors on board to help address these through the power of radio.
Nelson's scope widens from reporting and producing features on health, education, agriculture to human rights and disabilities. Over the years, he has benefited from series of training and advocacy programs, but still thinks there's more knowledge to be acquired and shared with listeners of his radio station and his community at large.
The Ghana Journalists Association Award winner is a graduate of Coady International Institute, St Francis Xavier University, Nova Scotia Canada where he obtained a Diploma in Development Leadership. He also holds a Diploma in Journalism from Manifold College in Accra.

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

Samuel Hinneh is a graduate from 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, publishers of the Daily Dispatch Newspaper, the leading political and research based newspaper in Ghana, reporting on science, development and technology issues.
He is also a freelancer for Science and Development Network (UK), the world's leading news hub for science, technology and development issues in the developing world. Samuel is also currently a contractor writer for Brooke Pattrick Publications (South Africa), which specialises in business-to-business publishing in the fields of mining, energy, equipment, infrastructure and the built environment on the African continent. Some brands include Civil Engineering Contractor, African Mining, among others.
He is also Ghana's representative for Group Africa Publishing Limited (Kenya), publishers of the Construction Review Magazine, African Mining Brief, and Agricultural Review Magazine. He also

freelance 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), which is sponsored by Bill and Melinda Foundation.

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

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

Umaru Sanda Amadu is a twenty five-year old Broadcast Journalist with an Accra based Radio Station Citi Fm (97.3 MHz) with specialization in General News. 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 at Citi Fm in Accra. He has been nominated for several awards and recently won the ''Jury's Special Award'' for 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.

Wilfred Otoo Daily Searchlight, Accra
244-519083 otoowilfred@yahoo.com

William Evans Nkum TV3, Kumasi
0244-775389 Arhenful2008@hotmail.co.uk

William Evans Nkum began his career as a journalist in 2007 at Kapital Radio, a kumasi based radio station. He later moved to TV3 a private television station in Accra where he is currently working as their Ashanti Regional Correspondent.
He loves news reporting with particular interest in Agricultural reporting since the sector contributes significantly to our Country's GDP. He is considering developing his Journalism career specialising in Agricultural Science related reporting. He holds a Diploma in Communication Studies from the Ghana Institute of Journalism.

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

Yakubu Abdul-Majeed is the Northern Regional correspondent for Ghanaian Times News Paper. 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 Pulic Administration from Ghana Institute of Management and Public Administration with a Diploma from Ghana Institute of Journalism.

B4FA Experts, Presenters & Mentors

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".

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 Master of Arts degree in Philosophy, a Postgraduate Diploma in Mass Communications, and a Bachelor of Arts degree in Sociology from the University of Nairobi. Daniel is waiting to graduate with an MA in Development Communication 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 about six years as Communication Officer with the International Service for the Acquisition of Agri-biotech Applications (ISAAA AfriCenter). Daniel also teaches mass communication and development communication at St Paul's University, Limuru, Kenya, as an adjunct lecturer. 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 West Africa Centre for Crop Improvement (WACCI), an institution established with funding from the Alliance for a Green Revolution in Africa (AGRA) in June 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 the International Crops Research Centre for the Semi-Arid Tropics (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.

Eric Okoree Ministry of Environment, Science and Technology, Accra
eriokor@yahoo.com

Eric Amaning Okoree had his graduate degree in biological sciences from the Kwame Nkrumah University of Science and Technology and also a Master of Science degree in Environmental Science from the same university. He also holds a Master of Biosafety degree in Plant Biotechnology from the University of Ancona, Italy. Eric is currently a Deputy Director in the Ministry of Environment, Science and Technology (MEST) and is the coordinator of Biosafety and Biodiversity programs in the Ministry. He also serves as the Secretary to the National Biosafety Committee. He is married with three daughters.

George Ameyaw Cocoa Research Institute of Ghana, New Tafo
gaakumfi@yahoo.co.uk

George Ameyaw is an enthusiastic plant virus research scientist, who enjoys being part of and leading a successful and productive research/academic team. He enjoys grasping new ideas and concepts, and being able to develop innovative and creative solutions to problems. George has worked for the Cocoa Research Institute of Ghana since 2003, before which he held a number of science tutoring and research assistant positions. George graduated from KNUST with a BSc Hons in agriculture, and holds an MSc and PhD in Plant Sciences from the University of Reading, UK

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.

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

After graduating in Botany from Oxford University, Jim Dunwell worked for 16 years at the John Innes Institute in Norwich where he obtained a PhD in Plant Physiology. His research interests included the production of haploid plants and the development of in vitro regeneration techniques for a range of crop plants. He then spent 10 years in the commercial sector at ICI Seeds, later Zeneca Plant Sciences, at the Jealott's Hill Research Station, where he was responsible for an international programme on the development and exploitation of transgenic crops. With the support of a BBSRC Industrial Fellowship, he moved in 1996 to the University of Reading where he is Professor of Plant Biotechnology and has

research interests in plant breeding, gene expression and protein evolution. He recently served on the UK Food Standards Agency Advisory Committee on Novel Foods and Processes, and the Royal Society Working Group on biological mechanisms for enhancing food-crop production. He am now a member of the Defra Advisory Committee for Releases to the Environment, the group that advises the UK government on the growing of GM crops.

Julia Vitullo Martin Journalist
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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.

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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.

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Lawrence Aboagye holds a BSc in Agriculture from the University of Ghana, an MPhil in Crop Production and Management from the Chiba University, Japan and a PhD in Production and Management of Biological Resources from the Graduate School of Science and Technology, Chiba University, Japan where he investigated the morphological, agronomic and physiological characteristics leading to the synthesis of ideo-types in groundnut. He started his research and management career at the CSIR-Oil Palm Research Institute and continued at the CSIR-Plant Genetic Resources Research Institute (PGRRI), concentrating on: collecting, characterization, evaluation, maintenance, documentation, distribution, regeneration and conservation of cereals, legumes, vegetables, root and tuber crops, fruit trees, medicinal plants and spices. He have peer-reviewed publications in reputable journals and a number of technical reports to his credit. His current research area is neglected and under-utilized plant species. Currently, Lawrence is a Principal Research Scientist and the Director of CSIR-Plant Genetic Resources Research Institute.

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Manfred Ewool has been employed at Crops Research Institute (CRI) since 1984 after completing Kwadaso Agricultural College. He has worked there as a Research Scientists and Breeder, completing a

BSc degree in Agriculture and an MSc in Agronomy (Plant Breeding). Presently as a Maize Breeder, he is involved in the national maize breeding programme to develop normal, Quality Protein and Pro-vitamin A maize varieties that are stable, high yielding, resistant to diseases and pests and tolerant to drought. Between 2007 and 2012 Manfred has been the lead scientist in the development and release of 14 new maize varieties with qualities including drought tolerance, nutritional qualities and industrial suitability. He is also involved in evaluating maize genotypes in multi-location trials and breeder seed production of commercial maize varieties. Manfred was the Head of the Maize Breeding programme at CRI from 2005 to 2008 and has led a number of projects in Ghana executed by CRI, including the Food Crops Development Project, West and Central Africa Maize Network, Agriculture Sub-Sector Investment Project, African Maize Stress Project, Drought Tolerant Maize for Africa Project, AGRA Project, HarvestPlus Maize Project, WIENCO Maize and NSL Project. He still coordinates the latter three. Manfred has 14 joint publications.

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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.

Wayne Powell University of Aberystwyth, UK
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Wayne Powell trained in plant breeding and cytogenetics at the University College Wales, Aberystwyth (H. Rees, FRS) and in quantitative genetics (Birmingham school Biometrical Genetics, J. L. Jinks FRS). His earlier work laid the foundations for the use of doubled haploids and cross prediction in plant breeding. He was awarded the Broekhuizen Prize in 1990 for outstanding contribution to European cereal science and obtained his DSc (Plant genetic manipulation) in 1993 (Birmingham university). His personal research interests are at the interface of plant genetics, genome science, plant breeding and conservation of genetic resources with a strong emphasis on the delivery of 'public good' outcomes. He has published over 250-refereed scientific journal papers that have attracted 9,300 citations, with an H index of 50, a further 120 book chapters and conference proceedings and presented numerous invited papers at international meetings and successfully supervised 20 PhD students and numerous visiting workers. His professional career has spanned academia, the public sector and commerce (Dupont).He is currently Professor and Director of the Institute of Biological, Environmental and Rural Sciences (IBERS) at Aberystwyth University. Formed in 2008 by merging the Institutes of Biological and Rural Sciences of the University with the Institute of Grassland and Environmental Research (IGER) to form one of the largest groups of academics and support staff in the UK focussing on plant and land based sciences, with more than 350 staff, 1,200 undergraduates and a complex range of stakeholders. In his current role he has lead and managed a significant organisational and cultural change programme to create a fully integrated Institute that embraces mission diversity: education, research and enterprise. This has involved attracting more than £80 million of investment to support new faculty appointments, capital infrastructure and national capability to underpin world class research.

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Based in Strasbourg, France, Bernie Jones specialises in the international 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.

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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 International Service for the Acquisition of Agri-Biotech Applications (ISAAA), based in the Philippines. A graduate of the University of Reading in Environmental Biology, she gained a DPhil in Plant Genetics at Oxford.

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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.

Ruby Ntirakwa B4FA Ghana
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Ruby Ntirakwa has wide experience as a reporter and news anchor. She has participated in international programmes including the US Department of Agriculture Borlaug Fellowship Programme, NEPAD – African Biosafety Network Seminars, and Africa Investment Forum. Ruby has reported extensively on development, political and health issues as well as global topics including agriculture, food security and climate change. She is a Political Science graduate of the University of Ghana with a Diploma in Communication Studies from the Ghana Institute of Journalism.

6. Training course and Field Trip highlights

The training workshop took place in Accra over a four day period, and included a number of games/simulations, a practical exercise (DNA extraction), and field trips to the University of Ghana at Legon's WACCI (West African Centre for Crop Improvement) facility and to the Biotechnology and Nuclear Agriculture Research Institute in Accra (BNARI – which is colocated with Ghana's only – research – nuclear reactor).

Participation

Almost all of the fellows selected at interview attended the workshop – those who did not cited failure to get permission from their media houses for such a long absence from work.

All but one of the international and national experts we had invited to participate were able to attend. Unfortunately, Dr Jasper Rees of the Agricultural Research Council of South Africa was also unable to get permission to attend, at the last minute. His section of the training was due to be quite a critical one, bridging from basic genetics and breeding techniques to higher technology options, including marker assisted selection, gene banks, hybrid seeds and tissue culture. We were however able to fill this gap in our training schedule with a joint journalism/technical exercise, by getting small teams of media fellows to interview a domestic and an international expert on each of these issues, which worked well.

Fellows

It was clear early on that few fellows had ever participated in such a long and intensive training course. Although they took the opportunity seriously, and participated actively, they found some of the days and sessions long, and found some of the technical side challenging – even though we had been careful to simplify it already.

It also became clear that for some of the fellows the agricultural side was as novel and strange as the biosciences side. Usually it was the journalists who were not based in the capital who understood and related to the agricultural knowledge side better. This issue was best exemplified by an unprompted intervention by one of the fellows during the discussion of "selection" as a traditional breeding method:

> "My brothers were brought up in the City, so they don't understand. If they had grown up in the village like me, they would remember father asking us each year to go and collect the biggest and best looking maize cobs from the field and bring them to him. He would hang them high in the kitchen, and we would use the kernels to plant the next year."

There was a great deal of confusion about the whole gamut of biosciences and breeding techniques, however, with many fellows equating hybrid seeds to GM, along with all other technologies in between!

Innovation

Consistent feedback throughout the course was that journalists rarely got to participate in courses like the one we had designed. The amount of time spent interactively, to try to forge understanding, combined with the practical exercises and mentoring designed to achieve the same outcome, were

clearly very unusual in terms of both training courses and interactions with scientists and technical experts that they had experienced before.

The DNA extraction in particular was received with great enthusiasm, and was the first time most of the fellows had ever done any hands-on science.

Local scientific participation

Perhaps one of the most surprising aspects of the training was the reaction from the local scientists. Few had ever had the opportunity to interact with journalists, but it became clear that few had also ever had the opportunity to participate in any sort of communications or public understanding event. The scientists, although they did also act as mentors, seemed as enthusiastic about the games and the practical as the journalists themselves.

We received some very surprised reactions from local media experts when they learned that we had persuaded local scientists to spend the full four days of the workshop with us – this was apparently unprecedented in local workshops. But the scientists themselves showed appreciation of the time they were able to spend informally with the journalists, and it was used as an opportunity for the two different professional cultures to exchange views and knowledge in a social setting. One piece of feedback we received was:

> "I have been a maize breeder for 25 years, and this is the first time I have ever had a chance to talk about my work to a journalist"

Field trips

For the field trips, the group divided into two, with each group visiting a different location. At WACCI, the group heard about the regional plant breeders' PhD and MSc development programme from the project director, Prof Eric Danquah, as well as visiting the University of Ghana's molecular biology laboratory (adjacent to WACCI) and WACCI's maize trial plots and sorting house.

At BNARI, fellows heard about the Institute's radiation breeding programme and experiments with gamma-ray food preservation, as well as seeing the commercial and experimental tissue culture facility the Institute operates, and biosciences research being carried out on insect crop pests (fruit flies) and disease vectors (mosquitos and tsetse fly).

Fellows used their time productively to carry out a large number of interviews with the scientists. But this was also the first time most of them had ever seen a laboratory, thus further breaking down the barriers between them and the scientific community.

Policy presentations

The workshop ended on a high note, with presentations on the commercial seed trade and regulatory environment in the country – areas where many of the journalists felt more comfortable – as well as a keynote presentation by the Chair of the Agriculture Select Committee of the Ghanaian Parliament (himself a former plant scientist).

Journalism exercises

Fellows were originally challenged to produce a number of original pieces throughout the workshop, but we soon realised that this was too challenging, and that they would prefer to work more thoroughly and produce a smaller number of higher quality pieces. We therefore asked fellows to produce two pieces for mentoring and judging. Some were predictably basic given the time and resources available, but some were of high quality and highly original.

Continuity

One of the most appreciated facets of the programme was the follow-up phase. Fellows were very pleased that the workshop was not, like so many others, a one-off event, and felt there was high value in remaining part of the fellowship and benefitting from further engagement and future opportunities.

7. In-course journalistic pieces produced

Journalism exercises – in course pieces produced by media fellows.

"Green Revolution possible Solution to Africa's Food Insecurity problem"

Francis B. Npong

Food insecurity presents another challenge to the struggling continent whose people have been living under a hornet's nest of social, economic, and political systems.

The continent has been struggling over the years to cope with changing times, conditions and ultimately the effect of climate change on existing struggles which include poverty, food insecurity, unstable economies, an unprecedentedly high rate of maternal and infants deaths, malaria infections, malnutrition and under development.

Food and Agriculture Organisation (FAO) reports 2012 report on food situation in Africa stated that about 8.7 million people are facing food insecurity (including 1.6 million in northern Mali) and more than 1 million children under the age of five are at risk of severe acute malnutrition.
Despite the crippling maladies, the continent is noted for the largest farmlands in the world, and provides favourable conditions for the growth of almost every single crop on earth. Yet in spite of this, Africa faces severe food shortages, starvation and malnutrition the cause of which has been associated mostly with soil infertility and quality of crop seeds.

According to the US Institute of Health, during the 1970s, it is estimated that 30 million people were directly affected by famine and malnutrition. About 5 million children died in 1984 alone. In Mozambique during the 1983-84 famine, about 100,000 people perished. In Ethiopia, Sudan, Somalia, Liberia, and Angola armed conflicts compound the problem. Ethiopia alone had 9 million famine victims in 1983. The non-availability and access to food is said to have sparked off conflict in parts of Africa.

It is against this background that experts in bioscience and food research have called for what they termed green revolution in Africa to reverse the African's food situation. Addressing journalists during a training workshop on plant breeding, genetics and biosciences for farming in Africa, Bernie Jones, an expert in bioscience technology said that initiating green revolution in Africa could be a possible solution to food insecurity condition in Africa.

The training programme organised by Bioscience for Farming in Africa (B4FA), UK based organisation is aimed at training journalists to properly communicate issues relating genetically modified crops and agriculture to the general public to enable them make informed choices.
According to him, governments in Africa could help correct the food situation by developing infrastructure and technology in agriculture. "Developing infrastructure and transferring technologies to farmers are sure ways to improving food security", he said.

Mr. Jones explained to this reporter that perceptions on GM food has been dangerous to people's health are misconceptions without scientific evidence and should be disregarded.

Food insecurity and malnutrition in Africa remains one of the most challenging development issues which the experts say would need green revolution as an urgent policy to be able to deal with it.

Mr. Thomas Ayamga, programme officer for Care International Food Security for Africa programme in a telephone interview said, Africa does not only need technologies and infrastructure to be able to be food sufficiency but a political will, quality seeds that are drought and disease resistance crops to be able to produce the food that could feed the continent explosive population. "Until this is done other policies on agriculture which do not address the above issues will not help", he said.

He also supported the idea of initiating green revolution but stressed the need to industrialize agriculture saying “investing in agriculture and technologies is the direction to achieving food security in Africa”.

On the issue of food security why is the NPP manifesto silent on GM foods?

By Wilfred OTOO

As the country goes to the polls this December, it's important for us as a people to pay attention to what the political parties have to offer the good people of Ghana by perusing their policy document in other that we make informed choices on who has the best of programmes to take our country to the next level of her development.

As i write this piece am limited in perusing the policy document of the ruling government, the National Democratic Congress,(NDC) concerning agriculture because, the document has not been made public.

I would therefore touch on one aspect of the agricultural sector, which has to do with their silence on genetically modified foods as captured by the policy document of the largest opposition party, the New Patriotic Party which is in the public domain.

The NPP needs to clarify the nature of the agricultural mandate they plan to execute, if voted into power, as stated in their Manifesto for Election 2012, Chapter Three: Section 7. Modernizing Our Agriculture and Ensuring Food Security.

I humbly call on every Ghanaian, irrespective of party political affiliation, to open their eyes widely, be informed and alert on the issues at stake in the future of Ghana's agriculture sector. First of all, what are the principal issues at stake?

Ghana has been targeted by the G8 for the accelerated proliferation of GM crops, in an attempt to ensure food security, and the NPP Manifesto conveniently chooses not to speak to this issue.

Agriculture is considered to be an anchor of Ghana's economy, and is estimated to creating value of approximately 14.2 billion dollars (roughly 23.9% of the 2014 GDP) and employs approximately, 4.6 million 56% of the workforce. However, the sector lacks sophistication and is dominated by subsistence farmers.

Approximately, three million small-holder farmers with average farm sizes between 0,5-2 hectares currently produce 95% of the country's food crops. Further, as indicated by the Ministry of Agriculture and AGRA. Ghana faces increasing food security challenges in the near future. This is due to the pervasively fragmented value chain, inefficiency, and obsolete farming techniques and equipment in the sector.

It is our purpose to challenge the NPP to come clean with the Ghanaian electorate. If the NPP seeks to distance itself from genetically modified foods they should do so very clearly. If on the other hand they do not see anything wrong with the introduction of Genetically Modified Organisms into our food chain, they must be honest enough and be forthcoming and open with the Ghanaian electorate.

To face the current challenges of agriculture, we need to address agriculture and land in a broader context by integrating multiple roles (economic, food production, nature and land management, employment etc.). Sustainable agriculture and land use is not just a means to obtain more food and income in socially acceptable ways, which do not degrade the environment. Rather, it has an all-encompassing impact on communities, environments, and consumers.

We must reach a consensus and common understanding of sustainable land use as an opportunity to improve the quality of the environment, including its physical (increased soil fertility, better quality air and water), biological, healthier and more diverse animal, plant, and human populations.

Land is not just a resource to be exploited, but a crucial vehicle for the achievement of improved

socioeconomic, biological and physical environments. Concretely, by paying attention to the multiple functions of agriculture and land use, all economic, social and environmental functions of agriculture, at multiple levels, are recognized and included in decision making in order to promote synergies between these functions and to reconcile different stakeholder objectives.

There are key policy options open to Ghanaians as a people, as to how do deal with issues in Food Sovereignty and Security. The issue of GM technology ought to have been a settled question by now, but that is not the case.

This development however is a worry to Dr. Kenny .E. Danso of the Biotechnology and Nuclear Agricultural Research Institute(BNARI) of the Ghana Atomic Energy, who is calling on government to support the technology financially to enable them conduct research into the technology in other that Ghana takes the bold decision of laying to rest the issue as to whether Ghana should go for it or not, insisting that other countries have done it and working for them, so the earlier as a country we settle the matter the better.

He reminded the policy makers that it was the same attitude which culminated in Ghana missing out on the green revolution; he says we must produce food for our people and so if there is a technology out there that has been texted to feed our people why the feet drugging.

Indeed, the world has a moral obligation to feed itself. What is invariably ignored by advocates of GM crops in explaining why almost a billion of people in the world go to bed, each day, hungry, is that actually, we have more than enough food to feed everybody now. In fact, we have doubled the amount of food to feed everybody in the world now, but people don't have access to food.

The NPP writes in its Manifesto:

“Modernizing agriculture is fundamental to our programme of transformation and Ghana needs a breakthrough in agriculture to achieve self-sufficiency in our food supply, particularly in grains, fish, and meat. Currently, we are only achieving 30% of our rice needs for example, while we have the potential to be 75% self-sufficient.

Our farmers are significantly strained by a number of transversal interventions such as expensive and unavailable inputs, poor infrastructure, expensive financing, obsolete techniques and equipment and poor policy support. For example fertilizer usage in Ghana is only eight kilograms per hectare as compared to 20 kilograms per hectare in Asia. Less than 50% of farmers use fertilizers and when available, it is at high cost. Improved seeds are generally not available and are also at a high cost. Farm roads are bad and credit is too expensive when available.”

I dare say that the NPP is speaking about Genetically Modified seeds" in their manifesto, under the guise of "improved seeds". Why has the NPP not thought it fit to explain what they meant by "improved seeds"? Because genetically modified seeds did not even appear for once. Do Ghanaians not have a right to know whether or not a political party intends to introduce genetically modified seeds into Ghana's agriculture?

Ghana can easily produce enough to feed itself and more. The main agricultural productivity problem Ghana faces is not the kind of seeds it uses. The main problem is unfair competition and agricultural dumping.

Hunger in most cases is a result of poor distribution. What Ghana needs is greatly improved distribution systems so produce does not rot in the fields or spoil on the way to market. We need better roads, reliable public transportation, and transportation assistance for farmers taking their products to market.

We need speedy electronic up to the minute information systems for farmers identifying markets and demand, providing weather information, etc. These are already available with mobile phone technology. It has been repeatedly demonstrated through UN sponsored studies that the smaller the farm, the greater the yield.

"The main problem with feeding all the people is distributing the food. Providing and facilitating a distribution system which is one crucial role of government".

Traditional seeds have been bred and honed over hundreds of generations to be perfectly adapted to the climate and conditions of the lands where they are grown. We need to encourage and enable farmers to save and work with Ghana's highly evolved traditional seeds.

This is why we need to be vigilant. Agriculture is to the life of our nation, in much the same way that oxygen is to our physical bodies. Agriculture is also a significant employer of more than half of the Ghanaian population, and sixty per cent of all women. An overwhelming majority of these farmers live on less than a dollar per day.

It is imperative to demonstrate how the NPP hopes to better the lives of the poor farmers through their promise to "initiate programmes aimed at fostering the growth of a diversified agricultural sector, with efficient small holders as well as medium and large-scale producers. Accordingly, we will support a number of private sector change agents in large-scale commercial farming whilst assisting small-holders to adopt modern techniques and practices."

Which private “large-scale producers” is the NPP talking about engaging in their manifesto here? We would like the NPP to be honest enough to come out and inform Ghanaians clearly that they have decided not to dabble in the GMO business, so that there could be a public debate.

We want the NPP to come out to clearly explain the anomaly, the people of Ghana need to know if a vote for the NPP is equal to a vote for GM crops or not. The NPP is being unfair to Ghanaians by asking them to vote NPP on the basis of promises to provide "improved seeds", for Life, the Environment, and Social Justice!

Media urged to collaborate with Agricultural experts to increase food production.

From: Yakubu Abdul-Majeed.

Media practitioners have been challenged to champion the fight against food insecurity in their communities by collaborating with Agricultural experts to reach out to farmers with new methods of farming.

Mr. Alex Abutu, of Africa Science Technology & Innovation News who made this call here lamented that many journalists and media houses devote much of air time and air space to politics at the expense of other important areas such agriculture which is he said the backbone of many economies.

He said it is time for journalists to change their focus by highlighting challenges of farmers as well as disseminate research findings to the targeted audiences.

Mr. Abutu who was speaking at the initial dialogue training workshop on Plant Breeding Genetics and Biosciences for farming in Africa noted that various science researchers have come out with many improved crop varieties but very of few of varieties have adopted by farmers. The workshop which brought together journalists and researchers was aimed at equipping media practitioners with needed skills to report properly on agricultural issues.

Mr. Abutu said journalists wield a lot of power hence the urgent need for them to play leading roles in wooing farmers to embraces the genetic modify crops.
He stressed that it was important for journalists to acquaint themselves with the science terms in order to accurately inform their audients on new technologies.

Mr. Alex pointed out that reaching out to farmers with new technology would not only ensure food security but would also improve income level of the farmers.
He however cautioned media practitioners to be circumspect in conveying research findings to the public by asking critical questions and demanding proof since science deal with analysis, data and test hypothesis.

Mr. Abutu noted that there were many concocted scientists who claimed to have solution to many problems and that it was prudent for journalists to verify such claims.

Dr. Kwasi Atokpale another facilitator on his part appealed to media to open their doors to scientists stressing many scientist in the country were willing and prepare to share their findings with them.
End.

Reduce your over dependence on fertilizer application SADA urged

By Noah Nash

An expert in plant Breeding has called on management of Savannah Accelerated Development Authority (SADA) to introduce an integrated soil fertility management approach.

According to Dr. Emmanuel Chamba of Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research, this will help reduce the over dependence on fertilizer application under the SADA mechanization program for the northern region.

VO

With the Implementation of the fertilizer subsidy program by government of Ghana for the past four years, it has cost one hundred and sixty four million cedis (164 million cedis) from 2008 to 2011.

This initiative by government is geared toward increasing fertilizer application rate by 20kg / ha under the African green revolution as well as ensuring food security and improved standard of living of farmers.

With continuous cropping on most farms, farmlands have been exhausted and rendered infertile in many parts of the northern region, with declined in yields recorded each farming season. The region has one farming season due to the rainfall pattern, increasing the over dependence fertilizer each crop season.

Under SADA mechanization program most farmers are supplied with hybrid seeds gear towards improving yields with various stages of fertilizer application and pesticides. In respect, most farmers have to battle with health related problems each farming season in the management of chemical fertilizers in the application.

The common problem is skin irritation; headaches, general body weakness and difficulty in breathing as some suffer direct inhaling of this chemical in their applications.

With the introduction of hybrid improved seedlings most farmer hardly can maximized yields without the use of fertilizer due to poor soil fertility, which has increase the demand for fertilizer each years. Under the 2012 budgetary allocation government have also made provision to subsidize 176 metric tonnes fertilizers and certified seedling at the cost of 124.1 million cedis, for the 2012 crop season.

But an expert in plant Breeding at the Savanna Agricultural Research Institute of the council for scientific and industrial Research, Dr. Emmanuel Chamba have urged management of SADA to introduce an integrated soil fertility management in their mechanization program so as to improve the soil fertility as well to reduce the over dependence on fertilizer application. He noted that continues application of fertilizer increases the level of acidy in the soil fertility, which does not restore the fertility of the soil.

SOT 1: Dr. Emmanuel Chamba, Savanna Agricultural Research Institute

“the other thing is that you can grow without fertilizer but in that case you will have use legumes crops before planting of the maize and the legumes crop will fix nitrogen in the soil and when you plant the maize, maize can make use of the nitrogen in that have been fixed as the legumes crop am just giving an example of a farmer who planted yam inter-crop with cowpea. The point is that most of the field

are old weeds grows very fast so they can cope with weeds control that is why. So I will advice that you plant legumes crop or cover crop first so that will introduce the nitrogen into the soil as all parts of the crop would have gone down into the soil. So the maize can use it when you planted. So yes it is possible to inter crop maize with a legumes crop but you got to time it before planting the maize crop".

National Development to Remain Illusion with Current State Of Scientific Research Funding

Kwabena Owusu-Ampratwum, Luv Fm

The Director of the West Africa Centre for Crop Improvement, University of Ghana, has observed national development will remain an elusive if successive governments continue to pay only pay lip service to funding scientific research.

Professor Eric Danquah says the current levels of funding are grossly inadequate to support programs aimed at achieving food security.

Many research institutions are therefore not able to carry out programs to fulfil their mission, where they do, such programs are donor funded and skewed towards the interest of the donor.

Ghana is one of the many countries in Africa where food security remains a major challenge.
Farming in the country has basically been subsistent with many farmers growing mainly for consumption; produce left is then sold on the market.

Even where production is on a commercial scale, limited mechanization, harsh environmental conditions and low yielding crop varieties have stifled yields severely.

For instance the Cereal yield (kg per hectare) in Ghana was last reported at 1814.30 in 2010, this is just about a 38 percent of the 7000kg per hectare average cereal yield in many developed countries.

For years, research institutions have been racing to find varieties of plants and other technologies to boost crop yield.

The country boasts of well-trained scientist in research institutes such at the Crop Research Institute of the Council for Scientific and Industrial Research ready to find ways to improve crop yield.

But the works of these institutions are greatly hampered by inadequate funding from central government.

According to Emmanuel Chambah, of Savanna *Agricultural Research Institute*, of the council for Scientific and Industrial research, the state has provided no funding at all for its work this year.

Prof Eric Danquah says up to ninety percent of the funds for research in Ghana come from donors, mostly from outside the country.

There is virtually a colonization of research funding in the country by foreign donors due to the vacuum left by inadequate funds from central government, the interest of such donors therefore drive the focus and direction of the research.
For one part, the funds are important in keeping the scientist busy with research that has the potential to change livelihoods, by coming out with new plant varieties that may be pest resistant, have larger and tastier fruits, drought resistant among other desired traits of a crop.
On the other hand over reliance on this kind of support in many instances has resulted in undesirable consequences for the nation in the quest of researchers to meet the targets and interest of the donor community.

Emmanuel Chambah of the council for Scientific and Industrial research says many scientific research programs have stalled at very crucial stages due to the exhaustion of funds provided by donors or the donor losing interest in the course of the project.

He states the classic example of the cotton research project in Ghana, the project started in 1988 with government funding, research was done to 1998, funding from government seized from then and the project stalled.

A French project with the Ghana cotton company at the time came in to rejuvenate the project after the stall.

The project was highly successful, producing two variety of cotton which was very beneficial to the farmers in the northern part of Ghana.

However the donor funds dried up in 2005, once again stalling the progress of research until recently when some donors began showing interest.

Currently cotton factories in Ghana have to rely on importation of raw materials from Burkina Faso at a price, when Ghana has the human resource to carry out scientific research to boost local production.

The Tsetse fly control program at the Ghana Atomic Energy Agency in Accra faces such a daunting challenge. Funds have already run out in the middle of the project and frantic efforts are underway to source additional funds to control the project.

This project aims resolving a very huge problem plaguing the animal rearing sector, which over the years has been troubled with trypanosomiasis or sleeping sickness, which vector is passed on by the tsetse fly.

If additional funds are not secured for the project, all the time and resources put in the research will virtually be wasted and the nation will gain nothing from a project which could have immensely curtailed the trypanomiasis menace livestock production

The inadequate government support and over reliance on donor funding has also resulted in researcher not focusing on their key areas of research, they rather divert to fields where funding is available in other not to sit idle.

For instance a maize breeder may be forced into cowpea breeding where he or she has little expertise because cowpea research is where the donor wants to invest.

Failure of the scientist to adopt cowpea breeding means a long wait for a time when another donor is interested in funding his or her area of research. Knowledge will be wasting away and the purpose of the nation spending resources on educating the scientist will not see the desired result.

On the other hand, venturing into cowpea production results in the neglect of maize breeding by the researcher or institution, and an opportunity to improve on yield is missed.

Many expensive research facilities at some research centres of the University of Ghana are wasting away due to the unavailability of funds to put them to use.

Many of the kraals and laboratories of the University of Ghana animal farm at Nungua in Accra are empty with expensively acquired equipment gathering dust and decaying because they are no funds to bring in animals for research.

The research station if adequately funded has the capacity to breed animals that are suitable for the Ghanaian climate to increase meat production, leading to a low cost of meat, thus contributing to the fight against malnutrition.

Besides the centre coming out with such useful research findings, it has the capacity to produce animals to sustain itself economically if the needed funds are injected.

As a country we imports tons of chicken, beef and other animal products at huge costs, whiles we neglect facilities with the potential to improve local production at cheaper and sustainable cost.

What could account for the inadequate funding of these research facilities and are governments and leaders not aware of the need to invest in science research if the nation is to develop.

According to the Director of Prof Eric Danquah the political will to invest in science research has not been followed with action..

Priorities have been place elsewhere whiles the main engine of growth in developed nations, Science research has been relegated to the background and the nation searches in vain for a “miracle” to develop.

The leaders in Ghana and Africa in general have reneged on numerous promises to dedicate funds to science research.

In the African Union Maputo Declaration on Agriculture and Food Security in 2003, African leaders including Ghana, agreed 10 percent national budget is allocated to agriculture development. This has not materialized in Ghana

Until successive governments follow the rhetoric of providing funds for research and agricultural with action, our research if any will be driven by donor interest and not national interest.

Achieving food security to lift ourselves from the third world would remain a dream in the most distant future.

The 'Rice City' must not die!

By: Nelson Nyadror Adanuti

The "Rice City" in Tamale, is one of the several rice fields in northern Ghana that has become a pale shadow of the once buoyant industry that fed many with fresh and nutritious rice. In addition to feeding, the local rice industry created employment and gave secured incomes to farmers, farmhands, seed suppliers, processors, marketers and others in the rice value chain.

***Cue frustration and Voice over**: "this whole place used to be futile for rice when we occupied here. From the proceeds, I supported my husband in managing the home and raised our children. Of course we had some of the rice to eat and sold the rest out. Now besides land ownership which affects mostly women, most people think the local rice variety is inferior to the imported brands. It is evident at the market where every consumer purchases for the imported rice. I don't know why we cannot also improve on our local varieties if that is the problem?*

Madam Azaratu Mumuni, a rice farmer once had a concession to grow rice within the Rice City enclave with her deceased husband, who she had seven issues with. She regrets that the beautiful green rice farms have narrowly given way to the mushrooming of metal container shops, garages, residential properties and hotels on the huge rice tracks.

Cue women processing rice and milling

By and large, people crave for the same things. They require food for their household, a roof over their heads, and education for their children.

Equally rice farmers at Nasia, Tumu, and Navrongo all in northern Ghana yearn for that same things, but the only difference is; their livelihoods remain threatened from stiff rice imports from elsewhere leading to a decline in local production and a heavy debt burden on farmers.
Overtime, the collapse in irrigation facilities and the removal of subsidies led to prices of key inputs like rice, maize, and soya seeds, fertilizer and tractor services rising to unprecedented levels. Several factors are responsible for the rise in prices and the farmers had no option than to push the costs to the consumers whose taste had also changed for polished rice.

According to the UN World Food Program's Executive Head, Josette Sheeran, *"People without food have 3 options: they revolt, they migrate or even die."* These are exactly the sad realities in northern Ghana; poverty, communal conflicts, a rising number of migrations among the youth, disease and malnutrition especially among pregnant women and children persist in the entire savanna belt which used to be the food basket of Ghana in the 1970s.

Dr. Wilson Dogbe is a Researcher at the Savanna Agricultural Research Institute [SARI] at Nyankpala near Tamale who also shares the opinion that the rice city must not be allowed to die.

He said through the New Rice for Africa [NERICA]; an improved variety of rice which targets small holder rice farmers there are hopes that production shorts falls would be addressed.
According to Dr. Dogbe the upland variety of NERICA is suitable for climates in the uplands of northern Ghana and the yields are three times more than others, and when attention is given to this variety, it will improve on the food needs of the people as well as reduce poverty in the area.

Notwithstanding this, Nashiru Adam, who is the National chairman of the Peasant Farmers Association; an advocacy group of farmers, suggests that any effort to revamp rice production in the north must begin with the supply of quality of seeds that fits the local climate.

Nashiru says he share Philanthropist and Microsoft founder, Bill Gates position that; "If you care about poor people, you need to care about agriculture," explaining that any program, plans and policies to increase rice production should include significant investment in the whole rice value chain like infrastructure, training for farmers, and access to credit, guaranteed pricing and readily available markets.

Yellow Corn Can Prevent Infant Mortality – Researcher

Stephen.Kofi Adoma Adom FM

A researcher and a Maize breeder with the Council for Scientific and Industrial Research- Crop Research Institute (CSRI) Mr. Manfred Bondzie Ewool says yellow corn is rich in Vitamin A and can prevent a lot of the infant mortality currently recorded in Ghana.

It is estimated that 17,200 child deaths are recorded annually in Ghana due to Vitamin A Deficiency (VAD) in children, and Mr. Ewool said that is alarming, but preventable.

According to him, research at CRIG shows Yellow Corn has enough Vitamin A to solve the many health problems in children and help the nation achieve the Millennium Development Goal (MDG) 4 which talks of reducing child mortality.

Mr. Ewool said Vitamin A Deficiency also results in decreased immunity in children, childhood blindness in developing countries like Ghana, and also contribute to morbidity and mortality from common childhood infections.

“But all that does not have to happen because yellow corn has enough Vitamin A to prevent them,” he said.

Available statistics from the Ghana Health services indicates 47% of mothers wean their babies on corn porridge, locally called Koko, while 23% use banku, a solid local delicacy made from corn.

It is estimated that Ghana spends millions of dollars to import Vitamin A supplements for kids, and that is a drain on national income.

A recent survey conducted in Ghana by the World Health Organization (WHO) presented a secondary analysis of data from the Ghana Vitamin A Supplementation Trial (VAST) which found that vitamin A supplementation of infants and children 6–59 months of age decreased mortality, hospital admissions, and attendance at clinics.

Mr. Ewool therefore recommended that mothers should wean their children on porridge or banku made from yellow corn, instead of while corn, and that could serve the purpose without the use of expensive Vitamin A supplements.

Drought tolerant Maize for Ghana: Better food security and livelihood

Audrey Dekalu

For Aba Antobam, a subsistence maize Farmer in Ghana, maize is her life. It's her main source of income, giving her money to send her children to school, visit the hospital, nourishes her family at every meal and put a roof over her head.

For subsistence and smallholder farmers In Ghana like Aba, buying improved maize seed, such as hybrid varieties, is a gamble. If rains fail, they can lose not only their crop, but also the savings they have invested in the seed.

However events such as the severe floods and drought coupled with unpredicted rainfall pattern and harsh weather conditions, especially in the three Northern regions, chieftaincy conflicts, and rise in global food and fuel prices have cumulatively heightened the already existing vulnerabilities among people and communities in these regions.

In response, Ghana in March 2010 in introduced Drought-tolerant maize which were high yielding and affordable in order to manage food security, to address the uncertainties and threats facing the farming communities, as well as explore ways of combating food insecurities especially caused by climates change in the country.

The varieties were collaboratively developed by the International Institute of Tropical Agriculture (IITA) and Ghana's Council for Scientific and Industrial Research (CSIR)-Crops Research Institute (CRI) and the Savanna Agricultural Research Institute (SARI).

Manfred Ewool, lead scientist and a maize breeder from the CSIR in an interview said Ghanaian farmers have welcomed these new varieties which are expected to boost maize production and have even given them local names–denoting their characteristics and importance in Ghanaian society.

They are CSIR-Omankwa ('gives life'), CSIR Aburohemaa, ('Queen mother of maize'), CSIR-Abontem ('extra early maize') and CSIR-Enii Pibi ('father's child').

Ewool explains that it has taken an average of over 10 years, to reach millions of Ghanaian people with improved drought tolerant maize varieties and notes that so far strides have been made in variety development, release and adoption; seed production; capacity building and training; and communication and advocacy.

However, Ewool notes that, "The extra early DT varieties will help bridge the 'hunger gap' during the planting season and farmers could plant early, harvest and sell or use it as food before the main season begins."

"On average they harvest between 1.5 and 2 tons/ha, and when drought hits this drops to 0.5 tons/ha, especially where local varieties are planted, however with the new DT maize varieties released, farmers could harvest between 1 and 2 tons/ha under drought adding that s the yellow DT variety – CSIRAbontem – could contribute to a national savings of US$ 1.8 million annually spent on importing yellow maize for the poultry industry.
These notwithstanding not all farmers use high yielding, locally adapted seed and have argued that replanting the seed results in lower yields and that they have to buy new seeds for each planting year.

However Bioscience for Farming in Africa (B4FA) scientists have argued that buying new hybrid seed was cost effective for higher yields than replanting the same hybrid seed which result in lower yields in order to boost the country's food security index.

With Ghana rated 68th out of 105 countries on the Global Food Security Index, and third in Sub Saharan Africa after South Africa (40th) and Botswana (47th) and an overall score of 43.1 out of a possible score of 100 something urgent needs to be done to stem the tide.

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern.

Recent statistics show that a total of 1.2 million Ghanaians are with limited access to sufficient and nutritious food throughout the year, whiles another 2 million are at risk or becoming food insecure during the lean season or at the onset of a natural or man-made disaster.

These figures constitute between 5 to 10% of the total population, but the majority of people at risk of food insecurity are concentrated in the three northern regions -Northern, Upper East and Upper West Regions, according to researchers.

Since less than one-quarter of African farmers use high yielding, locally adapted seed the scientist contend that just by applying existing and available agricultural advice and technologies, the productivity of African agriculture could double or treble.

With the development of new techniques, all existing tools to improve agricultural productivity such as biotechnology deserve careful consideration and should be made available for farmers. Professor Eric Danquah, Director of the West Africa Centre for Crop Improvement (WACCI) at the University of Ghana said sub Saharan African governments have paid only pay lip service to funding scientific research. He called on the government of Ghana government to invest in the training of a critical mass of scientists in addition to proving the necessary infrastructure for agriculture development in research institutions.

Since maize will remain a crucial part of the food security equation even while the agricultural economies of the region diversify, continued investments in both maize research and market institutions, some of which must be public, are essential.

It is therefore important to adapt local food production in order to manage food security, to address the uncertainties and threats facing the farming communities, as well as explore ways of combating food insecurities cause by climates change in the country.

Fighting food insecurity through agricultural biotechnology – the Ghanaian Experience

By Mark Boye

Whiles global population inches up and food production reduces due to many factors including the climate change phenomenon, it has been estimated that over 1 billion people mostly in developing countries are food insecure and out of this figure one third of them live in Africa.

Even though this staggering statistics appears worrying, it is important to note that African governments are bracing the challenge by putting in more resources in overcoming it. One of such African success is Ghana; the country is the third most food secure in sub-Sahara Africa.

In improving food security in Ghana and Africa, however, it has become imperative that we shift the paradigms and focus on holistic approaches.

Many a time, the problem have been identified which includes the use of outdated tools in farming, poor infrastructure, farmers inability to access research inputs, governments low investment in agriculture, civil wars as well as declining interest in agriculture.

Notwithstanding, the need to recognise appropriate scientific tools in tackling this challenge has become necessary than ever before. The success of the green revolution which was buoyed in the United States in the 1960'sand spread through the develop countries, could not have been achieved without vigorous approach in agricultural biotechnology.

After Ghana was hit by its worst famine in the 1980s due to drought, a lot of water has passed under the bridge and it has since being food secure.

The seeming success didn't come cheap; it could be attributed to massive governmental interest in research and providing support for farmers, over 60% of the Ghanaian working force are mainly in subsistent agriculture with a very few in commercial farming.

Besides, interventions like subsidies on inputs have been provided to farmers and motivations given to extension officers and breeders have led to bumper harvests and contributed in ensuring that the country is able to attain food sufficiency.

In 2011, the Ghanaian government passed the Bio-safety Act which sets the pace for the utilisation of more biotechnology tools including genetically modified crops. However, civil society organisations have expressed worry that the passage would bring chaos as there would be the introduction of some abnormal varieties of seeds or crops into the society thereby affecting the health of the populace.

Again it is the fear that the discovery of oil in commercial quantities may affect agriculture production, and bring about the much dreaded Dutch Disease. It seems early signs are showing as the last season of the nation's food production saw a slight deficit compelling the government to import maize for the first time in many years to augment local demand. It is against this backdrop that is why the passage of the Act and its subsequent implementation needs not to be under estimated. It will help demystify the perception surrounding GMOs and educate the public on the safety of GMOs.

The Biosafety Act 831 2011 will enable Ghana to regulate for responsible development, handling and use of genetically modified organisms derived from biotechnology. This Act, however, does not apply to GMOs that are pharmaceuticals for human use.

According to experts the law would help to establish a transparent and predictable process to review and make decisions on permit requests from applicants along the product development pipeline.
The 28-page Act has nine arrangements of sections, which include scope, objectives and Establishment, Administration, Handling of Requests for Approvals, technical advisory committee, regulatory agencies, inspections, finance and miscellaneous.

It also has five schedules which include-conduct of business and affairs of the board, information required in applications for release, importation and placing on the market, risk assessment and regulatory agencies.

Dr. Kenneth E. Danso of the Plant Biotechnology of the Biotechnology and Nuclear Agricultural Research Institute (BNARI) of Ghana Atomic Energy Commission (GAEC) said the Act serve as a platform for the country to attain food security. He said it would further ensure that GMOs appropriate for human consumption is adopted into the market.

The BNARI uses Tissue Culture tool to carry their research in Genetically Modified Organisms (GMOs). They use irradiation process to preserve crops which help in its shelf life and goes' a long way in overcoming post-harvest losses.

Biotechnology which has come to stay is defined as a set of tools that uses living organisms (or parts of organisms) to make or modify a product, improve plants, trees or animals, or develop microorganisms for specific uses. Agricultural biotechnology is the term used in crop and livestock improvement through biotechnology tools. Biotechnology encompasses a number of tools and elements of conventional breeding techniques, bioinformatics, microbiology, molecular genetics, biochemistry, plant physiology, and molecular biology.

The biotechnology tools that is important for agricultural biotechnology includes- Conventional plant breeding, Tissue culture and micro- propagation.

Others include Molecular breeding or marker assisted selection Genetic engineering and GM crops and Molecular Diagnostic Tools.

According to agriculturists biotechnology tools are to complement existing conventional practices and help boost yield through improved seeds.

It is therefore certain that Ghana's passage of her Biosafety Act would neutralise the threat posed by the Dutch Disease and make her food secure.

Ghana scores low in protein quality on world food security index

Samuel Hinneh

The new Global Food Security Index 2012 has found that the quality of protein in food consumption in Ghana is low.

This means Ghanaians food intake does not match the body's requirement—having all the required food content (balanced diet), resulting in malnutrition. Recent analyses based on state-of-the-art epidemiological evidence by the Ghana Health Service show that in Ghana, 40% of all deaths that occur before the age of five are due directly and indirectly to under nutrition, making it the single most important cause of child mortality.

Ghana scored 20.5 out of a possible 100, placing the developing country among one of the lowest performances in the sub Saharan Africa. Senegal scored 20.7, Mali 26.3 and Nigeria 12.8 on the same protein quality in the index.

Manfred Ewool, a plant breeder at the Council for Scientific Industrial Research (CSIR)-Crop Research Institute says some people consume kenkey, which is a carbohydrate, without fish, or any source of protein due to low income levels to buy fish, or meat.

However, "plant breeders in Ghana from 1990 to 2010 have developed 12 different varieties of maize which is high in protein, so a consumer of the maize is assured of adding enough protein to the food'', he said in an interview.

Ewool says many people in Ghana are not even aware that some types of maize, commonly called 'Yellow Maize' released by the Crop Research Institute of Council of Scientific Industrial Research have high level of protein contents.

Statistics from the World Bank indicates that the Malnutrition prevalence; height for age (% of children under 5) in Ghana was reported at 28.60 in 2008.

"CSIR does some promotion on the maize but it is not enough to get to a wider audience to know the qualities of the maize. So it is up to the Ministry of Food and Agriculture, Extension officers, and Non-Governmental Organisations (NGOs) to sensitise the general public about the product and its benefits'', he stated.

He noted that the Ministry of Health and the CSIR have collaborated in similar areas so it is up to them to take it up to draw the attention the maize is highly nutritious and more importantly contains high level of protein which prevents malnutrition.
"Therefore there is the need to involve NGOs, private sector and other ministries such Ministry of Health to draw strategies to create sustainable awareness of the product'' he added.

To contain malnutrition, he suggested the Ministry of Education and other partners working on the Ghana School Feeding Programme need to adopt the yellow maize in the preparation of food for school children to solve malnutrition.

In contrast, Israel had the highest mark, scoring 100, followed by Greece 92.4 and the United States of America in third, scoring 88.6. The Global Food Security Index considers the core issues of affordability, availability, quality and safety across a set of 105 countries. The index is a dynamic quantitative and

qualitative benchmarking model, constructed from 25 unique indicators, that measures these drivers of food security across both developing and developed countries.

Lawrence Aboagye, the Director of Plant of Plant Genetic Resources Research Institute at CSIR, said plant breeders need to improve on the protein content of crops produce by doing screening of the crops and then select the ones which have high protein content.

He suggested government needs to support research in crops by putting in place sustainable financial support to boost crops production in the country.

Mr Wayne Powell from the University of Aberystwyth, UK says the most important thing is that the poor are those who are mostly affected by protein quality-"this segment of the population do not have sufficient money to buy protein foods such as meat, legumes''.

He said on the average about 30% of Ghanaians spend their income on food, therefore the implication is having sufficient food to ensure people are not worried about food.

He suggested that one important thing for Ghana is to have more investment in research in agriculture to boost food production, invest more plant breeding skills, infrastructure and education.

Government ask to fund agriculture research - Scientist

Della Russel Ocloo

INSUFFICIENT support for sustainable agriculture research and technology development on the part of government continues to pose a threat to sustaining food security in the country. According to agricultural scientists, inadequate funding has seen stagnation in the sector's growth.

Although research institutions were making strides in the development of variety of plants and other technologies to boost crop yield, the deficiency in funding support had become a setback to their operations.

While successive governments had follow the rhetoric of funding for agricultural research, there are no action plans in place to ensure the achievement green revolution that have eluded Ghana over the past decades.

According to Dr Kwasi Atokple, a Genetics and Plant Breeding expert at the Savanna Agricultural Research Institute (SARI), government's support for research continue to decline. "If Scientists do not write proposals for external funding for their projects and activities, they become redundant, since government support only comes in the area of salary payment", Dr Atokple told the *Daily Graphic* in an interview on the sidelines of a media fellowship program for selected journalists in Accra.

He indicated that infrastructure development, provision of logistics and human capacity building which are key responsibilities for government to ensure an expansion in the sector remained non-existence. The lack of capacity had also seen a dwindling number of extension officers in the system.

"The farmer to extension ratio is high that it has led to inefficiency in the system", Dr Atopkle said, adding that until the establishment of the West Africa Centre for Crop Improvement (WACCI) in 2007, there was no institution to train breeders in the country.

He also lamented at these of raw materials by Ghanaian researchers by international organizations free of charge.

That he said was as a result of policies that do not make it possible for research institutions to sell their technologies.

"Multinational corporations should be made to pay for agricultural raw materials developed by Scientist as a way of revenue mobilization to augment the activities of research institutions in the country",Dr Atokple said.

Quality cowpea for consumers out soon

By Mohammed Suleman

Ghanaian summers of cowpea can now look within for the cowpea product they have long been yearning for following the use of biotechnology to produce an item that would meet their preference.

Crop scientists have indicated that the cowpea popularly known as Kana-nado and imported from Nigeria is high yielding, has a good taste, good cooking quality and very tolerant to the constraints of the environment hence Ghanaians tend to patronize it more than the local variety.

When this is done, the country would be saving millions of Ghana cedis as it currently imports about 10, 000 tonnes of cowpea annually to supplement demand. About 30 percent of the Ghanaian imports come from Burkina Faso and the rest form Niger.

Dr. Martin Deborah, a plant breeder at the West African Centre for Crop Improvement (WACCI), made these know on Wednesday when a group of journalist visited the Centre as part of an ongoing training workshop on Plant Breeding Genetics and Biosciences for Farming in Africa.

The rationale behind the development of the variety is that consumers seem to be patronizing the imported product rather than the local ones. "We are currently working to ensure that the material is tolerant to the constraint of the area because Ghana has different ecological zones."

Mr Yeboah observed that there was the need to develop varieties that farmers would like to use. That, he said, could be done when Ghanaian focused and invested in Science and Technology.

He was of the view that, Africa and Ghana in particular has the unique potential of influencing the global food security agenda. Successive governments, he bemoaned had paid lip services to research and it was time that "African governments got serious in terms of research and development.

More than 8 million hectares of cowpea are grown in West and Central Africa. Also it is known that Nigeria is the largest producer with 4 million hectares. Other producers are Niger, Mali, Burkina Faso and Senegal.

The popular varieties of cowpea in Ghana include Nhyira,Asontem, Bawuta, padi tuya.

Ghana must acquire technologies for genetic modification now - Scientist

By Malik Abass Daabu

With increasing number of African countries embracing genetically modified crops to ensure food security for their populations, more so against the backdrop of erratic rainfall patterns and harsh weather conditions, a research scientist, Dr. Kenneth E. Danso is advocating immediate steps to acquire technologies for genetic modification.

He says Ghana cannot afford to sit on the sidelines and be left behind in the race to achieve food security.

In 2007, many countries especially in sub-Saharan Africa suffered riots triggered by unbearably high food prices. Ghana was spared any riots. But recognizing the dangers food insecurity posed to the internal security of the state including the citizenry hitting the streets in protest against high food prices, the Kufuor government, amongst other measures reduced duties on imported food items such as rice in an effort to keep prices down.

Ghana is therefore deemed to be doing relatively well in terms of its food security efforts. DuPoint's 2012 Global Food Security Index however placed Ghana at an unflattering 68th position out of 105 in food security - a bleak assessment in many respects.

With this precarious food security situation in the country, there is doubt as to whether Ghana's reliance on conventional system of food production is sustainable. A Plant Biologist at the Biotechnology and Nuclear Agriculture Research Institute (BNARI), Dr. Kenneth E. Danso believes it is about time Ghana considered the introduction of genetically modified foods if it is to ensure sustainable food security. He told **Myjoyonline.com** that he was not oblivious of the contentious debates engendered by GM foods. He insists, however, that if Ghana is to avoid the pitfalls in the seemingly inevitable journey to GM foods, it must start acquiring the technology to handle the subject now.

Whilst the passage of the Biosafety Act of 2011, Act 831 is a crucial step, more needs to be done with respect to equipping the nation's scientists with the needed resources to acquire the appropriate technologies and research techniques in order to adequately police any GMO products, he asserted.

Dr Danso's view chimes perfectly with the objectives of the Biosafety Act which are: "(a) to ensure an adequate level of protection in the field of safe development transfer, handing and use of genetically modified organisms resulting from technology that may have an adverse effect on health and environment, and (b) to establish a transparent and predictable process to review and make decisions on genetically modified organisms…and related activities."
The Act establishes a National Biosafety Authority (NBA) to oversee all matters relating to genetic modification.
An agriculturalist currently pursuing his Masters Degree at the Middlesex University, Mr. Kweku Tuoho Bombason, however, does not believe that Ghana has the technical competence and logistical capabilities to undertake the complex but necessary testing and assessment of GM foods and products.

He told **Myjoyonline.com** that if the moribund state of the nation's regulatory bodies such as the Food and Drugs Board and the Ghana Standards Board was anything to go by, then he could not be convinced that the National Biosafety Authority will achieve any results.

“Have the Food and Drugs Board and the Ghana Standards Board been able to stop the flooding of our market with fake and dangerous drugs and food substances which are a huge risk to the health of Ghanaians? Do they even have the capacity and the tools to do that?” He asked.

Appearing pessimistic about the NBA, Mr. Bombason doubted whether there were trained biosafety officials to undertake rigorous, independent testing of product safety and whether the Council for Scientific and Industrial Research (CSIR) had the laboratories to undertake these tests.

Responding to the questions raised by Mr Bombason, a research scientist with the CSIR-SARI (Savanna Agricultural Research Institute), Dr. Emmanuel Chamba, said Ghana had professionally competent scientists to assess and test and validate genetically modified products.

He however conceded that currently the laboratories needed to do effective testing were lacking – a situation he said “is a major concern and I agree hundred per cent with [Bombason]”.

Mr. Bombason said it was precisely because of Dr. Chamba’s concession that Ghana has to be careful it does not go down a slippery slope to unsafe food products.

“We must be cautious in adopting scientific discoveries whose consequences we cannot anticipate because we lack the technical knowhow to that,” he warned.

He said even in Europe where there are capabilities to test GM products, the populations have resisted the introduction of GM foods there.

Dr Chamba disagreed, insisting that opponents of GM foods make their argument on the basis of sentiments and unproven fear not science.

He said since GM foods were introduced in 1996 in the United States, there has not been a single report of death or any complications resulting from the consumption of GM foods.
According to him, the advantages in adopting GM foods were so enormous the nation must not be a prisoner of fear.

He cited Burkina Faso where cotton production shot up to over 300,000 metric tonnes a year, with the introduction of cotton cultivation and said Ghana only managed to produce 40,000 metric tonnes – its production ever in 1996.

Whilst the debate over GMOs continues, there is consensus that Ghana has to put well staffed and adequately funded institutions in place, if it is to introduce GMOs without opposition from the general populace.

Hybrid Development To Advance Ghana's Food Production

Adelaide Arthur

V/T

Plant breeders in Ghana are hailing hybrid seeds as an effective material to achieve high yields. This, they believe, will eventually lead Ghana to achieve food security.

The July 2012 Global Food Security Index by the Economist Intelligence Unit ranks Ghana as the 68th food-secured country out of the 150 it sampled, using food availability, affordability and quality and safety as measurements.

Ghana's position on the rankings calls for drastic actions to be taken if the country intends to achieve Millennium Development Goal one, which requires that poverty and hunger must be halved by 2015.

V/O

Hybridization allows for the creation of new crop varieties with unique qualities and high performance rates. It is the crossing of two genetic materials to produce hybrids with desired traits.

The first trait of importance is increased yields according to sorghum breeder, Dr. Ibrahim Kwesi Atokple. Other traits include taste, drought-resistance as well as pest and disease-resistance.

Maize hybrid seeds for instance, can produce potential yields of between 6 to 7.9 tonnes per hectre. However, two to three tonnes are realised from planting farmers' varieties or what is known as open-pollinated varieties.

SOT – Dr. Ibrahim Kwesi Atokple, Soghum breeder, Savannah Agriculture Research Institute, CSIR

"Hybrid seeds take advantage of hybrid vigour. The hybrid vigour is the superiority of the offspring over the means of its two parents. Hybrid seeds are therefore, expected to perform better than the best open pollinated varieties else there would be no justification for creating those hybrids. With hybridisation, the best performing plants are selected to create extraordinary ones whereas, OPVs resort to indiscriminate pollination."

Dr. Atokple however, warns it is not advisable for farmers to replant hybrid seeds once the first cultivation has been harvested. Farmers will not be able to achieve high yields when hybrid seeds are replanted.

SOT – Dr. Ibrahim Kwesi Atokple, Soghum breeder, Savannah Agriculture Research Institute, CSIR

"If a farmer replants hybrid seeds, the vigour expressed in the first cultivation will be missed. Hybrid vigour reduces with time causing low yields over the period. The farmer loses at the end of the day."

The small holder farmer who is to benefit from these high performing varieties may dread purchasing new hybrid seeds every season when they are used to conventional ways of replanting best seeds selected from previous harvest.

Dr. Atokple disagrees with this assertion saying, seeds cost less than 1 per cent of the entire production cost. Hybrid seeds cost 2 Cedis 5 Pesewas per kilo meaning, a farmer will spend 20 Cedis for 8 kilos of usually seeds reqired for an acre of land.

Cotton and yam breeder, Dr. Emmanuel Chamber in an exclusive interview with Joy News said high yields do not come about just by using hybrid seeds. Management of the environment equally plays a significant role.

SOT – Dr. Emmanuel Chamber, Cotton and Yam Breeder, Savannah Agriculture Research Institute, CSIR

"Planting hybrid seeds requires more input such as fertilisers, constant watering, following strict planting regimes as well as excellent weed control to achieve potential yields. This is a more laborious task as compared to planting OPVs."

Small holder rural farmers have often complained about their inability to access hybrid seeds forcing them to depend on seeds they have stored from previous harvest.

Plant breeders told Joy News movement of hybrid seeds usually ends once they get to the regional capitals depriving farmers of getting the seeds they need.

Dr. Atokple is proposing that distribution of hybrid seeds should be decentralised so that farmers can easily access them. He however, does not think the seeds should be given to farmers free of charge. He says farmers will not appreciate the seeds once they get them without paying.

What plant breeders are asking is the sensitisation of farmers, especially those in rural areas, on the benefits of hybrid seeds which they say, is the key to achieving high and quality crop yields that could lead Ghana to achieve the much-desired food security.

The impact of lack of inadequate funding on research into science and technology in Ghana.

Kingsley E. Hope

In Ghana, governments are not interested in providing a pool of money simply for the purposes of satisfying researchers' curiosity toward national development.

Many of the research areas are undoubtedly going to be very important for the future advances not only in science and technology but wider societal benefits.

In simplistic terms, research is a systematic method of knowledge generation involving painstaking observation, data collection, analysis and then decisions or conclusions by which recommendations are made.

The overarching aim of research is to stimulate national innovation through its relevance to local needs and national development priorities.

However, the unfortunate situation has resulted in the shelving of major research programs in the research institutions in the country leaving the scientists in a state of frustration and dilemma.

Most of the research works are donor funded which give little room for the scientists to decide what to do to the benefit of the country apart from kotowing to the whims and caprices of the donor countries.

DR Alexander Yawson, Radiation Entomology and Pest Management Centre Manager at the Ghana Atomic Energy Commission lamented over the lack of funding that had stalled the Pan African Tse-Tse and Trypanosomiasis Eradication Campaign (PATTEC) project.

According to DR Yawson the project, which started in 2008, aimed at eradicating sleeping sickness among human beings as well as nagana in cattle, ''but we have to stop the work because of funding''.

Similar concern had been raised by DR. Emmanuel Chamba of the Savannah Agricultural Research Institute (SARI) of the Council for Scientific and Industrial Research (CSIR) of Ghana, that lack of funding had impacted negatively on the cotton industry in the Ghana as research work had collapsed.

He indicated further that the situation had even affected the training of plant breeders in the industry saying '' a lot of us were trained thanks to donor funds''.

The situation, to MR Manfred Owoo, a crop scientist at the Crop Research Institute (CRI) of the CSIR was serious that most scientists use their own money to carry out research work.
He noted that he had to drop a screening program for high levels of ion and zinc in maize because the donor agency declined to sponsor the project.
A former Vice Chancellor of the University of Ghana, Professor George Benneh, once intimated that ''there is the urgent need of increased funding activities'' which he described as ''one of the major problems of the country''.

Inadequate Plant Breeders In Ghana

William Evans Nkum

Ghana's food security stands at risk with limited plant breeders: Currently, there are only ten plant breeders in the entire country.

The 60% population in the farming rely on antiquated seeds which limits their yields after harvesting therefore, leaving a deficit in the number of crops which species can be transformed in order to ensure high yields to meet increasing demands for food.

William Evans Nkum takes a look at the implications of inadequate plant breeders in the country.

Plant breeding is the art and science of changing the genetics of plants in order to produce desired characteristics.

International development agencies believe that breeding new crops is important for ensuring food security.

The contribution of the plant breeder to the production of high yields can not be underestimated. Plant breeders develop seeds with in-built resilience to withstand abiotic and biotic stresses to ensure high yields.

In present day Ghana, plant breeders are in short of supply, despite, many crop research institute established across the country.

For instance, within the last 15 years the University of Ghana graduated 16 PhD students in agriculture but none in plant breeding.

Moreover, out of 44students currently doing their PhD in plant breeding at the West Africa Center For Crop Improvement at the University of Ghana, only 11 are Ghanaians.

Prof. Eric Yirenkye Danquah, the director of the West Africa Center for Crop Improvement, University of Ghana, has attributed the decline of number of Ghanain plant breeders to lack of sponsorships to facilitate research, which is very crucial in the training process.

Sot, super (Prof Eric Yirenkye Danquah): Government has to provide the necessary infrastructure and funding to develop new varieties. If not our aspiration for a food secured country will be an illusion.

He also stressed that, the problem of brain drain has contributed to the decline in number.
In the case of Kenya, the government has created a fund to support students in their research work.

Sot, super (Daniel Otunge from the Africans Agriculture Technology Foundation) said Higher Education Loans facility created by the Kenyan government has helped in training more plant breeders who are contributing immensely to the growth of agriculture in the country. There are over 500 plant breeders in Kenya now, thanks to the loan facility.

Plant breeding and seed improvement is crucial in attaining food security, hence, the need for the country to have more plant breeders.

For instance, in Ghana where maize is the most staple cereal crop, most of our smallholder farmers who grow maize use traditional seed which is susceptible to diseases.

According to Dr Manfred Ewool, from the CSIR Crop Research Institute, Ghana, these traditional maize grow very tall and it leads to lot of lodging: It also results in lower yields.
He said since the introduction of a breed maize seed, the trend of germination of the maize crop has changed for the better. Yields have also improved.

Sot,super: (Dr Manfred Ewool):The best variety now yields between 5.2 tons to 7.9 tons per hectare, which is good for smallholder farmers who have adapted the improved variety.

But, that is not enough for Ghana where currently, the national average maize yield is estimated at 1.6 tonnes per hectare; using improved technologies like a breed maize seed, yields of 4 to 5 tonnes per hectare is said to have been recorded on-form demonstration.
In the case of Kenya, farmers who are cultivating the best variety now produce between 10 to 15 tons per hectare.

Sot,super (Prof Jim Dunwell from the University Of Reading, UK): the future of farm will depend more importantly the quality of seed a farmer has.

But for smallholder farmers accept the application of breed maize seed to ensure high yielding breed seeds, government commitment is hugely needed.

The establishment of research funds to assist students is crucial. With the facility, students studying plant breeding will have the motivation which will invariably increase interest in the subject.

Faced with rapid population growth, climate change and increased pressure on the world's natural resources, there is renewed interest in the role of productive, science-based agriculture in meeting the world's future food needs sustainably and affordably.
Plant breeders have underpinned major advances in crop production in recent decades and can help deliver a sustainable economy.

End.

Is hybrid the solution?

By Umaru Sanda Amadu

RADIO SCRIPT FOR B4FA 1

As the old famer harvests food crops for sale at the end of the season, he also selects and reserves a bottle-full of corn grains, a number of stakes of cassava and some bulbs of onion as well as suckers of plantain. These, he intends to begin the next farming season with. The seeds are kept in a very secure location to last the next months in the lead up to the new season. While the seeds are reserved in a part of the farmhouse for the purpose, rodents including mice and pests including weevils would find their way into the reserved grains and damage them. The onion bulbs and cassava stakes would develop shoots at the least contact with moisture. And then, the preparation for the next season is jeopardized…

But this can be averted.

For centuries, farmers have been provided the hybridization technique of reproducing plants and animals on their farms. This has seen tremendous increment in world food production geared at ensuring food security.

For instance, when maize hybrids were first commercially grown in the 1930s, the United State's production of maize was 53 million Mg annually. But with the new technology, maize production grew to 76 million Mg by the 1950s. And according to the United States Department of Agriculture's National Agricultural Statistics Service, the production was up to 150 million Mg annually by the 1970s and 219 million Mg in the 1990s. This tremendous increase was due to the use of high yielding hybrids.

Hybrid seeds have proven over the years to stand the test of time including but not limited to, disease, unfavorable weather conditions and undesired growth.

Over the past few decades, food production in some parts of the world particularly in Africa has been threatened by several factors. This ranged from drought to diseases. This could be averted by adopting hybrid seeds but many farmers are skeptical and reluctant. Hybrid seeds are available for farmers in sub-Saharan Africa but this is not getting the desired patronage.
The focus of this report is to determine whether or not, the adoption of hybrids is the solution to Africa and the world's desire to face squarely, the food insecurity facing the peoples of the world.

Here in Ghana, many farmers, especially in the rural areas care less about any new technology that may be introduced. For them, "what we know is what we know" and they are bent on repeating that over and over again.
But as Senior Research Scientist with Savanah Agricultural Research Institute of the Council for Scientific and Industrial Research tells me, the future of food production for Ghana and the world as a whole depends on the seed type used and of course, the environment. For Dr. Ibrahim Kwasi Atokple, the use of hybrids is the only guarantee to food security.

Cue…Atokple 1 *(You can keep your seeds over and over but with time, there is reduction in yield which means you need to replenish. Anytime you want to plant a hybrid, procure a new one. If you keep the seed and use the following year, it continues to reduce and will lose the hybrid vigour).*

The inability for farmers to repeat seeds they used the previous year becomes a challenge for most crop producers in Ghana. And Dr. Atokple agrees this is a challenge that must be surmounted.

Cue… Atokple 2 *(I want to trace one of these problems to the seed distribution systems of the country. all the seeds are kept in Regional capitals where the processing and certification is done and the seed producers don't make frantic efforts to open up outlets in communities where the farmers are. Imagine a farmer traveling all the way from Yendi to Tamale to just pick two or three kilograms of sorghum seed for his one acre. He won't do it. The cost of transportation is more than the seed he is going to buy so I think one way out is to improve our seed distribution system so that as the fertilizers and the weedisides are sent to the farming communities, the seeds are also included in the package and that way, the farmers can have access.)*

Dr. Atokple will not advocate for free distribution of hybrid seeds but maintains farmers must be encouraged to use them.

The use of hybrid seeds is a "savior" to farmers worldwide who otherwise would have had their whole plantation turned to waste by fungus or some other kind of disease.

A lot of research has taken place in this new technology and others in the field of Agriculture. Here in Ghana, the Atomic Energy Commission is very instrumental in that regard. Dr. Kenneth Danso is a Principal Research Scientist at the Commission's Biotechnology and Nuclear Agriculture Research Institute, BINARI in Accra.

And he tells me what is done in this facility.

Cue… BINARI 1 *(One of our mandate is to use nuclear technology for breeding and we call that Mutation Breeding. In mutation breeding, what we do is that we take the planting material, for example, cassava sticks or plantain suckers or yam vines, we radiate them at appropriate doses using the Cobolt 60, the nuclear energy and when we radiate them, we go a plant and then we screen for the traits that we are interested in. Some of the traits may be, drought resistance, high yielding, or resistance to diseases. We also do hybridization here with the intention to improve food crops.)*

And for him, it is time Ghanaian farmers go hybrid. First, decentralization of the production of seedlings is necessary, he says.

Cue…BINARI 2 *(What we need to do is set up certified centers for the production of this disease-free cassava. We don't have it in this country and we need to do that for plantain and yam as well. We need to put systems in place where people buy seedlings. By providing planting materials throughout the year, we also contribute in ensuring food security).*

The advantages of these seeds as a means of reproduction in plants have been numerous. Obviously, the most important of these advantages, as highlighted above, is the high yielding nature of the crops. High yield, no doubt, is a farmer's foremost priority and this cannot be underestimated.

The crops have also been found to have more sweetness in them as well as enhancing beneficial components such as vitamins for consumers.

That's not all; post-harvest benefits such as anti-sprouting, anti-bruising and ripening control have been identified with crops of this nature.

So why don't many Ghanaian farmers turn to this new technology despite its glaring opportunities? And how exactly, can they be brought on board?

Dr. Atokple of Savanah Agricultural Research Institute of the CSIR offers some reasons.

Cue… Atokple 3 *(We need to demonstrate the potential of these hybrids over those land races to be able to convince the farmers to buy the hybrids. If we can demonstrate to them that within the same acre, you will get three or four times the yield from hybrid than their land races, they will go for it. And if you also demonstrate that those hybrids have the quality of their local materials, they will go for it)*

Man, by nature has been a staunch resistant to new ways of life. And this technology, no doubt, has been met with stiff opposition. But the approach by Ghanaian farmers is not new. When this technology was introduced in America in the 1930s, farmers were skeptical. But after seed promoters adopted several ways of driving home the point, virtually the whole of North American maize is grown from hybrid maize seed.

Perhaps, with a little more effort, education and sensitization, Ghanaian farmers might just come to terms with this new "thing" for the ultimate benefit of the Ghanaian people.

From the on-going Workshop of the Biosciences for Farming in Africa, my name is Umaru Sanda Amadu reporting for Citi News.

Lack of Usage of Research Findings; Threat to Food Security

By Stella Danso Addai

The lack of Linkages between Research Institutions and Ghanaian Farmers has been identified as the bane of poor farming in Ghana.

It is as well said to be the factor for African farmers' failure of adopting new genetic techniques and technologies from researchers to address food security and economic development.

The current ratio of Agricultural extension officers who transfer new technologies to farmers in the country is in the range of one extension officer to 2,200 farmers, a situation said to be a major challenge.

According to Dr. Kenneth E. Danso, Plant Biotechnologist at the Ghana Atomic Energy Commission, research institutions currently find it difficult to get support from the Ministry of Food and Agriculture (MOFA) due to various reasons.

He lamented that all research institutions in the country are placed under the Ministry of Science and Technology, adding that such situation had created difficulties for a smooth liaison between researchers and MOFA.

Dr. Danso stated it was only when government prioritize activities of the researchers and provide them with funds, Extension officers would find it difficult to reach out to all farmers and assist them with the modern methods of farming and proper application of agro-chemicals for increased production.

He stressed that it is time for government to commit more funds into the Agriculture research activities to enable farmers have access to the new technologies to enhance their productivity.

Although government is trying to promote Agriculture in the country, its failure to adequately resource researchers and agriculture extension officers in the country is still affecting food security.

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

The scientists have therefore come out with several new techniques such as tissue culture; a method used to propagate plants, mutation; a situation whereby animals and plants develop new characteristics as a result of natural change in its genes etc.
However such techniques are left on the shelves of the research institutions, due to lack of linkages between Research Institutions and Ghanaian Farmers.

It is on record that approximately 65 percent of Africans rely on agriculture as their primary source of livelihood and small-scale farmers are responsible for more than 90 percent of Africa's agricultural production.

Nevertheless, poor farming methods, low quality of planting materials and depleted soils continue to keep farmers' at bay due to lack of available of Agricultural extension officers to communicate information about the new techniques to them.

Mr. Daniel Otunge, African Agricultural Technology Foundation speaking to Daily Guide stressed that the time has come for researchers to have an alternative platform to educate farmers on what is available for them.

According to him, since genetical modification of crops has become successful to providing the world with all the crops that humanity depends on for food and fibres, Africa farmers should be encouraged to adopt the new technology.

Emanuel Chamba, a researcher at CSIR-SARI, Tamale also in an interview suggested that the time has come for both government and research institutions to prioritize farmers' participation in the research field.

He also stressed the need for Government to provide enough funds to Agriculture research institutions so that they could involve farmers into their various research activities and communicate effectively to them about the new technology.

Suggesting methods to involve farmers into the research of scientists, he said the researchers could adopt farmer field schools, to take the farmers into their fields and allow them to learn the new techniques, or adopt demonstration methods.

According to Dr. Chamba, formation of partnership with seed companies to grow packages and distribute to farmers who are reluctant to approach them could also be another strategy.
He therefore called on farmers to come together by forming co-operatives explaining that by so doing they could have access to loans to enhance their productivity.

"Since 40% of the country's Gross Domestic Product (GDP) comes from agriculture, and 70% of labour is employed by it, not only would Ghanaian farmers benefit from the new technology but the economy as a whole would also be a beneficiary", he emphasized.

Scientist urges growers to adopt cocoa hybrid

Noah Nash

A Plant Pathologist of the Cocoa Research Institute of Ghana has urged cocoa growers to adopt cocoa hybrid seedlings in the replacement of affected virus cocoa trees.

VO

Ghana's cocoa production level for 2011 increased to one million metric tonnes but current production estimate for 2012 have been peg to decline to 850 metric tonnes as a result of bad rainfall patterns forecast for the growing areas.

There is a decline in Ghana's cocoa production as a result of virus attack called the cocoa swollen shoot virus disease (CSSVD) on the cocoa plant. Attack by the virus leads to a reduction in the yield of cocoa in cocoa growing areas where yield would have been higher for most farmers.

Due to this particular virus disease most affected trees are removed to prevent the spread of the virus to healthy tree, while farmers are compensated and are assisted to replant their farms with cocoa hybrid seedling, which are tolerance to the virus.

This replanting process is without opposition from the some farmers who continuously prevent cocoa officers from cutting down the affected trees. it was also noted that some of the farmers were not direct owners by the immediate farmers operating the farms.

But Dr. George Ameyaw of the Cocoa Research Institute of Ghana is advocating for cooperation from cocoa grower to allow infected trees to be removed and replanted with new hybrid seed. He noted the current breeds of cocoa are high yielding and tolerance to the swollen shoot virus so there is the need for farmers to allow officers on farms and well destroy those trees. He further noted that would enhance the cultivation of every farmer.

SOT 1: Dr. George Ameyaw, Plant Pathologist, Cocoa Research Institute of Ghana

"It is a challenge and it is a big problem when the virus gets into cocoa farms the only means of getting it not spread to others farms or healthy trees is to remove the infected trees so we advocate and there is a policy by cocoa board been run by the cocoa swollen shoot virus disease controlled unit.

I will not say it is a good news some of the farmers don't know the implication that if you leave disease tree on your farm it will spread to other trees. So what they do is prevent or oppose cocoa officers from removing affected trees. Sometimes going to the extent of even fighting them and chasing them out of their farms. Because they think that once there are one or two pods on the tree on their farm they can get some money and it is ok with them. But the problem is if you leave an affected tree on your farm it keeps spreading so in the end it can damage your farm and new by farm as well. Because the virus has no boundary it will just move to any farm".

VO

A cocoa farmer, Musah Asante in an interview with Viasat news noted that it is difficult to allow trees that they have inherited from their fathers is destroyed since it takes time to grow these trees.

SOT 2(Akan): Musah Asante, Cocoa Farmer

I feel bad about it each time the officers approach me to advise me to let go off this tree. But the true is that how will I explained this to my uncles who handed over the farm to me. I am the one who brought the bad luck here.

VO

The head of the extension Division, Dr. Boakye Wiafe of the food and agriculture noted that more education would be extend to most farmers to understand the need for the cutting down. We will approach the ideas of compensation and concerns of the farm in the annual review session.

END

Ghana To Debut GMO Testing

Adelaide Arthur

V/T

Test planting of three Genetically Modified Organisms may start next year, according to agric researcher Dr. Ibrahim Kwesi Atokple.

Scientists at various Institutes of the Centre for Scientific and Industrial Research are expecting permits from the National Biosafety Committee to enable them proceed with the planting trials.

With on-going global debates over the health implications of genetically modified organisms, Ghana's parliament has passed a law to legalise importation of GMOs, joining countries like South Africa, Burkina Faso, Egypt and Kenya who are already producing and importing GMOs on the continent.

V/O

Genetically modified organisms are those whose genes have been altered by transferring into them, external genes of interest with the aim of enhancing their performance.

Using biotechnology, this action is taken at the molecular level. The transfer can be made between different species or varieties of the same species.

Seeds for genetically modified rice, cowpea and sweet potatoes are to be tested for specific traits that scientists believe are essential in enhancing crop production in the country.

Evaluations of the genetically altered crops are expected to last three years to allow scientists to critically analyse and be sure that the desired traits are inherent in the three GM crops before its adoption and use in the country.

SOT – Dr. Ibrahim Kwesi Atokple, Lead Investigator for Cowpea, Savannah Agricultural Research Institute, CSIR

"Each crop has a peculiar problem. The Sweet potato is addressing the issue of increasing essential amino acids. For rice, we are thinking of varieties that are resistant to salt because most of the rice fields have accumulated salt and farmers are abandoning that soil. If we get a rice variety that can tolerate the salt, it will be a plus since production will be increased. We are also looking at nitrogen-use efficiency in rice such that with little amount of nitrogen, the crop can give us appreciable yield."

A key pest of cowpea is an insect called bod-borer which feeds on the tender stems, flower buds, leaves and pods causing damage to all the plant parts. This can result in yield reduction of between 30 and 80 per cent, according to experts.

Certainly, this is not good news for cowpea production in the country which already records low yields. As such, it has become necessary to control pest infestation of cowpea by developing pest-resistant varieties, according to Dr. Atokple.

The test planting process will involve first examining the GM seeds in the field and then crossing them with farmer's varieties or what is known as open-pollinated varieties to create hybrid seeds with desired traits.

SOT – Dr. Ibrahim Kwesi Atokple, Lead Investigator for Cowpea, Savannah Agricultural Research Institute, CSIR

"At this point we are just testing the efficacy of the gene conferring the resistance of the insect to the plant in cowpeas. When we get that, then we cross those that have showed resistance with the ones cultivated by farmers. So a cross between the transformed material and conventional ones is what we are going to evaluate for final release."

The process, which is still at the trial stage will not be commercialised until scientists have ascertained that the seeds have product integrity in terms of quality, yield as well as acceptability by the farmers.

Dispelling general perception that GM foods may have some health implications on humans, Dr. Atokple stated quality and food safety is foremost in the entire project. Government has passed several laws to regulate inflows and future productions of GMOs to ensure that GM crops that enter the country are safe for use.

According to the Secretary of National Biosafety Committee and Coordinator for Biosafety activities with the Ministry of Environment, Science and Technology, Eric Amanning Okoree, decisions on applications will soon be made since all risk assessments have been completed by the Technical Advisory Committee set up to review the three applications.

The genetically modified seeds for rice and sweet potatoes will be imported from the United States while seeds for cowpea will come from Australia.

Establishment of 'Technology Transfer Unit', a panacea to the weak linkages problem between researchers and farmers

From: Yakubu Abdul-Majeed.

A Ghanaian biotechnologist has advocated the establishment of Technology Transfer Unit at the various research institutions, saying it would not only bridge the wide gap between the institutions and farmers but solve the copious challenges hampering the rapid adaptation of genetic modified foods in the continent.

Dr. Kenneth E Danso, A Plant Biotechnologist at the Ghana Atomic Energy Commission said the establishment of such unit would complement other efforts to address shortages in the continent. The Unit he said would not only be in-charge of disseminating researchers' findings to the communities but also solicit views from the farmers to researchers on the various genetic modified foods.

He stated that efforts to encourage communities to embrace the new technology would be a mirage if nothing is done to remove the cordon in between research institutions and the farmers.

"This big gap that exist between research institutions and the communities in Ghana in particular and Africa as a whole needs to be eliminated," Dr. Danso emphasized.

The gap, he said poses a threat to the attainment of the millennium development goals in respect to food security and all efforts should be marshal overcome it. Dr. Danso was addressing a cross section of participants of the Media Fellowship on Biosciences for Farming in African who visited his facility. The journalists were at the institute to acquaint themselves with the work and challenges of the scientists. The Biotechnologist remarked that very few farmers have bought into the numerous innovations introduced by the research scientists in the country.

Dr. Danso also appealed to the government and international bodies to resource the research institutions with more funds to able them carryout their mandate effectively and efficiently. He stressed that it was about time the policy makers in Africa walk the talks on resourcing research institutions by ejecting the needed funds into research related areas.

Dr. Kwasi Atokple, research scientist at Savannah Agricultural Research Institute in Tamale in a private discussion also confirmed the position, explaining that some of seed growers were not advertising their products. He noted that many seeds released by the research scientists have not produced the needed result due to low patronize.

Dr. Atokple added that the improved seeds were centralized at the regional capitals and that there was the urgent need to decentralize it.

He also suggested that more demonstrations should be carried on the seeds at communities.
This, he said could help address the low patronage of improved seeds which would go a long way to improved food security in the country, emphasizing the more seed growers and dealers outlet the better for farmers.

End.

Are GM Crops Safe?

William Evans-Nkum

Although, some scientists argue that GM crops have the ability of ensuring food security. But on the other hand, some environmental groups and farmers fear GM crops can damage the eco-system and might affect humans.

A scientist from the University of Reading, Prof Jim Dunwell has allayed fears that, genetic modified crops are risky to the human habitat.

William Evans-Nkum has been finding answers to GM crops.

Genetic modification is the use of modern technology techniques to change the genes of an organism such as plants. A GM developed plant has resistance against diseases caused by insects or viruses, or through increased tolerance towards herbicides. This, perhaps, gives the farmer less trouble of spending so much on agrochemicals to fight insects and pests.

Global adoption of biotech crop technology continues at an unprecedented rate. During 2011, 12 million hectares of GM crops were planted representing an annual growth rate of 8% over 2010- according to the International Service for the Acquisition of Agri-Biotech Application (ISAAA) report.

Dr Clive James, chairman of ISAAA on June 2012 in the USDA crop report also revealed that global adoption of biotech crops is expected to continue to grow in the future, particularly in developing countries, where there is a promising pipeline of new products.
Currently, there are 16 top biotech countries with Brazil leading the pace. South Africa is the largest grower of GM crops in Africa.

According to the Brookes and Barfoot report in 2012, it is estimated that, the economic gains from biotech crops for South Africa for the period 1998 to 2010 was US$809 million and US$133 million for 2010 alone.

Countries like Egypt and Burkina Faso have all passed the Biosafety Act, which allows them to import GM crops. Kenya is the fourth country to have passed the Biosafety Act.

In the case of Ghana, the Biosafety Act was passed in 2011, but it is yet to take full implementation, because a legislative instrument is yet to be effected to back the law that will legalise the importation of GM crops.

Some scientist see the breakthrough of GM crops as an engine to ensuring food security as the globe continues to be hit by population growth and climate change which are having an effect on the environment.

A scientist Prof. Jim Dunwell from the University of Reading, UK in an interview with TV3 during a media workshop on Bioscience for Farming in Africa said, with the continuous increase on global population, ensuring food is crucial to meeting emerging demand.

And GM crops, with its high yield and rich nutrients can meet the challenge.

But on the other hand, some environmental groups have expressed concerns about GM crops and their possible effects on the eco-system which might affect humans.

For instance in Kenya the "ECOLOGIST" on 8th September, 2011 reported on how government's decision to legalise the importation of GM crops was met with opposition by small-scale subsistence farmers who feared that the presence of GM seeds could contaminate existing seed stocks and decrease food security.

On March 28th 2012, the MailOnline in the UK also brought a report titled "Fears over GM wheat that fends off greenfly" with the composition of the story highlighting on how environmental groups in the UK fear that the new GM wheat could damage eco-system and might affect humans.

In his argument, Prof. Jim Dunwell said, even though, some questions have been raised over the influence of GM crops on the environment, there has not been any report on post consumption effect.

On 21st September, 2012 the CBSNEWS –Healthpop column posted on it site, "Study says genetically modify corn causes tumors, but other scientist skeptical." The report reveals a French study supposedly showed that mice that ate GM corn sprayed with weed killer were more likely to develop tumors, and the report has already sparked hot debate as some scientists have questioned the research method.

On 6th June,2012 thefricareport.com posted on it site "GM foods, the new anti-christ-Ghanaian priest" the story talks about how a Ghanaian priest sees the introduction of GM foods, linking it to a revolt against God.

But, Prof Wayne Powell, from the University of Aberystwyth, UK argues that, the introduction of GM crops is one of the scientific tool box unraveled to help address global food problems and not to influence religious beliefs.

The ordinary Ghanaian continued to be confused and draw the line between the opportunities of GM crops and their potential effects on the environment.

Scientists say they are yet to record an effect GM crops have on the environment, questioning other concerns being raised by some studies.

With Ghana yet to be gazette onto the list of GM crops imported countries, most Ghanaians and nutritionists, as well as stakeholders in the agric sector, will be looking at safety of GM foods.

Dr Ibrahim Atokple CSIR Savannah Agriculture Research Institute, Tamale noted that, imported GM crops for cultivation are likely to be tested again to satisfy validity. But as for imported GM foods, the standard boards will take care of that.

But, until Ghana presses on her green light to allow the inflow of GM products into her shores, more questions will be asked to satisfy curiosities about genetic modified crops.

End.

GMOs safer than GSM-Scientists

By: Francis B. Npong

An agricultural scientist Professor Wayne Powell has hinted that, the use of Global System for Mobile Communications (GSM) is more dangerous to humans' health than the consumption of genetically modified foods (GMOs).

The University of Aberystwyth's Professor's comments came at the time people were rubbishing GM foods and describing it as deadly to humans and animals. But speaking to participants in an interview section during a training workshop on plants breeding, genetics and biosciences for farming and organised by Biosciences for Farming in Africa (B4FF4) for some selected Ghanaian journalists in Accra, Prof. Powell explained that, the term GM foods or GMOs (genetically-modified organisms) refer to crop plants created for human or animal consumption using the latest molecular biology techniques.

He said, the modification of plants in the laboratory is to enhance their desired traits such as increased resistance to herbicides, pesticides, and drought or improved their nutritional content and that nothing dangerous about the use of GMOs has been scientifically proven.

The GM technology was developed after the second war II to help boost agriculture to meet global food supply. GM process involves the transfer of genes responsible for desired traits of plants such as drought and insects tolerance, or high nutritional content into a different plant. The best known example of this is the use of Bacillus thuringiensis (B.t. genes) used in corn and other crops, he explained.

He said "GSM is known scientifically to be causing damage to the tissues of humans. The use of GSM cell phones is dangerous more than genetically modified food but everybody uses GSM without complaining".

According to the scientist, though people were aware of the effects of radioactive waves produce by GSM on their health, they continue to use GSM phones simple because the benefits gain from the use of GSM are outweigh the dangers associated to it uses.

Prof. Powell dispelled perceptions held by sections of the general public that consumption of GM foods are dangerous to human health saying "what they say about GMOs are not accurate and scientifically proven". Professor Powell said, like other products, GMOs are not 100 per cent zero effects but the dangers associated to the consumption of GMOs have not been scientifically proven. "There is nothing that has zero effects so is GMOs", he said.

"The enhancement of desired traits has traditionally been undertaken through breeding, but conventional plant breeding methods can be very time consuming and are often not very accurate. However, genetics engineering can create plants with the exact desired trait very rapidly and with great accuracy", Professor Jim Dunwell from the University of Reading, UK indicated earlier in one of his presentations during the training programme.

He also disapproved negative comments associated to GM products and that GMOs are to ensure regular supply of food to the increasing population by controlling pests, crops diseases and improving their nutritional content for the wellbeing of both humans and animals. Prof. Jim Dunwell said the concerns raised against GMOs are as a result lack adequate knowledge about GM.

The Secretary to Ghana Biosafety Regulatory Authority, Mr. Eric A. Okoree said that concerns raised over the safety of GMOs are fears that existed when new discoveries are made. He however assured Ghanaians that the framework on biosafety has been put in place to address the concerns of its safety.

Some environmental activists, religious organizations, public interest groups, and professional associations and government officials have all raised concerns about GM foods, and criticized companies in agriculture business for pursuing profit without concern for potential hazards in the use of GMO. Most the concerns raised against GMO are based on environmental, human health risk and economic.

How Many More Cocoa Trees Will Be 'Cut Down'?

By Stella Danso Addai

More than 250 million cocoa trees have been damaged as a result of cocoa swollen shoot virus diseases (CSSVD) in Ghana, between 1946 to date.

According to Dr. George Ameyaw, a scientist at the Cocoa Research Institute of Ghana (CRIG), annual removal of CSSV diseased trees translates into an annual estimated loss of 50,000 tonnes of cocoa beans.

CSSVD was reported in Ghana in 1936 and is mainly spread by mealy bugs (Homoptera) insects.

Dr. Ameyaw made the revelation in Accra during a four-day workshop for selected media professionals in Ghana who are undergoing a six-month period training on the science of plant breeding being offered by the Cambridge UK-run Biosciences for Farming in Africa (B4FA) project.

The media professionals are expected to impact the acquired knowledge to farmers and other stakeholders in the long-term through networking opportunities.

It is expected that the programme would encourage dialogue and promote a better understanding of the available options for improving agricultural productivity in African countries.

Although Dr. Ameyaw told Daily Guide in an interview that the number of cocoa trees in Ghana was currently not available, he indicated about two million people are engaged in cocoa production in Ghana.

To ensure the safety of the cocoa trees, the CRIG has instituted some interventions to protect and promote the production of cocoa in the country.

The main measure frequently used by CRIG to control the menace, according to Dr. Ameyaw is through "cutting out" of infected trees from affected areas. A method said to be the oldest and most used strategy.

Other interventions, he said include the use of Resistant varieties, Barrier cropping, Eradication of wild host, Mealy bug control (Biological means of managing the vectors) and Mild strain cross protection.

Stressing on why CRIG had adopted the use of resistant varieties to control CSSVD, Dr. Ameyaw explained that tolerance levels of the released materials decreased over time, opting for the search for new cocoa genotypes with high level of resistance to the disease.

"Since the local materials (Amelonado) were susceptible to the CSSVD, the breeding for CSSVD resistance became the focus of research activities of the British Research Team (BRT) between 1969 and 1978".

Some CSSVD tolerant hybrids (crosses between two parents) were released to farmers in 1987 to control the disease. However, the level of tolerance declines over time. Hence the need for more research for high level tolerant varieties has been on-going all these years.

"It is considered that tolerant cocoa varieties hold the key to CSSVD management now".

Educating participants on various methods for screening new genotypes of cocoa for tolerance to the virus, Dr. Ameyaw said “CRIG starts with natural selection of cocoa trees which are not showing symptoms in endemic areas.

“We then use them as parents to generate best performing offspring's (tolerant to the disease). The hybrids are evaluated both in the laboratory and on the field”.

Best performing genotypes are selected and multiplied for farmers through the Seed Production Unit (SPU) of Ghana Cocoa Board.

Touching on the advantages about the new breeding techniques, Dr. Ameyaw noted that current cocoa seedling supply to farmers from SPU have some level of tolerance to the CSSVD disease.

“These types of cocoa yield more and can live longer in the mist of occurrence of the disease.
Among some of the other breeding activities on-going at CRIG for an improved cocoa variety for farmers are; drought tolerance, pest resistance, disease resistance, high yield and best flavor.

He therefore called on cocoa farmers to plant cocoa hybrids from the Seed Production Unit of Ghana Cocoa Board (COCOBOD) to increase their yield.

-END-

No Cause For Alarm …GM Foods Are Safe-Scientist

By Mohammed Suleman

Contrary to the argument by individuals and civil society groups that Genetically Modified (GM) crop product are dangerous for human consumption, a research scientist at the Savanna Agriculture Research Instituted, Dr Ibrahim Kwasi Atokple has deflated their claim saying; the products are safe and have no health implications as widely speculated.

Dispelling the claim, Dr Atokple emphasised that a number of research has being on going since the introduction of GM products onto the market to ascertain whether or not the products have any health implication but no single case has yet being reported. "So far, nobody has reported of any side effects, "he added. Hence, the arguments by those groups have no basis and without scientific evidence.

Admitting though that there may be some few allergies associated with the GM food, he maintained that even the conventional crop products also have some allergies.

"I want to mention that there may be few allergies, but even with the conventional crops there are allergies. Several tests are going on with evaluation but nothing has been found yet," he emphasised.

Genetically modified foods (GM foods, or biotech foods) are foods derived from genetically modified organisms (GMOs), such as genetically modified crops or genetically modified fish. GMOs have had specific changes introduced into their DNA by genetic engineering techniques.

Dr Atokple spoke to this reporter at the side-lines of an ongoing training workshop on Plant Breeding Genetics and Biosciences for Farming in Africa. The four-day workshop which is being held in Accra brought together some selected journalist from both the print and electronic media across the country.

Some civil society organisations had argued that the adoption of biotechnology by the country will create a dependency condition that could jeopardize the country's food sovereignty and that its food crop production will be dependent on multi-national seed and pesticides companies.

But, the research scientist s had a contrary view; he explained that Ghana had the capacity in terms of human resource and technical expertise to be able to produce the seeds that the multi- national companies were producing hence farmers will not need to get their seed from multinational companies. For him, the benefits to be derived from GM crops far outweigh the cost. However, there should be more education on GM crops for the myth around it to be removed.

Jim Dunwell, a scientist at the University of the reading in the United Kingdom, observed that some countries in Africa that had adopted GM crops and other hybrids varieties were making breakthroughs in their agriculture. It is therefore up to Ghana to acquaint itself with the success story of other countries that had adopted GM crop and decide to adopt or not.

Ghana in May 2008 passed a Legislative Instrument allowing research into GM crops pending the passage of the biosafety bill which was passed recently by the Parliament of Ghana.

Out of the 25 countries planting biotech crops, 15 are developing countries while 10 are industrialised countries. Another 30 countries have approved import of biotech products for food and feed use. Egypt Burkina Faso, Bolivia, Brazil and Australia were the first five countries to commercialize their

biotech crops with the increase in from 1.3 million to 13.3 million in the biotech crop countries between 1996 and 2008.

The Global value of biotech crops markets in 2008 was 7.5 billion US dollars with an accumulated historical milestone value of 50 billion US dollars for the period of 1996-2008.

Whose 'cookies' are we eating?

By Nelson Nyadror Adanuti

Whereas countries in Europe and the Americas spend Hundreds of Millions on research on agriculture and new technologies to achieve food sufficiency, security and development of their people, not much progress has been made in developing countries.

It is in response to this that African Union (AU) member countries at a meeting in 2003 signed unto the Maputo Declaration on Agriculture and Food Security in Mozambique, a declaration which enjoins them to commit 10 percent of their national budgets to agricultural development.

Dubbed the Comprehensive Africa Agricultural Development Program, the proponents say the program among others will eliminate hunger and reduce poverty through agriculture, but since the declaration was made no major investments in agricultural research and development have taken place as there is still an over reliance on funds from external bodies and agencies to undertake research activities.

This raises the issue of how commitments made at such high level platforms become just a charade and Ghana is not an isolated

Cue Mr. Ewool: *"In our bid to ensure food sufficiency, security and secured livelihoods and incomes for our people, it must begin with investing in a strategic area like Agriculture, Science and Technology, but regrettably state funding for public research is generally minimal*," says Manfred B. Ewool, a researcher at the Crops Research Institute of Ghana.

In an interaction with Diamond FM in Accra at a Dialogue and Training Workshop on Bioscience for Framing in Africa B4FA, Mr. Ewool said not so much progress has been made in terms of funding to research and development especially in Agriculture technology and innovations as the bulk of activities undertaken by public research institutions in Ghana is reliant on funds from external bodies and donors.

The Bioscience fellowship program for journalists aims among others at creating understanding among the fellows on agri-science related reporting and programming in four selected African countries; Ghana, Nigeria, Uganda and Tanzania.

Mr. Ewool, who is a maize breeder stated that the mandate of the public research institutions does not include commercialization and so therefore, government needed to show more commitment by investing in research saying 'if we have our own money, we can do what originates from us."

For his part, the Co-ordinator of Kenyan based Africa Agricultural Technology Foundation, Daniel Otunge, had this to say budgets for agricultural including research, development and innovation keeps declining with most governments across the continent increasing their spending on arms and ammunitions.

According to Otunge, countries like Kenya have expanded funds for research activities in recent years alongside providing irrigation and subsidies for farmers. He still believes that more needed to be done especially in areas of research and development, if the continent of Africa will want to feed its people.

A plant Biotechnologists at the University of Reading, United Kingdom, Professor Jim M. Dunwell, suggests that it was important for every country to invest substantially in agriculture alongside research and new innovation.

He said public private partnership in research has become the new order citing giant companies like Monsanto that have moved research out of the UK to rapidly growing economies like India and China where a lot of resources are being invested.

Prof. Dunwell however was quick to add that any external contact needed to be carefully considered.

Until African countries shift from a position of underfunding research and innovation, it will be a matter of 'the one who pays the piper calling for the tune' with the unending question of whose cookies are we eating, still lingering on!

Why consumers don't like GM foods

By Umaru Sanda Amadu (Citi Fm)

Radio Script for B4FA (II)

Since its introduction some decades ago, Genetically Modified foods have been espoused as the panacea to world food challenges. GM foods, as they are generally referred to, have been seen as a significant milestone in the development of man. It can be compared to the transformation from the food gathering stage of man's early development to the food production stage.

Scientists have disclosed that GM crops are pest resistance; a thing that will no doubt be great welcome news to farmers across the world. GM crops have also been found to be tolerance to herbicides and resistant to diseases. With this new technology, farmers are guaranteed a hustle-free cultivation period.

Perhaps, the most significant to crop farmers in Africa and Ghana, particularly in the northern sectors is the fact that GM crops are drought resistant. In some parts of the country rainfall is considered a blessing from God. Irrigation facilities are non-existence. This means drought-resistance crops will be more than welcome in these areas.

Again, several nutritional values have been attributed to GM foods. Crops have been engineered to provide more nutrients than the ordinary crops. For instance, researchers at the Swiss Federal Institute of Technology Institute for Plant Sciences have created a strain of "golden" rice containing an unusually high content of beta-carotene (vitamin A) needed by the human body. Plans were also put in place to develop a golden rice that also has increased iron content all aimed at improving the quality of nutrients produced by these foods.

In the area of pharmaceuticals, researchers are working to develop edible vaccines in tomatoes and potatoes. These vaccines will be much easier to ship, store and administer than traditional injectable vaccines.

And the list is unending…

But somehow, despite all these mouth-watering offers at stake, many a Ghanaian would purchase any crop but genetically modified ones from the market. This conclusion has not been scientifically backed but from a personal sampling, it appears many consumers in Ghana would readily opt for what they term, "local" crops than the GM crops which is also referred to as "exotic".

So why would people shun away from something as good as what is being described in the earlier statements? Could there be something the consumers are seeing that scientists and GM promoters are hiding?

I seek answers to this question from UK-based Professor of Plant Bio Technology, Jim Dunwell. And he contends, the reactions vary from country to country.

Cue…Jim *(In the US, people don't have the same level of concern. They know that the food has been approved; they know that the crops have been approved and they trust the regulatory system. They say if the government has gone through this process and these things have been tested, then the normal consumer is not sufficiently expert in some of those issues so there is a degree of trust there. In the UK the situation is different. I think there is no evidence anywhere in the world of a real health problem*

from anybody who has eaten GM foods and these foods have been on the market for over 16 years and this kind of food is now being eaten by millions and millions of people).

Recently, a Ghanaian priest, Prophet Emmanuel Gregory Awayevu Akpanya described GM crops as the new anti-Christ. The man of God quoted Bible verses to support his claim stating that scientists who have introduced GM crops are attempting to sort of challenge God, the all-creator. He further urged African governments to shun away from these crops.

Assertions like the priest's pose a major challenge to the introduction of this new technology. It is more challenging when it comes from opinion leaders of his kind who have a large following, most of whom would swallow whatever he says hook line and sink.

But Professor Dunwell, who is also a member of the UK's Advisory Committee for Releases to the Environment, a body that advises that country's government on application of various types of GM sciences, the views of the priest are unscientific and must be regarded as such.

Cue… Jim 2*(There are people who have very ethical objections and I respect those because that's their own personal view and everybody have a right to their view but objectively, as a scientist, I try to look at everything with the scientific detail of it. I will say to them that their whole life depends on the efficiency of Agriculture).*

Although researchers have come up with several exciting ideas which include the materialization of these crops, they most often fail to communicate their new technology. Scientists are mostly reserved to their laboratories and this appears to have a toll on the reaction of consumers to end products of genetic modification.

The programs director of the Biosciences for Farming in Africa (B4FA) project, Dr. Bernie Jones identifies with this challenge for which he tells me, journalists have been targeted to for education on the new technology.

Cue…Bernie *(What we are trying to do is promote knowledge and understanding of the use and utilities of biosciences and agricultural research for farmers on the continent and to do that, we are particularly working with the media in our focus countries and we are hoping to equip them with the basic understanding of the sciences involved to expose them to the different techniques that exist and most importantly, to introduce them to such communities. I think communication is one of the challenges. We need the research to get the right planting materials to farmers but we also need the means to get those materials to the farmers and that is where the communication comes in).*

The world population has topped 6 billion people and is predicted to double in the next 50 years. Ensuring an adequate food supply for this booming population is going to be a major challenge in the years to come and many Scientists see GM foods as being in a better position to avert that.

But with the serious misunderstandings and opposition to this new technology, the challenge of food production for the future might just be in jeopardy.

It is important to note that GM foods continue to engage in a "cold war" between several factors namely Environmental activists, religious organizations, public interest groups, professional associations, scientists and government officials especially over claims GM foods are aimed at pursuing profit without concern for potential hazards. Even the Vatican and the Prince of Wales have expressed their opinions about GM foods Scientists engaging in these production must not underestimate the harm they can cause this new technology. And when that is done, not only may we

see farmers moving in droves to adopt this new technology, consumers, might just buy into this new idea and opt for it as a great alternative.

For the Biosciences for Farming in Africa project, my name is Umaru Sanda Amadu with Citi Fm.

Prize winners

The following six journalists and pieces were chosen as winners of nominal prizes ($50 plus a WACCI t-shirt, supplied by Professor Eric Danquah)

- Nelson Nyadror Adanuti of Diamond FM, Tamale, for his piece “The Rice City must not die”
- Audrey Dekalu of the Daily Guide for her piece on “Drought tolerant maize for Ghana”
- Samuel Hinneh of the Daily Dispatch for his piece on “Ghana scores low in protein quality on world food security index”
- Umaru Sanda Amadu of FM for his radio script “Is hybrid the solution”
- Stella Danso Addai for her piece on “Lack of usage of research findings threatens food security”
- Adelaide Arthur of JoyNews/MultiTV on her TV script “Ghana to debut GMO testing”

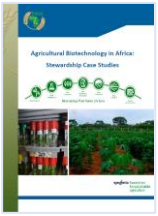
8. Material supplied to Fellows during training courses

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

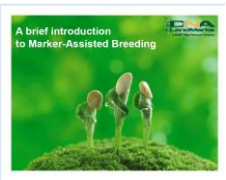


Syngenta/FARA: Agricultural Biotechnology in Africa – Stewardship Case-Studies

ASARECA Newsletter: The Agri-Forum

CABI Annual Report

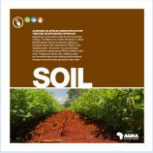
ATPS Policy Study: Why Informal Seed Sector is Important to Food Security



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



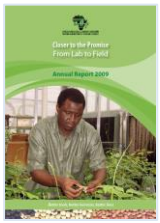
AGRA: Soil brochure

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

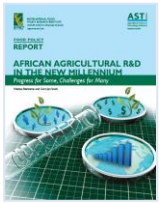
AGRA brochure: Africa's Green Revolution

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

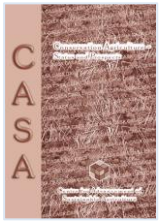
IITA: Research for Development Review

IFPRI Report: Country R&D Facts

Science Africa: Volume 15

AGRA Review 2011

AATF Annual Report 2010

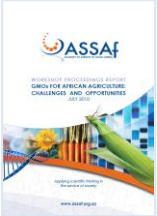


Centre for the Advancement of Sustainable Agriculture: Conservation Agriculture – Status and Prospects

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.

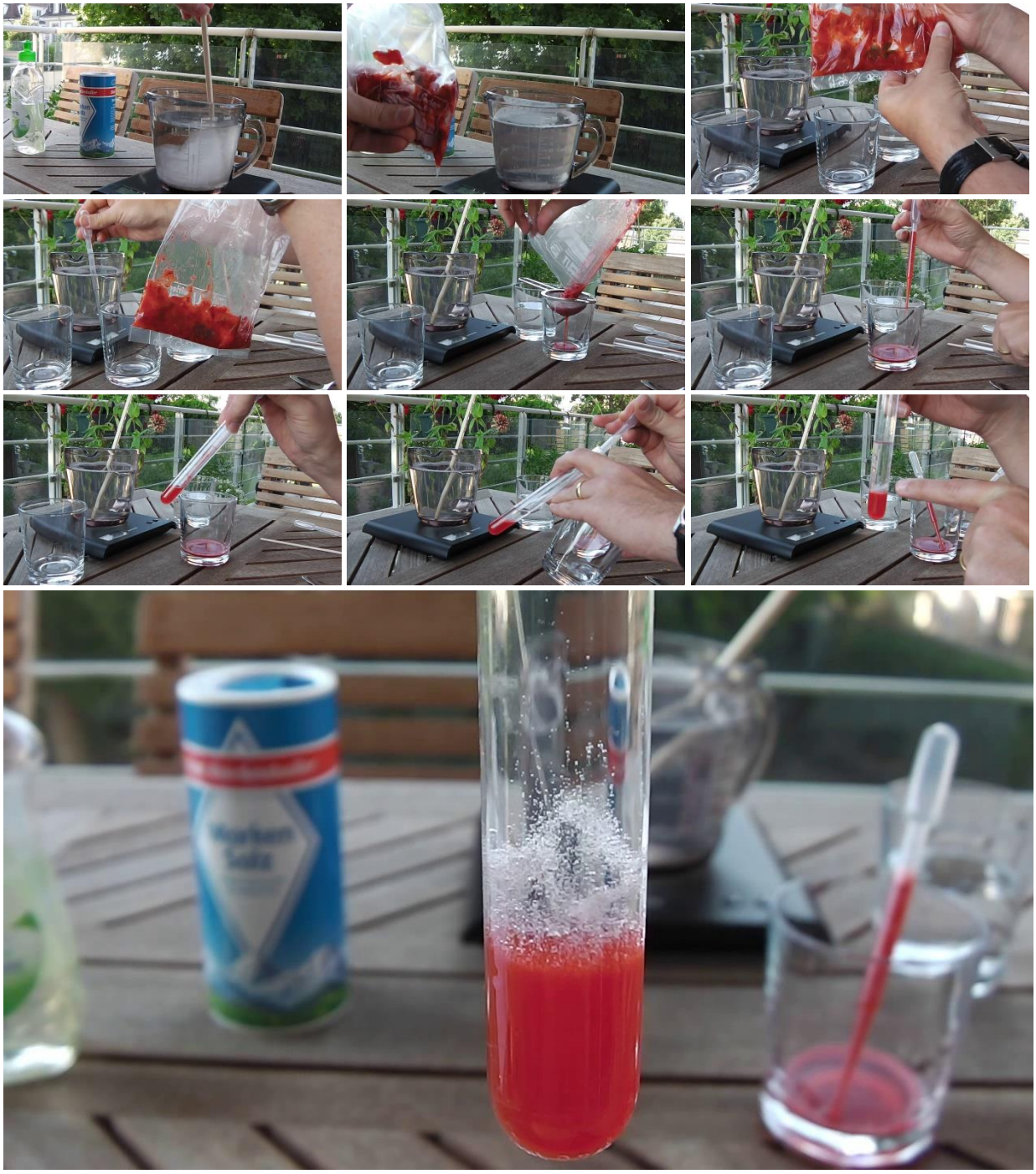
Likewise we included some basic free software (eg Adobe pdf reader, vlc media player) on the USB drive, since not all fellows had these available and would have found it difficult to download them locally.

We also included a number of background documents about the B4FA project and 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.



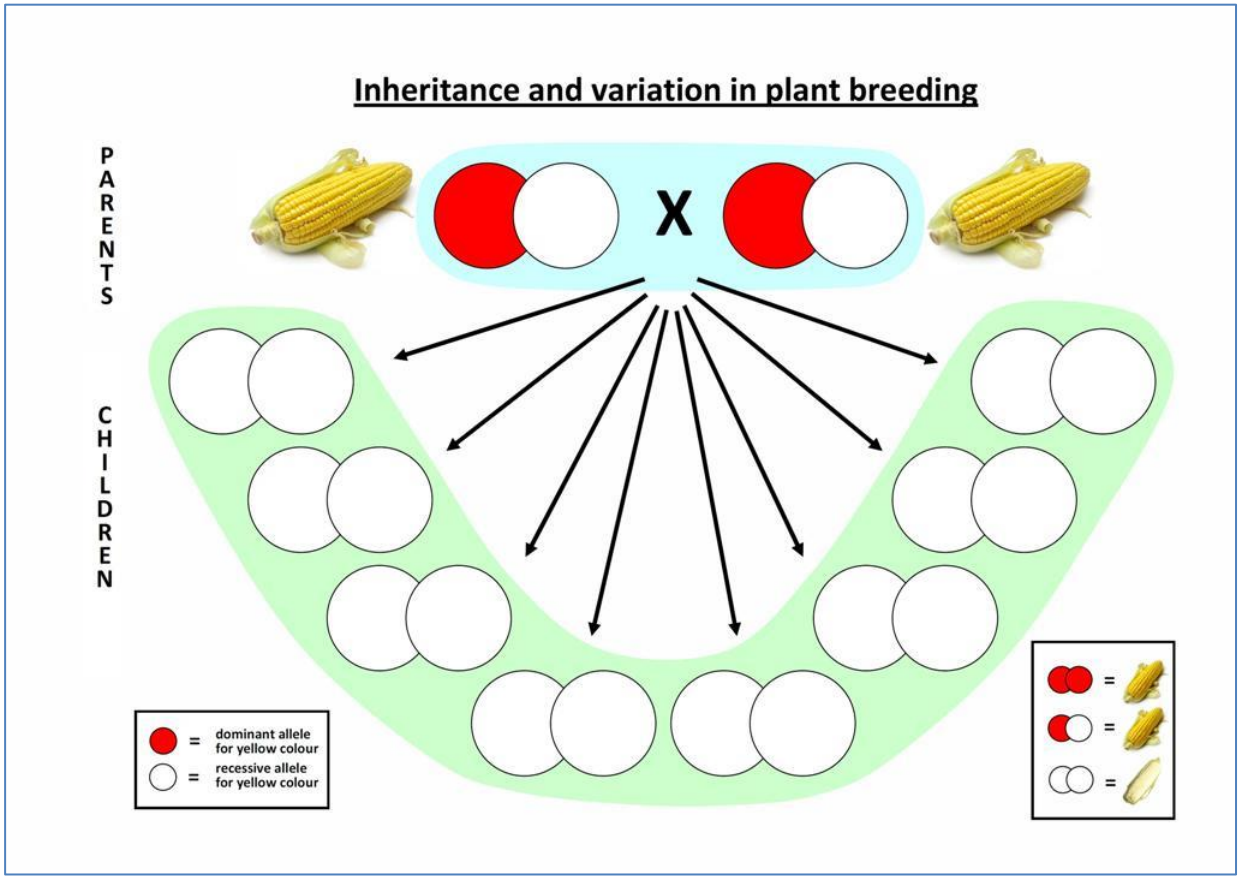
Following a simple experimental procedure (demonstrated beforehand through video – screenshots of which appear above) and mentored by B4FA staff and the research experts present, fellows prepared

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 counters from a bag and placing these on the blank circles of the "offspring" generation. The bags contained a large enough sample of equal numbers of **red and** white counters to ensure a near-random chance of either colour being drawn.

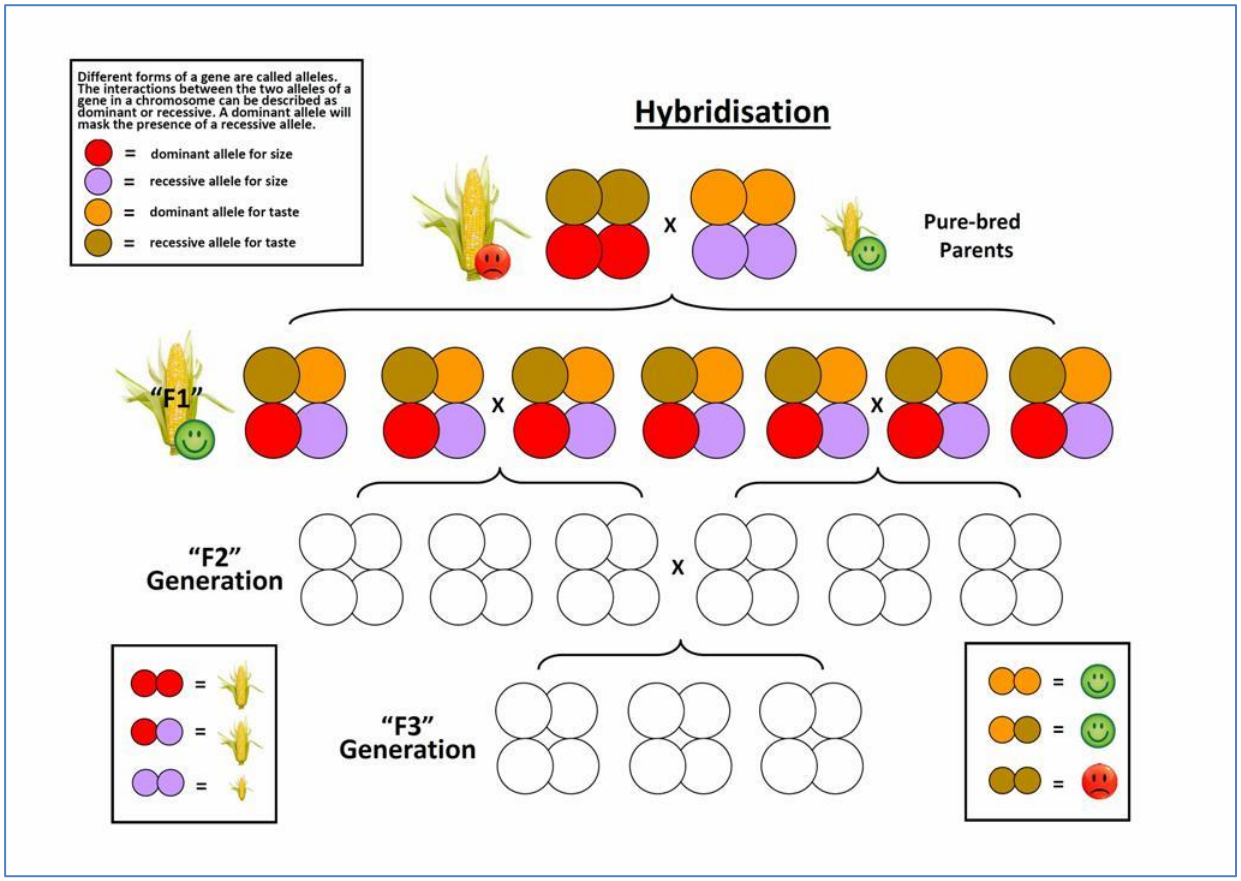


Once the worksheets had been populated with counters, fellows were asked to identify how the colour trait would be expressed in each of the "offspring" individuals, and tot up how many of each colour there were. With B4FA and local expert mentors, they were then encouraged to compare their results with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

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 size and flavour, 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 counters at random from bags containing equal numbers of each choice (one bag for each trait).



Once the worksheets had been populated with counters, fellows were asked to identify how the size and flavour 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.

9. Conclusions and recommendations

The training workshop represented an excellent start to our fellowship programme.

The innovative elements of the B4FA fellowship were highly appreciated (the long term engagement, the focus on understanding, the practical exercises and technical and journalistic mentoring) and received positive feedback.

The logistical complexity of the course was high, however (number of sessions, lectures and activities) so there is an opportunity to simplify this in the future, with fewer speakers and activities covering the same concepts. And occasionally the technical complexity got too high, so there is still a need to focus on bringing the material down to the most appropriate level to ensure understanding.

In terms of specific technical needs, the history of breeding and agriculture needed to be explained better, along with some basic information about plant physiology and reproduction (some fellows did not really understand what the presentations were referring to until they were standing next to a maize plant on the field trip with a researcher pointing out exactly what all the parts did).

F1 hybrid seeds are probably the most highly relevant technology to the local agricultural situation, but are very poorly understood, and frequently confused with GM or (when seed has been saved against the best advice) regarded as “fake seed”.

The section of the workshop programme that asked fellows to pretend to run a talkshow interviewing the scientists did not really work, as it was held too late in the evening and, since they took it very seriously, did not really have the “fun” element it had been designed to have.

Fellows also requested that the programme be adjusted to allow them to go on both field trips, to experience the maximum amount of diversity and opportunity for stories and interviews.

10. Presentations delivered in training course

Introduction

Dr Bernie Jones – B4FA Media Programme Director

Biosciences for Farming in Africa

Media Fellowship Programme
Ghana

Welcome

Dr Bernie Jones
B4FA Project Director – Media

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.

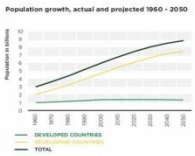
Sir John Templeton 1912 – 2008

- 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"
- *The Economist* observed that: Sir John revered thrift and had a horror of debt.....in his white-columned house in the Bahamas, overlooking the golf course, he still cut up computer paper to make notebooks
- Sir John's passing was marked by *Nature*: Templeton was a deeply spiritual, although unorthodox, individual. He lived a life firmly rooted in the Christian traditions of modesty and charity. Yet he was also a great admirer of science....which led him to form his foundation in 1987

Project Rationale

- Philanthropic objectives of our funders
- Global factors
  - Population growth
  - Climate change
  - Food security

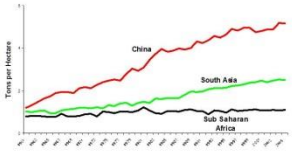
Population –> 9bn



Nothing new...

- Rev Thomas Malthus (1766 – 1834)
  - "An essay on the principle of population"
  - Populations checked by famine or disease
- But here we all are!

But look how different:



Africa

- High % of African GDP agriculturally based
- High % of Africans working in agric
- But green revolution "missed" Africa
- Unique disease/environmental challenges
- High % of farmers locked into subsistence
- Opportunity for economic and social development
- And US/Europe is part of the problem!

"Why don't farmers grow more?"

- Lack of inputs
- Poor planting material
- High costs of fertilizers
- Inappropriate technologies
- Poor land tenure
- Lack of water
- Poor extension services
- Variable and unreliable markets
- Poor infrastructure

But the mix varies from place to place

Gordon Conway (2010)

So what's happening?

- Many
  - Scientific Research Initiatives
  - Development Projects
- But
  - Little dialogue and public understanding
  - Much disinformation

Where does B4FA come in?

- Policy-makers' booklet of opinions by international thought leaders
- Series of Media Development Fellowships
- Series of studies on implementation, agricultural extension and demonstration
- Finding synergies

And now...

A welcome from the leader of our project...

Professor Sir Brian Heap

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?
  - Keep in touch: regular calls with local B4FA coordinators
  - Facebook discussion group
  - Networking events
  - Field trips (competitive)
  - Conference Bursaries (competitive)
  - Prizes (competitive)
  - Further training opportunities (competitive)

Our expectations of you?

- Engage in discussions
- Ask questions
- Participate in networking and other activities
- Write/broadcast more about the issues

- And let us know about it!

Housekeeping

- Format of each day
- Role of mentor/facilitators
- PLEASE no mobiles or emails in sessions
- Be on time – we cannot wait
- Attend all sessions

- Prizes

Practical Exercises

- 2 (at least) useable pieces from this course.
- 2 practical sessions on each
  - Preparatory
  - Production

- But also use the opportunity to interview the experts
- We would also like to interview you!

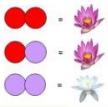
- Some more activities to be introduced later

Introductions

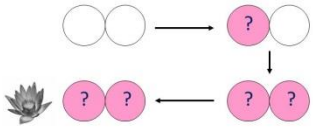
Over To You!

Genetics Simulation

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



For every child…



The result

- How many of each type of "child" did you get?
- Did you expect that?
- Statistically, 25% could be expected of the recessive trait

- Same in humans: eye colour, blood group…

DNA Extraction

What you will do

- Some real science!

- Perform a experiment yourself here in the conference room 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)

Something to keep the DNA on/in (phial, card)

All clear?

Let's watch me trying it at home last week…

Making up the extraction solution (buffer)

Preparing the fruit

Adding the extraction buffer

Straining/filtering the solution

Extracting the DNA

Final result

Now
It's
Your
Turn!

Bad Science

Heard a lot about…

- Science
- Scientific method
- Evidence
- Publications
- Experts
- Statistics

Should you always believe?

- Things to watch out for:

Ben Goldacre

"Battling Bad Science"

From TED

Things to look out for…

What do journalists need to look out for?

Briefing for "Interview Sessions"

- Day 2: Biotech for Agriculture 1
  - 5 teams of 2
- Day 3: Genes on Air – Talk Show game
  - 4 teams of 2
  - brief for this later on

Biotech for Agriculture

- Five topics:
  - Hybridisation
  - Tissue Culture
  - Mutagenesis
  - Marker Assisted Selection
  - Genebanks and Seedbanks

Biotech for Agric cont…

- Questions to ask…
  - What is the concept
  - Benefits
  - Risks/Problems
  - Examples
  - Etc…

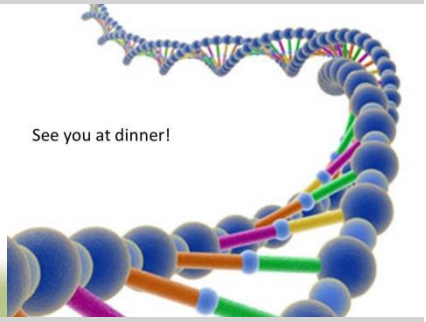
B4FA

Professional Journalism exercises

- 4 sessions – 2 articles
- Preparatory – story, angle, audience, source, interview questions
- Production
- Feedback & mentoring
- Print out your thoughts for the preparatory work
- Print out your article for us
- Remember to add your name, please

B4FA

See you at dinner!



Genetics, Biotech and Plant Improvement

(not) Jasper Rees

B4FA

Recap

- Crop improvement got a long way before genetics was understood
- What genetics help us understand about crop improvement
- What genetics teaches us about how to improve crops

B4FA

The Need

- Conventional breeding only got us so far…
- Emerging diseases
- Lack of traits in landraces
- Ever more elaborate searches for new characteristics
- Difficulty of introgressing desired characteristics
- Time-consuming nature
- Human dimensions to the challenge – food security in the 19th and 20th centuries

B4FA

Hybridisation

- Many people have heard the term – do you know what it means?
- Let's hear from our interviewers and interviewees…

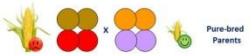
B4FA

Hybridisation

B4FA

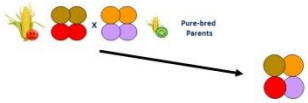
Hybridisation simulation

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



B4FA

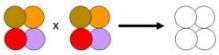
F1 generation



- Are all the same, as we can see on the worksheets

B4FA

But now let's save our seed



- In the F2 generation, there is equal likelihood of getting the recessive or dominant allele from each parent, so we can draw our counters out of the bags at random…
- What traits do your plants in the F2 generation exhibit? What about your neighbours'?

B4FA

And lets save the seed again

- In the F3 generation, the likelihood of dominant/recessives will depend on what the parents have.
- What traits do you have now? And what about your neighbours'?

B4FA

Over to you!

B4FA

Consequences of hybridisation

- Bought seed vs seed saving
- (Lack of) Ability of individuals or government research institutions to produce in desired quantity and quality
- Uniformity of resulting plants assisted mechanisation, quality control and processing

B4FA

Plant breeding as a commercial enterprise

- This is how commercial seed companies arose, and subsequent combined with agrochemical suppliers
- Far from being a commercial tactic, having to buy new seed each year was a scientific imperative, "guaranteeing" yield and quality

B4FA

Plant breeding as an applied science

- More and more difficult to get desired characteristics, traits and results
- Breeding moved away from hobbyists into the lab, as science itself evolved

Molecular biology

- What to do when the plants won't cross by themselves
- Tissue culture/Embryo rescue
- Similarity to assisted human reproduction?
- Let's hear from our interviewees…

Tissue Culture

Mutations

- Usefulness of mutations for "new" traits
- Awfully long wait though…
- How to accelerate?
- Is there any difference in outcome to natural process?
- Over to our experts…

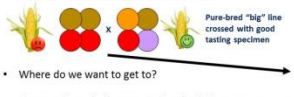
Mutagenesis

But still…

- Speed and uncertainty of breeding techniques
- Let's simulate that…

Breeding simulation

- Rather than our two true-bred lines for hybridisation, we start with a true-bred and a single "interesting" specimen



- Where do we want to get to?
- Can complete the first generation by picking counters out of the bags randomly
- What traits do your new plants have? What about your neighbours'?

Your next generation

- Now, as a breeder you have a choice. You can breed one of your best plants with itself, or cross-breed two of your best ones? Whichever you prefer!
- What do you get in the next generation? And your neighbours?

The third generation…

- Again – choose your best plant and breed it, or cross your two best ones?
- What do you get?

Were you successful?

- How can you tell your breeding programme has succeeded?
- Have you succeeded, failed, or do you need more time/generations?
- In reality, you'd need many more exemplars in each generation, and many more generations…

Backcrossing

- Also, chances are you'd need to get back all the good traits of your original true-bred line. So you'd have to back-cross. That would need even more generations…
- And don't forget that traditionally, you wouldn't have seen the genes, just the traits!

Time matters!

- Benefits of double cropping in Mexico to the green revolution
- Not all varieties can be "accelerated" like this though
- Yield lag and yield drag
- So imagine you could save time by "seeing" the genes like we could in the simulation…

Marker Assisted Selection

- Doesn't let you see the genes
- But lets you test for a marker associated with a particular trait
- Let's ask the experts!

Marker Assisted Selection

What else can we do with genetics other than breed?

- DNA sequencing & computational biology
- Genetic testing/diagnosis
- Fingerprinting & plant breeders' rights
- Gene banks, seed banks
- Now for our final interview…

Seed Banks and Gene Banks

Millennium Seed Bank

Let's have a look at what Kew Gardens in the UK is trying to do in collaboration with partners around the world…

But what can you use a seed bank for?

Let's look at….

Recap

- More "sophisticated" recent crop improvement is still trying to achieve same thing as farmers 500 years ago
- No fundamental difference to result, but new techniques let us address new and more immediate challenges
- Human consequence (fewer famines, better health, more obesity!, social and economic development of farming communities)
- But challenges are greater and greater, and new desired traits are more and more elusive
- Challenge of climate change, population, diseases

Thought/discussion

- Just as farmers selecting seed 1000 years ago, and specialists breeding new varieties 200 years ago, all the techniques discussed so far fall under the definition of conventional breeding and fall outside bio-regulatory frameworks
- Products emerging from these technologies still need to go through conventional processes though (seed certification etc etc)

New Technology

- There has always been a "new technology", from fire and the wheel onwards
- Perhaps unsurprisingly, human reactions have sometimes been similar…
- An interesting comparison from more recent history…

"Red Flag Laws"

- In the UK, the Locomotive Act 1865 set a speed limit of 4 mph (2mph in town) for self-propelled vehicles, and stipulated a crew of 3, one of whom needed to walk 60 yards ahead of each vehicle with a red flag to warn the general public and horse traffic
- Human walking speed is 4mph
- Justification: fear of accidents and prevention of damage to the highway
- Reality: evidence that road vehicles caused less damage to roads than horse drawn carriages.
- Laws were encouraged by those with interests in the railway and horse-drawn carriage industry!
- Emerging UK automobile industry advocated effectively for removal of the restrictive and non-sensical aspects of the earlier acts in the 1896 Act

More Red Flag Laws

- But: Pennsylvania enacted a Red Flag Law in 1896 requiring all motorists upon chance encounters with cattle or other livestock to

  1) immediately stop the vehicle
  2) immediately and as rapidly as possible… disassemble the automobile, and
  3) conceal the various components out of sight, behind nearby bushes

- This law was vetoed by the Governor!

Closing Session

Bernie Jones

Summary

- What we have covered
- Highlights
- Key issues and statements

Follow-up

- After this training course?
  - Keep in touch: regular calls with local B4FA coordinators
  - Facebook discussion group
  - Networking events
  - Field trips (competitive)
  - Conference Bursaries (competitive)
  - Prizes (competitive)
  - Further training opportunities (competitive)
- Our expectations of you?
  - Engage in discussions
  - Participate in networking and other activities
  - Write/broadcast more about the issues, and let us know about it

Awards

- Prizes
  - For best pieces produced on the course
- Awards
  - Certificates for our participants

Logistics

- Return equipment
- Sign expense receipts
- Ensure we have your contact information
- Ensure you have your course material
- Ensure you have your sign-in for the facebook group

Feedback

- Forms distributed earlier
- Please hand in to project staff
- Let us know any comments and thoughts at any time

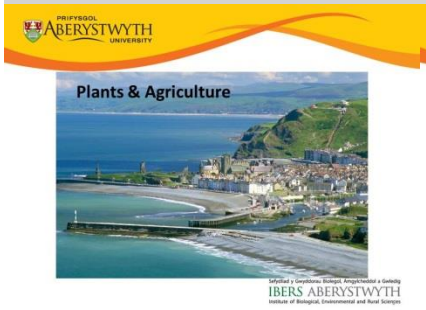
Thanks

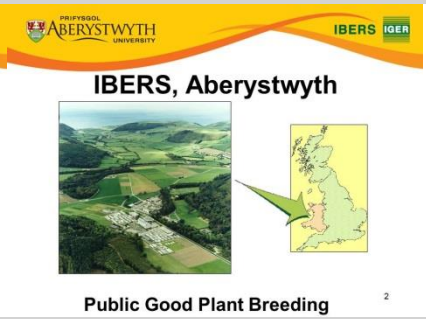
- To our presenters
- To our scientists
- To our project staff
- To YOU!

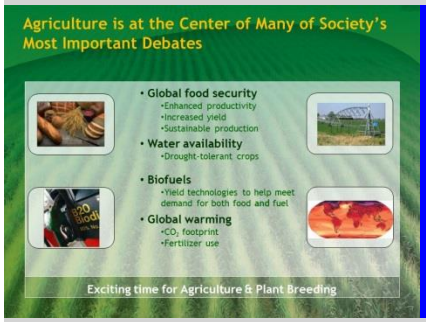
We look forward to seeing you all again soon!

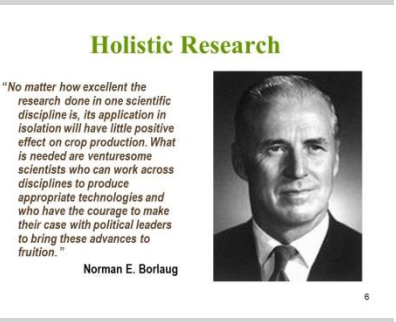
Plants and Agriculture

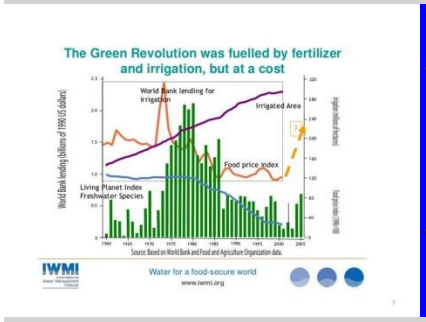
Professor Wayne Powell – University of Aberystwyth

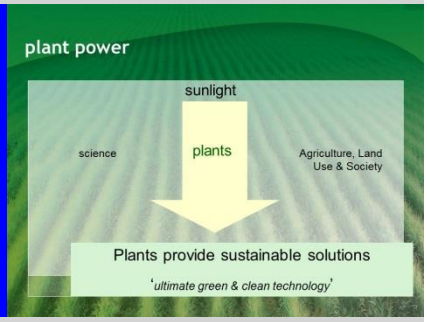


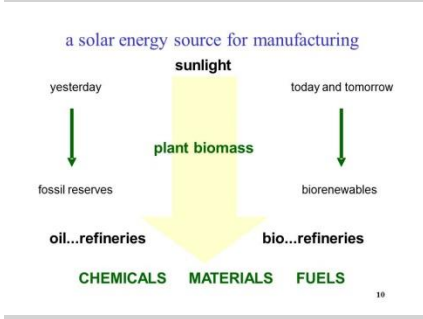


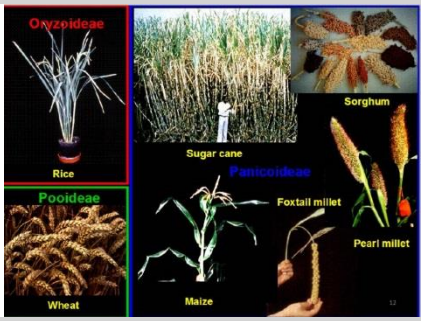


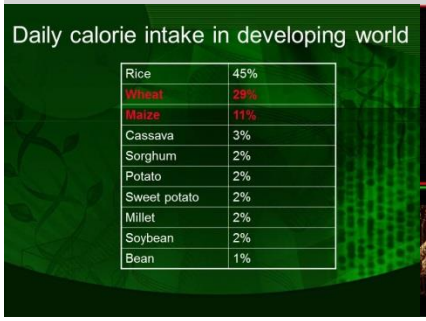




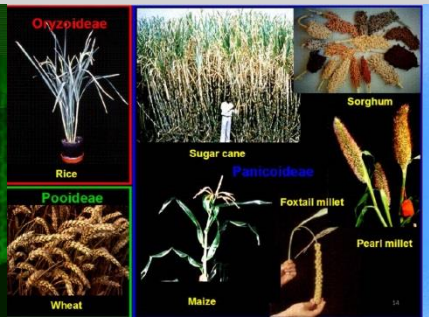








Rice	45%
Wheat	29%
Maize	11%
Cassava	3%
Sorghum	2%
Potato	2%
Sweet potato	2%
Millet	2%
Soybean	2%
Bean	1%



•DuPont Food security index
http://foodsecurity.eiu.com

•Father Green revolution: Norman Borlaug.

•Civilization founded on crops

•Importance of diversity

17

Charles Darwin

Evolution is driven by natural selection

18

Darwin's mentor

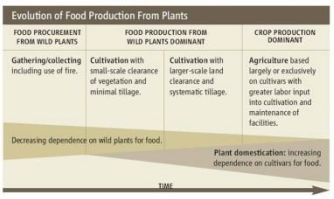
Henslow

two subspecies of P.nigra

Great Teachers often feature in the development of Great People!

19

Fundamental role of Diversity & Selection

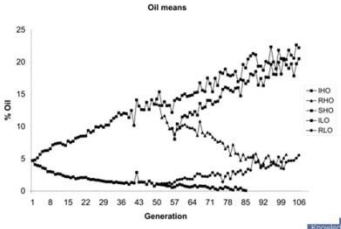


Reference: Michael Balter (2007) Seeking Agriculture's Ancient Roots, Science 316, 1830-1835

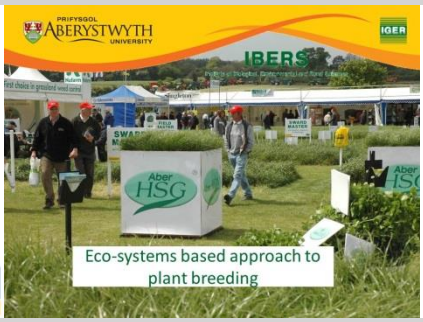
20

Selective breeding is a powerful tool

"Selection works."



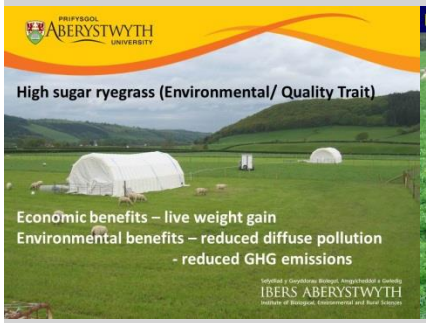
JW Dudley Crop Sci (2007) 47(S3)S20–S31

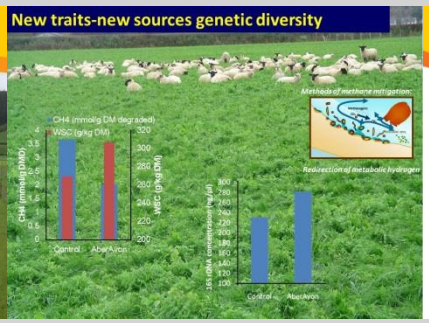


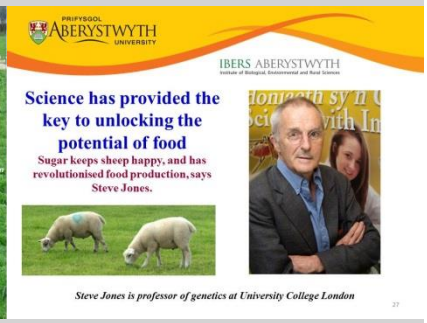
Grass crop domestication – increasing forage quality (Mean WSC over 5 years data)

Cultivar	Mean Water Soluble Carbohydrate Content
S23	17.1%
AberDart	20.6%
AberAvon	20.6%
AberStar	21.5%
AberMagic	23.7%

24







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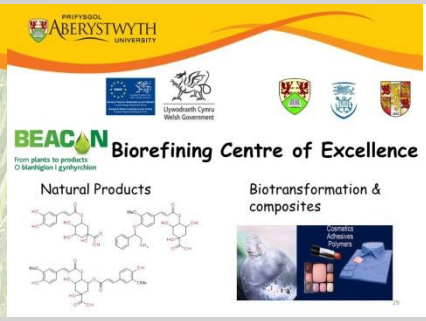
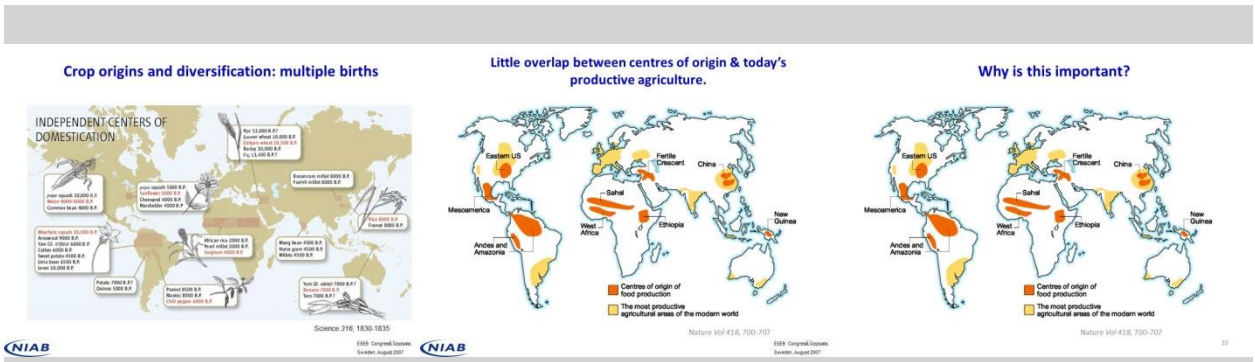
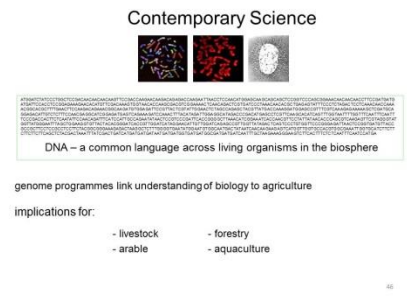


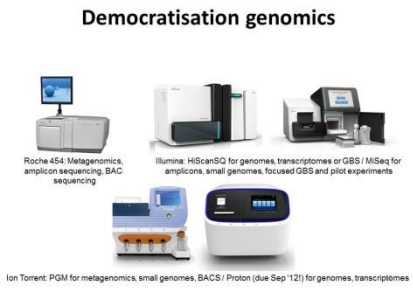
Vavilov 1887-1943

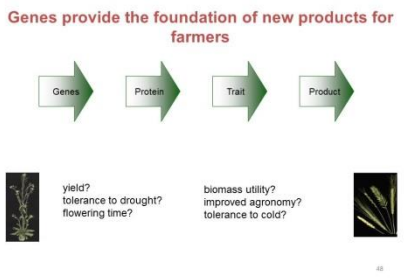
- Soviet botanist & geneticist
- Discovered and identified centres of origin/cultivated plants
- Criticised the non-Mendelian concepts of Lysenko
- Arrested in 1940, died of malnutrition in prison in 1943.

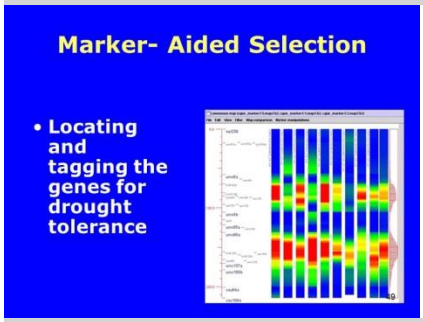
30

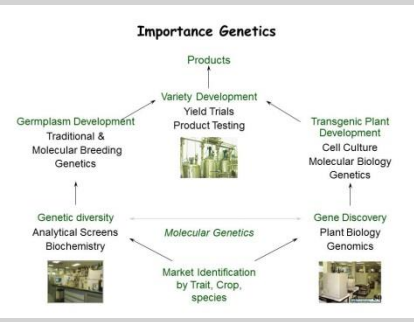

Crop origins and diversification: multiple births
INDEPENDENT CENTERS OF DOMESTICATION
Science 316, 1830-1835
Little overlap between centres of origin & today's productive agriculture.
Eastern US
Fertile Crescent
China
Sahel
Mesoamerica
West Africa
Ethiopia
New Guinea
Andes and Amazonia
Centres of origin of food production
The most productive agricultural areas of the modern world
Nature Vol 418, 700-707
Why is this important?
Drought in Africa between now and 2090
Red, Orange = More prone to drought
Blue = Wetter and less prone to drought
Hadley Centre, Met Office, UK
Crop Biodiversity
The Seed Vault at Svalbard
Global Crop Diversity Trust
Serendipity Natural Hybridisation
Many modern crop species are the result of ancient (or recent) hybridisation events.
Oilseed Rape
Cotton
Wheat
Maize
Wheat a classic allo-hexaploid
Triticum urartu AA
Aegilops speltoides BB
T. dicoccoides AABB
Ae. tauschii DD
Triticum aestivum AABBDD
T. spelta AABBDD
Science Vol 316, 1862-1866
Wheat a classic allo-hexaploid
The Magic of Heterosis
The New Rice for Africa
Organisation and importance of Diversity
Selection is a powerful tool but need to understand & know what to select for.
Importance engagement.
– Journalists to articulate and sell stories!
Breeding major technology platform for food, water & energy security
Time
New Opportunities for Agriculture
Demography, Global GDP and Water Withdrawals 1900 - 2000
Population increase about 3.6 times
Water withdrawals increased 6.8 times
GDP increased 19 times , about 3% per year (constant
Acknowledgements to Jan Lundqvist, SIWI
Water for a food-secure world
www.iwmi.org
The Life sciences revolution
Unlocking the genetic potential of the biosphere
Exciting time
Molecular biology
Computer science
Mathematics
Plant Breeding
Sustainable food production
Ag Chem & Seed Industry May 2000

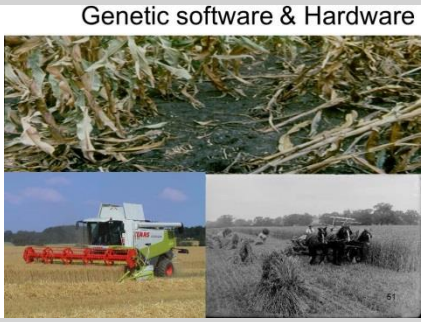

Contemporary Science
DNA – a common language across living organisms in the biosphere
genome programmes link understanding of biology to agriculture
implications for:
- livestock
- arable
- forestry
- aquaculture


Democratisation genomics
Roche 454: Metagenomics, amplicon sequencing, BAC sequencing
Illumina: HiScanSQ for genomes, transcriptomes or GBS / MiSeq for amplicons, small genomes, focused GBS and pilot experiments
Ion Torrent: PGM for metagenomics, small genomes, BACS / Proton (due Sep '12!) for genomes, transcriptomes


Genes provide the foundation of new products for farmers
Genes
Protein
Trait
Product
yield?
tolerance to drought?
flowering time?
biomass utility?
improved agronomy?
tolerance to cold?


Marker- Aided Selection
• Locating and tagging the genes for drought tolerance


Importance Genetics
Products
Variety Development
Yield Trials
Product Testing
Germplasm Development
Traditional & Molecular Breeding Genetics
Transgenic Plant Development
Cell Culture
Molecular Biology Genetics
Genetic diversity
Analytical Screens
Biochemistry
Molecular Genetics
Gene Discovery
Plant Biology
Genomics
Market Identification by Trait, Crop, species


Genetic software & Hardware

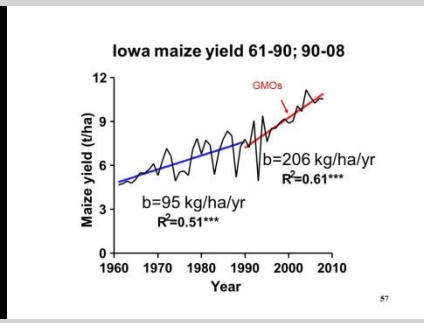

"The Three Pillars of Yield"
BREEDING
AGRONOMICS
BIOTECHNOLOGY
Strategically breed plants to create new, more robust seeds that perform better - and longer - in the field.
Use precision ag, planting density, plant health protection, and conservation tillage to make acres more productive.
Supplement breeding advancements by adding special beneficial genes to the plant.
ALL THREE ARE CRITICAL IN DELIVERING YIELD TODAY - AND TOMORROW

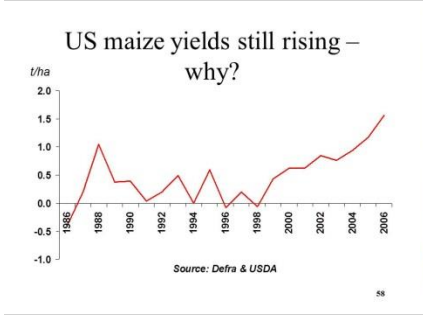

Rasike Farm, Chililila WG. MBILI maize-soyabean intercrop providing 1215 kg maize and 545 kg soyabean per ha when conventional intercrops failed. These results indicate that MBILI is a means toward greater food security.
Wamalwa Farm, Siritanyi FFS, Kanduyi. Maize-groundnut intercrop providing 5330 kg maize and 1203 kg groundnut per ha. These results indicate that MBILI can produce significant food surpluses.


Feeding future populations means doubling the productivity of neglected but nutritious crops such as yams and green bananas


Bioinformatics
Science
nature
DNA Sequencing and Genomics
SNP Genotyping
Systems Science

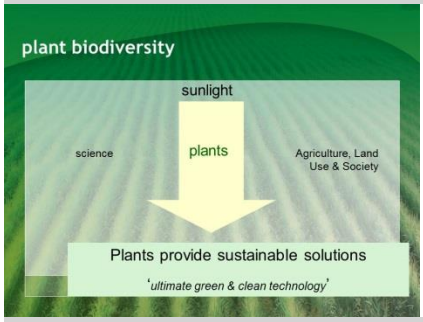

Genomics and the People Century
Science
RICE
Genomics-based research will make a difference but only if there is integration across social & natural sciences.

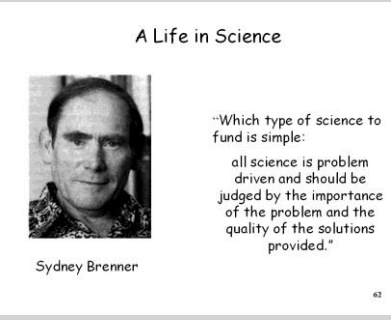

Iowa maize yield 61-90; 90-08
Maize yield (t/ha)
Year
GMOs
b=206 kg/ha/yr
R²=0.61***
b=95 kg/ha/yr
R²=0.51***
0
3
6
9
12
1960
1970
1980
1990
2000
2010

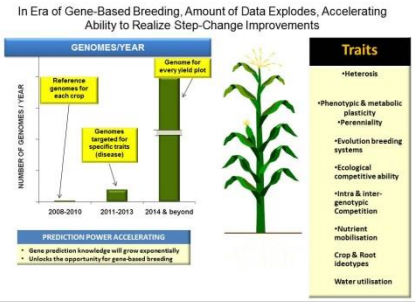

US maize yields still rising – why?
t/ha
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
Source: Defra & USDA

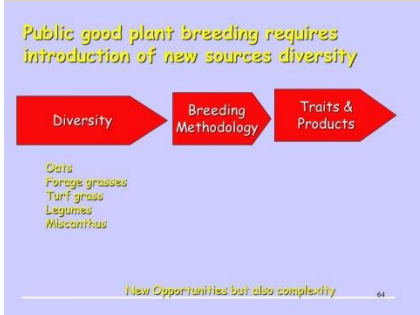

DIG FOR VICTORY
Scarcity
Security
The green revolution
Set Aside
Biofuels
Food Prices
Food Security
Subsidy and Surplus
Set aside, CAP changes


I WANT YOU TO USE BIODIESEL
Soil degradation
Estimated global water scarcity in 2050
Energy
Climate Change
Water (the new oil)
Food Security
Diet and Health

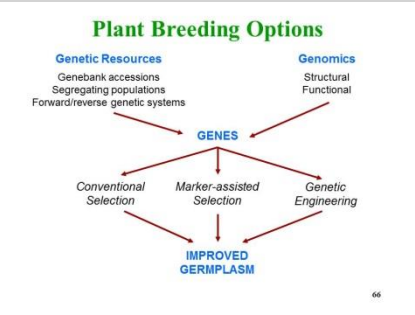

plant biodiversity
sunlight
science
plants
Agriculture, Land Use & Society
Plants provide sustainable solutions
'ultimate green & clean technology'


A Life in Science
Sydney Brenner
"Which type of science to fund is simple:
all science is problem driven and should be judged by the importance of the problem and the quality of the solutions provided."
62


In Era of Gene-Based Breeding, Amount of Data Explodes, Accelerating Ability to Realize Step-Change Improvements
GENOMES/YEAR
NUMBER OF GENOMES / YEAR
Reference genomes for each crop
Genomes targeted for specific traits (disease)
Genome for every yield plot
2008-2010
2011-2013
2014 & beyond
PREDICTION POWER ACCELERATING
Gene prediction knowledge will grow exponentially
Unlocks the opportunity for gene-based breeding
Traits
•Heterosis
•Phenotypic & metabolic plasticity
•Perenniality
•Evolution breeding systems
•Ecological competitive ability
•Intra & inter-genotypic Competition
•Nutrient mobilisation
Crop & Root ideotypes
Water utilisation

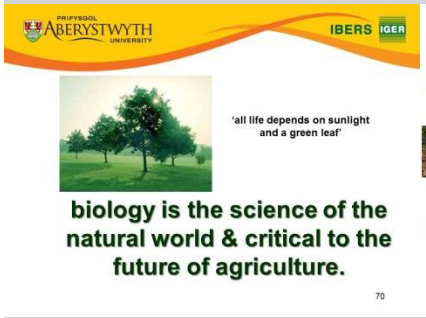

Public good plant breeding requires introduction of new sources diversity
Diversity
Breeding Methodology
Traits & Products
Oats
Forage grasses
Turf grass
Legumes
Miscanthus
New Opportunities but also complexity
64

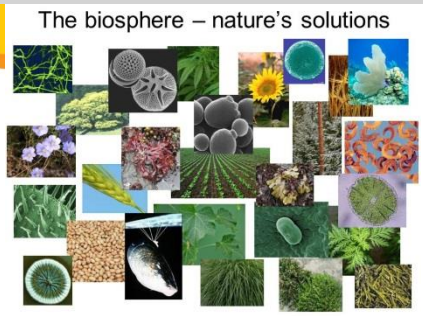

Participatory maize breeding in Africa
• Prioritize most important stresses under farmers' conditions
• Manage trials on experiment station and evaluate large numbers of cultivars,
• Select the best, and …
• Involve farmers
– Mother trials in center of farming community grown under best-bet input conditions
– Farmer-representative input conditions
– Farmer-managed baby trials
• Partnership with extension, NGOs, rural schools, and farmer associations
The Mother / Baby trial design
Collaborative, on-farm evaluation of maize cultivars
Performance under farmers' conditions and farmers' acceptance
65

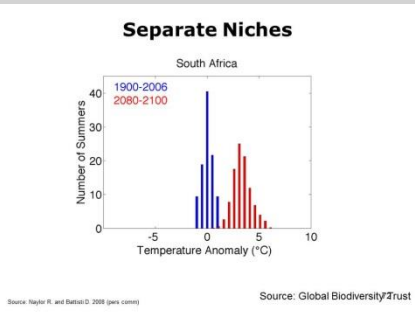

Plant Breeding Options
Genetic Resources
Genebank accessions
Segregating populations
Forward/reverse genetic systems
Genomics
Structural
Functional
GENES
Conventional Selection
Marker-assisted Selection
Genetic Engineering
IMPROVED GERMPLASM
66

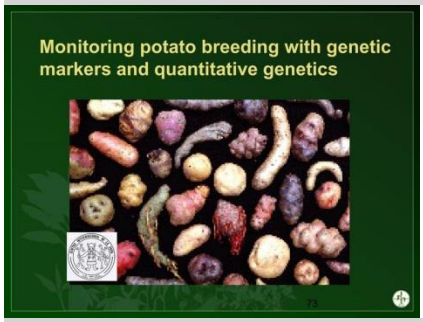

Crop Breeding Technology
CONVENTIONAL BREEDING
GENOMICS
GENETIC MODIFICATION
67

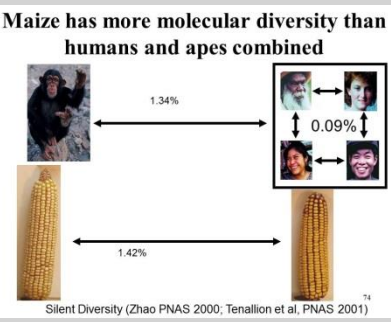

Ghana's Success Story
POVERTY RATE %
Rural Savannah
All rural
National
Rural forest
Urban
1991-92
1998-99
2005-06
Sources: Development Outreach, October, 08;Coulombe & Wodon, World Bank; Irish Hunger Report
• MDG 1 achieved
• Malnourished - 5.8m in 1993 to 2.7 m in 2003.
• Declines in % underweight children and mortality
• Strong agricultural growth since 80s
• 25% increase due to area expansion
• Maize yield up by 36%, cassava by 50%
• New maize, yam, rice and cassava varieties
• A pest resistant cassava.
• Strong growth in smallholder cocoa & pineapples
• Market liberalisation
• New rural infrastructure
All this is threatened by Climate Change
• Higher temperatures
• Greater & more intense rainfall
• Greater droughts
• River bank erosion
• Rising sea levels
• More intense cyclones
• Salt water incursions


PRIFYSGOL ABERYSTWYTH UNIVERSITY
IBERS
IGER
'all life depends on sunlight and a green leaf'
biology is the science of the natural world & critical to the future of agriculture.
70

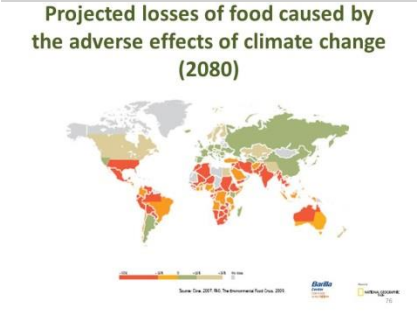

The biosphere – nature's solutions


Separate Niches
South Africa
1900-2006
2080-2100
Number of Summers
Temperature Anomaly (°C)
Source: Global Biodiversity Trust


Monitoring potato breeding with genetic markers and quantitative genetics
73


Maize has more molecular diversity than humans and apes combined
1.34%
0.09%
1.42%
74
Silent Diversity (Zhao PNAS 2000; Tenallion et al, PNAS 2001)


Selective Breeding is a Powerful Tool
Roslin Institute
Knowledge Transfer Network
75


Projected losses of food caused by the adverse effects of climate change (2080)

Science Journalism Skills

Alex Abutu – AFRICASTI, Nigeria

Science and Agricultural Journalism

Alex Abutu
Editor,
African Science Technology and Innovation News
www.africasti.com

Why Science?

- "Why we use scientific methods to evaluate things is that human beings are extremely susceptible to prejudice, group think, placebo effects, confirmation bias and a whole host of other factors. This means that some of the things which we strongly believe to be true, are in fact not! Scientific investigation attempts to overcome some of these effects to get a more objective view of an issue. A key tenet of the scientific method is that results must be reproducible given the same conditions. If a finding cannot be reproduced, it is not scientifically proven," Kirsty Newman

The scientific process

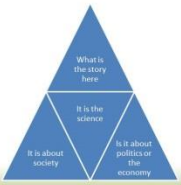
- Science is not magic
- You ask a question
- Construct hypothesis
- Test hypothesis
- Analyse the data
- Communicate the result to your peers then the public.

Why agric?

How to find a story

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

Is it a story?



Sources of information

- A good science story depend to a large extent 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:

Who do you trust?

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

Interviewing a scientist

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

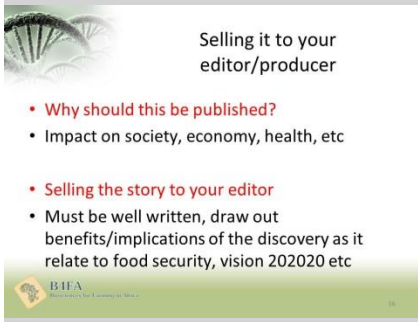
- Relationships with lobbyists
- How to get the truth from a lobbyist
- Investigative interviewing techniques

How do scientists react to the media?

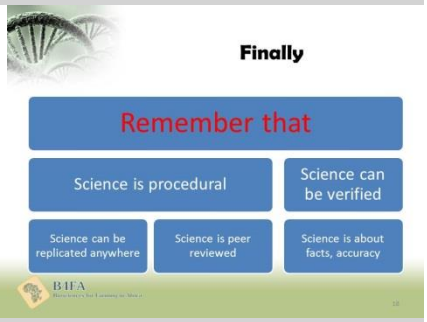
- What do scientists think of us?
- Misquote, misrepresentation, inability to understand common scientific jargon
- What can you do about that?
- Befriend them, Win their trust, cross check copy, make them understand you a journalist
- Building the relationship?

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
B4FA


Where to publish
www.africasti.com
www.scidev.net
Research Africa
Science Africa
Nature
www.islamonline.com
B4FA

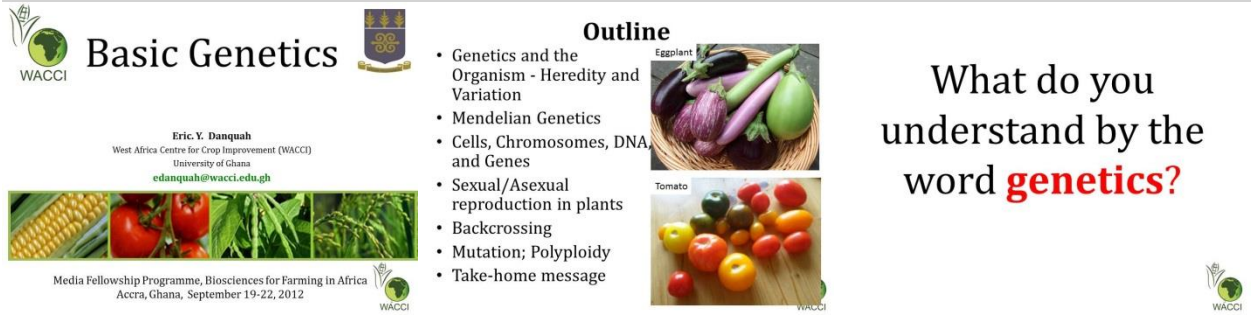

Finally
Remember that
Science is procedural
Science can be verified
Science can be replicated anywhere
Science is peer reviewed
Science is about facts, accuracy
B4FA

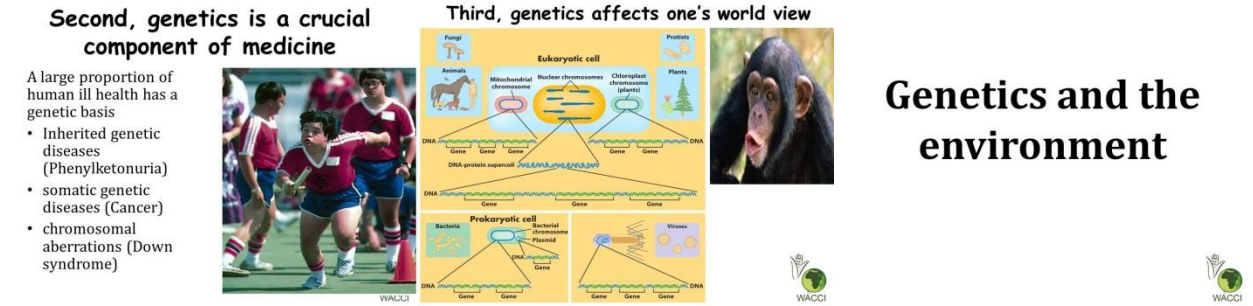

* NGOs/Lobbyists have an agenda
* You are not a scientist
* Science is not about opinion
B4FA

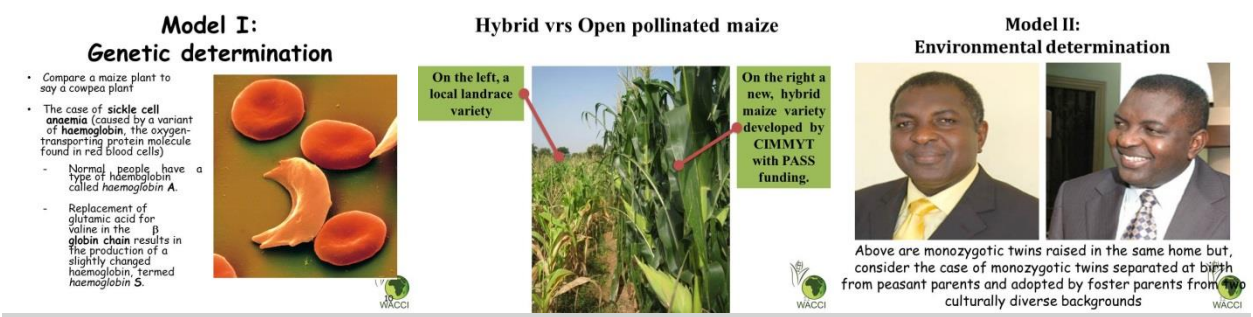

Thank You!
Midaasi !!
Mi da bo shi !!!
Alex Abutu
Editor,
African Science Technology and Innovation News
www.africasti.com
+23468701960
B4FA

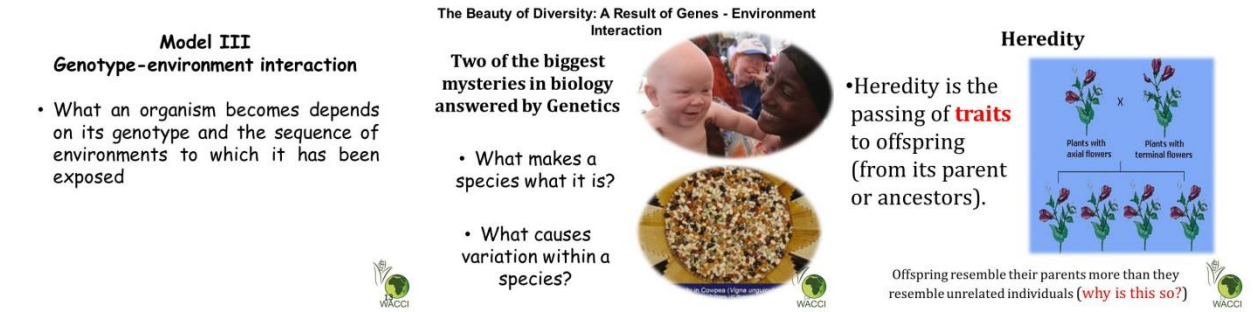
Fundamentals of Genetics

Professor Eric Danquah – University of Ghana/West African Crop Improvement Centre









What is a trait?

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

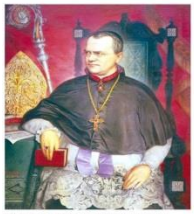
Can you think of examples of identifiable traits?

Variability

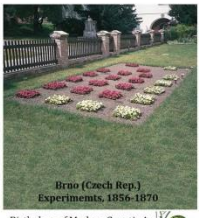
- Variability is the differences among individuals within any population

Variation in pigmentation in humans

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



Originator of the concept of the gene (autosomal inheritance)

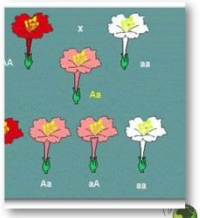


Birthplace of Modern Genetic Analysis
Augustinian monastry garden, St. Thomas
Brünn, Austria

The idea of blending inheritance

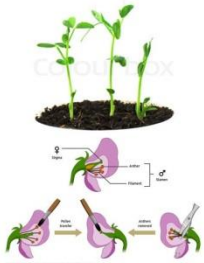
- Spermatozoon and egg contained essences from various parts of the body; at conception, these essences somehow blended to form a pattern for the new individual

Ideas in Science come in fashions called paradigms

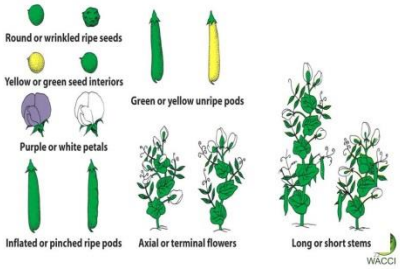


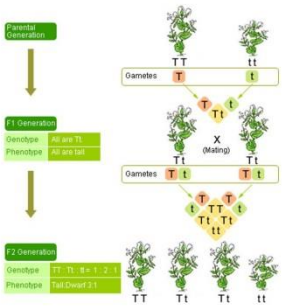
Reasons for choosing to study garden pea

- **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**



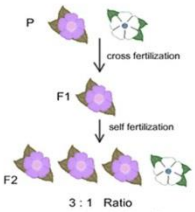
The seven character differences studied by Mendel



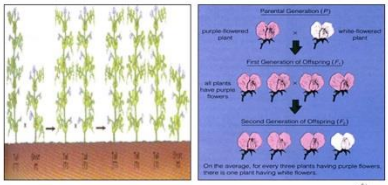


Summary and conclusions of Mendel's experiments

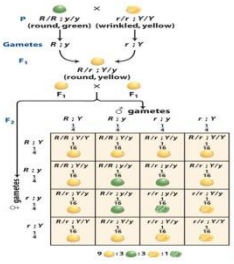
- After crossing pure parental strains, the F1 produced 100% of one character.
- After self-pollinating the F1, both characters showed up in a 3:1 ratio.
- Because the same types of ratio kept coming up, Mendel believed that there must be some mathematical formula or explanation for the observed data
- 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

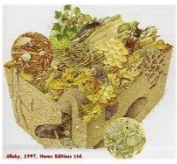


Mendel's Laws

- **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

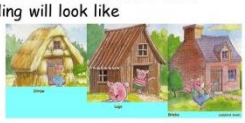
Organisms

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



Cells

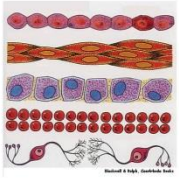
- Cells are the building blocks of organisms
- Think of bricks making a building
- The type of brick determines what the building will look like



Cells, cont.

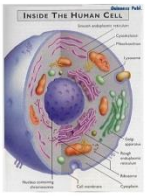
- in the same way, the type of cell determines the type of organ
- and, the type of organ determines the type of organism

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**



31

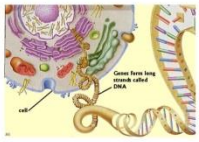
Cell management centres

- 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'

32

Cell blueprints

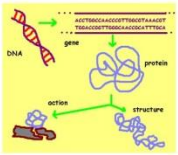
- The information is a code held on long strands called DNA



33

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



34

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.

35

Genes, cont.

Similarly,

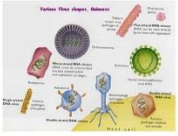
- Sunflowers have genes for yellow petals and
- Petunias have genes for purple petals

36

Genes, cont.

and …

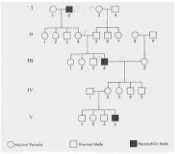
- HIV has genes that cause AIDS, while
- Chickenpox virus has genes that cause chicken pox or shingles



37

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



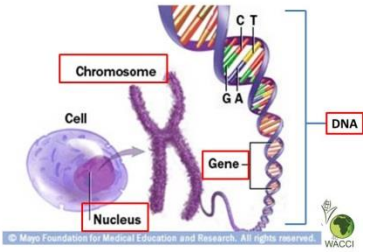
38

The Cell

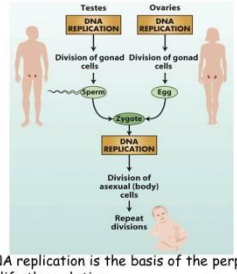
Cells are the basic functional unit of all life forms they hold all of the biological equipment necessary to keep an organism alive Earth

39

Inside the Nucleus of a Cell



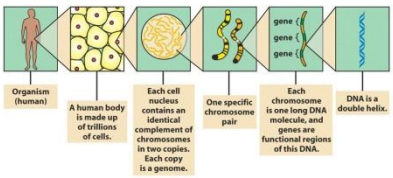
WACCI



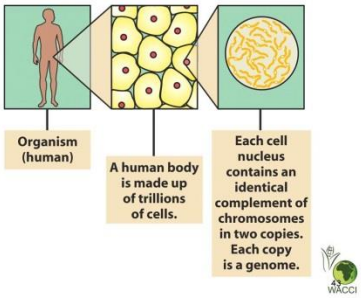
DNA replication is the basis of the perpetuation of life through time

WACCI

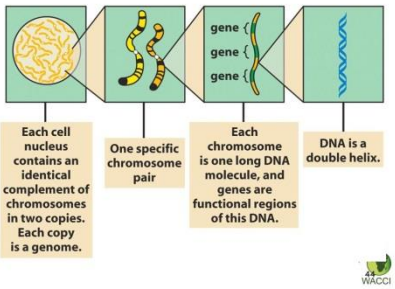
The genetic material in sharper focus following successive enlargements



WACCI



WACCI

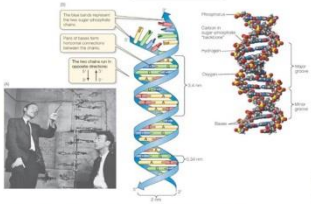


WACCI

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.

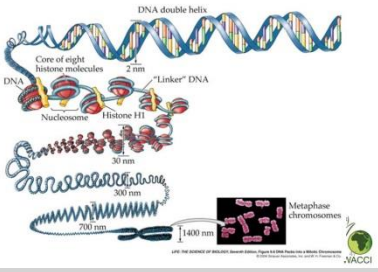


WACCI

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

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

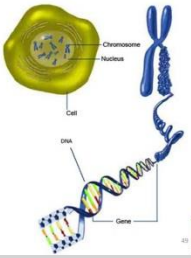
How complex is DNA?



Information Flow

What is a gene?

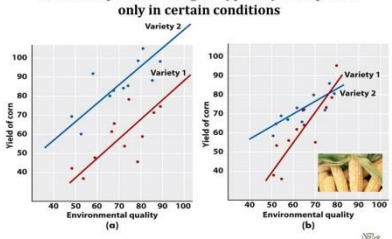
- A hereditary unit that occupies a certain position on a chromosome/DNA in the nucleus of a cell. This unit that has one or more specific effects on the physical appearance of an organism.



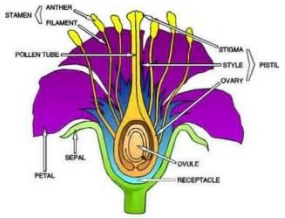
Significance of Mendel's work

- advances in plant and animal breeding

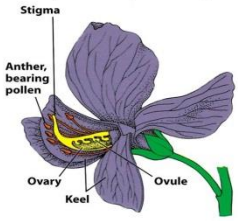
Some complex traits: A genotype may be superior only in certain conditions



Sexual reproduction in plants

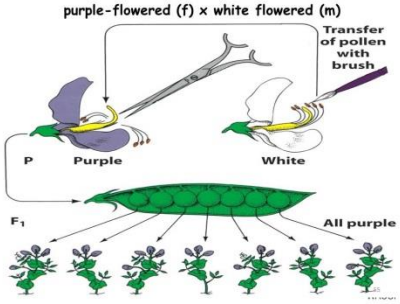


A pea flower with the keel cut and opened to expose the reproductive parts

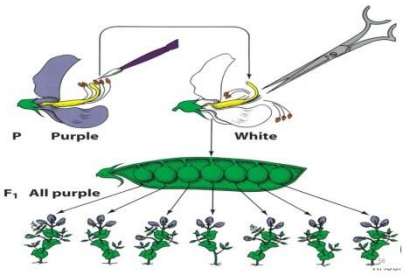


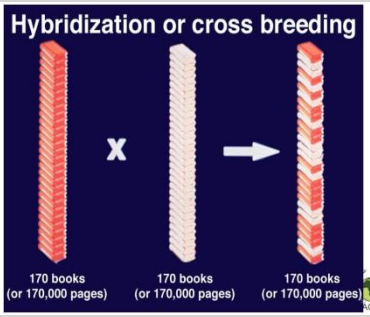
Artificial cross pollination

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



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





Backcrossing

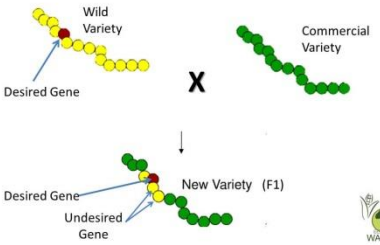
- Backcrossing is done with the main objective of incorporating a **desired gene**, either **dominant** or **recessive**, from a **wild** or **non commercial variety** to a highly productive, commercially successful variety which lacks that specific gene.

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

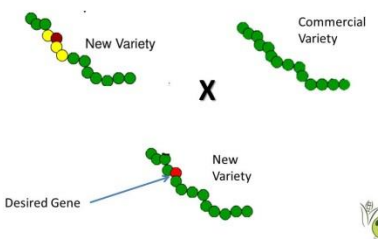
Backcrossing……. cont'd

- 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...



Asexual Reproduction

- Asexual reproduction is the formation of new individuals from the cell(s) of a single parent. It is very common in plants.
- All plant organs have been used for asexual reproduction, but stems are the most common.

Mutations - accidental changes in genomic sequence of DNA

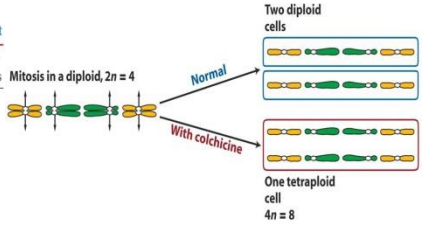
- **Can arise spontaneously** (Naturally occurring mutations) - Errors in DNA replication, Spontaneous lesions (naturally occurring damage to the DNA) , Transposable genetic elements
- **Can be induced**: mutagens (**physical** - Ionizing radiation e.g. X-rays and gamma rays, Non-ionizing radiation e.g. ultraviolet rays, Heat is a significant environmental mutagen; **Chemical** - Nitrous acid, EMS, Benzene, Sodium Azide; **Biological** - viruses)

Table 3-2 Numbers of Pairs of Chromosomes in Different Species of Plants and Animals

Common name	Scientific name	Number of chromosome pairs	Common name	Scientific name	Number of chromosome pairs
Mosquito	*Culex pipiens*	3	Wheat	*Triticum aestivum*	21
Housefly	*Musca domestica*	6	Human	*Homo sapiens*	23
Garden onion	*Allium cepa*	8	Potato	*Solanum tuberosum*	24
Toad	*Bufo americanus*	11	Cattle	*Bos taurus*	30
Rice	*Oryza sativa*	12	Donkey	*Equus asinus*	31
Frog	*Rana pipiens*	13	Horse	*Equus caballus*	32
Alligator	*Alligator mississipiensis*	16	Dog	*Canis familiaris*	39
Cat	*Felis domesticus*	19	Chicken	*Gallus domesticus*	39
House mouse	*Mus musculus*	20	Carp	*Cyprinus carpio*	52
Rhesus monkey	*Macaca mulatta*	21			

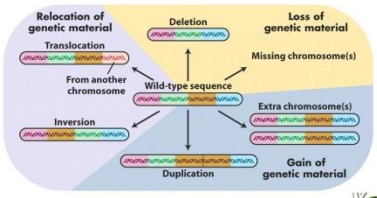
TABLE 15-1 Chromosome Constitutions in a Normally Diploid Organism with Three Chromosomes (Labeled A, B, and C) in the Basic Set

Name	Designation	Constitution	Number of chromosomes
Euploids			
Monoploid	n	A B C	3
Diploid	$2n$	AA BB CC	6
Triploid	$3n$	AAA BBB CCC	9
Tetraploid	$4n$	AAAA BBBB CCCC	12
Aneuploids			
Monosomic	$2n - 1$	A BB CC	5
		AA B CC	5
		AA BB C	5
Trisomic	$2n + 1$	AAA BB CC	7
		AA BBB CC	7
		AA BB CCC	7

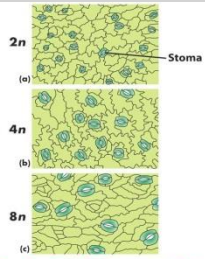


Colchicine added to mitotic cells during metaphase and anaphase disrupts spindle fibre formation preventing the migration of chromatids after the centromere is split. A single cell is created that contains pairs of identical chromosomes that are homozygous at all loci

Chromosome mutations

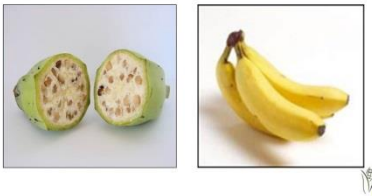


Polyploidy

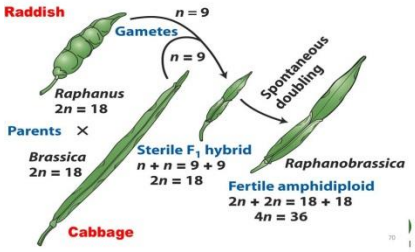


Epidermal leaf cells of tobacco plants, showing an increase in cell size, particularly evident in stoma size, with an increase in ploidy

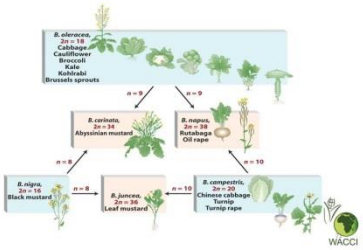
Triploid Banana



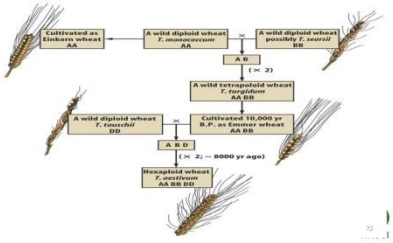
The origin of an amphidiploid (doubled diploid) - Allopolyploid

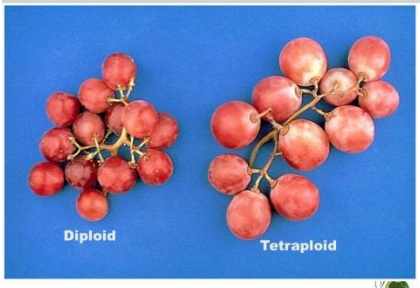


Three diploid species (blue boxes) of *Brassica* and their allopolyploids (pink boxes)



The proposed evolutionary history of modern hexaploid wheat in which amphidiploids are produced at two points. A, B, and D are different chromosome sets





Grapes

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

Maize Breeding Case Study

Manfred Ewool – CSIR Crop Research Institute, Kumasi, Ghana

RESEARCH FOR DEVELOPMENT

CSIR – CROPS RESEARCH INSTITUTE

B4FA Media Training
19-22 Sept, 2012 at Oak Plaza Hotel Accra
Presenter: M. B. Ewool

1

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2

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Ministry of Health
Farmers
International Centre for Maize and Wheat Improvement (Mexico)
International Institute of Tropical Agriculture (Ibadan-Nigeria)
Alliance For a Green Revolution in Africa
West African Crop Improvement Center at Legon-Accra and KNUST

3

RESEARCH EMPHASIS

Policy

- Millennium Development Goals and the Ghana Poverty Reduction Strategy
- Nutritional enhancement to solve widespread malnutrition problems
- Increasing maize productivity and farmers' incomes
- Consumer acceptability

5

Project 1. Development and promotion of maize varieties with high pro-vitamin A contents for enhanced nutrition.

6

INTRODUCTION

- Maize is a very important cereal staple in Africa
- Consumed in many ways without adequate protein or micro-nutrient supplement

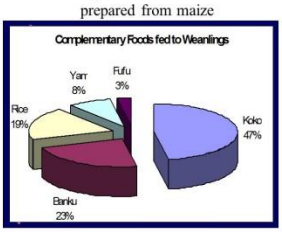
Malnutrition Problems

8

- The high prevalence of Vitamin A deficiency (VAD) in Ghana is partly attributed to
- Low bio-available Vitamin A in the predominant cereal, root, and tuber crops based foods consumed by adults as well as infants

9

Complementary foods fed to weanlings: 70 % of food for weanling children from Koko and Banku prepared from maize



10

Importance of Vitamin A (VA)

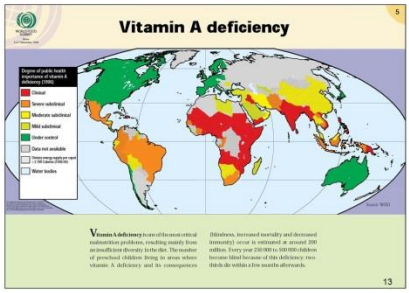
- Essential for
  - Visual system
  - Growth/Development
  - Immune function
  - Reproduction

11

Vitamin A Deficiency (VAD)

- VAD cause of childhood blindness in developing countries and decreased immunity
- contributes to morbidity and mortality from common childhood infections (WHO/NUT/95.3)
- affects about 40% of the world population (Lorch, 2005)
- In Ghana, may result in17,200 deaths annually in children (Badu-Akorsah, 2005)

12

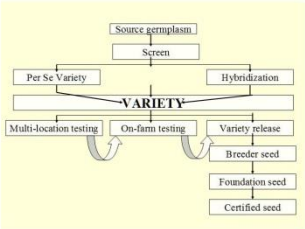


Dietary Sources of VA

Preformed VA	Provitamin A (proVA)
Retinol retinyl esters	β-carotene (βC) α-carotene (αC) β-cryptoxanthin (βCX)
Eggs, dairy, liver	Carrots, sweet potato, pumpkin, spinach

14

Schematic representation of breeding methodology is presented below.



15

METHODOLOGY FOR PVA (CONT'D)

Select Agronomically good and adaptable plants from the field and analyze in the lab for high levels of PVA

16

Results of mean pro-vitamin A and ß-carotene of 2 synthetics and 2 hybrids compared with 2 commercial checks evaluated at Ejura in 2011

Variety	Pro-vitamin A (µg/g)	ß-carotene (µg/g)
PVA SYN6	6.5	3.6
PVA SYN7	6.2	3.4
A0806-2	5.7	3.3
A0804-5	5.8	3.4
ABONTEM	3.0	1.7
GOLDEN JUBILEE	2.3	1.4
MEAN	5.3	3.0
SED	0.5**	0.3**
CV%	10.2	11.2

17

RESULTS FOR PVA (CONT'D)

18

PROJECT 2. QUALITY PROTEIN MAIZE DEVELOPMENT AND PROMOTION IN GHANA

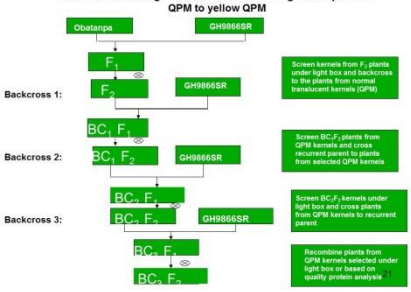
19

WHAT IS QUALITY PROTEIN MAIZE (QPM)

- Quality Protein Maize (QPM) is a cultivar that possesses double quantity of lysine and tryptophan than the normal maize variety.
- QPM is very good in solving mal-nutritional problems (especially Kwashiorkor) in infants
- QPM is suitable for poultry and livestock production

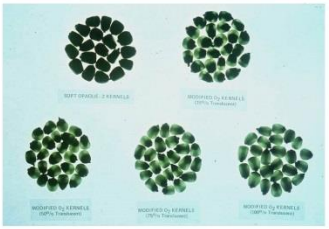
20

Backcross Breeding Procedures for converting Obatanpa white QPM to yellow QPM



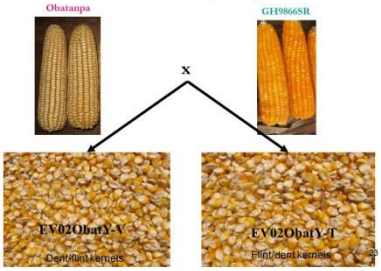
21

Methodology for QPM: Selection for modified QPM genes under light



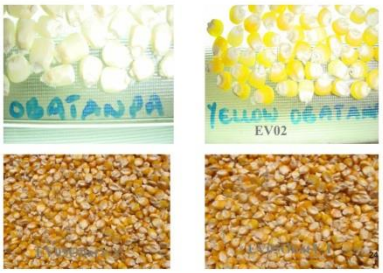
22

- **Conversion of Obatanpa to yellow**



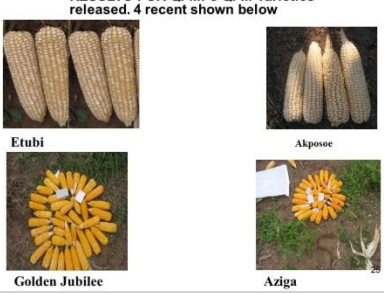
23

Conversion of Obatanpa to yellow: screening process



24

RESULTS FOR QPM: 8 QPM varieties released. 4 recent shown below



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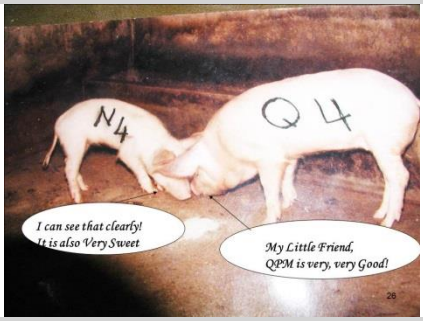


26

REACHING OUT TO FARMERS AND CONSUMERS

27

Field day at Kwadaso

28

Field day at Kwadaso

29

Field day at Kwadaso

30

Field day at Kwadaso

31

Field day at Kwadaso

32

Field day at Ejura

Sensory evaluation at Kwadaso

34

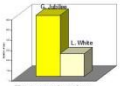
Sensory evaluation at Kwadaso

35

PRO-VITAMIN A MAIZE FOR IMPROVED HEALTH

37

GOLDEN JUBILEE IMPROVED EGG PRODUCTION AND YOLK COLOUR OF LAYER BIRDS



Egg production

38

CONCLUSIONS

- National goals (wealth creation)
  Maize imports >US$2M annually and this amount could be saved.
- Commercial impact
  National average yield of maize approx. 20 maxi bags/ha
  Sales GH¢100/bag =GH¢2,000 less cost of production/ha (GH¢1200) thus profit=GH¢800

  Yield of new varieties approx 60 bags/ha x sales GH¢100/bag =GH¢6,000 less cost of production/ha (GH¢1200) thus profit=GH¢4800

39

CONCLUSIONS (CONT'D)

- Social impact
  Improved yield will increase farmer income and reduce poverty (millennium development goal (MDG) 1)
- QPM and PVA maize varieties will reduce child mortality and improve maternal health respectively (MDGs 4 & 5).
- Benefits to Entrepreneurs
  Regular supply of maize to industries eg. GAFCO, General Mills Ghana Ltd., Nestle (200,000 tons/annum of maize may be requested) and >100,000 tons for the poultry industry
- Cost/kg feed reduced by 12-18% and 30% in piggery and in poultry respectively.

40

Acknowledgements

- Government of Ghana
- HarvestPlus
- Alliance for A Green Revolution in Africa
- WIENCO
- CRI/SARI staff
- Farmers

41

42

Cocoa Breeding Case Study

George Ameyaw – Cocoa Research Institute of Ghana

Cocoa Research Institute of Ghana

BREEDING FOR TOLERANT VARIETIES FOR COCOA SWOLLEN SHOOT VIRUS DISEASE (CSSVD) IN GHANA

George Ameyaw and Abu Dadzie

CRIG, New Tafo, Akim, E/R

Cocoa Research Institute of Ghana

PRESENTATION OUTLINE

- Cocoa production in Ghana
- Important diseases of the cocoa plant
- Breeding for CSSVD tolerant/resistant varieties
- Methods for breeding and selection for tolerance
- Supply of CSSVD tolerant varieties to farmers

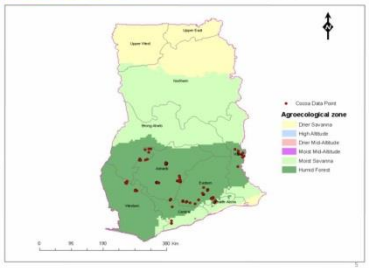
Cocoa growing regions in the world

Cocoa Research Institute of Ghana

Cocoa production in Ghana

- Ghana is the 2nd largest producer of cocoa beans after Ivory Coast
- Western region of Ghana produces 55% of total cocoa beans from Ghana
- Cocoa is a major foreign exchange earner for the country

Cocoa Research Institute of Ghana



RESEARCH ON COCOA

- CRIG is structured into scientific divisions/units and supporting divisions/units to facilitate research on various aspects of cocoa and other mandate crops

Scientific Division	Scientific Unit	Supporting Division/Unit
▪Agronomy ▪Soil Science ▪Plant Breeding ▪Plant Pathology ▪Entomology ▪Physiology/Biochemistry	▪ Social Science and Statistical Unit ▪New Products Development Unit	▪ Plantation Management ▪Administration ▪General Services ▪Accounts ▪Audit ▪Scientific Information

Cocoa Research Institute of Ghana

Important cocoa diseases in Ghana

- Black pod disease and Cocoa Swollen Shoot Virus Disease (CSSVD) are the most economically important diseases of cocoa in Ghana.

Cocoa Research Institute of Ghana

CSSVD in Ghana

- CSSVD was reported in Ghana in 1936
- The disease is spread by mealybugs (Homoptera) insects as a vector
- More than 250 million cocoa trees have died as a result of CSSV infection in Ghana (Approximately annual loss of about 50 million metric tonnes of raw cocoa beans)

Cocoa Research Institute of Ghana

Cocoa Research Institute of Ghana

CSSVD control in Ghana

- CSSVD is mainly managed through "cutting out" of infected trees from affected areas (The oldest and most used strategy)
- Other interventions include:
  - Use of resistant/tolerant varieties
  - Barrier cropping
  - Eradication of wild host
  - Mealybug control (Biological means of managing the vectors)
  - Mild strain cross protection

Cocoa Research Institute of Ghana

Use of resistant varieties to control CSSVD

❖ Local materials (Amelonado) were susceptible to the CSSVD

❖ Hence, breeding for CSSVD resistance became the focus of research activities of the British Research Team (BRT) between 1969 and 1978

❖ Some CSSVD tolerant hybrids (crosses between two parents) were released to farmers in 1987 to control CSSVD

Cocoa Research Institute of Ghana

Use of resistant varieties

❖ Nonetheless, tolerance levels of the released materials decreased over time. Hence the search for new cocoa genotypes with high level of tolerance/resistance to the disease.

➢ screening of new cocoa genotypes using conventional breeding methods and molecular methods.

❖ It is considered that resistant/tolerant cocoa varieties hold the key to CSSVD management

Cocoa Research Institute of Ghana

Screening of new cocoa genotypes

Methods for screening of new genotypes includes:

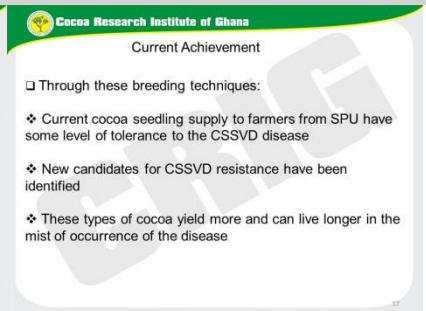
❖ Natural selection of cocoa trees which are not showing symptoms in endemic areas.

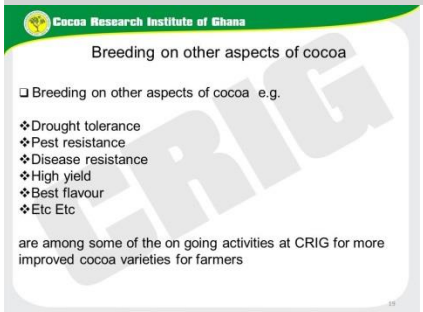
❖ Using them as parents to generate best performing offspring's (tolerant to the disease).

❖ The hybrids are evaluated both in the Lab and on the field

❖ Best performing genotypes are selected and multiplied for farmers through the Seed Production Unit (SPU) of Ghana Cocoa Board.


Cocoa Research Institute of Ghana
Current Breeding activities
Effect of CSSVD mild strains on growth and yield of cocoa
• Determination and selection of cocoa progenies which show tolerance and also perform better when inoculated with mild strains of the virus
Assessment of the protective capability of mild CSSVD strain against severe strains
• Determining the natural spread of CSSVD in different cocoa progenies.
Evaluation of some international clones for CSSVD resistance. (materials from cocoa growing countries in the world)


Cocoa Research Institute of Ghana
Current Achievement
❑ Through these breeding techniques:
❖ Current cocoa seedling supply to farmers from SPU have some level of tolerance to the CSSVD disease
❖ New candidates for CSSVD resistance have been identified
❖ These types of cocoa yield more and can live longer in the mist of occurrence of the disease


Cocoa Research Institute of Ghana
Breeding on other aspects of cocoa
❑ Breeding on other aspects of cocoa e.g.
❖Drought tolerance
❖Pest resistance
❖Disease resistance
❖High yield
❖Best flavour
❖Etc Etc
are among some of the on going activities at CRIG for more improved cocoa varieties for farmers


THANK YOU

Hybrid Sorghum Breeding Case Study

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

Hybrid Sorghum Production

Presentation at the Bioscience for Farming in Africa – Journalists Training Course, Accra, Ghana, Sept 19-22, 2012

By

IDK Atokple

1

IMPORTANCE OF SORGHUM

- Sorghum (*Sorghum bicolor* (L) Moench) is the fifth most important world cereal following maize, wheat, rice and barley.
- In most West African countries, sorghum alone accounts for 50% of the total cereal crop land area.
- In northern Ghana, it is cultivated throughout the savannah agro ecological zones, covering about 41% of the total land area of the country

2

IMPORTANCE OF SORGHUM

- The crop is consumed in the form of stiff porridge (tuo zaafi); thin porridge (koko) or fried dumpling (maasa) and in brewing local opaque beer pito.
- The leaves provide fodder for farm animals and the stalks are also used in fencing, roofing, weaving baskets, mats and as fuel wood.
- Sorghum presently has assumed commercial status in the breweries and has the potential in other products like weaning food and confectioneries.

3

Constraints to Sorghum Production

Constraints

5

Low Yield Potentials

- On-farm sorghum yields range between 500 and 800 kg/ha in the Northern Region and slightly higher (between 700 and 900 kg/ha) in the Upper Regions – resulting into regular annual deficits.
- Apart from the constraints mentioned above, the low yields are also caused by:
  - Cultivation of indigenous land-race varieties,
  - lack of a wide diversity of new improved varieties and hybrids,
  - Little or no use of fertilizer and low planting densities

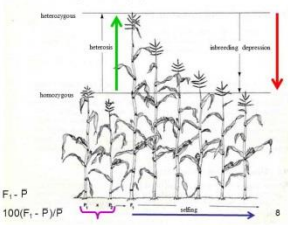
Opportunities for Sorghum Hybrid Production

- To meet the industrial demand and increase grain yield potential of sorghum genotypes, the use of sorghum hybrids is one of such technologies which could provide opportunities through the exploitation of heterosis and access to markets
- The development of agro industries using sorghum as raw material, and the emergence of private seeds growers and companies are incentives for development and release of high yielding hybrids for the benefit of the sorghum industry.
- CSIR-SARI has therefore drawn up hybrid production and extension program among other strategies to increase the productivity and production of sorghum through

7

Concepts of Hybrid Production - Hybrid Vigour (Heterosis)

Hybrid Vigour is the superiority of progeny (offspring) (F_1) over the mean of its two parents (P)

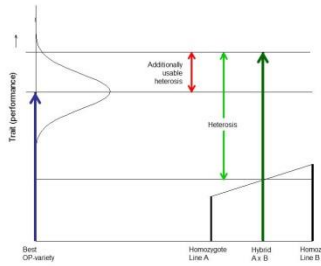


Heterosis = $F_1 - P$

Relative Heterosis = $100(F_1 - P)/P$

8

Hybrid Vigour - Heterosis



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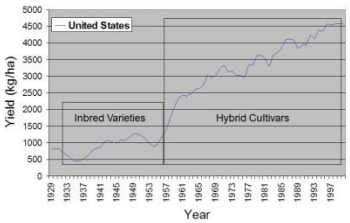
History of Hybrids in Sorghum



10

The Concept of Hybrid Production - Cytoplasmic Male-Sterility Systems for Hybrid Sorghum

Hybrid Seed Production – Getting the cross

- Hybrids are produced by hand emasculation in corn.
- In wheat, chemicals are used to sterilize the pollen.
- Cytoplasmic male sterility (CMS) is used for hybrid seed production in sorghum and pearl millet.

12

History of Hybrids in Sorghum – The hunt for cytoplasmic male sterility

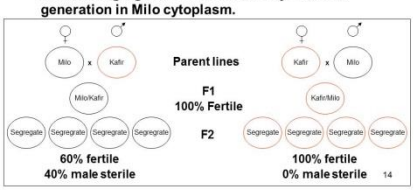
- Hybrid vigor was first recognized in sorghum in 1927 (Karper and Conner, 1927) using hybrid seeds produced by hand-emasculation.
- In 1948, researchers initiated studies to look for cytoplasmic male sterility as a method for commercial hybrid seed production in sorghum.
- Reciprocal crosses between Milo and Kafir produced the first evidence that a male-sterility inducing cytoplasm had been found (Stevens and Holland, 1954).

Quinby and Stevens, 1957. [Quinby JR. 1994. sorghum Improvement and Genetics of Growth. Texas A&M University Press. College Station.]

13

History of Hybrids in Sorghum – The hunt for cytoplasmic male sterility

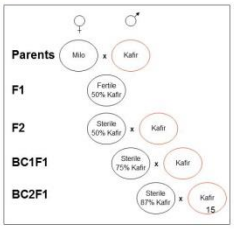
- Reciprocal F2 populations between Milo and Kafir showed segregation for male sterility in the F2 generation in Milo cytoplasm.



14

History of Hybrids in Sorghum – Seed parent lines

- CMS was used to create male-sterile parent lines by crossing and backcrossing kafir varieties (Combine Kafir 60 and Texas Blackhull Kafir) with male-sterile progenies of the Milo/Kafir cross.



15

Hybrid seed production

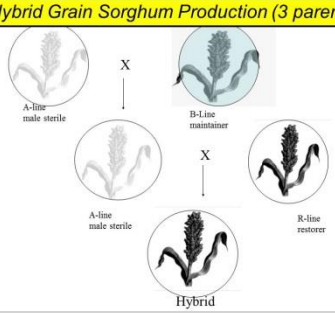
- Three different parent lines are needed to produce hybrid seed.

Seed Parent		Pollinator Parent
A-line	B-line	R-line
Seed parent	Maintainer	Pollinator
Male-sterile	Fertile	Fertile

A-line: Male-sterile line used as the seed parent in F1 hybrid seed production
B-line: Male-fertile maintainer that is genetically identical to the A-line and used as a pollen source to increase the A-line
R-line: Genetically distinct sorghum with fertility restoration genes and good combining ability for grain yield

16

Hybrid Grain Sorghum Production (3 parent lines)



17

Identification of B- and R-lines

- Hybrids obtained by crossing pollinators with a male-sterile line
- The testcrosses are evaluated for the sterility maintenance or fertility restoration in them through bagging test

Panicles bagged to observe for fertility reaction

- Bagging test - covering 4-6 panicles with a paper bag before anthesis, and observing the seed-set after 2-3 weeks

18

Evaluation of test crosses

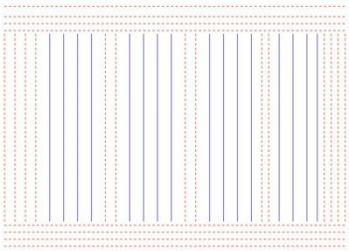
Reaction	Conclusion	Further usage
Testcrosses exhibiting absolutely no seed-set on all the bagged panicles	Maintainer or non-restorer or B-line	source of a new A-line
Testcrosses with complete seed-set on all bagged panicles	Potential restorer or R-lines	Serve as male parents to produce hybrids
Testcrosses with a partial seed-set on all the bagged panicles	Serve neither as restorers nor as maintainers	Male parents are rejected
Testcrosses with a full seed-set on some bagged panicles and no seed-set in others	Segregating for fertility-restoration or sterility-maintainer genes	Not pursued further

19

Production of A-/B-Lines – small scale

- Sowing A-/B-lines in the ratio of 4:2
- Rouging in A- and B-lines
- Removal of pollen shedders from A-lines
- Prune the florets of A-/B-lines with protruding anthers, bag and record date
- Pollinate after 4-6 days, each B-line bag can pollinate 2-3 A-line panicles, mark A×B and record date
- Repeat pollination after 6th or 7th day
- Bags removed after 15-20 days after pollination and stapled around peduncle
- Bulk harvest the panicles in A-lines and B-lines separately and label them clearly

20



Diagrammatic representation of hybrid seed production (A x R) plot

21

Tapping the peduncles of maintainers with sticks improves seed set on A-lines

22

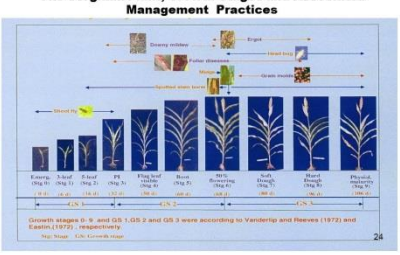
Production of A-/B-Lines – large scale

- Sowing A-/B-lines in the ratio of 4:2
- A strip of 1 m length should be sown with the B-line across entire field
- Roguing of the off-type plants and pollen shedders
- Open pollination by wind will ensure seed-set on the A-lines
- Self-pollination takes place in the B-lines
- Harvesting of A-line and B-line at different times, preferably one after the other to avoid mechanical mixing

23

Training of Seed Growers in Hybrid Production

The Sorghum Plant, Growth Stages and Associated Management Practices



24

Training of Seed Growers in Hybrid Production

Seed growers going through the theory of Sorghum hybrid production at SARI

25

Training of Seed Growers in Hybrid Production

26

Concluding Remarks

- Although seed production continues to be major constraint to adoption of hybrid seed technology in Ghana, I believe that hybrid cultivars have great potential for addressing food security.

27

Thank You

Genetic Modification

Professor Jim Dunwell – University of Reading

School of Agriculture, Policy and Development

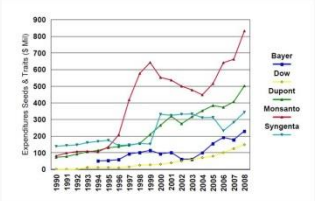
GM Crops: Production, Commercialisation and Regulation

Jim Dunwell

USA: Historic Maize Yields

2

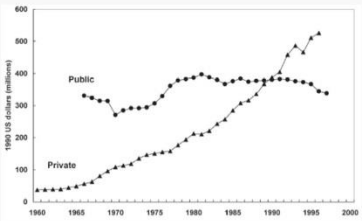
Expenditure on Seeds & Traits



Wilson & Dahl 2010

3

US Spending on Plant Breeding



4

Recap

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

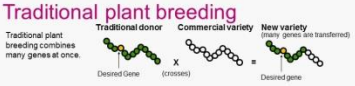
5

Previous technologies

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

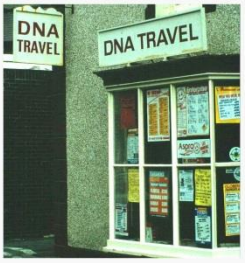
6

Traditional plant breeding



Plant biotechnology

7



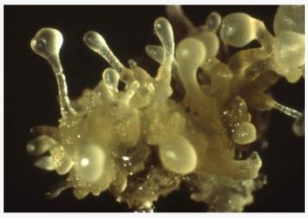
8

Ideal Transformation Method

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

9

Maize: Embryogenic Cultures



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Indirect Methods

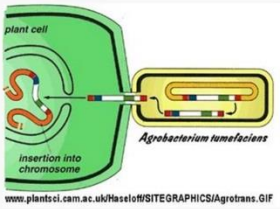
- Use of natural systems

11

Natural System for Gene Transfer

12

Agrobacterium Gene Transfer



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Direct DNA Methods

- No need for bacteria

14

Particle Gun

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

15

Biolistics

John Sanford

16

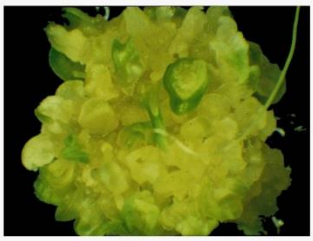
Particle Bombardment

17

Embryos after Particle Bombardment

18

Regenerating Wheat Embryo in Vitro



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Regenerated Wheat Plants

20

21

Jonathan Swift

22

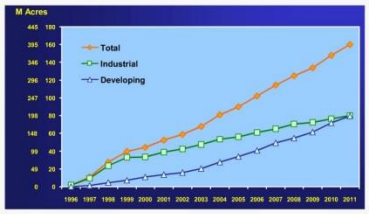
"And he gave it for his opinion, that whoever could make two ears of corn..to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country than the whole race of politicians put together" Jonathan Swift, 1726

23

Biotech Crop Countries and Mega-countries 2011

24

Global Areas of Biotech Crops 1996-2011



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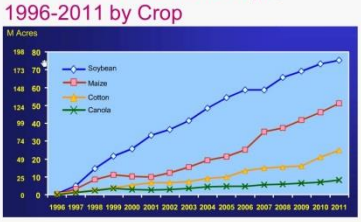
Global Area of Biotech Crops, 1996-2011 by Crop



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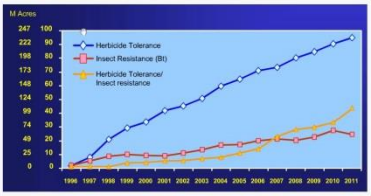
Global Areas of Biotech Crops, 1996-2011 by Trait



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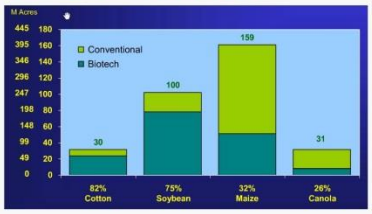
Global Adoption Rates (%) Principal Biotech Crops 2011



28

GM Crops 2011

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

29

Approved GM Traits in US

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

30

Herbicide Tolerant Sugar Beet

Control GM

31

Herbicide Tolerant Sugar Beet

32

Advantages of Herbicide Tolerance

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

33

Brazil - Double Cropping without Irrigation

Harvesting Soybean, sowing Corn, with no tillage

34

Insect Resistance

35

Bacillus thuringiensis (Bt) Toxin on Corn Borer

Control without toxin

36

Bt Toxin on Corn Borer

with toxin

37

Bt in Corn (maize)

38

Bt Corn

39

Insect Resistant Transgenic Rice with Bt against Stem Borer

40

Water Stress

Monsanto

41

Disease Resistance

1. Virus Resistance (approved products)

42

Transgenic Papaya Line with Resistance to PRSV

Deregulated in USA 1996

Now approved for sale in Japan, 27 May 2010

GM Control

43

GM Virus Resistant Papaya

44

45

"Input" and "Output" Traits

Input effects

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

Output effects

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

46

First GM Product in UK 1996

Reduced level of polygalacturonase enzyme

47

Commercialisation Pipeline

48

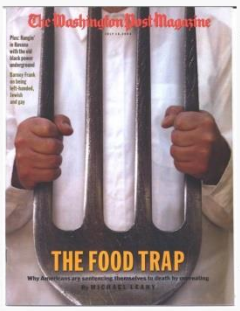
Output Traits

49

Why are fish oils important in human diet?

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

50

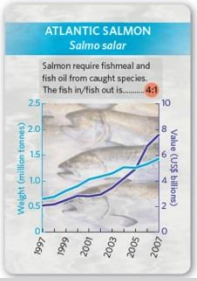


Moderate consumption (0.5-2g/day) of omega-3 long chain polyunsaturated fatty acids found in fish oils can help reduce the risk of CVD and metabolic syndrome.

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

51

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

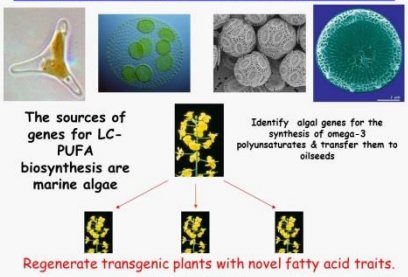


Unfortunately, marine fish in aquaculture require dietary provision of omega-3 LC-PUFAs. Aquaculture is a massively expanding industry, already consuming a large % of wild capture fish oil & meal. Vegetable oils cannot substitute for the dietary fish oils.

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

52

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



53

Benefits of Omega-3 Fatty Acids

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

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

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

Monsanto

54

Establishing a novel oils platform in *Camelina sativa*.

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

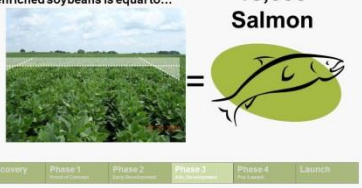
Camelina is a Brassicaceae and easily transformed. Oil profile is similar to Arabidopsis, so results should be equivalent or better to that observed in the model system. We have determined baseline datasets for lipid composition over seed development for Camelina

55

1 Acre of Omega-3 Soybeans: Comparison

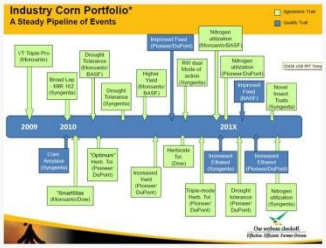
- OMEGA-3 SOYBEANS

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



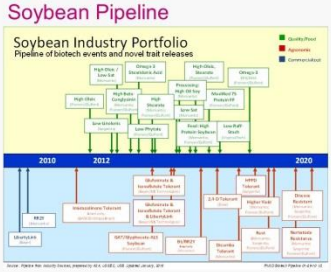
56

GM Corn Pipeline



57

Soybean Pipeline



US Soybean Export Council

58

59

International Dimension

60

Potential to Reduce Yield Gap

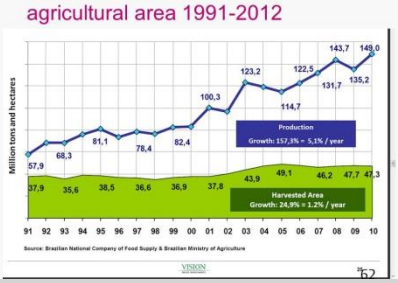
All Crops	Yield Gap (%)
North America	33
West /Central Europe	36
Eastern Europe/Russia	63
South America	52
East Asia (China)	11
South Asia (India)	55
Sub Saharan Africa	76

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

OECD Trade and Agriculture Directorate

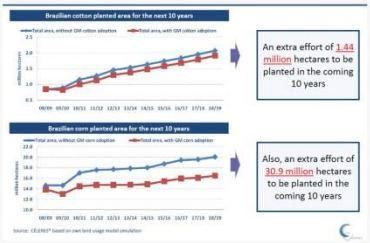
61

Brazil: Grain production and agricultural area 1991-2012



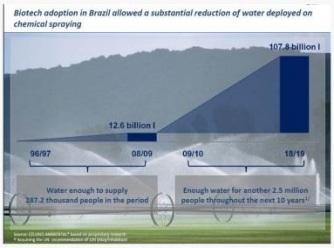
62

GM Crops in Brazil



Celeres 2010

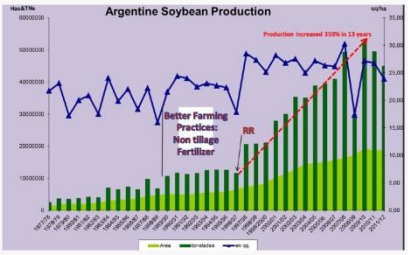
GM in Brazil: Water Saving



Celeres 2010

65

Argentine Soybean Production



Bt Cotton in India

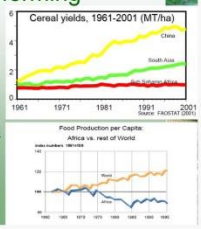
In the period, 2002 to 2008, Bt cotton generated economic benefits for farmers valued at $5.1 billion, halved insecticide requirements, contributed to the doubling of yield and transformed India from a cotton importer to the major exporter. In 2008 alone, the benefits accruing from Bt cotton in India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

ISAAA 2010

66

African Agriculture: Under-Performing

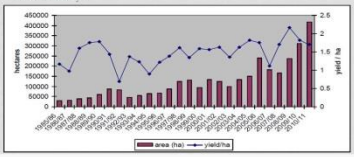
- Yields are stationary or declining
- Yet population has continued to increase
- Production per capita is declining



67

South African Experience: HT Soybeans 1

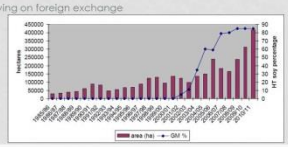
- Yields were relatively stagnant for the 15 years prior to introduction of HT soy beans .
- Introduction of HT soy bean had little if any impact on yield
- Farmers benefited mainly through saving on weed control chemicals, fuel and machinery.



68

South African Experience: HT Soybeans 2

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



69

South African Experience: HT Maize 1

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

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

70

South African Experience: HT Maize 1

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

71

72

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

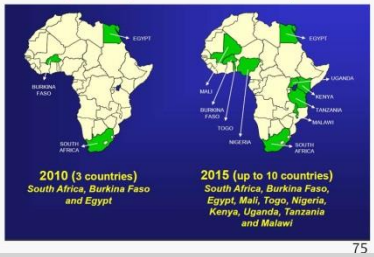
73

Maruca Resistant- Cowpea

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

74

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



75

Policy on GM crops...

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

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

76

Ag Biotech has Lengthy Product Development Cycle and Large Investment Process

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

77

Safety Assessment Occurs Throughout the Development Process

8 to 10 years

Discovery → Field testing → Product testing → Marketing

Product Concept | Gene Discovery | Evaluation | Line Selection | Line Selection | Variety Development | Field Production | Market

Initial Safety Assessment
- Choice of Genes/Proteins
  - Source
  - Safety
  - Ethics
- Environmental
  - Gene / crop

Biological/Agronomic Equivalence
- Greenhouse to field
- Agronomic performance
- Event screening - phenotype
- Event selection (<1%)

Comparative Product Safety
- Food
- Feed
- Environment

Post-market
- Post-market surveillance
- Supplemental food/feed studies, as needed

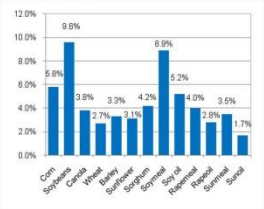
78

Charles Darwin
(1809-1882)

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

79

Increase in World Commodity Prices without Biotech



Brookes et al 2010

80

81

Future Prospects

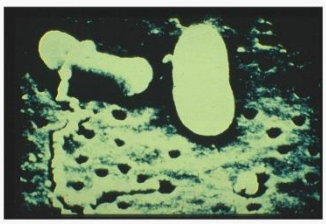
- High value products
- Healthy food
- Biofuels
- Phytoremediation

82

High Value Products

83

Polyhydroxybutyrate PHB



84

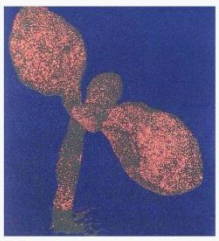
Plastics in Plants

85

Plastics in Plants

86

Plastics in Plants



87

Healthy Food

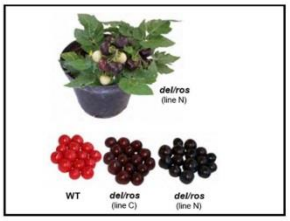
88

Golden Rice: Increased Vitamin A

Golden Rice.org

89

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



Protection against heart disease etc ? Martin et al 2008

90

Increased Anthocyanins in Tomato

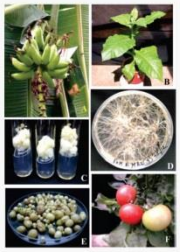
	ug /gfwt	umol/gfwt
control	2.82	0.01
E8-Rosea1	9.74	0.03
E8-Rosea1 + E8-Delila Plant N	951.47	1.52
E8-Rosea1 + E8-Delila Plant Z	77.12	0.12

91

Pharming in Plants

92

Vaccines in Plants



Kumar et al. 2007

93

Conventional Field Crops

Maize
Rice
Barley

94

Novel or Non-food Field Crops

95

Other Crops

Tobacco - antibodies
Safflower - insulin
Alfalfa
Sugar Cane

96

Harvesting *Nicotiana*

Sterile F_1 Hybrids

University Kentucky

97

First Pharma Product?

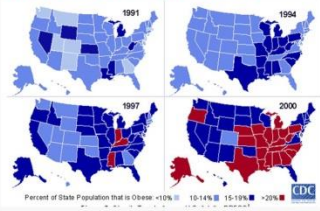
- Proinsulin from Safflower

98

Why Insulin?

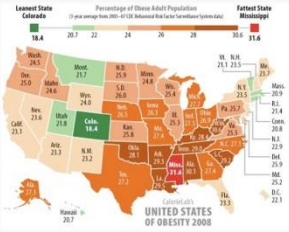
99

Obesity Trends Among US Adults



10

USA Obesity 2008



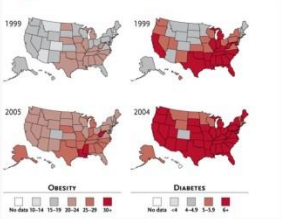
10

Increasing weight is associated with an overall increase in risk

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

10

Obesity and Diabetes



10

Insulin demand in USA

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

SemBioSys

10

Why Safflower?

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

SemBioSys

10

Why Safflower?

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

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

SemBioSys 10

Safflower: Field Production

SemBioSys 10

Other Species used for Pharma Production

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

(also duckweeds, moss and algae)

10

Economic Perspective

10

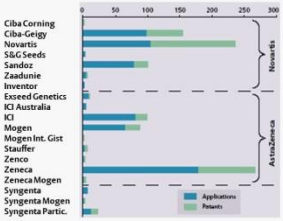
IP and Industry Structure

11

Five companies hold 75 percent of all ag-biotec patents

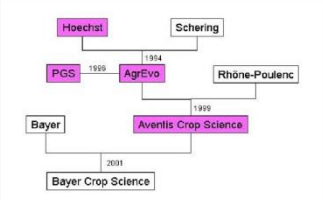
11

Syngenta Patent Portfolio



Graff et al 2003 11

AgBiotech Consolidation



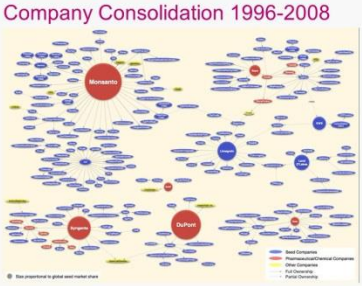
(CAMBIA) 11

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

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

Pila 2008 11

Company Consolidation 1996-2008



Howard 2009 11

Public/Political Perspective

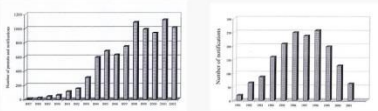
11

GM in Europe

Nature Biotechnology, April 2011 11

Effect of European Moratorium

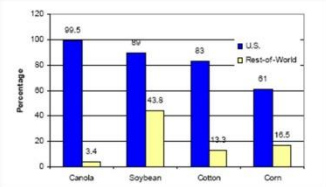
USA **Europe**



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

11

Intensity of Biotech Crops US vs Rest of World, 2006



11

Conclusion

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

12

Genetic Modification and Science Communication

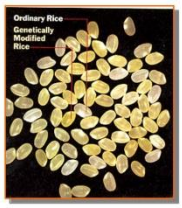
Professor Jim Dunwell – University of Reading

Communication: GM and the Media

Jim Dunwell

1

Vitamin-enhanced: Golden Rice



2

3

Understanding the GM food revolution

4

Types of Media

- TV
- Radio
- Newspaper

5

Differences between Types of Media

- Legal obligations
- Broadcast media have legal responsibility to be 'impartial': Broadcasting Standards Commission
- Not the case for written journalism: Press Complaints Commission

6

Facing the Press

- Of all media, newspapers longest lasting.
- Often first to publish, followed up by TV/radio.
- Crisis, controversy and conflict provide good story.

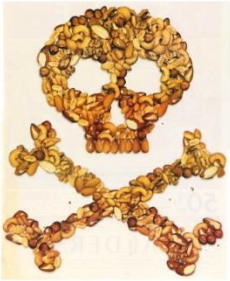
7

8

Modern Myths

- Allergenic nuts
- Tryptophan
- Pollen and butterflies
- Potatoes and rats
- Plant viruses

9



10

MP sparks off bogus modified food scare

MP links genetic food to 37 deaths

11

Brussels to debate ban on mutated food crops

Gene crops could spell extinction for birds

12

Recurrent Problems

- 'Mad boffin' syndrome
- The need for drama/conflict
- Overestimating knowledge
- The cutting room floor

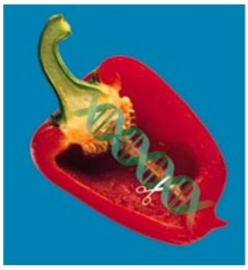
13

14

THE KNOWLEDGE

GAP

15



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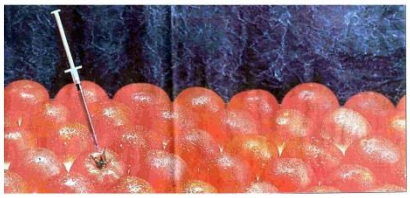

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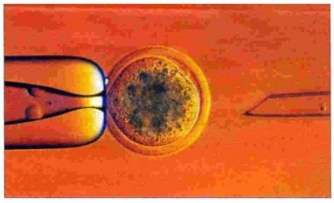
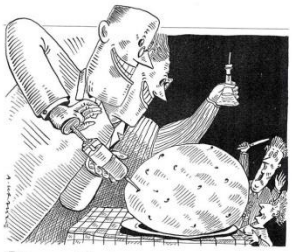


18



Stop the crops

19

THE QUESTION OF SCALE

•THE QUESTION OF SCALE

20

Genetic Engineering

21

Distortion

22

'The Independent' Newspaper

Modified pollen kills threatened butterfly

23

'The Scientist' Magazine

24

THE QUESTION OF CONTEXT

25

Products of Modern Breeding

26

Effect of One Gene!

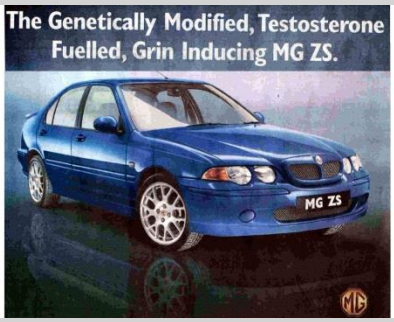
27

28

SEEING THE WHOLE PICTURE

29

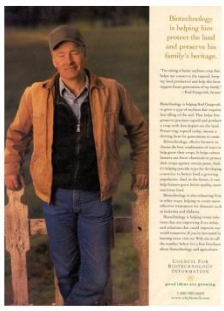
30



33

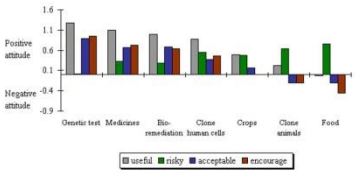
INTERNATIONAL PERSPECTIVE

34



35

European Attitudes to GM



36

Societal Concerns about Food Biotech

- Food Safety
- Environment
- Socio-Economic
- Corporate Control
- Ethical

37

Perception of Agriculture

38

TRUST?

- **Do you trust what scientists say regarding the safety of:**

	A lot	A little	Not at all
Organ transplants	57	35	7
New medicine	37	55	8
Mobile phones	28	52	21
British beef	33	44	22
GM food	16	44	40
Cloning animals	13	38	49

39

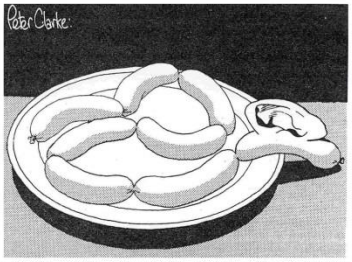
TRUST?

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

40

41

42



43

The Question of Balance

44

Biotechnology can Benefit Global Agriculture

- Environmental Impact - Decreased Use of Pesticides
- Reduce Losses from Pests and Diseases
- Improve Nutrient Efficiency
- Improve Productivity

Drought Exacerbates the Need for Food Aid


DAILY NATION
The newspaper that serves the nation
Moi: Save our starving nation
Biwott blamed over power crisis
Donors rally to the President's Sh11bn aid plea

In Kenya year 2000

- 30 out 53 districts affected
- 22 million people affected
- 2.2 million at risk of starvation

46

Why Public Anxiety with Biotech Crops?

- **Societal Concern About Biotech is Understandable**
  - **Strong Assurance of Safety Needed**
  - **Unfamiliar with the Technology**
  - **Lack of Reliable Information**
  - **Unaware of Safeguards**
  - **Negative Media Opinion**
  - **Opposition by Activist Groups**
  - **Mistrust of the Industry**

Scientific Community has neither addressed public concerns nor communicated the value of this technology effectively

47

Why Opposition to Biotech in Europe?

- Distrust of Regulators. No FDA.
- Food Scares..*BSE,*
- Mistrust of Companies
- Cultural Affinity for Food
- Reverence for Environment
- Media Sensationalism; Green Activists

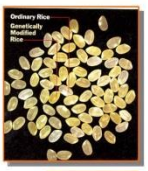
48


This will make you sick
Act now: stop patenting on crops
ACTIONAID
ActionAid campaigns against food patenting

49

Golden Rice

- Milled rice has no beta-carotene
- Vitamin A deficiency - 200 million children and woman
- About 500,000 children go blind (60 every hour)
- 2 million children die each year
- Golden Rice may provide one of the many solutions
- Soon to be on the market



Ingo Potrykus (Switzerland) and Peter Beyer (Germany)

THE HIDDEN AGENDA

51

Reality (Nature Magazine)

- "It seems that intergeneric gene flow might occur by transgene introgression within the genome of the weeds, but slowly and at a low probability under natural optimal conditions because four generations were needed to provide herbicide-resistant plants with a chromosome number and morphology close to that of the weed. It is likely that under normal agricultural conditions this event is rare when the wild radish is the female parent" - *Chevre*

52

Interpretation (Guardian)

- 'Demon Weed' Fear
- GENETIC engineering could create superweeds, scientists from the national agricultural research centre at Le Rheu in France report in the journal Nature today. Big chemical companies have been working on herbicide-resistant soya and cotton unaffected by weed sprays.
- But environmental campaigners are worried that the gene for herbicide resistance could transfer itself naturally to a wild plant and create a herbicide resistant weed that could take over the world. – *Tim Radford*

53

GM Field Trial

Rothamsted Research 2012

54


Heavy police presence thwarts anti-GM protest
Faced with a major security operation, campaigners withdraw to fight another day

Cotton Breeding Case Study

Dr Emmanuel Chamba – CSIR Savannah Agricultural Research Centre, Tamale, Ghana

Presentation Outline

- Introduction
  - Cotton and benefits
  - some major production constraints
- Research focus/objectives
- Basic plant breeding principles
- Research methods used
- Results
- Seed multiplication plan
- The way forward – Bt cotton introduction

2

Cotton and Benefits

- Major cash crop in Northern Ghana
- Plays a key role in the economy of households in the region by providing
  - additional income to households
  - benefits from residual fertilizer for production of maize in rotation

  Cotton reduces striga seeds in the soil when rotated with striga susceptible crops

Fertilizer and insecticide diversion

3

Cotton and Benefits cont'd

- Potential of cotton to the economy of Ghana is 500,000 ha capable of producing 200,000 metric tons of lint.
- with a market value of US$ 350,000,000

4

5

Some major constraints of cotton production in Ghana

- Lack of improved seeds to sufficiently renew the seed stock resulting in low seed cotton yields and poor lint quality (exhibits)
- The average seed cotton yield in Ghana 775 kg/ha as against a West African average of about 1100-1200 kg/ha.
- Ghana highest total production is less than 40,000 MT . In Burkina Faso it is 300,000 MT

6

Seed source of cotton production in Ghana

- Cotton companies depend on imported seed from neighbouring countries such as Burkina Faso, Togo, Mali and Senegal
- Most of the imported seed are third or fourth generation seed with very low genetic potential and low viability.

7

Research focus

- To introduce, develop, test and recommend improved varieties for the cotton growing areas
- To develop appropriate cultural control practices for cotton production

8

Specific objectives of Cotton Improvement programme

Develop improved varieties with

- High and stable yields across the cotton belt of Ghana
- High lint-seed ratio (ginning outturn-GOT)
- High quality lint- staple length, strength etc
- Tolerance to insect pest/diseases and drought

9

Principles of plant breeding- The four stages of the plant breeding process

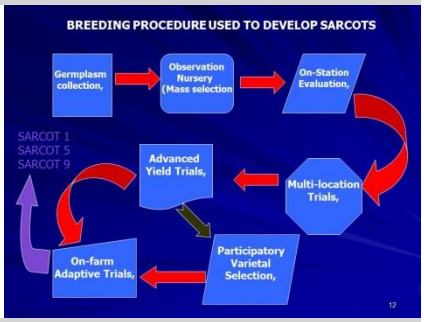
- Breeding – creation of variability
- Selection to fix desired genes
- Evaluation of the selected lines
- Cultivar release

10

Principles of plant breeding-sources of genetic variation

- Plant introduction – collections of plant genotypes
- Hybridisation – crosses within species
- Interspecific crossses/intergeneric – between two deferent genera
- Mutation
- Other sources- breeding lines
- Trans genic plants

11



12

Breeding Procedure

- Germplasm collection from Togo, Burkina, Cote d'Ivoire, Syria, China, USA, Benin, Zimbabwe (1988- ongoing) 60
- Crosses
- Observation Nursery – 1996
- On station-replicated evaluation of 19 selected genotypes -1997-1999

13

Breeding Procedure

- Researcher managed multilocational testing of 8 selected genotypes- 1999 – 200
- Locations: Nyankpala,Yendi,Walewale (NR), Wa(UWR), Bawku and Pusu-Namgo(UER)

14

Breeding procedure continues

- Conducted Farmer Participatory Varietal Selection (PVS) trial of 8 cotton genotyes at Nyankpala from 2001-2002
- 3 lines of cotton with broad adaptation were identified after years of evaluation

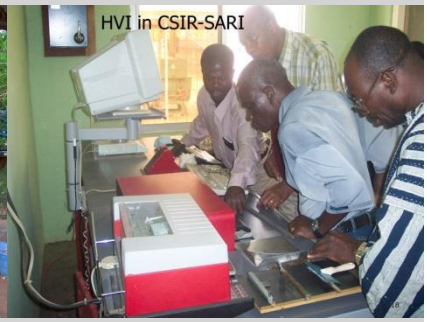
15

Breeding procedure continues

- Farmer managed researcher supervised on-farm evaluation of 3 genotypes of cotton from 2003-2004
- Locations: same as before

16

17

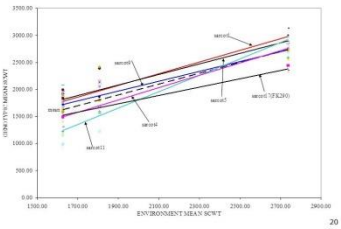


18

Yield and quality parameters

Potential yield (kg/ha)	FK 290 Commercial variety	SARCOT 1	SARCOT 5	SARCOT 9	STANDARD VALUES
	1900	2100	2100	200	2000
Yield across regions (kg/ha)	1239	1443	1471	1425	1000
Lint index (GOT) %	44.5	46.5	44.4	44.2	40-48
HVI Readings					
length (mm)	29.00	29.05	30.7	26. 75	25 - 333
Short fibre index	5.1	5.5	3.95	8.5	The smaller the better
Micro	3.10	3.28	4.12	4.25	3.7 – 4.2

19



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Varietal release

- Two of the cotton lines evaluated were released as varieties to farmers in 2005. These varieties are SARCOT 1 and SARCOT 5

21

Seed Multiplication Scheme

YEAR	SEED GENERATION & AREA	PROJECTED QUANTITY OF SEED IN METRIC TONNES (MT)
YEAR I	BASE (Foundation Seed) 12 ha ↓	4.5
YEAR 2	First reproduction (certified seed) 400 ha ↓	220
YEAR 3	Second reproduction (Certified seed) 11,00 ha ↓	6,000 -11,000
YEAR 4	Farmers seed 242, 00 – 440,000	

22

Cotton seed multiplication field at Nyankpala

23

The way Forward

- Introduction of Bt Cotton, Ghana Government initiative and SARI is a core institution in the process
- Bt Workshop in June, 2012 and Burkina preparations
- Bt (*Bacillus thuringiensis*), NOT Biotech cotton
- Bt – soil microrganism in soils worldwide
- Why Bt cotton

24

Major Cotton Insect Pests

Cotton bollworm

- Bollworms are key pests of cotton
- The larvae damage plant terminals and also chew into squares and developing bolls, resulting in abscission of these floral parts and loss in seed cotton yield

25

Current control methods

- Control relies on insecticides eg Polytrin C, Tiham, Thunder, Karate and Dunsbarn
- An average of six sprays are applied in a season
- Chemicals are expensive and detrimental to the farmer and the environment

26

Merits of Bt Cotton

- Reduction of pesticide application from 6 to 2 times (resistance to Bollw)
- Reduction in walking distance (Burkina Faso farmer experience
- Reduction in risk from insecticide exposure(social implications)and poisoning
- Reduction in labour cost
- Reduction in chemical cost

27

Merits of Bt cotton continues------

Increase in cotton production
Increase in seed cotton yield of 30% BF

- Increase farmer income
- Improve farmer livelihood

Demerits of Bt cotton:
NONE

28

Bt cotton breeding procedure

- Confined field Trials (CFTs)
- Introgression of A x B
- A = Donor variety
- B = Farmer preferred variety (SARCOTS)
- Breeding (fore and background) using backcrossing procedure

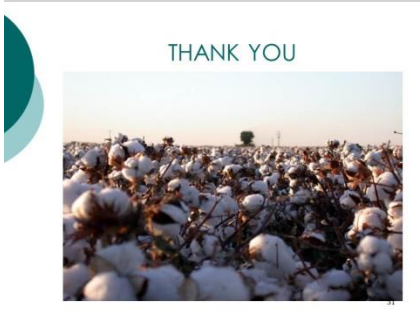
29

Conclusion

Increase in cotton production

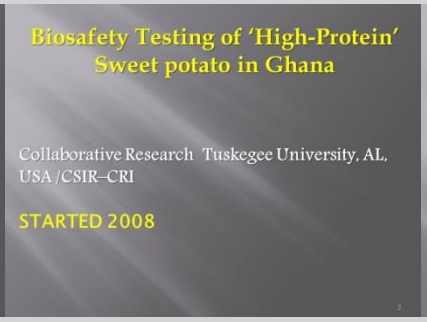
- Increase farmer income
- Improve farmer livelihood

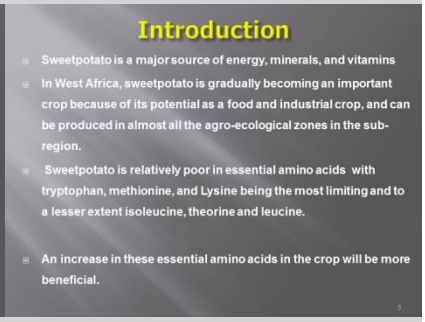
30

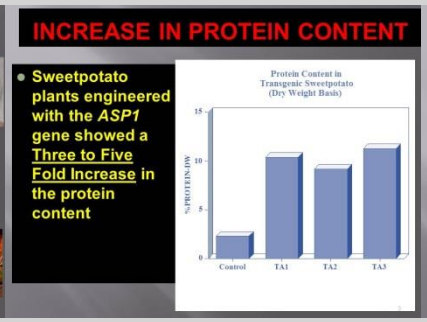

THANK YOU

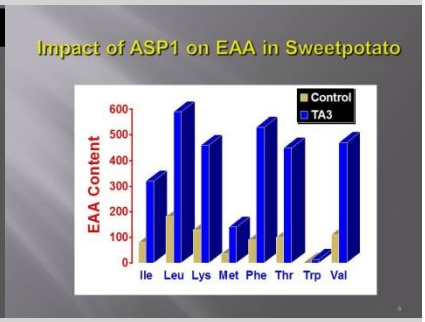
GM Projects in Ghana - Overview

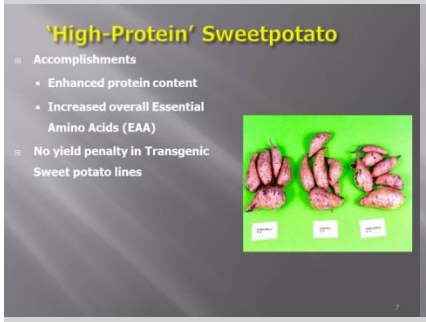
Dr IDK Atokple – CSIR Savannah Agricultural Research Centre, Tamale, Ghana

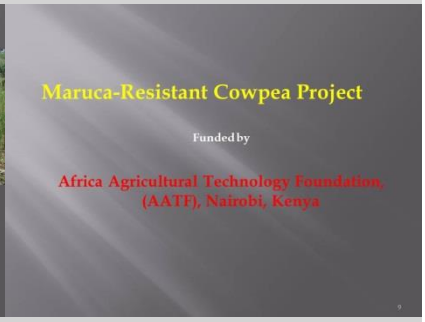


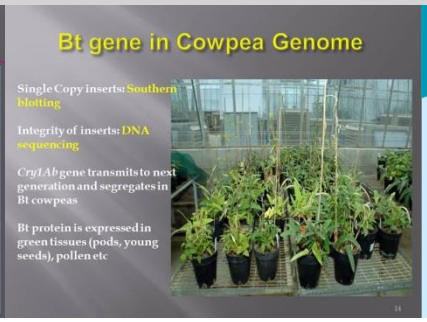


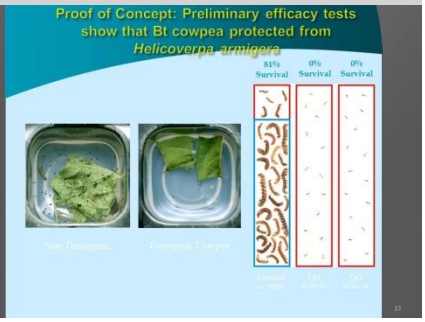












Bt cowpeas are protected from *Helicoverpa armigera*

Bt cowpea is highly toxic to *H.armigera*

		% Mortality
Non Transgenic	[illegible]	[illegible]
Transgenic Line	CP81A	100%
Transgenic Line	705A	100%
Transgenic Line	705C	94%
Transgenic Line	705D	94%
Transgenic Line	703C	100%
Transgenic Line	705B	100%
Transgenic Line	705F	83%
Transgenic Line	706A	100%
Transgenic Line	706B	100%
Transgenic Line	706C	93%
Transgenic Line	710B	88%

CSIR-SARI/CRI Setting the Pace of Introducing GMOs into Ghana

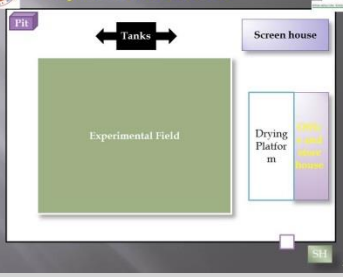
CAPACITY OF CSIR-SARI/CRI IN CONDUCTING AND MANAGING CFT

- Formation of the IBC
- Research Team
- Training in Field Management Skills?
- Logistics/Infrastructure

Containment Greenhouse at CSIR-CRI

Confined field

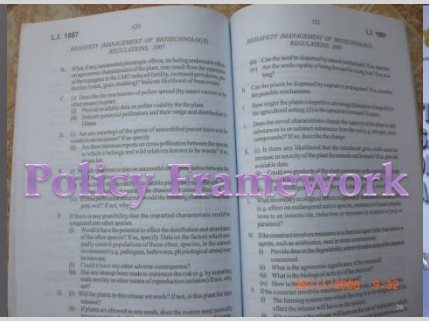
Layout of the CFT site

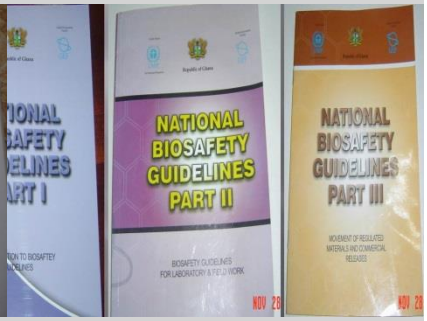


Front view of Confined Field Trial Site, CSIR-SARI

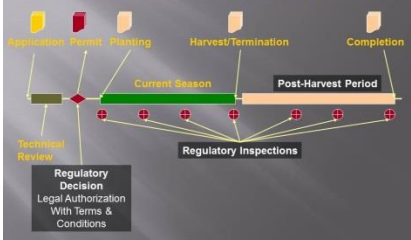
Legal concern- Regulations

- Ghana has signed the Cartagena Protocol on Biosafety
- The national biosafety framework and regulations have been developed.
- Environment safety : testing of Bt cowpea must be conducted according to international and national regulations
- Ensures food and feed safety





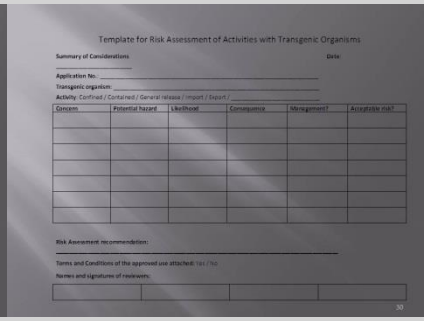
Confined trial process



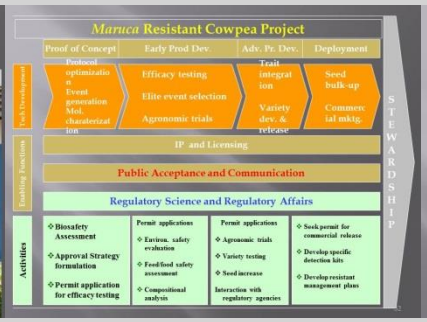
3 critical control points for field trials

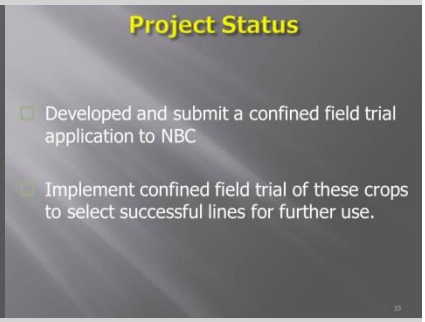
Aim to:

- 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




AATF-PBS training effort on biosafety & regulatory compliance


Maruca Resistant Cowpea Project
Proof of Concept
Early Prod Dev.
Adv. Pr. Dev.
Deployment
Protocol optimization
Event generation
Mol. charaterization
Efficacy testing
Elite event selection
Agronomic trials
Trait integration
Variety dev. & release
Seed bulk-up
Commercial mktg.
Tech Development
Enabling Functions
IP and Licensing
Public Acceptance and Communication
Regulatory Science and Regulatory Affairs
Activities
Biosafety Assessment
Approval Strategy formulation
Permit application for efficacy testing
Permit applications
Environ. safety evaluation
Feed/food safety assessment
Compositional analysis
Permit applications
Agronomic trials
Variety testing
Seed increase
Interaction with regulatory agencies
Seek permit for commercial release
Develop specific detection kits
Develop resistant management plans
STEWARDSHIP


Project Status
Developed and submit a confined field trial application to NBC
Implement confined field trial of these crops to select successful lines for further use.


Meeting with the NBC and Min Env. Sci & Tech Accra, Ghana

Plant Genetic Resources Conservation Case Study

Lawrence Aboagye – CSIR Plant Genetic Resource Research Institute, Bunso, Ghana

PLANT GENETIC RESOURCES CONSERVATION IN GHANA

PAPER PRESENTED BY

L. M. ABOAGYE
CSIR-PGRRI

BIOSCIENCE FOR FARMING IN AFRICA
JOURNALISTS TRAINING COURSE

19TH -22ND SEPTEMBER , 2012, ACCRA, GHANA. 6

PGR MANAGEMENT IN GHANA

- Ghana has a national PGR management programme
- PGRRI of the CSIR is the organization mandated for the Coordination of PGR activities.

7

CSIR-PGRRI

- PGRRI was established in 1964 as PIE division.
- Became a centre in 1994 and an Institute in 2005.
- A 5-year strategic has been drawn (2009-2013).

8

MANDATE

- CSIR-PGRRI has the mandate to collect, characterize, evaluate, document, conserve, distribute and utilize plant genetic (PGR) from Ghana and abroad.

9

VISION & MISSION

- The vision of CSIR-PGRRI is as follows: To become a centre of excellence with improved facilities for short, medium and long term conservation and to encourage sustainable utilization for wealth creation.
- PGRRI has the mission to collect and conserve PGR of Ghana and those from abroad to prevent their extinction.

10

Genetic Resources of Plants

- Plant genetic resources are those materials containing actual or potential value
- They are the basic raw materials for crop improvement today and for the future

11

Genetic Resources of Plants

Genetic resources of plants could be found in:

- Wild and weedy relatives
- Land races
- Bred varieties (*Obaatanpa*, *Asontem*, *Abasafitaa*)

12

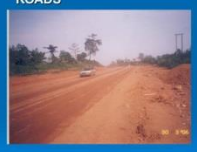
The Need to Conserve

- A lot of plant resources are being lost through the activities of man and natural hazards: These include:
- Farming activities(slash and burn)
- Construction(Roads, townships and dams)
- Bush fires
- Introduction of new or improved varieties (*Obaatanpa*, *Asontem*, *Ayiyi*)

13

CONSTRUCTION

ROADS



DAM

14

BUSH FIRES

15

ACTIVITIES - MINING

16

ACTIVITIES OF PGRRI

Collect
Characterize
Evaluate
Conservation
Maintenance
Documentation
Distribution &
Utilization

17

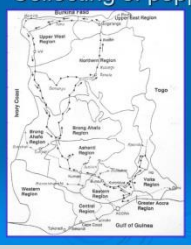
Collection of germplasm

Collecting Team

Collecting of Germplasm

18

Collecting of pepper



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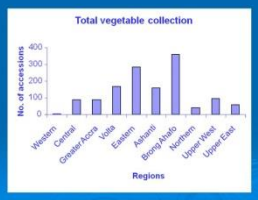
Vegetable germplasm collected



20

GERMPLASM COLLECTING

- To date a total of 10,000 accessions of legumes, cereals, vegetables, root and tuber crops, medicinal plants, timber species and wild species.

21

CHARACTERIZATION OF PEPPER

Traits evaluated		SDI
Stigma Position In Relation To	Exerted or Same Level	0.124
Fruit Shape At Peduncle	Obtuse, Cordate, Acute	0.333
Neck At Base Of Fruit	Absent or Present	0.32
Fruit Shape At Blossom	Pointed, Sunken, Blunt	0.371
Fruit Cross-Sectional	Smooth, Corrugated, Slightly corrugated, Intermediate, Very corrugated	0.575
Fruit Persistence	Persistence or Deciduous	0.028
Fruit Pungency	High	0
Fruit Set	High, Intermediate, Low	0.458

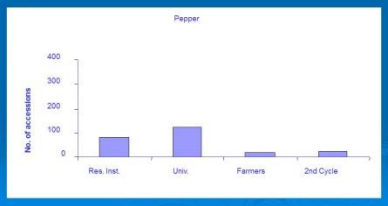
22

EVALUATION

Trait	Range	Mean	SD	CV(%)
Fruit length	1.3-17	5.01	2.28	41.2
Days to 50% flowering	2-117	82.77	13.59	18.61
Days to 50% fruiting	66-143	95.38	12.98	13.6
Fruit width	4.8-28.2	13.31	5.49	41.24
Fruit wall thickness	0.1-3.24	1.07	0.41	38.31
Mean fruit weight	0.25-18.3	2.46	1.86	75.6
Yield per plant	0.3-223	65.16	57.11	87.64

23

DISTRIBUTION



24

IN-SITU CONSERVATION

In the natural ecosystem, there are 280 forest reserves and 15 protected areas.

These areas contain wild species, medicinal, plants and wild relatives of cultivated crops.

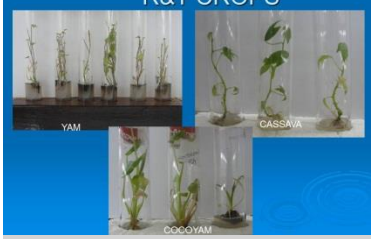
25

EX-SITU CONSERVATION

- Conservation of orthodox seeds under cold storage at PGRRI, CRI, OPRI, UG, etc

26

EX-SITU CONSERVATION R&T CROPS



27

EX-SITU CONSERVATION

- In-Vitro conservation at CSIR-PGRRI , CRI, CRIG, UG & FORIG.

28

No. of accessions of R & T crops in in-vitro genebank

Crop	Total Number in the Gene bank	Number of accessions *in-vitro*
Cassava	334	140
Yam	393	138
Cocoyam	75	72
Sweet Potato	21	21
Frafra Potato	26	26
Colocasia	80	3
TOTAL(* 2011)	939	400

29

COLLABORATION NATIONAL

30

COLLABORATION - INTERNATIONAL

31

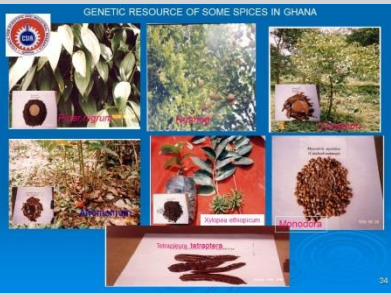
YAM GENETIC RESOURCES

32

LEGUME GENETIC RESOURCES UNDER CONSERVATION IN GHANA

33

GENETIC RESOURCE OF SOME SPICES IN GHANA



34

ECO-TOURISM

35


PLANTING MATERIALS
PRODUCTION
THANK YOU
PLANT GENETIC RESOURCES
RESEARCH INSTITUTE
(CSIR)
36
37

Regulatory Dimensions of Biotechnology

Eric Okoree – Ministry of Environment, Science and Technology of Ghana

REGULATORY DIMENSIONS

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MEST
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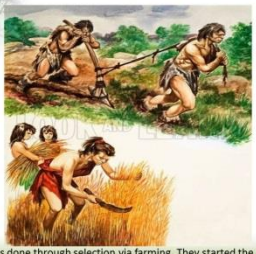
SEPTEMBER 22, 2012

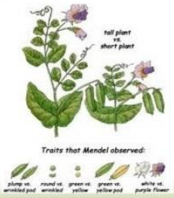
HISTORY OF REGULATION

The early man was the first biotechnologist
The first to combine genes.



This was done through selection via farming. They started the art of combining genes- No regulations then.

Then Mendel came out with the theory of hereditary



Following Mendel's revelation, scientists began to self pollinate varieties of crops bring about hybrids

Biotechnology developed into different forms including tissue culture (conventional) and recombinant DNA technology (modern) and was practiced for centuries/decades without anybody caring about threats to health and the environment.

However, concerns about hazards and safety halted recombinant DNA for some time.

Many scientists worried that hybrid molecules from recombinant DNA experiments could result in dangerous new organisms that could pose a threat to public health. Others were deeply concerned about ethical issues related to genetic engineering, especially as it might be applied to humans.

A conference was organized in Asilomar to address these concerns.

ASILOMAR CONFERENCE 1975 (BY SCIENTISTS)

In February 1975, the U. S National Academy of Sciences decided to look into the potential hazards. The committee organized the International Congress on Recombinant DNA Molecules at the Asilomar Conference Center in California. About 140 concerned parties (mostly molecular biologists, but including also a few physicians, lawyers, and journalists) participated.

Watson and Paul Berg

Berg and several colleagues organized the Asilomar meeting to bring together "people who were engaged in the research and expertise in bacteria and viruses to help assess the potential hazards

A sense of urgency pervaded the meeting, because researchers were impatient to put the new technology to work. Although most of the participants suspected that there was no real hazard

The meeting decided not to address the ethical issues surrounding genetic alteration but to stick to safety issues they felt they could address as scientists

The meeting came out with a set of safety guidelines that involved working with disabled bacteria that could not survive outside the lab.

The guidelines not only allowed research to resume but also helped persuade the U. S. Congress that legislative restrictions were not needed--that scientists could govern themselves.

However, this did not end the discourse.

GREAT PUBLIC INTEREST AND DEBATE

Public concerns for biotechnology let to environmental groups, consumer organizations, religious groups, and farmers' organizations actively participating in an intense public debate on biotechnology, especially regarding biosafety

GREAT PUBLIC INTEREST AND DEBATE Conti.

People around the world tend to accept biotechnology in medical applications more easily than biotechnology in the field of agriculture or food processing

Because of the many concerns, Europe and the United states and other parts of the world started to develop regulations.

The outcome, is an internationally unprecedented set of new regulations

US AND UK REGULATORS IN PARTICULAR BEGAN TO TAKE THE ISSUE SERIOUS

U. S

To address these concerns, the Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), and the Food and Drug Administration (FDA) shared responsibility for regulating agricultural biotechnology in the United States. In particular, EPA regulates pesticides created through biotechnology as a part of its regulatory jurisdiction over all pesticides marketed and used in the United States. As such, the EPA has tailored its basic regulatory framework to fit the distinctive characteristics of these genetically engineered biological pesticides.

U. K

Britain had a wide ranging risk debate on GMO releases, that included ethical and socio-economic aspects. In response, the British *Department of the Environment* (DoE) announced 'precautionary controls' in the Environmental Protection Act of 1990. This required a prior risk assessment and consent for each GMO release.

Industry regarded biosafety controls as helpful for enforcing a collective self-discipline among biotechnologists as well as protecting their public image

VIEWS IN THE 1970'S AND EARLY 1980'S

General Outcome

- "general conclusion reached that provided suitable precautions taken, the benefits outweigh the risks"
- "there has been a general reduction in restrictions in most countries as knowledge and experience of the techniques have been obtained..."
- "the safety of genetic engineering research has ceased to be a major reason of concern"

B4FA

RIO EARTH SUMMIT DECLARATION 1992

The central focus of the summit was the question of how to relieve the global environmental system through the introduction to the paradigm of sustainable development.

B4FA

Principle 15

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

B4FA

Principle 15 simplified

WHEN AN ACTIVITY RAISES THREATS OF HARM TO THE ENVIRONMENT OR HUMAN HEALTH, PRECAUTIONARY MEASURES SHOULD BE TAKEN EVEN IF SOME CAUSE AND EFFECT ELATIONSHIPS ARE NOT FULLY ESTABLISHED SCIENTIFICALLY

B4FA

CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

- The conservation of biological diversity,
- The sustainable use of its components and,
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources,

CBD

B4FA

THE CARTAGENA PROTOCOL ON BIOSAFETY

This is a Protocol under the CBD which deals with Genetically Modified Organisms (GMOs)

Objective:

To contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements.

B4FA

EFFECTS OF CARTAGENA

National Biosafety Frameworks

Although NBFs vary from country to country, they usually contain a number of common elements:

- A Government policy on biosafety, often part of a broader policy on biotechnology.
- A regulatory regime set in place to address safety in the field of modern biotechnology. This includes laws, guidelines and regulations to guide practices in modern biotechnology.

B4FA

- A mechanism to handle applications for permits for certain activities, such as releases of GMOs into the environment..
- A mechanism for 'follow up' actions such as enforcement and monitoring for environmental effects.
- A mechanism for public awareness, education and participation.

B4FA

EFFECTS OF CARTAGENA

- Biosafety laws - make provision for:
  - ✓ Biosafety Authority
  - ✓ Transboundary movement and release of LMOs
  - ✓ Risk assessment
  - ✓ Biosafety Clearing House- http://bch.cbd.int/(Global, Ghana profile)
  - ✓ Biosafety policies

Biosafety Act, 2011 (Act 831)

B4FA

REGULATIONS IN AFRICA

- THE African Model Law on Biosafety
- ECOWAS Biosafety Protocol: Provides a common sub-regional regulatory frame-work to ensure safe trans-boundary movement of biotechnology products including living modified organisms for agriculture purposes, from one member state to the other.

B4FA

WAEMU, ECOWAS and CILSS

- Since 2010, WAEMU, ECOWAS and CILSS continue to work on the harmonization of regional biosafety regulations. Country members provided comments which are being incorporated in a final draft before final approval by all countries.

CILSS: Permanent Interstate Committee for drought control in the Sahel

B4FA

- Agricultural Biotechnology Network in Africa (ABNETA)- Goal: To support the use of Biotechnology to improve Agriculture in Africa
- The Common Market for Eastern and Southern Africa (COMESA) draft policy of GM technology
- National policies- Many Africa countries participated in the Framework project.

B4FA

REGULATORY SITUATION IN B4FA FOCUS COUNTRY

Nigeria- Law at the level of Senate

Tanzania – Biosafety Law passed

Uganda- No biosafety Law passed.

Ghana- Biosafety Law Passed.

B4FA

EFFECTS OF REGULATION

- Permissive vs restrictive implementation
- Timescales and costs
- Expertise for assessment and testing
- Strict liability, eg Tanzania

B4FA

THANK YOU

bch.cbd.int

https://bch.cbd.int/about/countryprofile.shtml?country=gh

B4FA

Commercial Dimensions of Agricultural Biotechnology

Daniel Otunge – African Agricultural Technology Foundation, Nairobi

B4FA's Media Fellowship Programme, GHANA

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 transfer of proprietary technologies to smallholder farmers in sub-Saharan Africa.

AATF Projects

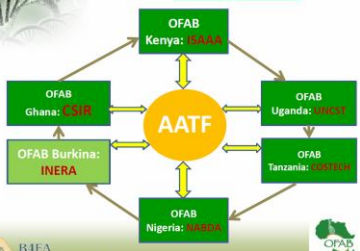
- **AATF: Projects include:**
  - ✓ WEMA,
  - ✓ Cowpea,
  - ✓ Nitrogen Efficient Rice,
  - ✓ Striga Control in maize,
  - ✓ Aflatoxin control,
  - ✓ Virus resistant bananas;
  - ✓ Cassava,
  - ✓ OFAB

About Open Forum on Agricultural Biotechnology

- This is a platform for sharing credible, factual and balanced information on modern biotechnology with a view to impacting policy making process.
- Started by AATF in 2006 in Nairobi

Dr. Noah Wekesa, former Minister for Science & Technology, KENYA, opening OFAB in 2006

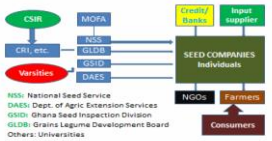
OFAB Chapters



SEED TRADE IN GHANA

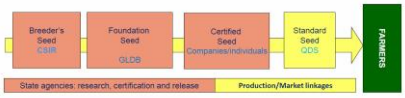
Ghana seed system

- 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 Leguma 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 research institutes

- **Breeder's seed is given to GLDB to produce Foundation 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

- National public universities in Africa also play significant roles in production of breeder's seed
- They do this to fulfill both training and commercial purposes
- **For instance,** the University of Ghana's
  - Institute of Agricultural Research (IAR) and
  - West African Center for Crops Improvement, etc

Role of Seed Companies

- Ghana has about 30 registered small-to-media companies
- The small, local companies make significant contributions in multiplication of foundation seeds
- The multinationals like **Monsanto, Pioneer, Bayer, Syngenta, Pannar, SeedCo, Viba Seed,** etc., have the resources to produce their own seeds breeder's seed, **including biotech ones**, and present to authorities for NPT, DUS, certification and release.
- There is fear of control of seed supply by multinationals

Role of Seed Companies

- Plant breeding is a very expensive undertaking that 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 Institute for Tropical Agriculture (IITA)
  - ✓ International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
  - ✓ Africa Rice Center (WARDA)
  - ✓ International Rice Research Institute (IRRI) and
  - ✓ International Potato Center (CIP)

Role of regional organizations

- NEPAD centers of excellence
- 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,
- WACC (West African Center for Crops Improvement)

SEED REGULATORY ENVIRONMENT

Seed regulation in Ghana

- The Ghana Seed Inspection Division (GSID) is responsible for seed certification and release. Certification steps include:
  - Determination of eligibility of cultivars/seeds; Verifying source; Field inspections; Lot examination; Sampling; Seed testing; Labeling; Sealing; Quality control
- GSID has on seed packaging materials which they sell to seed growers

Seed regulation in Ghana

- The National Seed Council (NSC) is responsible for policy formulation
- National Seed Testing Laboratory carries out testing:
  - Moisture content,
  - DUS (Distinctness, Uniformity and Stability),
  - Purity
  - Germination
  - Health

Biotech crops go through even more rigorous tests

Seed regulatory environment

The country has the following regulations that affect seed:

- Seeds (certification and Standards) Decree of 1972
- Seed and fertilizer Act Law
- Biosafety Act 2011
- Biosafety Regulations

The Media needs to interrogate the current system to guard against Overregulation

Use of other inputs

Use of other inputs like fertilizer is still very low in Africa compared to other regions of the world because:

- Inputs are very expensive due to taxes
- Lack of availability,
- Poverty

Hence interventions by:

- Seed companies,
- Relief agencies,
- Governments,
- NGOs (eg AGRA, IFDC)
- Churches

HOW SEEDS REACH FARMERS

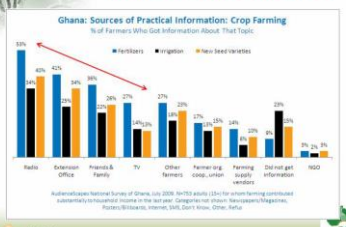
Role of seed companies:

- The seed companies in Ghana are increasingly becoming the central players in production and distribution of seeds to farmers.
- They reach farmers through:
  - Agro-dealer networks
  - Demonstration plots and extensive network of
  - sales and marketing agents
  - Promotion
  - Media
  - Farmer field days
  - Exhibitions

Role of extension service:

- In Ghana DAES is responsible for agriculture extension
- However, generally the extension service is:
  - Ineffective
  - Underfunded
  - Understaffed

Role of information



Role of information:

Information on available varieties is provided to farmers right form the time of variety release which are usually made public through the press and catalogues.

- Sources of information include:
- seed companies (promotion, demo farms, sales & marketers, exhibition, info materials)
- The mass media
- agro-dealers,
- NGOs
- Extension
- Use of ICTs (mFarms, esoko, etc.)
- Farmer associations
- Exhibitions

Farmer level promotion

This is mainly done by:

- Seed companies (sales agents)
- Industry association (SEEDPAG)
- Traditional meetings
- Demo farms
- Farmer field schools
- IEC materials, etc
- Extension service
- Farmer Groups (*eg Ghana National Association of Farmers &Fishers*)
- NGOs, (AATF, AGRA, ISAAA, World Vision, Action Aid, Oxfarm, among others)

(SEEDPAG: Seed Producers Association Of Ghana)

Role of AFSTA:

- The African Seed Trade Association is an industry body formed to promote trade in quality seeds and innovative agricultural technologies
- It has about 26 National Seed Trade Associations and 70 member seed companies spread across Africa.
- In Ghana it operates through SEEDPAG.
- Main programs include: ASIESA, WASA,COMRAP and Biotech awareness.

Role of AFSTA:

- The national associations partner with government departments and seed companies to create channels through which farmers can access seeds more easily.
- Organizes annual congress where farmers get information at exhibition booths.

Congress: 5-8 March 2013

AFSTA Congress 2013 MAURITIUS

Role of AGRA:

- The AGRA's Program for African's Seed Systems (PASS) is perhaps the most ambitious and well coordinator effort to improve supply of quality seeds to farmers in Africa.
- PASS aims to increase Africa's capacity to breed, produce and deploy quality seeds to farmers

Dr Joe Dvries, PASS Director

Role of AGRA:

PASS programs encompass:

- Strengthening seed regulatory frameworks
- Advocating for better polices and laws
- Building capacities of seed companies
- Developing agro-dealer networks
- Supporting farmer cooperatives
- Funding local seed producers
- Academic and skills training

THE STATUS OF PLANT INTELLECTUAL PROPERTY RIGHTS (IPRS) IN Ghana

What is IPR

- 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.
- Article 27 of the **TRIPS** (Trade-Related Aspects of IPRs) **Agreement** have brought about a major shift towards Plant Variety Protection (PVP)
- Other important bodies that emphasize IPRs are **UPOV** (International Convention for the Protection of New Varieties of Plants and **ARIPO** (African Regional Intellectual Property Organization) .

IPRs

- New Plant Varieties are eligible for the intellectual property protection under UPOV , WIPO, TRIPS and ARIPO among others.
- Few countries in the sub-region have Plant Breeder's Rights law.
- Protection of plants through intellectual property is riddled with controversy centered on the threat to food security.

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.**

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

- 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

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 foundation seeds
- Underinvestment in diffusion strategies
- Poor agro-dealer network
- Weak national seed trade/grower associations

Comments and discussions

THANK YOU

www.aatf-africa.org

www.ofabafrica.org

Keynote Address

Dr Ahmed Alhassan MP – Chair of Parliamentary Agriculture Committee, Ghana

Biosciences for Farming in Africa
First Media Fellowship for Journalists
Oak Plaza Hotel, Accra.
September 22, 2012

Keynote Address
by

Hon. Dr. Alhassan Ahmed Yakubu (MP)
Chairman, PSCFAC

Biotechnolog**y** may have been well-defined over the period of this training workshop and the merits well explained by more competent scientists.

It is simply a cutting edge technological tool used to speed up conventional systems of arriving at agricultural products that are superior to already existing ones. These may include new crop varieties, species and products for health, agriculture and environmental management sectors. The foregoing are often referred to as red, green and grey biotechnology respectively.GE and Biotechnology may involve the transfer of genes between unrelated species to achieve a desirable trait in the off spring (GMOs). This procedure is to respond to biotic (diseases and pest) and abiotic (water and fertilizer use) factors that inhibit productivity of crops and animals. Indeed biotechnology is to bioscience as digital technology is to modern ICT.

Just like most scientific researches, biotechnology is of good intent, that is, to provide relative comfort to humankind in their everyday life.

Our focus today is how to communicate the lofty ideals of biotechnology to our clients – readers and viewers of our products, news.

There is no gain saying that science and other news worthy subjects have to compete for the same space in the news media. Scientists conventionally published journals to exchange views between themselves. This was when science like the legal profession was better appreciated if it was not understood and had to be explained. Whereas the legal profession remains pricy for not being understood by ordinary people, science and scientists are constantly being harassed for lack or inadequate understanding of the subject of science.

This development has been due to the closeness of science and society and the latter beginning to ask critical questions so that there is better appreciation of science products before they are consumed.

The issue has become more critical with the advancement of science into the realms of biotechnology and sophisticated products such as GMOs being a consequent output.

Indeed the debate has become so intense that many have forgotten that biotechnology is simply a tool for plant scientists to use in their conventional breeding efforts to secure better plant products for mankind.

The ethical dimension of bioscience has become the debate to the neglect of the historical and contemporary food security challenges that confront us in our part of the world. These very challenges triggered the need to seek solutions via scientific research and innovation.

It has to be stated emphatically that the context of the debate on GMOs must be indigenized to reflect African and developing country challenges in agriculture and food security rather than it (the debate) being a derivative of discussions in the North (developed countries) whose challenges are quite different from what pertains in Africa.

Africa's development challenges are so different and unique that there is the need to approach GE/biotech debate with our challenges well defined. Africa has FS challenges. The needed agriculture led industry to provide the needed jobs for our youthful population remains a distant dream. Management of our sanitation and environment are not influenced by modern science and technology.

The trinity of water, seed and fertilizer are very important resources that need to be used in a sustainable manner and conserved for the future. GE crops that will help us realize these objectives must be encouraged in Africa where these resources are most limiting and constitute the most expensive factors of production. African agriculture is currently heavily subsidized by public funds going into irrigation, seed and fertilizer support schemes. This input subsidy schemes visit a heavy toll on national budgets on an annual basis.

If the journalism fraternity in Africa can contribute to reposition the Biotechnology debate such that the agenda meet African challenges in bioscience, then the resultant outputs will inform decisions our scientific community will make now and into the future.

As long as our debate on bio scientific tools and products remain global in context, the understanding of our domestic situation will continue to evade our attention. We need to for instance focus on what benefits we can derive from biotechnology for African farming and secure FS for Africa rather than pour all our ink on explaining the hazards of GMOs /biotechnology products, which are not based on evidence.

The first commercially available GM food (GM tomato) was allowed to be released by the USA Food and Drugs Board in 1996. Africa joined later with South Africa in 1997 (Bt cotton), and Egypt and Burkina Faso in 2008. Indeed till date many African countries including Ghana are still at confined trial stage (CFT) with GE crops! Compare this to the fact that i-phone5 released a few days ago may already be in Ghana today. This hesitant and discriminatory embrace of science is not the best for Africa!

What is fact is that no human being has suffered any injury resulting from the consumption of GM foods as we know so far. Ghana and many other African countries have the needed infrastructure and human resource base to adopt GE in order to crack the recalcitrant challenges of food security and agriculture led economic growth of our country. In the immediate to medium term, focus should be on crops such as cotton, cowpea, maize and rice because these crops are the heaviest consumers of imported inputs (fertilizer, pesticides etc.) used to drive their production. Food production and productivity have to increase without committing more land resources. GE as a tool must be the best pathway.

Who are engaged in the debate?

In the particular case of scientific reporting, it is important that the stakeholder participation is expanded to include policy makers and implementers as well as farmers, so that the debate is more informed and concrete conclusions become the outcome.

In the last two decades the African farmer has been the main determinant of the agricultural research agenda. Thus, farmers have led scientists to develop new technologies for farming that targets food security. Biotechnology as a new tool to achieve same must engage farmers from the outset. After all, manipulation of genes is natural and occurring all the time on farmers' fields. Farmers are eventually the pathway through which new varieties will come to consumers. Any varieties that consumers will reject will not be supported by farmers. In other words biotechnology products will be subject to rigorous censorship by farmers as has always been the case till now. Scientists have long since integrated farmers in the decision-making processes of what research to embark upon in order to respond to the needs of farmers and consumers. Farmers are also an integral part of the research chain, assisting scientists every step of the way to achieve consensus in technologies that will enhance agricultural production and productivity.

It is heartwarming that because of the perceived problems that may emanate from biotechnology application, developing nations have been proactive in establishing the necessary legal frameworks within which to practice biotechnology research. Provision of legal frameworks constitutes a convergence point for both advocates and those who lobby against to agree that safety should not be compromised in GE science and generation of products (GMOs) for consumption.

In Ghana, pieces of legislation have been passed by Parliament to regulate bioscience research including biotechnology. Examples include: Plants and Fertilizer Act (Act 803), Biosafety Act (Act 831) and Biosafety Regulations (L.I.), Public Health Act more recently. These in addition to international conventions and treaties that Ghana has signed up to impose obligations and responsibilities on scientists and other stakeholders in biotechnology research, to ensure that research practice and products thereof are safe for human consumption.

These must engage journalists in their quest to protect Ghanaians from harm derived from the consumption of GMOs.

After going through the training, you have become the critical mass of empowered journalists who should become a loud and very informed voice for bioscience among your colleagues in the media.

It is not going to be easy but with perseverance, the love for science and the desire to break new grounds we will succeed.

I humbly appeal to the organizers and funders of this program to try and institutionalize it so that science and technology will take its rightful place in the socio-economic culture of our countries. This will entail using ICT tools to inure to the benefit of science and technology application in agriculture and other productive and service sectors of the economy.