E A G L E S European Action on Global Life Sciences | Food Symposium

Proceedings of the EAGLES Food Symposium

4

December 2008

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Bibliotheca Alexandrina

Egypt, 13–16 April, 2008

In association with

BioVision Alexandria 2008

EUROPEAN FEDERATION OF BIOTECHNOLOGY

Introduction

This EAGLES Food Symposium was held under the direction of Dr. Ismail Serageldin, Director General, Bibliotheca Alexandrina, Egypt and Chair of EAGLES. Its objective was to present the state of research and current European programmes on major food, agriculture and biotechnology themes that could address the challenges of food security, quality and safety in developing and emerging countries (DECs). It focused on European responses to the global challenges posed by food sufficiency, quality and safety and environmental security in the developing world.

The symposium drew on reports and recommendations from previous EAGLES Food meetings and related international foray and on multilateral stakeholder dialogue to provide recommendations on how European programmes and policies related to food in DECs can be improved.

This Food Symposium is one in a series of meeting being held as part of the Specific Support Action "European Action in Global Life Sciences – Food Forum" funded by the EU under the 6th Framework Programme for Research. An EAGLES Food Workshop was held in Hangzhou, China on 4-5 December 2006 on the topic of Livestock Farming and an EAGLES Food Event on ICT was held in Pretoria, South Africa 14-16 November 2007. An EAGLES Food Forum Consultative Meeting was held in Barcelona 18-20 September 2007 in association with the 13th European Congress on Biotechnology. And an EAGLES Food workshop on IPR and DEC-related issues is being held at IRRI in the Philippines 5-7 May 2008.

Symposium Programme

Monday 14 April 2008 **17.30 – 19.30** **Opening Plenary Session**

Chair: Professor Patrick Cunningham
Reporter: Jim Flanagan

Keynote Address: Professor Ismail Serageldin

Success stories:
GM Technology Professor Marc van Montagu

Soybeans Dr Eduardo Trigo

Tuesday 15 April 2008 **09.00 – 10.30** **Global Convergence in Food Supply 1**

Chair: Jim Flanagan
Reporter Professor Norman Casey

Roger Beachy Improving the Human Condition through Plant Sciences – Bringing the Advances in Biotechnology to bear

Malcolm Elliott Impediments to Global Convergence in Food Supply

Tuesday 15 April 2008 **11.00 – 12.30** **Global Convergence in Food Supply 2**

Chair: Malcolm Elliott
Reporter: Jim Flanagan

Clive James Global Status, Impact and Future Prospects of Commercialising Biotech Crops

Chengcai Chu Rice Improvement in China: Agro Biotechnology – the driving force for the next Green Revolution

Tuesday 15 April 2008 **13.30 – 15.00** **European Research Policy and Global Food Supply**

Chair: Huanming Yang
Reporter: Jim Flanagan

Christian Hoste European Contribution to Agricultural Research

Gurdev Ghush Improving the Nutritional Status of Food Crops

Stephen Jarrett Making Ready-to-use Therapeutic Foods readily available to treat Children with severe acute Malnutrition

Tuesday 15 April 2008 **15.30 – 17.00** **Conclusions and Recommendations**

Chair: Professor David McConnell
Reporter: Jim Flanagan

Discussion leaders:
Adel el Beltagy
John McDermott
Huanming Yang
Tom Arnol

Overall Conclusions and Recommendations

Key messages from the Food Symposium - Statement from EAGLES

Life scientists from the developing world told their European colleagues at the EAGLES Food Symposium, held this week at the New Library of Alexandria (Egypt), that they are dismayed and even horrified at the persistent failure of Europe to deploy its life sciences effectively in the fight against hunger. Our Asian, African and Latin American colleagues have said that they simply cannot understand why that on the continent of Darwin and Pasteur, the voices of science and reason have been devalued.

The meeting took place against the background of the greatest crisis in food security in 40 years. Ismail Serageldin, Director of the New Library and Chairman of EAGLES expressed moral outrage at the fact that 800 million people suffer from chronic hunger and that there are 40,000 hunger-related deaths every day. He called for a commitment that hunger should be abolished in the same way that slavery had been – some Europeans decided that slavery was an affront to human values and led the world in a passionate campaign to make all men free. There must be an immediate response if Europe is to fulfil its obligations to humanity.

Life scientists everywhere have a responsibility to address these global challenges and to ensure that policies facilitate this. The people of Europe and their leaders should pay careful attention to the knowledge and advice of distinguished life scientists and humanists from the developing countries.

Food crisis and bio fuel

Although starvation and malnutrition have affected millions of people for decades, there is a new and real crisis in feeding the world's poorest and most vulnerable people. The new pressures arise from the diversion of traditional food crops to energy in Europe and elsewhere, and animal feed in the emerging economies. It is a predictable man-made crisis which is also threatening the political stability and peace in the world.

In addition, climate change is real and will have very great effects in those parts of the world where food supply is already under threat. There is a compelling argument for Europe to stop using crops, traditionally used for food, as sources of fuel. National and regional policies must be immediately reviewed in this regard.

As stated at the conference: "Stop burning poor people's food to power rich people's cars".

European life sciences can and must help to provide new solutions to the energy crisis without taking food from the poor.

Food impact statement

No new energy/fuel production system should be introduced in Europe without research that demonstrates that the system will not have a negative effect on local and global food supplies and security. This research should be summarized in a "food impact statement".

Response to climate change

The strategies for dealing with climate change in Europe and elsewhere have not taken sufficient account of scientific evidence. It is vital that Europe rigorously assess the technical and scientific evidence concerning all strategies for mitigating climate change.

Plant sciences in Europe

Without physics and engineering we could not have put a man on the moon: without the plant sciences we will not be able to abolish hunger. The ability of Europe to respond to the hunger crisis is now threatened because European plant sciences, after decades of neglect, are weak.

Europe used to lead the world in plant sciences. Plant biotechnology grew out of discoveries made in Europe by Marc van Montagu and Jeff Schell, and European plant breeders were experts in producing the new varieties that gave rise to food surpluses in Europe. But students and researchers are deserting the plant sciences discouraged by the collapse of public support and excessive over-regulation.

Meanwhile, abroad, there is a revolution in plant sciences that is sweeping through the Americas, Asia and Australia. New plant varieties, developed by brilliant scientists using a combination of biotechnology and classical plant breeding now account for a huge proportion of world grain, soy and cotton production. These new varieties are of great value to the farmers, large and small, and great benefit to the consumers.

For now, Europe is a bystander, unable to participate adequately in the great global projects that are dedicated to bringing a Green Revolution to Africa and an Evergreen Revolution to Asia and the Americas.

Summary of the Opening Plenary Session

Professor Ismail Serageldin in his keynote address identified climate change and food security as major current issues. Climate change affected everything and he was gratified that the Intergovernmental Panel on Climate Change (IPCC) has reached a consensus on the scientific facts involved and produced a consensus document that brought an acceptance of the realities of climate change. In contrast the International Assessment on Agricultural Knowledge, Science and Technology for Development (IAASTD) had much less success in reaching consensus on the causes of the current food crisis and solutions to the problem. The poor are left very vulnerable. He made a plea that all should work in harmony with nature and establish harmony for the future. He was inspired by the success of the European Union not only in economic but also in social equity terms. He asked Europe to expand the European ideal to the rest of the world at this time of crisis, danger and fear in the world to achieve greater world solidarity.

He paid tribute to the group of talented people who set up EAGLES, the European Action on Global Life Sciences which was a great bridge building institution that should take up the challenge to achieve the concept of a common humanity. He referred to Peter Singer of Canada who advocated committing 5% of global research budgets to projects concerning problems of the poor. He stressed the importance of reaching out to scientists

in developing countries, who were overcoming many difficulties and fighting against adversity to make progress and bring the best of science to solve problems of humanity. He referred to the almost magical property of knowledge as capital in that it was not used up when shared and used, both giver and receiver are enriched and existing knowledge helps to create new knowledge.

Professor Marc van Montagu strongly made the argument that modern biotechnology provides a coherent answer to many of the challenges facing food and agriculture such as food security, environmental constraints on productivity and meeting demand for plants for fuel and industrial feed stocks. Availability of arable land is declining while world population continues to increase. Drought and salinity will be significant constraints on productivity. Crop choices and crop variety improvement using GM technologies, "omic" technologies and marker assisted selection offer attractive scientific solutions.

There has been a marked increase in demand for grains for bio fuel, animal feed and industrial feed stocks. Priorities for sustainability are to develop technologies for production of bio fuels in ways that do not threaten food supplies and to bring national and international policies on bio fuels in line with technological advances.

Insect resistance genes are a tool for reducing pesticide use. Herbicide tolerance genes are a tool for promoting no-till agriculture. Nuclear male sterility genes are a tool for increasing yield. Actions necessary to realize the potential of new technologies in genetic modification of plants include improving science education and awareness of the importance of science in decision making, moving from educating the public to engaging with the public, discussing new products with consumer organizations and explaining the consequences of not using GM plants.

Eduardo Trigo described the success story in Argentina with the use of GM soybean varieties. Argentina was an early adopter of GM crops and has enjoyed direct and indirect economic and social benefits from them. The first release was a soybean with glyphosate tolerance in 1996. The share of GM crops of the total planted area has reached almost 100% for soybeans and about 60% for maize and cotton. Adoption of GM soybeans has resulted in increased yields, increased area grown, reduction in production costs, much greater growing of soybeans as a second crop leading to a "virtual" area expansion of greater than 3 million ha and environmental benefit from the adoption of "no till" systems. Economic benefit in the 10 year period 1996-2006 has been quantified as US$20 billion and resulted in the creation of about 1 million jobs – about 36% of total new jobs created in Argentina in this period.

Summary of the Panels

Panel C-1 Global Convergence in Food Supply Part 1

The key messages from the talk of Roger Beachy were:

- The earth is a tough place to grow crops
- Plant breeding has been very successful in increasing output, and in saving land with environment gain
- Genetic yield potential must be increased 50% over the next 3 decades

- Biotech is going to play a key role
- Public Private Partnerships will be needed
- New technologies and improved varieties can save chemicals, fertilizers, water and land and increase nutritional value
- 22 countries now grow GM crops involving 10.3 million farmers
- Many GM crops have been developed but are not out there in the fields because of cost and regulatory hurdles that must be passed
- Important that public sector scientist is involved but this is not happening – cost dictated that only Big Business can afford to be involved.

Malcolm Elliott discussed the impediments to global convergence in food supply. There is need to double the world's food supply by 2050. Constraints to achieving this include water resources as agriculture is using 70% of water extracted. Loss of resources such as land, top soil and forests are critical and steps must be taken to minimize these.
The idea of using food for fuel was abhorrent. Rising prices for food would set back the anti poverty alleviation effort. Biotech had an important role in solving food security problems. It can help with constraints such as improving tolerance to abiotic stress and drought stress.

Panel C-2 Global Convergence in Food Supply Part 2

Clive James, Chairman and Founder of ISAAA, the International Service for the Acquisition of Agri-Biotech Applications gave a talk on the Global Status, Impact and Future Prospects of commercializing Biotech crops. He told the success story of biotech crops over the last 12 years and their role in helping to meet the Millennium Development Goals. No single approach was sufficient. Multiple approaches were necessary including conventional biotechnology, new technologies, population stabilization and improved food distribution systems. He stressed the importance of acceptance issues such as Food Safety, Environmental Impact, Ownership, Ethical and impact on international trade. And the critical need for improved productivity in food production, improved incomes and the need to protect biodiversity. He concluded by saying that the uptake of biotech crops was the greatest success story in adoption illustrated by an increase from 1.7 million ha in 1996 to 114 m. ha in 2007, with 43% in developing countries.

Chengcai Chu in a talk entitled "Rice improvement in China: Agro-biotechnology – the driving force for the next green revolution" described the success story in developing rice varieties using GM and other new technologies to help feed the 22% of the world's population that live in China from 7% of the world's arable land. He described the concept of Green Rice with insect and pathogen resistance, high yield and high efficiency in fertilizer use and salt and drought tolerance. Approval of new GM varieties required Food safety assessment and necessary regulatory assessment.

Panel C-3 European Research Policy and Global Food Security

Christian Hoste described the European contribution to Agricultural Research for Development, ARD. There is substantial activity in ARD in the European Commission programmes and in member states. European policies supporting development are well

defined in various documents. Priority is given to Africa and due acknowledgement is given the political framework put in place in Africa. Total annual expenditure on ARD in 14 countries reporting was €540 million. The main challenges, opportunities and priorities for ARD in Europe were:

- To develop a comprehensive European funding strategy for ARD recognizing the need to keep a balance and considering different national priorities
- To mobilize all European capacities to contribute to ARD recognizing that Agriculture and Agricultural Research (AR) are back on the ODA agenda, that the distinction between North and South AR is less and less relevant and that Europe needs to consider more its international dimension
- To explore innovative mechanisms to increase effectiveness and efficiency of research and education platforms in both DECs and Europe
- Need to establish a task force to elaborate proposals to foster complementarities and synergies at political, programmatic and capacity levels between AR for DECs and AR for Europe.

Gurdev Khush gave a presentation on improving the nutritional status of food crops. Micro-nutrients, minerals and vitamins are needed for good health. Millions of children suffer from Vitamin A deficiency and eye problems. Iron and zinc deficiencies are common. Solutions to these problems involve dietary diversification, food fortification, supplementation and bio-fortification. Iron and zinc content varies greatly among varieties and the currently best yielding varieties are generally low in micro-nutrients. Genetic Engineering approaches have been very successful in increasing the level and bio-availability of minerals and vitamins in improved rice varieties and other crops – Golden Mustard, Golden Peanuts and Golden Bananas. Target traits for future improvement include improved digestibility, balance of Amino Acids and elevated levels of vitamin E.

Stephen Jarrett described the very successful programme lead by UNICEF but involving many Development NGOs (including CONCERN) that makes Ready to Use Therapeutic Foods (RUTF) available at local centres to treat children with severe acute malnutrition. The food paste used is produced locally, is like peanut butter and is based on Peanuts/Whole milk powder/ oils. The ambition of the programme is to increase production to 50,000 mt annually which would approach half the critical need.

Panel C-4 Conclusions and Recommendations

Adel el Beltagy, John McDermott, Huanming Yang and Tom Arnold lead a discussion that resulted in the Statement from EAGLES outlined in the Overall Conclusions and Recommendations section above.

European Action on Global Life Sciences (EAGLES)

EAGLES Consortium

The EAGLES Consortium presently comprises a number of well-known scientists from the EU and Developing Countries in approximately equal proportions. They are combining their expertise and knowledge of the life sciences, with much experience of the role of the life sciences in the DCs. They have substantial knowledge of the way in which the life sciences are organised,

mobilised and applied in Europe and in the developing world. Many have worked together on other major projects. The group has established relationships, complementarities and synergies which will be valuable in designing and implementing the EAGLES programme.

Chairmanship

Prof. Ismail Serageldin, Chairman of EAGLES, Director of the New Library of Alexandria
Dr. Huanming Yang, Co-Vice Chairman of EAGLES, Director, Beijing Genome Institute
Prof. David McConnell, Co-Vice Chairman of EAGLES, Smurfit Institute of Genetics, Trinity College Dublin, Ireland
Jens Degett, Executive Director, Madrid, Spain

EAGLES and Scientists' Global Responsibilities

The OECD countries have dominated the development and application of life sciences over the last 25 years – lacking a global perspective they have defined the economic, commercial, legal and ethical frameworks for biotechnology without taking any significant account of the needs of the developing world. Developing World problems pose huge humanitarian challenges for life scientists. Distinguished Third World scientists, who are making very significant contributions to international science, are in a position to give powerful advice on the development of life sciences. Europe has a duty to listen to them. A new dialogue is required in which the needs, the voices and the opinions of the emerging and developing countries should be clearly identified, heard and heeded. EAGLES will serve as a platform for achieving this dialogue between scientists from the DECs and European politicians, policy makers, members of the media and other leaders of public opinion.

The EAGLES declaration

The members of EAGLES are determined to ensure that the skills and resources of European life sciences are properly used for the benefits of mankind.

The members of EAGLES believe:

- That the greatest humanitarian challenges for the life sciences lie in the problems of illness, starvation and environmental degradation which are faced by hundreds of millions of people in our world today, and will be faced by millions more in the coming decades.
- That life scientist everywhere has a responsibility to address these global challenges.
- That European life scientist could and should make a much greater contribution to meet these challenges.
- That European policy should facilitate the life sciences in meeting these challenges.
- In addressing these challenges that the people of Europe and their leaders should pay careful attention to the knowledge and advice of distinguished life scientists and humanists from the developing and emerging countries.

Speaker and Chair Profiles

Professor Patrick Cunningham is Chief Scientific Advisor to the Government of Ireland. He holds a Professorship of Animal Genetics in Trinity College, Dublin. He was formerly Deputy Director (Research) in the Agriculture and Food Research Institute in Ireland (1980-1988), visiting Professor at the Economic Development Institute, World Bank (1988) and Director of the Animal Production and Health Division, Food and Agriculture Organisation of the UN, Rome (1990-1993). He is co-founder and Chairman of the biotechnology company, IdentiGEN. He has been President of the European and World Associations for Animal Production and served on the European Life Sciences Group that advised Commissioner Busquin.

Jim Flanagan is the recently retired Director of Teagasc, the Agriculture and Food Development Authority in Ireland. He now works part-time as a consultant to Teagasc in Strategic Planning. He is President of the European Association for Animal Production (EAAP) 2004-2008, a member of the EU Standing Committee for Agricultural Research (SCAR), a member of EURAGRI, the representative body for National Agri-Food Research and Policy organizations in Europe and Vice President of the World Breeding Federation for Sport Horses (WBFSH). He was formerly Chief Inspector and Head of the Professional and Technical Services in the Ministry of Agriculture and Food and Assistant Professor in the Department of Statistics and Computer Science at West Virginia University in the USA.

Ismail Serageldin is Director of the New Library of Alexandria (BA); he also chairs the Boards of Directors for each of the BA's affiliated research institutes and museums and is Distinguished Professor at Wageningen University, The Netherlands. He serves as chair and member of a number of advisory committees for academic, research, scientific and international institutions and civil society efforts which includes the Institut d'Egypte (Egyptian Academy of Science), TWAS (Third World Academy of Science), The Indian National Academy of Agricultural Sciences and the European Academy of Sciences and Arts. He is former Chair of the Consultative Group on International Agricultural Research (CGIAR, 1994-2000), founder and former Chair, the Global Water Partnership, (GWP, 1996-2000), and the Consultative Group to Assist the Poor (CGAP), a microfinance programme (1995-2000). He has also served in a number of capacities at the World Bank, including as Vice-President for Environmentally and Socially Sustainable Development (1992-1998) and for Special Programmes (1998-2000). He has published over 50 books and monographs and over 200 papers on a variety of topics including biotechnology, rural development, sustainability and the value of science to society. He holds a Bachelor of Science degree in Engineering from Cairo University and a Master's degree and a PhD from Harvard University and has received 18 Honorary Doctorates.

Marc van Montagu is Emeritus Professor at Ghent University, Belgium and Elected and Acting President of the European Federation of Technology. He is a pioneer in molecular biology. He and his colleague, Jeff Schell, discovered the mechanism of DNA transfer from Agrobacterium tumefaciens to plants, and constructed the first chimerical plant genes. Van Montagu applied this new technology to study gene regulation and to discover

the molecular basis of several plant physiological reactions. He also produced major contributions to the identification of genes involved in plant growth, development and flowering. He ranks among the 100 top existing contributors to biotechnology; and is one of the most cited scientists in the field of plant and animal sciences. His laboratory raised two spin-offs: Plant Genetic Systems (PGS) and Crop Design. He has been granted numerous awards, including the Japan Prize. In 1990 he received the title of "Baron" due to his scientific accomplishments. He is a member of several academies of science, engineering and agriculture (USA, Russia, France and Italy).

Dr. Eduardo Trigo is Director of the CEO Group in Argentina, a consultancy firm specializing in the agricultural economics and policy fields. He is an agricultural economist with a PhD from the University of Wisconsin and currently serves as Scientific Adviser to the International Relations Directorate of the Science, Technology and Innovation Secretariat of Argentina and as a member of the Academic Council of the "Alberto Soriano" Graduate School of the Faculty of Agronomy at the University of Buenos Aires. In the past he served on the Board of Directors of the National agency for the promotion of Science and Technology of Argentina and on the Biotechnology Policy Advisory Committee at the Secretariat for Agriculture, Livestock, Fisheries and Food, Virginia University in the United States.

Norman Casey attained the BSc (Agric) and MSc (Agric) degrees at the University of Natal and the DSc (Agric) at the University of Pretoria. In 1979, he accepted an academic appointment at the University of Pretoria in animal production physiology. As Professor, he was the departmental head, Department of Animal and Wildlife Sciences, from 1992 to 2005. He is chairperson of the Ethics Committee, Faculty of Natural and Agricultural Sciences and sits on the Senate Committee on Research Ethics and Integrity. He is Honorary President and former President of the South African Society of Animal Science and is a Ministerial appointee on the Council for Natural Scientific Professions. He is President of Congress of the World Association of Animal Production, was Vice-president of the International Goat Association (2000 to 2004) and chaired the 8th International Conference on Goats (2004) and 9th International Symposium on Ruminant Physiology (1999). He has received awards for research and academic excellence and for services to the Animal Science profession. He serves on the editorial boards of Livestock Science, Small Ruminant Research and the SA Journal of Animal Science. He has sixty-nine scientific peer reviewed publications, eighty conference proceedings and presentations, twenty-two books and reference manuals, thirty-eight contracted scientific reports and has supervised forty-five MSc and seventeen PhD candidates and promoted two Honoris Causa candidates.

Roger Beachy is founding President of the Donald Danforth Plant Science Centre, a non-profit research institute in St Louis, Missouri, USA. He earned his PhD at Michigan State University and held post-doctoral positions at the University of Arizona and Cornell University, New York. He held academic positions at Washington University, St Louis and the Scripps Research Institute, La Jolla, California where he was co-founder of the International Laboratory for Tropical Agricultural

Biotechnology. He is a member of the US National Academy of Sciences, a Fellow of the American Academy of Microbiology and the American Association for the Advancement of Science. He has received the Wolf Prize in Agriculture, the D. Robert Hoagland Award from the Society of Plant Biologists and the Ruth Allen award from the American Psychopathological Society among many others. Beachy serves as Chair elect of the AAAS section on Agriculture, Food and Renewable Resources and is President of the International Association of Plant Biotechnology. He is recognized for his work in molecular virology and gene expression in plants as well as for his pioneering research in developing transgenic plants that are resistant to virus infection. His research includes studies of mechanisms of transgenic virus resistance in rice and sweet potato, characterizing functional activities of transcription factors and developing a chemical gene-switching system for use in plants.

Malcolm Elliott is the Executive Director of The Norman Borlaug Institute for Crop Improvement. He graduated with First Class Honours in Plant Sciences from the University of Wales and received his PhD in Plant Biochemistry from The University of Wales. He was a Fulbright Scholar and Research Fellow at Yale University (1967-1969); Lecturer in Plant Biochemistry at the University of Leicester (1969-1971); Professor and Head of the School of Life Sciences De Montfort University, Leicester (1971-1974); Chair of the College of Deans at De Montford University (1989-1993) and then founding Executive Director of the Norman Borlaug Institute (1994 to date). Professor Elliott is the author of several hundred research publications with emphasis on molecular biological approaches to cereal improvement. He was awarded the Charles University Medal (1993), the Gregor Mendel Gold Medal for Biological Sciences Research of Exceptional Merit (1993), the Jan Evangelista Purkyne Medal (1994) and the DSc (Honoris Causa) of the Bulgarian National Centre for Agricultural Sciences (2006). Professor Elliott envisages the Norman Borlaug Institute's role as facilitating the delivery of food security and creation of wealth in the developing world by applying cutting edge plant science techniques in crop improvement programmes that will enable the sustainable enhancement of global agricultural production.

Clive James is Chairman and Founder of ISAAA (International Service for the Acquisition of Agri-Biotech Applications) in the USA. He was born in the United Kingdom where he received his early education including a PhD from Cambridge University. He subsequently worked as a Researcher with the Federal Department of Agriculture in Canada, with the FAO in Rome, Italy, as Senior Adviser to CIDA in Canada and as Deputy Director General of CIMMYT in Mexico. He has wide experience in the broad area of international agricultural research and development and in the potential contribution of biotech crops in alleviating poverty and hunger.

Chengcai Chu is Principal Investigator and Laboratory Head at the Institute of Genetics and Developmental Biology, Chinese Academy of Sciences (CAS). He graduated in 1986 from the Department of Biology, Anhui Normal University. He received his Masters Degree in the Institute of Botany, CAS in 1989. From 1993 to 1996 he worked in the Institute of Plant Genetics and Crop Plant Research (IPK) in Germany as a PhD

student and received his PhD degree from the Martin Luther University in Germany in 1996, following which he worked as a post doctoral fellow in Professor Dr. Uwe Sonnewald's Lab at IPK. He joined the Institute of Genetics, CAS in 1999.

Professor Chu received the CAS Young Scientist Award in 1999. The work in his laboratory mainly focuses on gene regulation, manipulation of metabolic pathways and functional genomics studies by using rice as a model system and molecular breeding via modern biotechnology.

Huanming Yang is Director and Professor of Beijing Genomics Institute (BGI), Chinese Academy of Sciences (CAS) and coordinator in China of the International Human Genome Sequencing Consortium, the International HapMap Consortium and the International Genome Sequencing Consortium. He began his career in human genetics/genomics after his M.S. in 1982 from Southeast China University in Nanjing and his Ph.D. from Copenhagen University, Denmark in 1988. He did post doctorates at CIML in Marseille, France, Harvard Medical School and UCLA in Los Angeles. Following which he became Professor at Peking Union Medical College/Chinese Academy of Medical Sciences in 1994. He co-founded the Human Genome Centre at the Institute of Genetics, CAS in 1998 and then Beijing Genomics Institute (BGI) in 1999.

Professor Yang received the award of Research Leader of the Year 2002 from Scientific American, the Qiu Shi award by Hong Kong Qui Shu S & T Foundation, the Nikkei Asia Prize for Science 2003 from Nihon Keizai Shimbun, Inc, Japan and the 2005 Award in Biology from the Third World Academy of Sciences and many national awards.

Dr. Christian Hoste works at CIRAD (Centre de Cooperation Internationale en Recherche Agronomoque pour le Developpement) in France where he is coordinator for European and International Agriculture Research for Development (ARD) systems. He is also the Director of ECART-EEIG (European Consortium for Agricultural Research in the Tropics), a European Economic Interest Grouping composed of six research organizations from five member states and Director of the EU funded ERA-ARD project. Christian is an Engineer in Agriculture with a PhD in Animal Genetics and a French "Doctorat d'Etat" in Natural Sciences. His experience includes 17 years in livestock research and development in Sub-Saharan Africa and 15 years agricultural research organization and management for different international and bilateral institutions. He has actively contributed to the launching of GFAR, the Global Forum in Agricultural Research.

Gurdev Khush is Adjunct Professor at the University of California, Davis. He was born in India where he received his early education. He received his PhD in Genetics from the University of California, Davis in 1960 where he served on the faculty for 7 years before joining the International Rice Research Institute (IRRI) in the Philippines as Plant Breeder in 1967. He was promoted to Head of Plant Breeding in 1972. He lead IRRIs price breeding programme for 35 years. High yielding, disease and insect resistant varieties developed under his leadership and their progenies are now grown on 60% of world riceland; and world rice production has doubled in a 30-year period. For his contribution to world

food security, Dr Khush received the Japan Prize in 1987, the World Food Prize in 1996 and the Wolf Prize in 2000. Dr Khush was elected to some of the world's most prestigious academies such as the Indian National Science Academy, The Third World Academy of Sciences, the US National Academy of Sciences and the Royal Society.

Stephen Jarrett is Principal Adviser, UNICEF Supply Division engaged in strategic issues and problem solving concerning the supply function supporting children's programmes in 160 countries with over $1 billion procurement value annually. He has overseen the global procurement and management of vaccines, pharmaceuticals and immunization materials. Currently he advises UNICEF on the introduction and scale up of new technologies related to child survival and development, needed by countries to meet the Millennium Development Goals. His current specific focus is on ready-to-use foods for combating child nutrition, including local manufacturing. Previous work with UNICEF included diverse field assignments in programme management in several countries of the Americas in the 1970s, as senior health officer in China in the 1980s supporting the achievement of universal child immunization. He has also worked as a senior adviser to UNICEF on health systems strengthening, with a focus on drug supply systems in Sub-Saharan Africa and other low income countries. He holds a BSc degree from the University Of Southampton, UK and a MPH degree from Columbia University in New York, USA. He has published numerous articles on issues concerned with immunization and health services strengthening.

Professor David McConnell, a molecular biologist, is Professor of Genetics in Trinity College, Dublin. He is Chair of the EAGLES Food Forum and of the EBF Task Force Group on European Action on Global Life Sciences (EAGLES). He is a member of the European molecular Biology Organisation and the Royal Irish Academy. He received his PhD from the California Institute of Technology and held the Eleanor Roosevelt Research Fellowship at Harvard University in 1976-1977. He has pioneered the development of molecular genetics and genetic engineering in Ireland.

Adel El-Beltagy is currently Chair of the Global Forum on Agricultural Research (GFAR), adviser to the Minister of Agriculture on Research, Chairman of the Agricultural Research Development Council (ARDC), board member of the Bibliotheca Alexandrina, Chair of the International Dryland Development Commission (IDDC) and Professor at the Faculty of Agriculture at Ain Shams University. He was Director-General of the ICARDA (the International Center for Agricultural Research in Dry Areas) 1995 to 2006 and Director/Board Chairman of the Agricultural Research Center in Egypt (1991-1995). Professor El-Beltagy was made a Fellow of the University of Wales in 1993, was Chair of the Scientific Technical Council of the International SAHARA and SAHEL Observatory (1993-2002) and First Under-Secretary of State for Land Reclamation, Egypt (1986-1991). He is a foreign member of the Russian Academy of Agricultural Sciences, Academician of the Tajik Academy of Agricultural Sciences, Honourable Academician of the Kyrgyz Agrarian Academy, Honourable Professor of the Scientific Council of the Azerbaijan Agricultural Academy, Fellow of Third

World Academy of Sciences (TWAS). He has been awarded the Al-Istiklal Medal by His Majesty King Abdullah II bin Hussain of Jordan and is a member of L'Institut d'Egypte. He has authored/co-authored more than 140 scientific publications.

John McDermott is the Deputy Director General – Research at the International Livestock Research Institute (ILRI) in Nairobi, Kenya. He has the responsibility for coordinating ILRI's research program which spans the range of livestock sciences and socio-economics across tropical regions where livestock are crucial to the livelihoods of poor people in Africa and Asia. John is a veterinarian and epidemiologist and has been involved in research on livestock services and infectious diseases primarily in Africa but also in Asia, North America and Europe. John also holds the post of Professor in the Department of Population Medicine, University of Guelph, Canada.
ILRI works at the crossroads of livestock and poverty, bringing high-quality science and capacity-building to bear on poverty reduction and sustainable development for poor livestock keepers and their communities. ILRI is a non-profit-making and non-governmental organization.

Tom Arnold is a graduate in Agricultural Economics from University College, Dublin and has Masters Degrees from the Catholic University of Louvain and Trinity College Dublin. He was appointed Chief Executive of Concern Worldwide in October 2001. Concern is Ireland's largest NGO working in emergencies, long term development and advocacy, working in some 30 countries, mainly in Africa and Asia. Prior to working with Concern he was Assistant Secretary General and Chief Economist with the Irish Department of Agriculture and Food. He was Chair of the OECD Committee of Agriculture from 1993 to 1998 and Chair of the Working Group on Agricultural Policies and Markets from 1990 to 1993. In an earlier stage in his career he worked with the European Commission, three of which were in Africa. Tom was a member of the UN Millennium Project's Hunger Task Force (2003-2005) and a member of the world Economic Forum Expert Group on poverty and hunger. He is currently Chair of the European Food Security Group, a network of 40 European NGO's working to enhance food security in developing countries. He is a member of the Advisory Board for the International Food Policy Research Institute's (IFPRI) 20/20 Initiative, which seeks to develop and promote a shared vision and consensus for action for assuring sustainable food and nutrition for all by 2020. In May 2006 he was appointed an alternate member of the Advisory Board of the UN's Central Emergency response Fund (CERF).

Summaries of Papers Presented

OPENING PLENARY SESSION

Keynote address: Success stories in the DECs and Lessons for the future

Professor Ismail Serageldin, Director of the New Library of Alexandria, Egypt

Professor Serageldin very much agreed with the importance of climate change and the food crisis as major current issues as identified by Professor Cunningham in his introduction to the session. Climate change was most important as it affected everything and he reminded the audience of the words of Professor Swaminathan that "we are all here as the guests of the green plants and those who tend them". It was very satisfying that the Intergovernmental Panel on Climate Change (IPCC) had reached a consensus on the scientific facts involved and produced a consensus document that brought acceptance of the reality of climate change. In contrast, the position related to the food crisis was very different. He regretted that the international panel set up for food, the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), had much less success in reaching consensus on the causes of the current food crisis and solutions to the problem. The increasing prices for food and the inability to reach a consensus on causes and solutions left the poor even more vulnerable. Those who have get more and those who have not get further left behind. He reminded the audience of the words of a Nobel Laureate, Richard Ernst earlier in the conference that the "food of the poor was being burned to provide fuel for the cars of the rich". The poorest of the poor in Africa live on $1 a day while cattle in the developed world receive feed subsidized at $2 per day.

Professor Serageldin made a plea that all should work in harmony with nature and the need to establish harmony for the future. He was inspired by the European Union experience, which had given peace for over 50 years. It had shown that the near impossible could be done. Despite an incredible mosaic of languages and traditions, the youth of Europe cannot imagine European countries going to war over anything or that French and Germans will ever fight again. The European Union ideals were not only economic but also included social equity as evidenced by the Maastricht Treaty provisions concerning the social solidarity of Europe and recognizing differences among people. He asked Europe to expand the European ideal to the rest of the world at this time of crisis, danger and fear in the world to achieve greater world solidarity.

Professor Serageldin paid tribute to the group of talented people who had the vision to set up EAGLES, the European Action on Global Life Sciences. It had the ambition of bringing the best of scientific knowledge and know-how in the life sciences to bear on the problems of the poor. He referred to Peter Singer of Canada who advocated committing 5% of global research budgets to projects concerning problems of the poor. He also stressed the importance of reaching out to scientists in developing countries. He referred to the almost magical property of knowledge as capital in that it was not used up when shared and used, both giver and receiver are enriched and existing knowledge helps to create new knowledge. EAGLES was a great bridge building institution that should

take up the challenge to achieve the concept of a common humanity.

Despite the many difficulties, great progress was being made in generating and using knowledge in the developing countries. Unsung heroes fight against adversity to make progress and bring the best of science to solve problems of humanity. He invited all to become members of EAGLES and to look at the world that others do not see, look at things as they could be rather than accept things as they are, say why not and remember the words of Ghandi "let us be the change that we want to see".

Balancing the global demand for food, feed, fibres and fuel: The GM approach

Marc Van Montagu, Chairman, Institute of Plant Biotechnology for Developing Countries, University of Ghent, Belgium

Challenges facing Agriculture include food security issues, environmental constraints on productivity and meeting demand for plants for fuel and industrial feed stocks. Biotechnology provides a coherent answer to these challenges. Availability of arable land is declining while world population continues to increase. Hectares of arable land per capita declined from 0.43 in 1961 to 0.26 in 1997 and are expected to reduce to about 0.15 in 2050. Arable land is becoming seriously degraded or infertile. Drought and salinity will be the most significant constraints on productivity. Many existing cultural practices are unsuitable – such as many intensive irrigation systems. Crop choices and crop variety improvement using GM technologies, "omic" technologies and marker assisted selection offer attractive scientific solutions. The search for new candidate genes continues and many promising ones have emerged to generate a new pipeline of GM crops using technologies such as micro arrays and transcript profiling. For example, drought resistant species such as Xerophyta viscisa and Physcomitrella patens and halophytes such as Thellungiella halophila and Prosopis strombulifera.

The impact of the production of bio fuels was discussed. In 2007, 93 million acres of corn in the US was used to produce 9 billion litres of ethanol and adding 210 million lbs of N-fertilizer as inputs to the 7,900 square mile dead zone in the Mississippi delta. Use of grains for bio-fuel production has contributed to the increase in grain commodity prices- almost four fold increases for wheat and three fold for rice and a 60% increase in maize from 2000 to 2007. There has been a marked increase in demand for grains for animal feed but especially in the developing countries of China and East Asia. Output and export of bio-ethanol from Brazil has increased markedly. Agricultural feed stocks are increasingly being used in Bio-refineries e.g. plastics from plants.

The potential of non-food crops such as Miscanthus, Sweet Sorghum and Castor beans must be explored to reduce pressure on food/feed grains as fuel sources. Priorities for sustainability are:

- Develop technologies for the production of bio fuels in ways that meet demand in more secure and less harmful ways on a meaningful scale and in ways that do not threaten food supplies
- Bring national and international policies on bio fuels in line with technological advances.

Technology provides a coherent answer to many of the challenges. It is required to:

- bridge existing yield gaps
- reduce environmental impact

- reduce pesticide inputs
- improve nutritional quality.

There is a need to explore new genetic resources / orphan crops and to bring new technologies to the developing countries.

Insect resistance genes are a tool for reducing pesticide use. Herbicide tolerance genes are a tool for promoting no-till agriculture. Nuclear male sterility genes are a tool for increasing yield.

The application gap can be bridged by Molecular Biologists interacting much more with stakeholders in public services, companies, civil society, other scientific disciplines (e.g. ecologists, nutritionists and food scientists). But less developed countries have a gap in resources and also a big gap in knowledge and insufficient scientific capacity even to stay meaningfully connected to global advances in science and technology.

There are major public concerns in Europe about GM crops related to human and animal health but there have been no adverse effects reported with approved GM crops anywhere; and related to the environment but there is a long list of beneficial environmental effects, with no alarming scenario substantiated on investigation. The high level of testing and regulation required in Europe means that the price tag for getting GM plants approved is so high that SMEs and third world countries are effectively excluded. Only multinationals can become involved.

We have had 10,000 years of genetically modifying plants using selection, crossing, genomic fusion, mutagenesis and cloning. The living world is one large gene pool of functional genes and pseudo-genes. This gene pool is permanently evolving and this is the basis of evolution. Nature is one big genetic laboratory and it is not meaningful to distinguish between genes by species.

Actions necessary to realize the potential of new technologies in genetic modification of plants are:

- improve science education and awareness of the importance of science in decision making
- move from “education the public” to engaging with the public
- discuss new products with consumer organizations
- explain the consequences of not using GM plants

The Argentinean experience with agricultural biotechnology: lessons for the future

Eduardo Trigo, Director Grupo CEO S.A., Buenos Aires, Argentina

Argentina was an early adopter of GMO crops and has enjoyed significant direct and indirect economic and social benefits from them. A large number of biotech “events” have gone into the bio safety evaluation process since 1991 involving over 10 different species. Insect resistance and herbicide tolerance are the most important traits and stacked events are becoming important in recent times. To date 11 events have been released for commercialization, 8 in maize, 2 in cotton and 1 in soybeans. The first release was a soybean with glyphosate tolerance in 1996.

The share of GM crops of the total planted area has reached almost 100% for soybeans, about 60% for maize and cotton. The rate of adoption has been similar to that of hybrid corn in Iowa in the 1930s and Mexican wheat in Argentina in the 1970s. Adoption of GM

soybeans has resulted in increased yields, increased area grown, reduction in production costs, much greater growing of soybeans as a second crop leading to a "virtual" area expansion of greater than 3.0 million ha and environmental benefits from adoption of "no till" systems.

Economic benefit in the 10 year period 1996-2006 has been quantified as US $1,763 billion in reduced production costs and US $17,974 billion from area expansion giving a total benefit of almost US$20 billion. Of this 76% went to farmers, 10% to Government and 9% to technology suppliers. Indirect economic benefits at farm level include increased efficiency in livestock production from a smaller area. Environmental benefits arise from a significant increase in no-till farming from about 1 m ha in 1996 to 16m ha in 2003. Total use of herbicide has about doubled but average toxicity level has substantially reduced. Negative effects are the depletion of soil minerals especially Phosphate (7.6 million tonnes in terms of triple superphosphate) and some reduction in organic matter in the soil due to more monoculture replacing traditional crop rotations.

Adoption of GM soybeans is estimated to have resulted in the creation of around 1 million jobs in Argentina – about 36% of total new jobs created in this period. The success of early adoption of GM soybeans in Argentina was compared to Brazil – a much later adopter – that has obtained only about 10% of the economic benefit of Argentina even though it is a larger producer of soybeans.

Factors that were important in the Argentina GM soya success story include:

1. well adapted varieties
2. a well functioning local plant breeding programme
3. presence of bio safety institutions
4. investment in biotech went hand in hand with conventional agricultural research investment.

Undue delay in approving GM maize varieties was a contributing factor to reduction in maize/soybean rotation practices because maize was less profitable without GM varieties. Replacing Phosphorous would cost about 12% of the overall benefit of using GM soybean varieties.

Panels C-1 and C-2
GLOBAL CONVERGENCE IN FOOD SUPPLY

Improving the human condition through plant sciences: Bringing the advances in Biotechnology to bear
Roger Beachy, President of the Donald Danfort Plant Science Centre

The earth is a tough place to grow crops, 75% is covered with water, 12.5% is naturally inhospitable for farming, 9.5% has poor soil or is covered by cities; 3% has top soil where food can grow. Improved technology greatly increased world cereal output between 1950 and 2000 with minimal increase in land use. Increased genetic yield potential is essential, of the order of 40% over the next three decades. Biotechnology is needed to achieve this as well as Public Private Partnerships.

Crop biotechnology has a history of safety. Over 1.4 billion acres of transgenic crops have been planted since 1996 involving six species with no adverse safety related issues of health or environment being validated. Biotech crops reduced the amount of pesticides by more than 225,000 tm and reduced soil loss, improved water quality and

gave energy savings in cultivation in 2005 equivalent to removing 4 million cars from the roads.

Twenty two countries are growing GM crops commercially; 10.3 million farmers grew GM crops in 2006 of which 9.3 million were small holders. The IAASTD (Inter-governmental Assessment of Agricultural Science and Technology Development) report 2006 concluded that GM crops can be part of the tools that will make progress to achieve the Millennium Development Goals to alleviate poverty.

New varieties combine tools and knowledge of systems: insect and disease resistance, herbicide resistance, nutritional quality and climate stress tolerance to harness yield potential and there is great promise of more to come. It is imperative that public sector scientists be engaged in all types of relevant agri-technologies including biotechnology.

Factors limiting the development and release of new biotech varieties include

- Access to Intellectual Property including key enabling technologies;
- Cost of Research and Development;
- Cost of achieving product approval;
- Limited commercial pull for new products and slow adoption;
- Lack of experience by public sector scientists;
- Lack of appropriate guidelines.

Success will require new training and broader collaboration than ever before.

Impediments to global convergence in food supply

Malcolm Elliott, Director, Norman Borlaug Institute for Crop Improvement

We must double the world's food supply by 2050 and most of this must be on land already in use as there is limited potential for land expansion except in the Americas and Sub Saharan Africa. Most production growth must occur in countries where it is currently produced and expansion of irrigation is crucial to meeting food demand. Irrigated agriculture currently takes 70% of water extracted and covers 17% of cultivated land, providing 40% of the world's food. By 2030, the FAO expects the world's irrigated area to increase by 50 million ha (18%).

Over the last 50 years the earth has lost 20% of its agricultural land, 20% of its top soil and a third of its forests. During the next 50 years 10% of arable land will be lost to salinity while climate change and water shortage will cause colossal problems. The battle against hunger is being lost. Reasons include poverty – cannot simply afford to buy food, land degradation, war, disease, and drought. The recent spiralling cost of basic foods has provoked riots and threatened millions with starvation. Examples of price increases from March 2007 to March 2008 are corn 31%, rice 74%, soybean 87% and wheat 130%.

Sustainable agriculture is the 21st century challenge for agricultural scientists. Plant gene technology has a role in sustainable production, in improved nutrition and health and in the emergence of new industries involving pharmaceuticals and industrial feed stocks. Crop biotechnology can enhance insect and disease resistance, herbicide resistance, climate stress, nutritional quality and genetic yield potential. Biotechnology offers solutions to increasing salinity by enhancing salt tolerance using genes from mangrove plants and to aluminium toxicity which threatens a third of arable land.

Cold stress tolerance offers potential for higher yields and better stand establishment and gives flexibility in planting and earlier crop emergence. Research on incorporating resistance to sweet potato feathery mottle virus into sweet potato in Kenya is showing promise with initial field trials of transformed varieties in the US and Kenya. Similarly, research is ongoing in transforming of papaya in SE Asia with genes giving resistance to papaya ringspot virus. Reduction of inputs of synthetic nitrogen fertilizers is possible by intracellular colonization of cereals and other crop plants with nitrogen fixing bacteria.

But anti-science zealots have plant biotechnology under siege. There is a challenge for scientists to show the benefit of plant biotech and build trust and confidence in science. This requires a commitment to safety assessment, comprehensive regulatory reviews and continuous quality control protocols, audits and standards.

The global area of biotech crops continues to grow with a 12% increase, 12.3 million ha between 2006 and 2007. Twenty three countries planted biotech crops in 2007 and in these countries benefits drive adoption.

Global status, impact and future prospects of commercialized biotech crops

Clive James, Chair, International Service for the Acquisition of Agri-biotech Applications (ISAAA)

ISAAA is a not-for-profit charity co-sponsored by public and private sector organizations. Its mission is to share knowledge on crop biotechnology and to contribute to poverty alleviation by increasing crop productivity and income generation.

A food, feed and fibre strategy is needed to double global production by 2050. No single approach will achieve this sustainably. Conventional crop improvements alone will not double crop productivity by 2050. GM/Biotech crops are not a panacea but are important. A successful strategy will have multiple approaches that address the principal issues – population stabilization, improved food distribution systems, a crop improvement strategy that integrates the best of conventional and the best of biotech to optimize productivity and contribute to food, feed and fibre security.

Acceptance issues related to biotech crops include food safety, labelling and traceability, impact on the environment, ownership of the technology, ethical considerations and impact on international trade.

The global area of biotech crops has increased dramatically from first sowing in 1996 to 114.3 million ha in 2007 in 23 countries with 55% of the world's population involving 12 million biotech farmers, 90% of whom are resource poor farmers. Global adoption rates for biotech crops in 2007 were 64% soybean, 43% cotton, 24% maize and 20% rape seed. Impacts of biotech crops include improved productivity and income, protection of biodiversity, positive environmental effects and social benefits – more affordable food, feed and fibre.

The future for biotech crops is bright. Continued growth in the US, Canada and Australia was predicted with an expanded range of crops featuring more agronomic and quality traits plus the very important trait of drought

resistance. Brazil, India, China, Vietnam and Pakistan have great potential for adoption of GM crops. The number of African countries adopting GM crops is likely to increase modestly led by Egypt, Burkina Faso and Kenya. Slow to modest growth in Europe was foreseen mostly in Eastern countries. Use of Biotech crops for bio fuels – ethanol and biodiesel- has a potential to contribute to higher biomass production and higher efficiency. Projections for 2015 were 40 biotech countries, 100 million biotech farmers planting 200 million ha.

Biotech crops can contribute to achieving the 2015 Millennium Development Goals and more sustainable agriculture by:

- increasing global crop productivity in sustainable production systems that conserves biodiversity;
- contributing to the alleviation of poverty and hunger;
- reducing the environmental footprint of agriculture;
- mitigating climate change by speeding progress in breeding.

The two major challenges for the future are:

- responsible and efficient stewardship;
- improved communication with society to achieve knowledge based decisions re biotech crops.

Agrobiotechnology – the driving force for the next green revolution

Chengcai Chu, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences

Food security is the number one challenge for Chinese agriculture because of population increase and arable land decrease. A minimum of 120 million ha of cropland is needed to feed its people who are close to the current cropland area. China has 22% of the world's population but only 7% of its arable land. Urbanisation is leading to millions of farmers working in the cities and quite a lot of cropland abandonment.

Yield per ha increased steadily during the 1980s and 1990s but now has reached a plateau and total production has decreased because of loss of cropland. Per capita production decreased from 414 kg in 1996 to 333 kg in 2003.

Water resource per capita in China is ¼ of the world average and agriculture uses 65%. A sustainable environment is a second challenge for China. A third challenge is coping with natural disasters and international competition. China imported 31 million tons of soybeans in 2007, about 2/3 of its consumption. The annual application of pesticides has increased steadily having more than doubled from 1980 to 2000. Fertilizer input has also increased steadily to 40 million tons up from about 10 million tons in 1980 but yield increase has lagged behind fertilizer increase.

New technology is the key to solving food shortage. In China the First Green Revolution was semi-dwarf rice which gave a 30% yield increase, the Second Green Revolution was hybrid rice which gave another 30% increase and the Third Green Revolution is Marker Assisted Selection and GM which will give more output from less input. With the completion of the rice genome sequence China undertook rice functional genomic research and has cloned many genes for important agronomic traits. Examples are genes that control rice tillering, enhance salt tolerance, improve hybrid rice seed

production, cytoplasmic male sterility and fertility restoration genes, enhance drought resistance, control grain size and improve grain yield.

China is working on the concept of "Green Rice" with insect and pathogen resistance, high yield and high fertilizer use efficiency and salt and drought tolerance. Marker assisted selection has improved resistance to plant hopper; transgenic techniques have given many improvements in insect resistance e.g. rice stem borer, and disease resistance e.g. rice bacterial blight. Genetic modified rice is under large scale field tests. Yields of GM varieties are improving and exceeding non GM varieties. Costs of pesticides used for GM varieties were dramatically reduced as was farmer poisoning in rice fields and labour costs. The economic benefit of GM rice was estimated at US$97 – 120 per ha.

China's Agro-Biotech development policy is to promote biotechnology as one of the national priorities to secure sustainable development of China agriculture but with caution involving food safety assessment and evaluation of the long term effects on a case by case basis before genetically modified food is brought to the market.

Great achievements have been made in China Biotech. Several products are available and many are in the pipeline. China is anxious to work with developing countries and to share its biotech knowledge.

Panel C-3 EUROPEAN RESEARCH POLICY AND GLOBAL FOOD SUPPLY

European contribution to Agricultural Research for Development (ARD)

Christian Hoste, CIRAD, France and Jean Luc Khalfaoui, Executive Secretary, EIARD

ARD – Agricultural Research for Development – is research that addresses the agricultural challenges and issues faced by developing countries, emerging countries and countries in transition (DECs). Agriculture is used in its broadest sense.

ARD has three major specificities:

- The agenda and priorities are set by the beneficiaries;
- Knowledge is not only generated but also shared;
- Capacity development is an integral component of the research.

Coordination of ARD in Europe involves EIARD – the European Initiative on ARD – at policy level, ERA-ARD and EFARD (European Forum on ARD) at the programme level and ECART-EEIG, NATURA and other European ARD providers at the project level.

EIARD is an informal European policy coordination platform of EU member states plus Norway and Switzerland and the European Commission.
ERA-ARD is a Coordination Action under the ERA-NET scheme of the 6th Programme of Research whose objectives are to increase the effectiveness and efficiency of European research planning, organization and funding to fight poverty and hunger and support a more rapid and sustainable development of the poorest countries of

the world and to strengthen the European position and contribution to the regional and global ARD system.

ECART-EEIG is the European Consortium for Agricultural Research in the Tropics – a European Economic Interest Grouping. It has members in France, Italy, Portugal, United Kingdom and The Netherlands, with a pool of over 1,600 research scientists and technical officers. Its aims include;

- Improving coordination and cooperation among European ARD organizations;
- Facilitating access to European skills and expertise by DECs;
- To organize, facilitate and implement joint participation in European and international programmes and projects.

NATURA is a non-profit organization that aims at developing concerted actions towards poverty reduction and sustainable rural development. It has 26 members from 16 European countries with strong representation from universities.

European policies supporting ARD are elaborated in:

- The European Consensus on Development, November 2005;
- European Union Strategy for Africa. October 2005;
- Advancing African Agriculture, July 2007;
- Joint Africa – EU Strategy adopted in Lisbon in December 2007;
- In preparation: Communication "Strategy on Research for Development", 2009.

Key features of European ARD policies:

- Contribute to achievement of the Millennium Development Goals;
- Commit the Member States as well as the European Commission;
- Acknowledge the role of agriculture, S & T and specifically agricultural research for the development of southern countries;
- Give priority to Africa;
- Acknowledge the political framework put in place in Africa (NEPAD, AU) and their institutions (FARA) and channel interventions through them;
- Set as a political objective the partnerships between Africa and the EU in particular for research institutions;
- Support the need to maintain a European capacity in ARD;
- Should acknowledge soon the organizational model put in place for ARD and promote it for other research domains e.g. human health, energy.

European programmes supporting ARD include EU programmes and member state programmes. Elements of the EC Development Programme involved in ARD include the Food Security thematic programme and the European Development Fund. Elements of the Research Programme 7 involved include the Environment and the Food, Agriculture and Biotechnology thematic areas.

The ARD annual budget in 14 European countries reporting totals about €540 million. Donors include Ministries of Education and Science (63%), Ministries of Foreign Affairs (34%), Ministries of Agriculture (1%) and private Foundations (2%). Priority beneficiary regions are Africa 56%, Asia 26%, and America 18%. Recipients are National Organisations 51%, CG institutes 20%, DC organizations 16%, IARCs 4% and undefined 9%.

Challenges, Opportunities, Priorities

- To develop a comprehensive European funding strategy for ARD recognizing the need to keep a balance and considering different national priorities;
- To mobilize all European capacities to contribute to ARD recognizing that Agriculture and Agricultural Research (AR) are back on the ODA agenda, that the distinction between North and South AR is less and less relevant and that Europe needs to consider more its international dimension;
- To explore innovative mechanisms to increase effectiveness and efficiency of research and education platforms in both DECs and Europe;
- Need to establish a task force to elaborate proposals to foster complementarities and synergies at political, programmatic and capacity levels between AR for DECs and AR for Europe.

Improving the nutritional status of food crops

Gurdev S Khush, University of California, Davis

Human dietary requirements include the macronutrients - carbohydrates, lipids, proteins and amino acids and micronutrients including 17 minerals, 13 vitamins and many phyto-chemicals. Consequences of micronutrient malnutrition include higher morbidity, higher mortality, lower cognitive ability, lower work productivity, impaired growth and impaired reproduction. Micronutrient deficiency is estimated to cause a 5% annual loss in Gross Domestic Product in South Asia.

Malnutrition generally affects 800 million people who go to bed hungry; 250 million children are malnourished; 400 million people have vitamin A deficiency; 2 million people are iron deficient and 1 billion people reside in iodine deficient regions. Deficiencies of iron, zinc and vitamin A are most debilitating.

Improving the nutritional status of children and adults is a highly effective way to increase economic productivity in agriculture and other sectors. Possible solutions to micronutrient deficiency include dietary diversification, food fortification, supplementation and bio-fortification. A strategy suggested was to develop micronutrient dense staple crops using the best traditional practices and modern biotechnology to achieve pro-vitamin A, iron and zinc concentrations that can have measurable effect on nutritional status. Plant breeding technology can achieve this. It was noted that polishing results in up to 70% loss in iron and up to 25% loss in zinc content of rice.

A rice variety has been bred by IRRI and released in the Philippines – High Iron Rice – with enhanced micronutrient levels and good yield. Genetic engineering has been used to improve the bioavailability and level of iron in rice involving the introduction of a ferritin gene from soybean and Phaseolus bean, introduction of a phytase gene and selection of low phytase mutants. Genetic engineering for vitamin A synthesis in rice endosperm involves introduction of three genes under control of endosperm specific promoters - two from daffodil and one from Erwinia uredovora – giving Golden Rice. A molecular aided backcrossing programme has enabled the transfer of carotenoid loci into two IRRI bred rice varieties.

The CGIAR Harvest Plus programme includes Bio-fortification with rice, wheat, cassava, sweet potato and beans as priority crops. There is significant genetic variation for iron and zinc and both conventional and transgenic approaches are being used. New high yielding orange fleshed varieties of sweet potato in Sub-Saharan Africa have good levels of carotene while most of the currently grown white or creamy fleshed varieties grown have little or no carotene. Orange coloured roots in cassava have 9-10 times more carotene than white roots. Other projects on bio-fortification of crops with vitamin A are Golden Mustard (India), Golden Peanuts and Pigeon Peas (India) and Golden Banana (Australia). Incorporation of the opaque2 gene into maize through breeding to develop quality protein maize doubled the amount of lysine and tryptophan.

Ready-to-Use Therapeutic Foods (RUTF): Addressing the situation of children with severe acute malnutrition by developing national production in Sub-Saharan Africa
Steve Jarrett, UNICEF

Two of the 2015 Millennium Development Goals are to eradicate extreme poverty and hunger and to reduce child mortality. Twenty million children under the age of five suffer from severe acute malnutrition (SAM) and 6.5 million of these are in Africa. A nutritional RUTF paste was developed in 1999 in France to be used under supervision of a qualified health worker. A UNICEF project promotes the use of this product in Sub-Saharan Africa. It has achieved a 79% recovery in cases of severe acute malnutrition in over 20,000 children in 21 programmes in Malawi, Ethiopia and Sudan.

RUTF is an enriched peanut paste mostly from locally available products – peanuts, full fat milk powder, vegetable oil, sugar and mineral mix. National production has many economic, identities, social and political advantages.

The RUTF project lead by UNICEF has an initial target to produce 50,000 tonnes in 19 countries by end 2011 but severely malnourished African children need 90,000 to 140,000 tonnes annually. Current production capacity is circa 16,000 – 18,000 tonnes in Ethiopia, Malawi, Niger, Zambia, Kenya, France and India. To meet the 2011 target, start up funding of about US$82 million is required as is involvement of many partners including national governments, International organizations, academia, NGOs, investors, global and local producers.
The future vision is for a range of ready-to-use foods to treat and prevent malnutrition in children and other vulnerable populations wherever needed – using Therapeutic Foods, Supplementary Foods and Complementary Foods.

Issues arising in production of RUTF include peanut quality, inspecting peanuts for aflatoxin, use of biotechnology to improve quality and production efficiency of peanuts by small scale farmers, milk powder availability and increased local milk production.

Members of EAGLES Food Steering Committee:

- Dr Ismail Serageldin, Chairman of EAGLES, Director of the New Library of Alexandria, Egypt
- Prof David McConnell, Chairman, EAGLES Food Forum & EFB EAGLES Task Group, Co-Vice Chairman of EAGLES, Trinity College Dublin, Ireland
- Prof. Huanming Yang, Co-Vice Chairman of EAGLES, Director, Beijing Genome Institute, China
- Prof Patrick Cunningham, Scientific advisor to the Government of Ireland, Professor in Trinity College Dublin, Ireland and European Group on Life Sciences
- Dr Adel El-Beltagy, , Chair of the Global Forum on Agricultural Research (GFAR), Professor at the Faculty of Agriculture at Ain Shams University
- Prof Arturo Falaschi, Director-General, International Centre for Genetic Engineering and Biotechnology, Italy
- Prof. Luis Herrera- Estrella, Nacional Polytechnic Institute, Mexico
- Prof Marc van Montagu, Emeritus Professor at Ghent University, Belgium, Elected and Acting President of the European Federation of Technology and European Group on Life Sciences
- Mr. Albert Sasson, Special Adviser to the UNESCO Director General, Paris
- Prof M S Swaminathan, Chairman, Swaminathan Research Foundation, Chennai, India
- Jennifer A Thomson, Dept of Molecular and Cell Biology, University of Cape Town, South Africa
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Photos: Jens Degett
Above: The “golden Rice” experimental field at IRRI, The Philippines, 2008.
Below: EAGLES session at BioVision, Bibliotheca Alexandrina, Egypt, 2008.