AFRICAN AGRICULTURAL TECHNOLOGY FOUNDATION
FONDATION AFRICAINE POUR LES TECHNOLOGIES AGRICOLES

Closer to the Promise
From Lab to Field

Annual Report 2009

Better tools, better harvests, better lives

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better tools, better harvests, better lives *mieux s'outiller pour récolter plus et vivre mieux*

Annual Report 2009. Closer to the Promise: From Lab to Field

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Participants to the stakeholder meeting on aflatoxin control in maize and peanut at Ibadan, Nigeria.

AATF Executive Director, Daniel Mataruka, and COSTECH Director General, Hassan Mshinda, sign a collaboration agreement to set up OFAB Tanzania chapter.

Some participants to the AATF-ISAAA workshop on science communication for scientists held in Abuja, Nigeria.

AATF Director General visited the ACRN offices.

January

- The Water Efficient Maize for Africa (WEMA) project's technical partners from the International Maize and Wheat Improvement Center (CIMMYT), Monsanto, AATF and the National Agricultural Research Systems (NARS) met in Peyreholade, France where breeding methodologies including choice of germplasm, testers, checks and approaches, and synchrony of events were discussed.

February

- The Internal Biosafety Committee (IBC) at the Savanna Agricultural Research Institute (SARI), Ghana, cleared the application to conduct CFTs of *Maruca*-Resistant Cowpea in readiness for submission to the National Biosafety Committee (NBC) in Accra.
- WEMA project held the first project review and planning meeting in Johannesburg, South Africa. The partners reviewed progress of 2008 activities and also held thematic side meetings to plan for 2009 activities.
- AATF and Instituto de Investigação Agrária de Moçambique (IIAM) signed the country agreement for implementing the WEMA project in Mozambique.

March

- Dr Daniel Fungai Mataruka, a private sector strategist, joined AATF as Executive Director succeeding Prof Jennifer Thomson, who had served as the Interim Executive Director since September 2008.
- WEMA teams in Tanzania and Uganda held stakeholder workshops to create awareness on the WEMA project.
- The Federal Government of Nigeria approved the application by the Institute for Agricultural Research (IAR), Zaria, to conduct *Bt* cowpea confined field trials in Nigeria marking a significant milestone towards development, testing and deployment of *Maruca*-resistant cowpea in the country.

April

- AATF, and the International Institute of Tropical Agriculture (IITA), organised a stakeholder meeting on aflatoxin control in maize and peanut at Ibadan, Nigeria, to discuss prospects for a biocontrol method that uses fungi occurring naturally in Nigeria to reduce the concentrations of aflatoxins in maize and out-scale it for the management of aflatoxins.
- The AATF Board of Trustees held its thirteenth meeting in Nairobi, Kenya. Idah Sithole-Niang was nominated as Vice Board Chair, among other key decisions.
- The Open Forum on Agricultural Biotechnology in Africa (OFAB) launched its Nigeria Chapter as a collaborative effort between AATF, the National Biotechnology Development Agency (NABDA) and the Agricultural Research Council of Nigeria (ARCN) to help increase awareness and understanding of biotechnology, its products and use.
- WEMA project held a three-day refresher course in Johannesburg on procedures for preparing applications for confined field trials (CFT) for its partners from Kenya, Uganda, Tanzania, Mozambique and South Africa.
- The Mozambique WEMA team held a stakeholder workshop to create awareness on the WEMA project.

May

- AATF and the International Institute of Tropical Agriculture (IITA) organised a stakeholder meeting to assess the options available for control of *Striga* in maize fields in Nigeria, and build a partnership for evaluation and deployment of Imazapyr-Resistant (IR) maize technology in the country.
- The Open Forum on Agricultural Biotechnology (OFAB) in Africa opened its Tanzania chapter as a collaborative effort between AATF and Tanzania's Commission for Science and Technology (COSTECH) to help raise public understanding of biotechnology.

June

- A workshop was jointly organised in Nigeria by the Institute for Agricultural Research (IAR), Zaria, AATF and the Programme for Biosafety Systems (PBS) to build capacity on regulatory compliance with special attention towards supporting the successful installation, management and execution of confined field trials (CFTs) for the *Maruca*-resistant cowpea.
- AATF and the International Service for the Acquisition of Agri-biotech Applications (ISAAA) held a two-day workshop on science communication for scientists in the *Maruca*-Resistant Project in Abuja, Nigeria, in June 2009 to equip project partners with skills on effective agricultural biotechnology communication, media relations, issue-management and designing and packaging comprehensive communication messages.

August

- AATF opened its first satellite office in Abuja, Nairobi, to serve as liaison for AATF in the west African region. The office is hosted by the Agricultural Research Council of Nigeria (ARCN) at its Annex Offices in Jabi.
- Transgenic cowpea was planted in a CFT for the first time in Africa at the Institute for Agricultural Research (IAR), Zaria, marking a significant milestone towards achieving a *Maruca*-resistant cowpea for use by smallholder farmers in Africa.
- Farmer field trials of AflaSafe™, an indigenous biological control technology to mitigate aflatoxin contamination in maize and groundnuts, were installed in five zones in the Kaduna and Oyo States of Nigeria.

- A 'Risk Communication and Media Handling' workshop for the WEMA communication team and spokespeople was held in Nairobi to equip participants with effective biotech communication, media relations and issue management skills.
- The WEMA project held a workshop on 'Confidentiality in Technology Development' in Nairobi to sensitise members of the project partnership on the need for and ways to maintain confidentiality in the course of implementing project activities.
- The WEMA regulatory team organised a 'Confined Field Trial Compliance' training of trainers workshop in Uganda that focused on protocols and procedures for complying with confinement measures during confined field trials.

September

- The Nitrogen Use-Efficient and Salt-Tolerant (NUEST) Rice for Africa project organised a product development workshop in California, USA, for its partners from National Agricultural Research Systems who will be conducting NUEST CFTs. The partners familiarised themselves with the Arcadia company's laboratory work on the transgenic rice, including its approach in the conduct of greenhouse and field trials for NUE and ST.
- The WEMA-Kenya team planted mock trials at its CFT site in Kiboko. The mock trials were part of capacity building for conducting WEMA transgenic trials in 2010.
- WEMA-South Africa was granted a permit by the Department of Agriculture, Forest and Fisheries to conduct transgenic drought-tolerant maize trials in Western Cape province.

October

- AATF management commissioned an organisation development exercise to assess whether a growth strategy could be implemented and whether the organisational design, systems and staffing could evolve to support such growth.
- Two inspections of the *Maruca*-resistant cowpea CFT were carried out – one by biosafety inspectors from the Federal Ministry of Environment, Nigeria and the other by an external consultant with the support of USAID. Both confirmed that the CFT was carried out in compliance with the national requirements of Nigeria as well as USAID special requirements of Internal Environmental Evaluation.
- WEMA-Tanzania planted its mock trial in preparation for conducting transgenic trials in 2010 at its Dodoma CFT site.

November

- AATF finalised review of its Business Plan 2009-2013 that presents the structure, mission and objectives of the AATF intervention, the activities and sub-activities it performs, and sets out the AATF's current project portfolio and the projects it is planning to implement over the next five years. The business plan also sets out a series of operational principles that define how AATF seeks to maximise its impact; and provides details of the staffing, governance, proposed budget, milestones and impacts of the AATF intervention.
- AATF management reviewed its priority areas and broadened the scope to allow for a balanced portfolio of projects to include high value crops, soil related constraints, breeding methods and mechanisation. The problem areas were reclassified into six thematic areas – impact of climate change on agriculture; pest management; soil management; improved breeding methods; mechanisation; and nutrition enhancement in foods.
- The AATF Board of Trustees held its fourteenth meeting in Abuja Nigeria where they gave notional approval to the Foundation's management to adapt a revised and reclassified priority areas list, among other key decisions.
- The Federal Republic of Nigeria registered AATF as a corporate body with the Corporate Affairs Commission, effectively recognising AATF as an association of persons established for charitable purposes with authority to transact business in the country. The registration marked progress towards the Foundation's quest for host country status in Nigeria.
- WEMA-South Africa planted the first transgenic drought tolerant maize trial at the CFT site in the Western Cape. The team also held a national stakeholders' meeting in Potchefstroom. The meeting was attended by representatives from the seed industry, universities, farmers, farmer organisations, provincial departments of agriculture, biotechnology advocates, non-governmental organisations, and scientists.

December

- DFID carried out a review of AATF activities 2003-2009 in view of the renewal of the DFID grant for 2010-2014.
- AATF approved a grant to NABDA for the completion of biosafety level-2 facilities at IAR, Zaria, Nigeria.
- A tri-partite discussion between AATF, CORAF and INERA on the project proposal to test *Bt* cowpea in Burkina-Faso, Mali and Togo was held at the Togolese Institute of Agricultural Research (ITRA), in Lome.
- Bill Gates, the Co-chair and Trustee of the Bill and Melinda Gates Foundation visited the AATF offices and held discussions with AATF and CIMMYT on the WEMA and the Drought Tolerant Maize for Africa (DTMA) projects funded by the Foundation to address drought tolerance in maize for Africa.
- The WEMA-Mozambique team held a sensitisation meeting for over 25 media and farmer organisation representatives at the Chokwe CFT site.

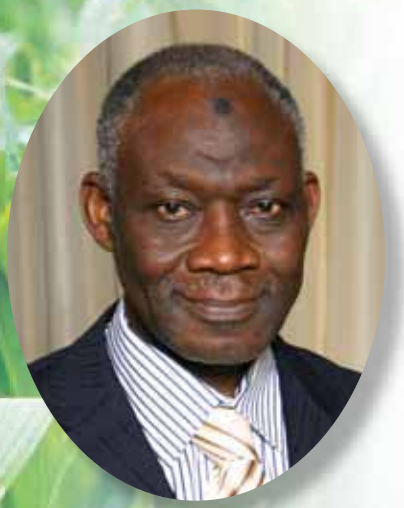
Top to bottom:

Participants to the 'Risk Communication and Media Handling' workshop for the WEMA communication team and spokespeople held in Nairobi in August.

WEMA mock trial planting in Kenya.

AATF Board members during the fourteenth meeting held in Abuja, Nigeria.

Bill Gates visited the AATF offices for discussions with AATF and CIMMYT on the WEMA and DTMA projects in December.



Message from the Board Chair

The year 2009 was another exciting one for AATF as it registered some landmark achievements.

The *Maruca*-Resistant Cowpea project received a major boost when approval was granted by the Federal Government of Nigeria to carry out a confined field trial (CFT) in the country. This trial, the first in Africa for the cowpea project, was carried out in partnership with the Institute for Agricultural Research (IAR) Zaria in August. It marked a significant milestone towards achieving a *Maruca*-resistant cowpea for use by smallholder farmers in Africa and I would like to thank the Government of Nigeria for granting approval for the trial to be carried out and the project staff and partners for their effort and dedication.

Aflatoxin continues to cost us lives every year and we were very happy to join hands with the International Institute of Tropical Agriculture (IITA) in conducting the first farmer field trials of AflaSafe™, an indigenous biological control technology to mitigate aflatoxin contamination in maize and groundnuts in Nigeria. The farmers who participated in the trials reported very good results as detailed later in this report and we therefore aim to continue implementing the trials and to seek commercialisation of AflaSafe™ as soon as possible.

The Water Efficient Maize for Africa Project also recorded very good progress with all the five WEMA country partners identifying suitable sites to conduct CFTs. Mock CFTs were conducted in Kenya and Tanzania as part of capacity strengthening in readiness for implementation of the actual transgenic trials. In South Africa, the project was granted approval to conduct transgenic trials.

We were also privileged to have the opportunity to increase our pool of knowledge through carrying out a study on the relevance of Chinese agricultural technologies in smallholder farming systems in Sub-Saharan Africa (SSA). The study was commissioned by the Rockefeller Foundation in preparation for the 2009 Forum on China-Africa Co-operation (FOCAC) meeting. The study established that a number of Chinese agricultural technologies could be useful in addressing constraints faced by African smallholder farmers as noted further on in this report. The key Chinese agricultural technologies identified included improved crop varieties, such as high fertiliser use efficiency super rice hybrid, with yields as high as 13.5 tonnes per hectare, that may be suitable for the rice growing regions of SSA; varieties of multiple-disease resistant high-yielding wheat and maize; slow release fertilisers; and dry land technologies, water conservation and harvesting techniques.

In the *Striga* Control in Maize project, AATF and partners have now moved to expand use of the Imazapyr Resistant (IR) maize to west Africa while the joint AATF/IITA project that is seeking to develop bananas resistant to banana *Xanthomonas* wilt disease is moving towards confined field trials. The Nitrogen Use-Efficient and Salt-Tolerant (NUEST) Rice for Africa project made commendable progress towards the genetic transformation of the upland and lowland New Rice for Africa (NERICA) varieties in addition to making the decision to include the water use efficiency (WUE) trait in the project to address drought effects on rice.

The Open Forum on Agricultural Biotechnology in Africa (OFAB), expanded its reach into two other countries – Nigeria and Tanzania – during the year. The Forum has been instrumental in increasing understanding of agricultural biotechnology in Africa and providing a platform for people in Africa to discuss its possible use and challenges. It is my belief that open discussions on issues around the application of

agricultural biotechnology will help build a support base for scientific evaluation of the technology and contribute to rationalising debates on biotechnology.

We had some changes in top management during the year. Daniel Mataruka joined the Foundation as Executive Director in March 2009 and he immediately commenced a programme aimed at moving AATF to its next level especially through expansion in Sub-Saharan Africa and addressing organisation development issues. Dr Mataruka is a national of Zimbabwe and he previously worked with Tongaat Hulett Starch (THS), a leading large scale agro-business company operating in southern Africa.

Two other senior managers – Sylvester Oikeh and Alhaji Tejan-Cole – joined the organisation during the year. Sylvester, a soil fertility agronomist, joined AATF in February as Project Manager for the Water Efficient Maize for Africa (WEMA) project. He brings to the AATF more than 18 years of interdisciplinary experience in research and development projects in natural resources and crop management. Alhaji Tejan-Cole joined AATF in November as Legal Counsel responsible for intellectual property issues and legal matters. Tejan, who also serves as the Board secretary, brings to AATF experience in intellectual property management gained in Sierra Leone, his home country, and in the Caribbean nation of Belize. Both Sylvester and Tejan bring to AATF excellent credentials and experience that will help the organisation attain its mandate.

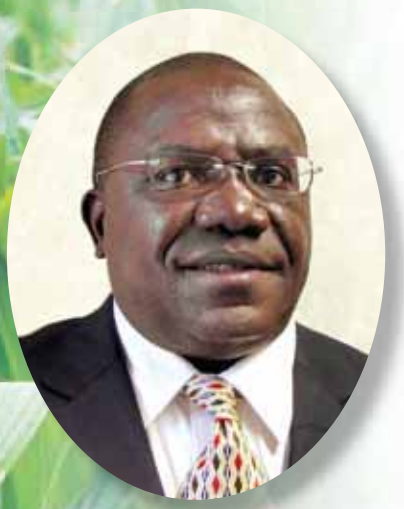
We were happy to welcome to the Board of Trustees Idah Sithole-Niang, an Associate Professor and Head of Department at the University of Zimbabwe's Department of Biochemistry. Idah teaches molecular biology and her research work focuses on cowpea crop improvement. She is also a Technical Advisor for the Program for Biosafety Systems (PBS) for Sub-Saharan Africa, serves on the Oversight Committee of the Improved Maize for African Soils (IMAS), is Vice Chairperson of the Research Council of Zimbabwe, and a Steering Committee member of the African Women in Agricultural Research and Development (AWARD).

Eugene Terry and Assétou Kanouté completed their terms in office. Eugene was a key member of the Board as he oversaw the formation of AATF as Implementing Director between 2002 and 2004 prior to joining the Board. His contributions were of great value to the Board and he will be missed. Assétou was one of the early Board members having joined the Board in 2004 and she has been instrumental in injecting a different point of view into the Board discussions. The two continue to be friends of AATF and they remain valued members of the AATF family.

One of the greatest challenges during the year revolved around the operating environment. With most of the AATF projects entering the confined field trials phase, there has been increased awareness of the partially developed regulatory environment. In all the countries the AATF operates in apart from South Africa, the regulatory environment is quite challenging as the necessary biosafety regulations and supporting regulations are yet to be put in place. What is encouraging however is the awareness by these governments on the need to take action and we look forward to these being implemented perhaps in 2010.

Overall 2009 was a busy and fruitful year for AATF. We recorded successes and progress and the staff, as usual, excelled in the performance of their work. I must, therefore, on behalf of the Board of Trustees, express my immense appreciation for the high level of commitment by the staff, partners and our investors. Indeed as Board Chair I extend these appreciations to my fellow Board members for dedicating time to the organisation without reservation. I urge you all to continue nurturing this young organisation on its journey to realising its mandate.

Prof Walter S Alhassan
Board Chair



Message from the Executive Director

Partnerships, collaborations, synergy and value addition have been central to any decision taken at AATF during 2009. These have been complemented by the AATF core values of integrity, dedication and accessibility which have influenced activities undertaken by the organisation during the year. The year 2009 therefore was a year that saw a number of internal reviews and reflections taking place as the organisation sought the best way of moving towards attainment of its core mandate – access and delivery of affordable agricultural technologies for sustainable use by smallholder farmers in Sub-Saharan Africa (SSA).

Having been in operation for over five years, management decided to review the first Business Plan, developed in 2003, to reflect the current status and plans for the next five years. Thus, one of the key activities during this reflective process was the revision and production of a new Business Plan for the organisation. The AATF Business Plan has been the key guide to AATF's interventions in agricultural development in Africa and defines AATF's current project portfolio and projects planned for implementation over the next five years. It also lays down a set of operational principles that define how AATF seeks to maximise its impact; and provides details of staffing, governance, proposed budget, milestones and impacts of the AATF intervention.

We also reviewed the AATF priority areas and reclassified them to align with the current key constraints to agricultural productivity as defined by the sub-regional organisations and the global trends along the food-energy-climate change nexus. The review broadened the original AATF scope of work under six themes – impact of climate change on agriculture; pest management; soil management; improved breeding methods; mechanisation; and nutrition enhancement in foods. The Board of Trustees approved these six areas that now form the basis for AATF work.

With support from the Bill and Melinda Gates Foundation, we were able to commission an organisation development exercise that was completed in December. This was based on the urgent need for a plan of action towards meeting the strategic challenges besetting AATF – whether a growth strategy could be implemented at AATF and if the organisational design, systems and staffing could evolve to support such growth. The exercise looked at helping the organisation build capacity to deliver more effectively the current and future programmes and services as well as to position itself as the neutral intermediary and responsible party between owners and/or holders of proprietary technologies and those that need them to promote food security and enhance livelihoods for smallholder farmers in SSA. It was an informative exercise that defined a number of key activities that AATF should start implementing in 2010. Some of the activities include enhanced efforts towards resource mobilisation, review of the AATF strategy and organisational restructuring.

During the year we were happy to open the first satellite office outside Kenya. The office, opened in Abuja, Nigeria, serves as liaison for AATF in the west African region. This first outpost office also represents AATF efforts to set its footprint on as much of Sub-Saharan Africa as possible. This saw AATF being registered as a corporate body with the Corporate Affairs Commission of the Federal Republic of Nigeria which effectively recognised it as a charitable organisation that can transact business in that country. I would like to thank our hosts and partners, the Agricultural Research Council of Nigeria (ARCN) for their support in achieving these key milestones.

The year also presented opportunity for AATF to contribute to Africa's capacity building in agricultural research and development. We carried out a number of capacity strengthening activities for staff and project partners. Different projects held sessions with project partners and staff on communication, regulatory compliance and intellectual property and confidentiality management to help support project success and relationship management in public/private partnerships. These capacity strengthening opportunities were appreciated by partners who found them useful and value adding to their work performance. We received support from various partners and investors and I wish to thank them all for this support.

AATF also produced the first comprehensive report on Chinese agricultural technologies that could be useful for smallholder farmers in Sub-Saharan Africa (SSA).This report was commissioned by the Rockefeller Foundation and it is covered in greater detail in this report.

The year was not without challenges and the key one remains agricultural biotechnology acceptance in Africa, especially the policy environment and misunderstanding of its benefits and uses. AATF will therefore continue to work with partners in collaborative initiatives that seek to inform stakeholders correctly for their better decision-making. It is encouraging to note that the African Union, the New Partnership for Africa's Development, the various regional economic communities and sub-regional organisations are taking biotechnology seriously and are involved in helping educate decision makers in Africa. These concerted efforts can only bear good fruit and we are thankful to all these partners.

As we move forward towards contributing to better agricultural technologies for our farmers in Sub-Saharan Africa, I would like to reiterate that partnerships, collaborations, synergy and value addition will continue to buzz through our minds at AATF to ensure that we are moving towards this goal. My pledge to our investors, beneficiaries, partners and staff is that the commitment by AATF to its goals will be maintained as it plays its part in this endeavour.

Daniel F Mataruka
Executive Director

Above: A Barabaig girl in front of her thatched homestead in Tanzania.

Right: Cowpea almost at maturity.

Who We Are

The African Agricultural Technology Foundation is a not-for-profit organisation that facilitates public-private partnerships to access and deliver appropriate proprietary agricultural technologies for use by resource-poor smallholder farmers in Sub-Saharan Africa.

AATF provides expertise in identifying, accessing, developing, delivering and using patented agricultural technologies. The Foundation also contributes to capacity building in Africa by engaging institutions on the continent in the diverse partnerships through which it executes its mandate.

AATF is a registered charity under the laws of England and Wales and has been given tax-exempt status in the USA. It is incorporated in Kenya and in the UK and has been granted host country status by the Government of Kenya where it is headquartered.

Vision – what we want for Africa's farmers

Prosperous farmers and a food-secure Africa through innovative agriculture.

Mission – what we do for Africa's farmers

To access and deliver affordable agricultural technologies for sustainable use by smallholders, in particular resource-poor farmers in Sub-Saharan Africa, through innovative partnerships and effective stewardship of technologies and products along the entire food value chain.

Core Values – what keeps us strong

We strive to uphold three enduring core values: Integrity, Dedication and Accessibility. These values guide our decisions, actions and relationships as we work towards fulfilling our mission.

Our Strategy

Facilitating public-private partnerships, technology stewardship and information and knowledge management are key aspects of our strategy. We anchor our activities within three strategic thrusts:

- Negotiating access to proprietary technologies that enhance the productivity of agriculture in Africa;
- Managing partnerships for project formulation, product development and deployment to introduce innovative agricultural technologies to African farming systems; and
- Managing knowledge and information to support technology identification and development, as well as helping create policy environments that are more conducive to smallholder agricultural development.

Our Roots

The model for the African Agricultural Technology Foundation resulted from two years of consultations by the Rockefeller Foundation and the Meridian Institute with several African, North American and European stakeholders.

The sessions, referred to as the 'Biotechnology Dialogues', were held to determine ways to close the growing gap between the agricultural science controlled by developed countries and the needs of the poor in the developing regions of Sub-Saharan Africa. The involvement of stakeholders in these deliberations was ensured through a Design Advisory Committee (DAC), comprising representatives from African national agricultural research services, the Consultative Group on International Agricultural Research (CGIAR) centres, African seed and biotech companies, the Organisation for Economic Co-operation and Development, crop science corporations, and donor organisations. The DAC served as the architect of AATF, defining the major underlying principles and an operational model for the Foundation in addressing food security and poverty reduction challenges. The Committee also elucidated the core rationale for AATF and its fundamental principles, mission and business model.

Governance

AATF is a flexible organisation designed to respond to the changing needs of its stakeholders. The Board of Trustees charts the course by deciding which interventions hold the greatest promise for reducing poverty and increasing food security.

This creates a healthy separation between the setting of priorities and monitoring of progress on the one hand, and day-to-day management and operations on the other. AATF's Board members are distinguished individuals from around the world, while the Foundation's staff are all nationals of countries in Sub-Saharan Africa.

Investors

- *The United States Agency for International Development (USAID):* The agency responsible for providing and managing US economic and humanitarian assistance worldwide;
- *The United Kingdom's Department for International Development (DFID):* The UK Government department responsible for promoting economic development and the reduction of poverty globally;
- *The Bill and Melinda Gates Foundation:* Guided by the belief that every life has equal value, the Bill and Melinda Gates Foundation works to help all people lead healthy, productive lives. In developing countries, it focuses on improving people's health and giving them the chance to lift themselves out of hunger and extreme poverty. In the United States, it seeks to ensure that all people – especially those with the fewest resources – have access to the opportunities they need to succeed in school and life;
- *Howard Buffet Foundation:* A private foundation that primarily supports agricultural development and clean water delivery in rural areas, focused in Africa and Central America; and
- *The Africa Harvest Biotech Foundation:* A not for-profit organisation designed to use science and technology, especially biotechnology, to help the poor in Africa achieve food security, economic well-being and sustainable rural development.

Partners

- Agricultural producers and consumers;
- National and regional institutions and agencies (NARs, SROs, RECs, ECA, FARA, AU/NEPAD);
- International institutions/agencies (CGIAR, ARIs);
- Local/international NGOs;
- Agricultural technology industry IP holders (Monsanto, Arcadia Biosciences, BASF, DowAgro, Pioneer/DuPont, Syngenta);
- African trade and agribusiness organisations;
- African governments

Above: In South Africa, an Ndebele woman outside her colourfully painted house.

Right: A *Striga* infested maize farm in western Kenya.

Striga Control in Smallholder Maize Farms in Sub-Saharan Africa

For the past five years, AATF and partners have been promoting IR maize to counter the threat of Striga *to maize production in Sub-Saharan Africa (SSA). After successful trials in Kenya, the technology is now being promoted in all regions of Africa.*

Background

For decades, the *Striga* weed has been an intricate problem and a leading cause of food insecurity and rural stagnation in Africa. The witchweed, as *Striga* is also known, parasitises the roots of cereal crops – literally strangling them – and dramatically reduces their yields. A resilient and deceptively beautiful plant, *Striga* infests about 2.5 million hectares under maize on the continent, causing economic losses in excess of US $1 billion annually. Smallholder farmers in Africa often watch helplessly as *Striga* spreads from field to field and many of them have been forced to abandon maize cultivation altogether.

For this reason, one of the first projects that AATF facilitated after its founding was on reducing the threat of *Striga* to maize production in SSA. This initiative involves extensive field-testing and demonstration of StrigAway® maize, a technology developed by the joint effort of the International Maize and Wheat Improvement Centre (CIMMYT), the German chemical firm BASF, and Israel's Weizmann Institute of Science. The StrigAway® technology combines high-

yielding maize varieties that are resistant to Imazapyr herbicide and the coating of the maize seeds with the Imazapyr herbicide that is effective in killing *Striga*. The resistant maize seeds are coated with the herbicide before planting, and as the maize seedlings emerge, they take up the herbicide from the seed coat into their system. The maize seedlings also exude germination stimulants that cause *Striga* seeds in the vicinity to germinate. The *Striga* seedlings then attach to the maize roots and imbibe the herbicide and are killed. Within a few seasons of using StrigAway®, the *Striga* seed bank in the soil drops significantly, greatly reducing the threat posed by the weed, enabling better maize harvest by farmers. StrigAway® is currently at the product deployment phase, which focuses on facilitating product awareness, seed multiplication, uptake and stewardship for long-term benefits to target stakeholders.

Success and challenges in Kenya

In 2008, trials conducted by AATF and partners in the fields of farmers in western Kenya conclusively demonstrated the effectiveness of StrigAway® with maize yields increases of up to four times from *Striga*-infested plots. Members of the Mwangaza Farmers Group from Vihiga District, western Kenya, who have been planting IR maize in their *Striga*-infested fields for the past four years, bear witness to the effectiveness of the technology. The group uses an integrated approach, incorporating animal manure and mineral fertilisers, legume rotations and intercrops. They also dig trenches around the maize fields to limit *Striga* dispersal. The Mwangaza Farmers Group members own small pieces of land averaging half a hectare. Using the IR maize technology, they have been able to improve maize productivity from an average of 100kg to 900kg in the 0.5ha plots. Furthermore the farmers can now grow a wide range of high yielding maize varieties including the hybrids. This example shows that the sustained use of IR maize technology in an integrated approach can significantly reduce the threat of *Striga* weeds in just eight seasons (four years). Notably, *Striga* is very prolific, with each mature plant producing more that 20,000 seeds that are easily dispersed by wind, water, animals and farm implements. Thus, to prevent a relapse, a community approach that mobilises members to jointly use control measures in an area is best to stem out re-infestation across fields.

Despite the progress in curtailing *Striga* weeds, the key limitation to the adoption of the technology is the timely availability of certified IR maize seeds in required quantities. For instance, although over 1.7 tonnes of IR maize were sold during the March to July 2009 maize season, many agro-dealers ran out of stock before the planting season was over. The project is therefore engaging seed companies in discussions to identify means of stimulating timely production of adequate quality seed. Towards this goal, AATF facilitated the formation of a network of agro-dealers in western Kenya to help in quantifying the amount of seed required and its dissemination to farmers. This data will guide seed production by the current IR maize seed producers – Western Seed and Kenya Seed. This process is vital to encourage production by the seed companies as it assures them of a ready market to absorb their production. In 2009, the agro-dealers estimated that 80 tonnes of IR maize could be sold for the 2010 long rainfall season, which runs from March to July. As a result, Kenya Seed and Western Seed companies commenced plans to produce certified IR maize seed. They planned to have the seed available for sale before the April 2010 long rains season.

In March 2009, AATF facilitated acquisition of 1.6 tonnes of certified IR maize seed by Resource Projects Kenya (RPK) for sale to agro-dealers in Kenya. The agro-dealers were to pay RPK on sale of the seed. This arrangement worked well and RPK has received all the money and the proceeds will be used to create a revolving fund at AATF for the purchase of more certified seed for strategic demonstrations near roads, footpaths, and schools in areas where IR maize technology awareness is scanty or lacking.

Another challenge for the adoption of IR maize is lack of adequate operating capital by rural based agro-dealers, who are best placed to supply the IR maize seed to farmers in remote regions. These agro-dealers are unable

to purchase and retail substantial quantities of IR maize, fertilisers and legume seeds. The AATF project therefore considers it essential that these agro-dealers are advanced 'start-up' credit funds to enable them stock sufficient quantities of the inputs required for the IR maize technology in the initial phases of commercialisation.

Policy incentives are also required to encourage commercial seed companies to engage in sustainable production of technology specific seeds like the IR maize. Seed producing companies are sceptical about the potential business opportunity presented by production of IR maize. This is mainly because the IR seed is targeted for resource-poor farmers whose purchasing power is often lower than the commercially oriented medium to large scale farmers. There is need to support activities that create effective demand among farmers in order to win the confidence of seed producers to increase and sustain production of IR maize and other relevant legume seeds. Policy interventions such as tax waiver may encourage seed companies to invest in equipment for the production and distribution of IR maize seed.

Expanding IR maize across Africa

In 2009, the AATF *Striga* control project expanded the release of IR maize varieties for commercial seed production to other African countries. In Tanzania, eight new IR maize varieties have been identified for further national performance trials and distinctiveness, uniformity and stability (DUS) tests. This will provide new IR maize varieties suitable for various agro-ecological zones of Tanzania.

Tanseed International Limited, the lead partner in Tanzania, produced another set of certified IR maize seed under irrigation during the October/November season. In 2009, 200kg of IR maize seeds were planted in two districts in the southern and lake zones of Tanzania. Unfortunately severe drought led to complete crop failure. This hindered on-farm work, which would have provided data to support national performance trials and DUS tests of the new varieties by the regulatory agency.

The company will require a dedicated seed treatment facility to ensure quality coating of seeds as well as warehouse space to store increased tonnage. To this end,

Charles Odiero

I am the Programs Manager of the Organisation for Transforming Initiated Technologies, known more widely as OTIT. This is a non-governmental organisation based in Siaya, western Kenya, which was initiated to foster better food production and health among the communities in the area. We have three shops across the region where farmers can purchase seeds and farm inputs and also exchange information. OTIT acts as the secretariat for WeRATE, a network that brings together 11 agrovets, of which I am the chairman. Our role in AATF's IR maize project is to deliver the seeds to the farmers in the region. We cover the entire Siaya District, which has a total area of 1,520 square kilometres, targeting the areas that are most heavily infested with *Striga*. For this reason, we have to rely on the smaller agrovets in the district's interior. AATF pays Western Seed, the company that produces the seeds, for the quantity of seeds that we require and we, the agrodealers, then obtain the seeds from the company through AATF's lead partner, Resource Project Kenya, on credit. This is because many of the agrovets are very small and cannot afford to pay cash up front. We pay for the seed once we have sold it.

So far, we have reached over 2,700 farmers on a one-to-one basis. But there are others who have purchased the IR maize after hearing about it through workshops. In 2009, during the long rains season, we had projected 1.4 tonnes of seed demand based on what the farmers and the agrovets had told us. However, we only sold 500kg because the seeds arrived late. Nonetheless, the farmers who have been planting IR maize are happy with it because before cultivating IR maize, they were harvesting very little maize from their plots. The IR maize is a new intervention for them, which is enabling them to harvest up to eight bags, up from just 20kg per acre.

Our aim is for the farmers to increase this yield even further to 15 bags per acre. In the first instance, this will mean that the farm families are food secure. In addition, by selling the surplus harvest, they will have some extra cash in their pockets for other household needs. This is good for development and for our agrovet businesses as well since the farmers will have better purchasing power.

Another important benefit of the project is that we are learning a lot of new things. Through the AATF, we have learnt the biology and life cycle of *Striga* and good agronomic practices. Before, we had no idea which angle to attack the weed from. For instance, we used to uproot and dispose it very poorly. From the agro dealers' perspective, our businesses are being marketed through the project. We have also upped our marketing skills, since it is upon each individual agro-dealer to look into the interior for partners, lest their stock goes stale. We have also learnt how to calculate the economic returns, using what farmers invest in the soil versus what they harvest out of it. In turn, this has opened the eyes of the farmers and encouraged them to adopt the IR maize.

The AATF has also provided us with extensive support by availing the seed, financial assistance and technical backstopping in the maintenance of our secretariat office, building capacity of personnel in data collection and business management.

they have developed a commercialisation plan for certified IR maize seed production, which is under review by the project partners.

As the Imazapyr herbicide is registered only for experimental and testing purposes in Tanzania, the finalisation of its registration process is necessary to permit use in commercial seed.

AATF facilitated the export of 500kg of open pollinated IR maize seed to Uganda in March 2009. The seed was used in about 1,000 product demonstration fields by the Africa 2000 Network, in collaboration with other partners. A month later, the second season national performance trials in the country were sown using six IR maize varieties. These will provide data for nominating the most promising IR maize varieties for potential release and registration in 2010. AATF, BASF and the Ugandan Seed Certification Service, and the Ministry of Agriculture officials held consultations and are following up on registration of Imazapyr herbicide in Uganda.

In southern Africa, the CIMMYT office in Zimbabwe commenced efforts to evaluate germplasm suitable for Malawi. In line with this effort, in August 2009, AATF participated in the New Seed Initiative for Maize in Africa (NSIMA) meeting, which was held in Lusaka, Zambia, to discuss plans for deployment of IR maize in Malawi and other southern Africa countries. It was decided that regional trials be conducted in the region during the October 2009 planting season to identify the best adapted IR maize varieties and to enhance awareness of IR maize technology.

In Nigeria, a stakeholders meeting was held in May 2009 to design the commercialisation and delivery of IR maize technology developed by the International Institute of Tropical Agriculture (IITA) office in Ibadan to farmers. In collaboration with partners, IITA-Ibadan led the multiplication of breeder and foundation seeds of promising IR maize varieties, as well as 24 researcher-managed trials involving IR maize hybrids, under naturally occurring *Striga hermonthica* infestation.

Resource mobilisation

AATF has jointly developed a proposal with IITA, CIMMYT and BASF and submitted it to the Bill and Melinda Gates Foundation. The proposal targets control of the *Striga* weed in maize-based cropping systems of Kenya and Nigeria.

On 12 May 2009, AATF and the Kenya Ministry of Agriculture organised the National *Striga* Stakeholders' meeting in Nairobi. This precipitated the preparation of a concept note for *Striga* control in Kenya, which is part of the Kilimo Trust Regional *Striga* Control Initiative for East Africa. The concept note was submitted to the Program Committee of Kilimo Trust on 10 July 2009 and was tentatively approved and endorsed by the full Board of Trustees meeting of Kilimo Trust in October/November 2009.

The *Striga* control project business plan is being revised to guide the out-scaling of activities, especially in southern and western Africa. The business plan will also be used for resource mobilisation.

Above: A Ugandan woman takes a break. Her circular, thatched home is typical of the Bantu-speaking peoples of Sub-Saharan Africa.

Right: Cowpea at pod filling stage.

First Ever Confined Field Trial of the *Bt* Cowpea in Africa

On 25 August 2009, the first ever Bt *cowpea in Africa was planted with permission from the Federal Ministry of Environment, at a confined field trial (CFT) site in Zaria, Nigeria. The crop was sown by a team led by Mohammad Ishiyaku, the project's Principal Investigator, at the Institute for Agricultural Research (IAR) in Nigeria, one of the partners in the AATF* Bt *cowpea project. This event marked a significant milestone towards providing farmers in Africa with* Maruca*-resistant cowpea varieties.*

Background

In the dry savannas of tropical Africa, cowpea is considered the most important food grain legume. Grown on more than 12.8 million hectares of land in these regions, the crop provides an alternative source of protein for nearly 200 million people in Africa. Moreover, in addition to providing good control for soil erosion, cowpea enhances soil fertility due to the crop's ability to fix nitrogen.

However, about 70%-80% of the total cowpea crop grown in Africa is lost due to various biotic and abiotic constraints. Most of these losses are caused by the *Maruca* pest, a voracious pod borer that intensely attacks and ruins the crop during the flowering and pod-forming stages. As a result, the average cowpea grain yields in Africa are quite low, at 0.05 to 0.55 tonnes per hectare, way short of the potential 2.0 to 2.5 tonnes per hectare[1].

1 According to studies by the International Institute of Tropical Agriculture (IITA) and the Bean/Cowpea USAID Collaborative Research Support Program (Purdue University).

The AATF-coordinated project[2] involves inserting into cowpea the *Bt* gene Cry1Ab, known to be toxic to *Maruca vitrata*. In 2008, controlled field trials (CFT) of the best experimental cowpea transgenic lines were conducted in Puerto Rico, to determine how well they would stand up against heavy insect infestation. This CFT included the top 14 transgenic lines developed to date by TJ Higgins and his team at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Plant Industry laboratory in Australia. The tests indicated good growth and performance of the lines under field conditions. They also showed that the *Bt* protein is affording resistance to *Maruca* pod borers.

The CFT in Puerto Rico served as a good learning experience on how such trials should be managed, as well as a guide for the future selection of transgenic lines to be tested. Using this information, the AATF cowpea project researchers identified additional promising transgenic lines from among those being produced at CSIRO. The second trial with six new lines of cowpea expressing Cry1Ab gene was conducted again at the University of Puerto Rico's Adjuntas Agricultural Experiment station during June–October 2009. This work was done by a team led by Dimuth Siritunga and Fernando Gallardo from the University of San Juan; Jeff Stein of the Program for Biosafety Systems (PBS) and Larry Murdock from Purdue University under the control of the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS).

In early August 2009, other members of the project team, including TJ Higgins from CSIRO, Mohammad Ishiyaku from IAR, Jeremy Ouedraogo from the Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso, Nompumelelo Obokoh from AATF, Joe Huesing from Monsanto, Larry Beach from USAID, and Venu Margam from Purdue University, visited the trial and made the first assessment of the efficacy of these plants when they were still flowering. As expected, the growth of the plants was variable, but the high expressing, homozygous lines were less vigorous in growth and showed signs of stunting. The cowpea breeders from Africa explained that the introgression process will break the apparent linkage of resistance with reduction in vigor observed in some of the events. This further raised a question of how best to screen the plants before transferring them into the field. Therefore, later in the year the CSIRO team in Australia used a Lemna Tech Scanalyser, to measure the growth rates of selected transgenic lines against that of the non-transgenic parent line. The results showed good reproducibility between the replications. The growth rate differences were reflected in the seed 'yield' per plant. From the preliminary results, it seems that the technique of measuring plant growth in the greenhouse can be used as a reliable predictor of how the plants will perform in the field.

The other challenge for the second CFT in Puerto Rico was the absence of *Maruca*, which meant that efficacy data could not be obtained. The researchers concluded that the season was too dry for the successful mating and survival of the insects. Although Dr Gallardo released large numbers of lab-reared, second instar larvae and adults during the floral bud forming and the first flowering stages, they did not successfully infest the plots because of the low humidity.

The trial was harvested in October and data was collected on the total weight of pods; total number of pods; total seed weight; weight of 100 seeds and number of seeds per pod. The total number of pods, number of pods per plant and total amount of seeds per plant were drastically reduced in the transgenics compared to the wild-type plants, which was attributed to the overall less vigorous phenotype of the transgenics. One line was the best among the transgenics in each of the categories. The pods on the wild type plants also formed and matured a week or two weeks ahead of the transgenics. On the other hand, the weight per pod, number of seeds per pod and weight per seeds remained comparatively the same between the wild types and the transgenics.

In the meantime, the CSIRO team continued to generate more lines using the same Cry1Ab construct. A total 163 transgenic lines were generated and moved from tissue culture to the glasshouse. The CSIRO researchers commenced an evaluation of the phenotypes from the 163 lines already produced. Based on the outcomes of a world cowpea strategy meeting in Purdue held in August 2009, Dr Higgins will continue to screen and analyse the existing lines and design a new Cry1Ab gene construct in 2010. This work will target the *Bt* protein

2 Partners in the cowpea project include: the Network for the Genetic Improvement of Cowpea for Africa (NGICA); the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia; the national agricultural research organisations of Nigeria, Ghana and Burkina Faso; the International Institute of Tropical Agriculture (IITA), Nigeria; Monsanto Company; and Program for Biosafety Systems (PBS).

to the chloroplast compartment in order to evaluate the effect of sequestering the protein on the stunting phenotypes of the transgenics.

First *Bt* cowpea in Africa

In July 2009, IAR obtained a permit from Nigeria's Quarantine Services for the importation of six transgenic lines of cowpea as well as the non-transgenic parent line into the country. On 2 August 2009, a consignment of *Bt* cowpea seed, appropriately packaged and labelled, was shipped by DHL from CSIRO offices in Australia to Nigeria. The consignment was accompanied by a phytosanitary certificate issued by the Plant Biosecurity in Australia. Five days later, the seeds were received by IAR and witnessed by regulatory officials from the Nigeria Quarantine Service and Biosafety Office.

On 25 August 2009, Dr Ishiyaku and his team planted the first *Bt* cowpea in Africa, at a CFT site in Zaria. They planted four transgenic lines alongside the parent control, and a susceptible local variety. These lines included two being tested in Puerto Rico to enable comparisons between different environments and trials. Three border rows and internal guard rows, and the susceptible line were planted before the trial to attract more *Maruca*. A series of artificial infestations was conducted to increase insect pressure. Starting from 17 October 2009, each plant in each plot was infested with five *Maruca* larvae (instar not determined).

On 20 and 21 October 2009, the second row of each plot was infested with five and four *Maruca* larvae, respectively. An additional 10 larvae of the pest were introduced on 22, 23 and 24 October 2009, 10 *Maruca* larvae were dispersed in the second row of each plot, while the corresponding first row was left with natural *Maruca* infestation in the field. From this trial, entomological data comprising total number of peduncles, total number of pods, total number of flowers per week and the total number of flowers with *Maruca* per week was recorded and is being analysed to assess pod damage by *Maruca*.

The biosafery inspectors from the Federal Ministry of Environment also carried out their inspection of the CFT at four different phases of the trial. An external audit of the CFT by an international biosafety expert was conducted on 27 October 2009. The audit confirmed that the CFT of the transgenic cowpea was carried out in compliance with the national requirements of Nigeria as well as USAID special requirements of Internal Environmental Evaluation.

Capacity strengthening

In June 2009, IAR, AATF and PBS organised a workshop to strengthen capacity on regulatory compliance and biotechnology communication, paying special attention to the management of CFT sites. The forum brought together the principal investigators on cowpea from the collaborating African countries; Nigeria, Ghana and Burkina Faso. In attendance also were CFT trial site managers, technical personnel, agents of the regulatory authorities engaged in monitoring and enforcement of regulatory compliance during CFTs of GM plants, as well as government officials and journalists.

The key aspects of the regulatory workshop included discussions on the dominant biosafety considerations for a CFT and expounded on the 'Pillars of Confinement' including control of the plant material; prevention of gene flow; and prevention of persistence. The forum also emphasised that appropriate confinement requires good practices for material and genetic confinement and requires well-trained and equipped trial personnel, routine and emergency procedures, good record keeping as well as documentation and structured inspection.

The participants also visited the CFT site at Zaria where they were taken through the safety procedures that had been put in place to ensure compliance with

TJ Higgins

I have been researching plant gene technology, particularly in improving legumes for their nutritional value and resistance against pests and diseases, for more than 30 years. I was first introduced to the wonders of cowpea by Larry Murdock when he invited me to a workshop in Dakar, Senegal, in 2001. During that forum, I met Mohammad Ishiyaku, Joe DeVries, Joe Huesing, Ousmane Coulibaly, Jess Lowenberg-DeBoer, Robert Paarlberg, AB Salifu, BB Singh, Idah Sithole-Niang, Jesse Machuka, Issa Drabo, Ndiaga Cisse, Ray Bressan, Laurie Kitch, Louis Jackai and Jeff Ehlers, among several others. It would be an understatement to describe this group of scientists as fervent cowpea fans. Although I knew nothing about cowpea at the beginning of that workshop, by the end of it I was almost an 'expert' – such was their knowledge and enthusiasm.

The team of scientists, which later became known as the Network for the Genetic Improvement of Cowpea for Africa (NGICA), had an impressive array of expertise that they had been unstintingly applying to the improvement of cowpea, many of them as volunteers. One skill that was still in an embryonic form was that of genetic transformation, also known as genetic engineering. This was something that I had some experience of, based on my work on other

the standards set for safety regulations in Nigeria. The communication skills training workshop discussed the building blocks of effective communications, how to design and package effective messages, issue management in agricultural biotechnology and media relations which included a mock media interview that prepared partners for the announcement of the CFT approval by the Federal Government of Nigeria.

The capacity strengthening workshops were facilitated by PBS and the International Service for the Acquisition of Agri-biotech Applications (ISAAA). A 'Frequently Asked Questions' (FAQs) sheet on the *Bt* cowpea project and one on CFTs were produced to support communication and information sharing on the project, and are available on the AATF website (www.aatf-africa.org/publications/fact_sheets).

Challenges

One of the challenges for the project was the low level of insect pressure in the field. To solve this problem, AATF and Purdue University are developing a contract for an entomologist working with Larry Murdock at Purdue University to assist the project partners in the development of laboratory protocols to establish and successfully maintain the *Maruca* colony. The scientist will also provide support in optimising the methodology for handling eggs and larvae for artificial infestation in the field in Puerto Rico. These procedures will also be used in the CFT to be conducted in Africa.

The second challenge was the laborious and time-consuming procedures used to evaluate a large number of lines to eliminate those with multiple inserts. The researchers faced a bottleneck regarding the use of Southern blot analysis, a process normally used to test for gene copy number and the presence of backbone sequences. Fortunately, Joe Huesing of Monsanto and Larry Beach of USAID provided useful insight on alternative procedures used in industries. Based on these ideas, Dr Higgins visited Monsanto and Third Wave Technologies in Madison, Wisconsin to evaluate quantitative PCR and Invader Technology. So far the results in the laboratory in Canberra with Q-PCR look promising, offering the possibility of determining gene copy number on T_0 material, which could allow the assessment of lines with multiple inserts at a very early stage and save greenhouse space.

In May 2009, an attempt by Ibrahim Atokple, the principal investigator (PI) in Ghana, to submit a CFT application to the secretary of the National Biosafety Committee (NBC) was unsuccessful. This was because a new minister had taken office in the Ministry of Environment, Science and Technology and needed to be briefed by the NBC on the management and regulation of GMOs in Ghana. Two months later, the project team, with support from the NBC, held a briefing meeting with the newly appointed Minister of Environment, Science and Technology to seek her authority to use the Legislative Instrument (LI) as guideline for the conduct of the CFT as they await the passage of the Biosafety Bill. Following several consultative meetings by the NBC and other key stakeholders, the minister gave approval to the NBC to receive and process applications for GMOs intended for field trials and contained use.

Next steps

In 2009, the Project Advisory Committee (PAC) recommended that the project allows time to learn from the trial in Nigeria prior to expanding CFT activities into other countries. Depending on the outcome of the Nigeria trials, a decision was to be made on whether to conduct CFTs in Burkina Faso and Ghana or just conduct a more elaborate repeat trial in Nigeria. Other future plans include more education and awareness activities on biotechnology.

legumes. The group conferred on me the challenge of perfecting the process of transferring genes into cowpea so that the breeders would have an additional genetic tool with which to improve the crop.

I was daunted by the task, but at the same time I was so impressed with the vision of the group that I went away to think whether I would give it a try.

With the help of Rockefeller Foundation and a little later, USAID and AATF, I set about fine-tuning a method for gene transfer to cowpea. A critical component for this to happen was the Canberra-based expertise of Stephanie Gollasch, Carlos Popelka, Andy Moore and Lisa Molvig. They all had experience of gene transfer for other crops, which proved vital for the development of a robust system for cowpea.

We now have a system up and running and have introduced genes for insect protection. We hope that the first of the lines that we develop will protect the plant from the *Maruca* pod borer. We have produced scores of lines and have selected several candidates for further trialling. Prof Ishiyaku is now testing these plants in the field in Zaria, Nigeria.

Since my first meeting Prof Ishiyaku and hearing about the farmers that he works with, I have been inspired to work harder to ensure that he will be able to produce pod borer-resistant cowpeas in his breeding programme. If he can increase the yield of cowpeas in farmers' fields, then our endeavour will have been most worthwhile. Indeed, for a lab-based scientist, the cowpea project has been hugely satisfying. I can see how our work can help resource-poor farmers and make a contribution to food and ecological security for Africa.

Above: Like the Ndebele of South Africa, the Sirigu of Ghana decorate their houses with geometric paintings. The paints are made out of locally available natural materials.

Right: Disease-free banana plantation.

Developing Transgenic BXW-Resistant Bananas

AATF and IITA, in partnership with NARO of Uganda, have made considerable progress towards developing transgenic bananas resistant to the banana Xanthomonas *wilt (BXW) disease. This work has involved transformation using two resistance genes – the plant ferredoxin-like protein (*pflp*) and the hypersensitivity response assisting protein (*hrap*) – isolated from sweet pepper. These genes were inserted into cell cultures and meristematic tissues of four important banana varieties in Uganda. The project partners have submitted an application for a permit approval from the National Biosafety Committee after getting approval from NARO-Institute Biosafety Committee to conduct confined field trials at the National Agricultural Research Laboratories (NARL), Kawanda.*

Background

The banana *Xanthomonas* wilt (BXW) disease, which is caused by the bacterium *Xanthomonas campestris* pv. *musacearum (Xcm)*, was first reported in Ethiopia about 40 years ago. The disease seemed to remain isolated in that country until 2001 when it was first seen in Uganda, the world's second largest producer of banana after India. Since then, BXW has quickly spread throughout east and central Africa, threatening the livelihoods and food security of millions of people. BXW affects nearly all commonly grown banana cultivars, its damage being both extreme and rapid.

Scientists from the International Institute of Tropical Agriculture (IITA) in partnership with the Uganda National Agricultural Research Organisation

Abubaker Muwonge

I am a PhD researcher from Uganda. My interest in biotechnology started when I was pursuing a Masters degree at the Middle East Technical University, in Ankara, Turkey. The opportunity to undertake the course came to me in 2003, after I won one of two merit scholarships granted by the Islamic Development Bank in Africa that year. I chose to study biotechnology because it was a novel area of research and I am always keen to undertake new challenges. Besides, as biotechnology is applicable to almost all fields of science, I felt it would give me a good base as a scientist.

My MSc project was on the transformation of *Bt* genes in Irish potatoes. Through this work, I got intrigued about the potential of biotechnology for smallholder farmers in my country, Uganda, and across the east African region. After my studies, I returned home, where I joined the National Agricultural Biotechnology Center (NABC). For three years, I focused on cloning genes to be put in bananas for weevil resistance. I then got a PhD scholarship through the IITA to work on a banana project funded by the AATF. My PhD research aims to develop bananas which have the plant ferredoxin-like protein (*pflp*) and the hypersensitivity response assisting protein (*hrap*) genes stacked in the same cultivar. I will also assess the potential of these lines for enhanced resistance to the bacterium *Xanthomonas campestris* pv. *musacearum (Xcm)* which causes Banana *Xanthomonas* wilt (BXW) disease. I am conducting most of my research at the NABC facilities in Uganda, and part of the work will be done at the University of Pretoria, South Africa.

So far I have developed over 150 lines of sukali ndizi and over 200 lines of gonja majala. I have also conducted some preliminary molecular characterisation on these lines. The results have been encouraging, as I have found both the *pflp* and *hrap* genes to be present in the lines. The next step is to multiply and evaluate the lines in the screen house for superior materials, which will later be used for confined field trails, after regulatory approval.

One of the hitches that I face in my work is the lack of some of the equipment I need at the NABC. Fortunately, I can conduct part of my research activities at the University of Pretoria. There is a lot of research going on at the Centre which means there is a great demand on the available facilities. In effect, I have to work long hours to make sure I complete my project in good time. But I feel privileged to be working with a dedicated and experienced team of researchers from the IITA and the Uganda National Agricultural Research Organization (NARO) here at the NABC. I also feel proud to be part of the solution to the constraints of banana production, as I know that the knowledge I am generating is contributing directly to the production of bananas that are resistant to Xcm. The day such plants will be available to rural farmers will be as much a landmark for me as it will be for them. As an agricultural scientist, I think there is no greater joy than helping improve the food security and the incomes of one's own people, and I know that bananas which are resistant to Xcm will achieve these two goals for the people of east Africa.

(NARO) started developing transgenic bananas resistant to BXW in early 2004. IITA approached AATF seeking access to candidate genes conferring resistance against BXW. Beginning 2005, AATF launched a project, in partnership with IITA and NARO, aimed at producing BXW-resistant banana cultivars through genetic transformation. Based on work done by Teng-Yung Feng of the Academia Sinica in Taiwan, the project has made considerable progress towards inserting two resistance genes: the plant ferredoxin-like protein (*pflp*) and the hypersensitivity response assisting protein (*hrap*) isolated from sweet pepper into banana. The main objective of the project is to develop transgenic banana plants resistant to *Xanthomonas* wilt. In 2009, a number of transformed lines containing either *pflp* or *hrap* genes were put through laboratory testing and screen house trials in Uganda.

Above: Leena Tripathi, biotechnologist with IITA and project principal investigator of the BBW-resistant banana project, inspecting transgenic banana in the lab.

Advancing research

The project researchers envisioned the next steps to include demonstrating that stacking the *pflp* and *hrap* genes in the same banana cultivars would enhance resistance. The initiative also aims to clone and validate additive construct with *pflp* and *hrap* genes stacked together, and to transform and regenerate transgenic plants. The work extends to the molecular analysis of transgenic plants and testing efficacy of *hrap* and *pflp* for resistance against BXW under laboratory conditions.

In 2009, more than 300 putatively transformed plants were regenerated. Out of this, 100 lines were selected for validation via Southern blot and PCR assay. The Southern blots confirmed transformation events and indicated a low copy number (1 to 3) for most events. A further 20 lines were tested with RT-PCR and northern blot analysis. The transgenic lines were evaluated for BXW resistance using *in vitro* assay. The promising lines were also evaluated using potted plants in the screen house. The lines showing resistance under screen house conditions will be further evaluated under confined field trial (CFT). The application requesting for permit approval from the National Biosafety Committee to conduct a CFT at the National Agricultural Research Laboratories (NARL), Kawanda has been filed.

Tissue culture workshop

At the close of 2008, the researchers from AATF and Academia Sinica felt that the project would benefit from a workshop on tissue culture propagation to address quality control and efficiency issues, as well as opportunities for deploying tissue culture plantlets through public and private sector organisations that specifically target smallholder farmers. This event was seen as a component of the larger Banana Improvement Project, which was developed as a result of AATF's recognition of an urgent need to reduce the loss of banana germplasm. The Foundation also saw a requirement to ensure the sustainable delivery of new materials to farmers through tissue culture techniques coupled with appropriate product stewardship.

The tissue culture workshop took place between 8 and 14 April 2009 at Academia Sinica in Taipei, Taiwan, and was attended by representatives from both public and private sectors. Participants included Erastus Nsubuga, Chief Executive Officer, Agro-Genetic Technologies (AGT), Uganda; Jesca Mbaka and Alice Muriithi of the Kenya Agricultural Research Institute (KARI); and Julius Mugini of the Mikocheni Agricultural Research Institute (ARI, Mikocheni), Tanzania. The discussions revolved around ways to enhance efficiency and effec-

tiveness of tissue culture practices in the Great Lakes region in Africa. Academia Sinica, through Prof Feng, organised training modules in various aspects of tissue culture. The topics covered were the initiation of mother plant, subculture, regeneration and rooting, weaning and hardening.

The team learnt more about the production system being used by Academia Sinica, and how it contributes to the low cost of banana plantlets at the Taiwan Banana Research Institute, which sells them at 40 cents as compared to about US$ 1 in Africa.

The participants shared pointers on various cost cutting measures in development of tissue culture banana plantlets. To cut on costs, it was suggested that one could generate multiple shoots from meristematic tissues, and also use liquid charcoal as rooting media.

The workshop was an eye opener and provided significant strides towards improving tissue culture techniques that will contribute to production of affordable banana plantlets for resource-poor farmers in the Great Lakes region of Africa.

The participants recommended that a similar regional training workshop should be held in Africa to enable wider participation and empowerment of more stakeholders in the banana industry.

Knowledge sharing, capacity strengthening and regulatory compliance

The research and accomplishments made through the BXW project were presented at the Tropical Crop Biotechnology Conference 2009, held in South Africa, and in Public Understanding of Science meetings (CGIAR Science Forum, June 2009). The research was also featured in *Plant Disease Journal*.

In the meantime, Muwonge Abubaker, who commenced his PhD studies in 2008 under the project, continued his research on how to enhance resistance against *Xanthomonas campestrisis* pv. *musacearum* in bananas by co-expressing *pflp* and *hrap* genes. He is expected to earn his doctorate, which he is undertaking at the University of Pretoria, South Africa, by 2011.

The process of finalising the application for CFT is underway. The application was submitted to the Institute Biosafety Committee (IBC) for review and after getting approval from IBC it has been forwarded to the National Biosafety Committee (NBC) for approval.

Next steps

Based on the vast amount of knowledge being generated under the project, the researchers hope to present their work at more scientific meetings. A research paper will be published in a refereed journal to protect the work and make it available in the public domain.

Having accomplished the signing of a tripartite agreement between IITA, NARO and AATF in 2009, the project expects to establish a testing facility for CFTs in Uganda.

Above: Transgenic banana plants at the Kawanda laboratories.

The laboratory-based studies will also continue, including the transformation for stacking both *pflp* and *hrap* genes, molecular characterisation of transgenic plants regenerated and the evaluation of transgenic banana plants. This work will also include the maintenance and multiplication of transgenic lines and the production of antibodies for *pflp*. The research will also cover the evaluation of transgenic plants for fungal diseases like black Sigatoka.

Currently, researchers are waiting for approval permit from the National Biosafety Committee to conduct a CFT at NARL, Kawanda.

Above: A member of the Maasai tribe in Tanzania.

Water Efficient Maize for Africa (WEMA)

In March 2008, AATF launched a public-private partnership aimed at producing higher yielding, drought-tolerant maize varieties and deliver them to millions of African smallholder maize farmers. In 2009, building on accomplishments by the project partners in the inaugural year, promising conventional drought tolerant test-cross lines were evaluated under water-stressed conditions. Mock confined field trials (CFT) were conducted in two countries in east Africa, while a permit to conduct transgenic trials was approved for the Republic of South Africa.

Most of Sub-Saharan Africa is characterised by recurring drought, posing a persistent challenge to millions of smallholder farmers who rely on rainfall to grow their crops. Indeed, drought contributes significantly to poor crop yields, causing insufficiencies, as well as high prices of major foods in Africa.

In March 2008, AATF launched the Water Efficient Maize for Africa (WEMA) project, a public-private partnership that capitalises on an innovative combination of conventional maize breeding, marker-assisted breeding and biotechnology. The goal of the project is to develop higher yielding, drought-tolerant maize varieties. The overall aim of WEMA is to deliver the improved maize seed to millions of farmers in five eastern and southern Africa countries, royalty-free, alongside the best agronomic practices. Funded by the Bill and Melinda Gates Foundation and Howard G Buffet Foundation for an initial five-year phase, the project is being implemented by AATF in conjunction with several partners, including the national agricultural research systems (NARS) of Kenya, Mozambique, South Africa, Tanzania and Uganda, Monsanto Company and the

International Maize and Wheat Improvement Center (CIMMYT).

Breeding progress

During the inaugural year of the WEMA project, Monsanto evaluated promising elite maize inbred lines, developed previously by itself and CIMMYT, which are adapted to tropical mid-altitude ecologies found in Sub-Saharan Africa. Based on this work, in 2009, the WEMA breeding team tested several conventional drought tolerant test-crosses under well-watered and water-stressed conditions. The researchers observed differences among the test-crosses in terms of their physical reactions to water stress which helped them identify which would perform well under drought. Progress was made developing tropical drought tolerant transgenic hybrids that will be evaluated for performance in the five partner countries. The team also developed double-haploid lines, which were multiplied in nurseries.

CFT facilities and mock trials

WEMA country partners identified suitable sites to conduct CFTs in the five countries. During the last quarter of 2009, Kenya and Tanzania were able to complete the development of the sites and acquire the necessary regulatory approvals to conduct mock trials while South Africa was able to plant its first transgenic trial. The site development included the installation of irrigation systems for managed drought stress in Tanzania and South Africa. Plans for a similar scheme were commenced in Kenya and Uganda.

The mock trials using conventional drought tolerant germplasm established in Kenya and Tanzania aimed to test and calibrate the irrigation facilities, and simulate the steps that will be followed during the actual CFTs for the transgenic maize varieties scheduled for 2010. The mock trials also provided an opportunity for researchers working on the WEMA project to be trained on the regulatory procedures of carrying out the trials. Although conducting a mock trial does not require regulatory approval, a notification to do so was submitted to the National Biosafety Committees (NBC) in the two countries as part of the training. Approval was given after the application and the sites were assessed and found to comply with the requirements to conduct a transgenic CFT. A similar notification was submitted in Uganda in mid-October 2009. In RSA, the permit application submitted to the Registrar of GMOs for the conduct of transgenic trials was approved in September 2009 and the trial planted in November 2009.

Regulatory compliance

The regulatory environment of WEMA partner countries was profiled and a strategy document to secure regulatory approvals for the conduct of CFTs and ensure compliance was completed. The project also developed a policy document to guide the conduct of regulatory team members during the CFT application review process. Training workshops on CFT compliance for the WEMA teams involved in the different countries were held. Importantly, a Compliance Training Manual and Site Managers' Handbook were prepared. Also, as part of capacity strengthening, a workshop was held to guide the regulatory and product development team leaders from the five partner countries on compilation of the regulatory dossiers.

Baseline environmental risk assessment studies were carried out in Tanzania and Uganda, but are yet to com-

mence in Mozambique. However, such studies are not required in Kenya and RSA. A preliminary report is available for Uganda.

Communications

The WEMA communications team managed to garner commendable media coverage. The team also conducted two capacity building workshops on communication and media handling.

The media handling and biotechnology communication workshop was held in August 2009, targeting over 35 project spokespeople drawn from the Product Development, Regulatory Compliance and Communications and Outreach teams. The workshop focused on equipping participants with effective biotechnology communication, media relations and issue management skills. The Executive Media Training for the AATF management who speak on WEMA issues, among others, was held in July 2009.

In addition, the team showcased the project in over 10 regional and global agriculture-related events. This created awareness amongst a wide range of stakeholders, including scientists, policy makers, central and local government leaders, and farmers. In all these events WEMA was viewed as one of the possible solutions to counter the shortage of maize occasioned by frequent droughts affecting the region.

Outreach to in-country stakeholders to create awareness on the project and get their buy-in was done in four of the countries through national stakeholder meetings.

Project governance

The project partners identified potential issues that could adversely affect WEMA project activities and some proposals were made to mitigate them. AATF facilitated the drafting of a confidentiality agreement between each NARS partner and Monsanto for field testing of water-efficient transgenic maize germplasm. In this respect, a confidentiality training was held for partners in August 2009 to discuss key issues relating to private sector confidentiality requirements especially regarding information management and the public good responsibility of the public sector and the confidential elements in WEMA.

Monthly meetings of the Operations Committee were held to approve 2009 work plans and budgets, review mid-year progress reports by each team and also the whole project. The committee also reviewed the monthly bulletins, hire of consultants, site development progress, policy documents, major WEMA meetings, training workshops, and management issues brought to their attention by the Project Manager.

The Executive Advisory Board (EAB) of the WEMA project continued providing overall oversight of the project. The Board held its annual meeting during the Project's Annual Review and Planning Meeting held in Johannesburg, South Africa in February 2009. During the meeting the Board received highlights of the WEMA project activities and achievements in 2008 and proposed activities for 2009 from the teams. Dr Ephraim Mukisira, Director, Kenya Agricultural Research Institute, was elected chair to the Board, taking over from Dr Dennis Kyetere, Director General National Agricultural Research Organisation (NARO) Uganda.

The Product Development, Regulatory, and Communication teams held monthly teleconferences and face-to-face meetings where necessary to discuss progress, provide inputs and address challenges related to their work.

Challenges

One of the challenges encountered was the reality of dealing with dispersed teams, in terms of planning and time management, due to a greater requirement of the number of meetings and travel.

Another was the loss of staff involved in the project teams, who had already conceptualised the project and been trained. For instance, the departure of AATF Legal Counsel from the Foundation slowed down activities under IP management. However, a new Legal Counsel has been recruited and commenced work in the third quarter of 2009.

The Communication team members who also service other organisational responsibilities have had difficulties carving off time from their already busy, normal job schedules in their respective organisations for WEMA activities. The team is exploring ways in which they can utilise the services of biotech communication consultants in the countries to undertake some of the activities.

In the area of product development, partners have had to grapple with the rapidly evolving field of molecular breeding which has required flexibility in adoption of new strategies like association mapping projects. Partners in the project also have different processes that have necessitated the development of new standard operating procedures to enable the efficient transfer of seed between countries and partners.

Next steps

In 2009, the WEMA project made good progress, accomplishing or initiating activities in over 90% of its preset milestones. Strategies to address the areas that are lagging behind were put in place during the mid-year project review.

The plans ahead include continued drought-tolerance breeding activities, and the completion of the development of sites and the establishment of drip irrigation systems in partner countries.

The WEMA team will also sustain capacity strengthening efforts to address areas such as risk assessment, processing and handling of applications for the conduct

of transgenic trials and media relations and biotechnology risk communication. Biotech communication sessions for journalists in partner countries to enhance science and or biotechnology reporting in the media will also continue. In addition, linkages will be created between WEMA and regional initiatives such as African Biosafety Network of Expertise (ABNE), International Centre for Genetic Engineering and Biotechnology (ICGEB) and biotechnology communication organisations. The project partners will facilitate the establishment of an Intellectual Property (IP) management team and implementation of milestones related to IP.

The team will submit the final copies of CFT Training Manual and CFT Compliance Handbook to the WEMA secretariat, alongside the production and dissemination of targeted policy briefs in the five partner countries and outreach to parliamentary groups.

Right: Yoseph Beyene of WEMA CIMMYT during an evaluation visit to the trial site at Kiboko, Kenya.

Kingstone Mashingaidze

I have been working as a plant breeder for almost 30 years, mostly as a university senior lecturer and maize breeder in Zimbabwe and focussing on the development of drought and low – nitrogen tolerant varieties. In 2004, I moved to South Africa, where I am currently working as a Programme Manager for Plant Breeding and Biotechnology at Agricultural Research Council (ARC) Grain Crops Institute. In March 2008, I was appointed the Coordinator and Principal Investigator of the WEMA project in South Africa. I was very pleased with this appointment, as the aims of WEMA resonate with my own research ambitions – to give smallholder farmers appropriate varieties suited to their marginal farming areas.

Maize is the most important crop grown by smallholder farmers in South Africa, being the mainstay of rural diets as well as a cash crop. South Africa produces about 11 million metric tonnes of maize annually, surpassing the country's annual local consumption of about 9 million metric tonnes. But while the country is a net exporter of maize, about 14 million South Africans – 40% of the population – are food insecure due to various factors. First, just like in most Sub-Saharan countries, farming in South Africa is severely constrained by drought and low soil fertility (particularly nitrogen deficiency). In fact, less than 15% of South Africa's land is arable. In addition, just 10% of the total maize crop in South Africa is cultivated under irrigation, and this is mostly in large-scale commercial farming areas. Such farmers are able to obtain yields of about 4 to 4.5 tonnes per hectare, compared to yields from the largely non-irrigated smallholder farms, which average a mere 1 tonne of maize per hectare. Smallholder farmers often lack the cash to purchase additional food for their needs.

Predictions are that climate change will make the farming situation worse in South Africa, with shorter seasons, more rainfall variability and higher temperatures expected in the region. Therefore, drought tolerant varieties are urgently required to stabilise the household food production and, in the long term, the income of smallholder families.

In South Africa, we fully developed the confined field trial (CFT) site (fencing and installation of the drip irrigation system) and planted on 28 November 2009. We had an excellent plant stand and look forward to successfully implement the irrigation protocol in order to evaluate the efficacy of the transgene (MON 87460) earmarked for WEMA. I am excited at the possibility of combining hybrid technology and biotechnology to provide farmers with drought tolerant high yielding varieties.

My major disappointment at the moment is the prevalence of inaccurate information about genetically modified (GM) crops in South Africa. It is important that African political leaders embrace biotechnology and that they facilitate a sober, informed debate about the technology and encumbering issues of food security, involving the range of stakeholders from farmers, civic organisations, scientists to the media.

On my part, I am committed to doing my part through WEMA. I am proud of the great public-private partnership created through the project. Indeed, I commend the AATF personnel for their professionalism, transparency and ability to communicate and handle the needs and expectations of people of diverse personal and organisational cultures. I am also grateful to all our supporters, who ensure that we have adequate resources to create solutions for African farmers. In fact, WEMA is a good example of indigenous African leadership for African problems.

Above: A meal being cooked outside a typical mud house in Burkina Faso.

Right: Farmers planting rice in Lokossa, Benin.

NUEST: Transforming New Rice for Africa

Although still at an early product development stage, the NUEST project has made significant progress towards the genetic transformation of the upland and lowland New Rice for Africa (NERICA) varieties. The initiative is well on its way towards realising its goal of overcoming the major constraints of an otherwise rapid expansion in the production and consumption of rice across Africa.

Background

In December 2008, AATF officially launched the Nitrogen Use-Efficient and Salt-Tolerant (NUEST) Rice for Africa project. The initiative aims to genetically transform some varieties of the New Rice for Africa (NERICA) to improve their productivity in nitrogen-poor soils and in fields that have become excessively salty over time. The goal is to provide smallholder rice farmers with higher yielding varieties that are well adapted to the upland and lowland rice-growing areas in Africa.

Funded by USAID, the NUEST project will be implemented over a 10-year period. Arcadia Biosciences will provide access to genes that confer nitrogen use efficiency and salt tolerance, while the Public Intellectual Property Resource for Agriculture (PIPRA) will donate the required plant transformation technologies. The national agricultural research institutes of Burkina Faso, Ghana, Nigeria and Uganda will conduct the necessary field trials to test the performance of the transgenic lines. These institutes will also carry out the marker assisted breeding needed to move the desired traits into rice varieties already known to and preferred by farmers and consumers. Moreover, these partners will ensure dissemination of new varieties to smallholder rice producers. AATF will hold the license of the genes donated by Arcadia Biosciences and PIPRA and also oversee

the coordination of the project, as well as the facilitation of product delivery to farmers.

Progress in 2009

In 2009, PIPRA started negotiations with the technology owners, and the drafting of legal agreements for the use of the plant transformation platforms in NUEST. PIPRA also designed and synthesised two plant transformation plasmids that are being used by Arcadia Biosciences on rice. The AATF Legal Counsel has completed the consultancy contract for PIPRA's support services.

The seeds of NERICA upland varieties 1 and 4 and NERICA lowland varieties 19 and 20 were received from the African Rice Center (WARDA). They were first grown in the green house under quarantine at Arcadia Biosciences to produce enough materials for the transformation work. The transformation of the upland varieties with the NUE and Salt Tolerance vectors commenced with good progress while the establishment of a regeneration and transformation protocol for the lowland varieties was initiated. As a result, the first transgenic rice events (upland ST) were planted in the green house in October/November 2009. The upland NUE transgenic events were planted in soil at the end of the year while the lowland (NUE and ST) events will be transferred from tissue culture to the soil in the greenhouse in January 2010.

One of the key developments during the year was the decision by the project partners to address drought effects on rice through inclusion of water use efficiency (WUE) trait in the project. This was arrived at during a meeting held in December 2009 between AATF and Arcadia. The approach will be to use a combined ST-WUE binary vector, based on successful progress at Arcadia with positive synergistic effects between the ST and WUE traits.

Capacity building

In September 2009, the NARS representatives who will be conducting NUEST field trials travelled to California, USA, for a product development workshop at Arcadia Biosciences. The participants were familiarised with the company's laboratory work on the transgenic rice, including its approach in the conduct of greenhouse and field trials for NUE and ST. They also visited an ongoing confined field trial (CFT) of the NUE rice in the Californian Central Valley. Most importantly, the trip served as an opportunity to define the 2009 to 2012 milestones and activities for the NARS partner institutes. This is especially in preparation of the CFT for the homozygous T2 transgenic rice lines that will be available by 2011.

During the workshop, attention was drawn to the high cost of deregulation and the need to limit the

events to be taken through this process. As a result, it was decided that only one upland NERICA variety would be deregulated.

Based on its better response in tissue culture and its larger adaptability for cultivation in various growing regions, NERICA-4 was chosen as the upland focus for the project. For the lowlands, the group agreed to concentrate on the NERICA-L19 variety. Therefore, although the ongoing regeneration of NERICA-1 shoots from NUE and ST transformations will be continued as normal, no new co-cultivations will be performed.

The partners also agreed that since salt tolerance was not a problem in the uplands, it would be more prudent to consider developing a transgenic rice that is drought tolerant.

Feasibility studies

The Project Advisory Committee reviewed and endorsed the terms of reference for carrying out a project feasibility study by AATF. The tasks include:

- Evaluating the technical and economic feasibility of rice improvement for improved nitrogen use efficiency (NUE) and high soil salinity tolerance through genetic transformation and eventual deployment of the product in smallholder farm environments of Sub-Saharan Africa, taking into account infrastructure, human resource, product capability and policy requirements.
- Assessing data and information on rice production, marketing, distribution and consumption in target countries.
- Conducting cost-benefit and break-even analyses to enable documentation of economic benefits and market demand associated with deployment of the transgenic rice in Sub-Saharan Africa.
- Evaluating the expected impact of the project in the target countries in terms of rice yields, income, welfare, trade and smallholder agriculture.
- Conducting an analysis of the seed delivery systems in the target countries and recommending an effective seed system for the project.
- Assessing socio-cultural factors likely to influence development and uptake of transgenic rice, including consumer preferences and acceptability.

Challenges and next steps

Although the project is still at the early product development stage, so far the laboratory activities for product development are progressing as scheduled. The only major problem encountered was the loss of the first four experiments due to overgrowth of *Agrobacterium*.

In order to progress beyond the research stage, to the development and commercialisation of the rice varieties with enhanced nitrogen use efficiency and salt tolerance, the current material transfer agreements will be augmented by license agreements. The AATF Legal Counsel will work with the IP team from PIPRA and Arcadia Biosciences to review the necessary set of agreements to support the use of the plant transformation for this project.

A field protocol will be developed, based on Arcadia Biosciences and International Center for Tropical Agri-

Paul Kofi Dartey

I have been working on rice for the past 17 years as a rice breeder, evaluating rice lines obtained from international centres and making crosses aimed at obtaining adapted, high yielding varieties. In that time, I have been able to understand first-hand the challenges of rice production in my country.

In Ghana, rice is the second most important cereal. Ghana is a country of great cuisine, which varies from one region to the next. But rice is one food that is enjoyed throughout the country. Indeed, everyday, the aroma of Jollof rice, a spicy dish that includes tomato sauce and meat, wafts across the country; from homes to 'chop bars'. Every school child's lunch box is certain to contain rice. Rice is also the main food in the school-feeding programme.

Our estimated national consumption of rice per year is 561,400 tonnes. On the other hand, our local production is estimated at 107,900 tonnes, representing just 19.2% of the demand. Therefore, every year we have to import close to half a million tonnes of rice to make up the deficit. Ghana currently spends around USD 700 million on rice importation, working out to USD 200 to USD 300 per household.

In 2008, as a result of the world food crisis, the price of rice rose by over 100% from the previous year – the highest rise for any single crop. These price hikes were also driven by the rapid changes in people's lifestyle and eating habits, particularly in urban areas, which have increased rice consumption. When we compute population growth alongside the increase in per capita consumption, we can project a rise of 1,680,000 tonnes per year after 2015.

From a production point of view, the picture is markedly different. Most of the country's land is suitable for rice production. Currently, we grow rice in three ecologies: upland, rainfed

culture (CIAT) standard operating procedures (SOP). In addition, a Memorandum of Understanding (MOU) will be signed between CIAT, USAID and AATF for CIAT to start the preparation of the CFT.

The activities to be carried out at the NARS institutes will include the testing of non-transgenic upland NERICA-4 varieties for agronomic performance, milling and market acceptability. The NARS will also conduct seed amplification, milling and sensory tests for the lowland NERICA-19. They will also select and advance the preparation, including the levelling and set up of irrigation facilities, of sites for the N deficiency variety CFT. They will also commence work on the isolation and depletion of soil N with maize and conduct preliminary survey and soil analyses for salinity.

In regard to regulatory compliance, a preliminary biosafety assessment of the DNA sequences of the genes and promoters, terminators and introns will commence. The team will also outline the activities to be carried out in 2010 in preparation for the CFT to be carried out at CIAT and by the NARS partners.

Right: NUE rice at flowering stage.

lowland and irrigated ecologies, totalling about 118,000 hectares, with average yields of 1.5, 2.5 and 3.5 metric tonnes per hectare, respectively. However, rice production in Ghana is constrained by several biotic and abiotic factors. For instance, nitrogen deficiency occurs throughout the country. Mitigating this deficiency through the application of organic fertilisers is impractical, due to the huge quantity required. Fertiliser costs are high and the government has to subsidise prices by half the cost. Fallowing periods would allow for regeneration of fertility, but this has dwindled because of pressure on land from the growing population. The application of inorganic fertilisers remains the best option.

Therefore, the possibility of rice varieties that will use available nitrogen efficiently is welcome news to rice scientists, farmers and the Ghanaian economy as a whole. The increased domestic rice production will contribute directly to foreign currency saving and balance of payment, in addition to improving farmers' economy. It will also keep rice breeders in employment.

Another constraint is drought, which is a recurrent problem nationwide, and which is likely to get worse due to climate change. In recent years, drought has occurred when the rainy season should be at its peak. Our irrigation facilities are rudimentary and not widespread. Moreover, rice varieties differ with respect to drought tolerance and this is exploited in breeding. Drought can cause total rice crop failure. We therefore need plants that will utilise water efficiently.

The other problem is salinity, which occurs mostly in coastal soils and on irrigated schemes. In 2009, AATF supported us to survey 17 coastal soils. Thirteen sites had high salt contents, out of which, four, namely Ashaiman, Afife, Kpong and Okyereko, were growing rice. We sampled the rice crop on these four sites and found them to be poor and we are, therefore, looking forward to salt tolerance genes being incorporated into rice.

The AATF-coordinated NUE/ST rice project is very good news, and offers some hope to rice farmers. As a breeder, I see it as a vehicle to bring transgenic rice varieties possessing combinations of nitrogen use efficiency, water use efficiency and salinity tolerance to Ghanaian rice farmers. I am also excited by the possibility of freely backcrossing these genes into other varieties. These genes, particularly the NUE and WUE, could be bred into all our future rice varieties without restrictions from patent owners. Although a myriad of other harvest and postharvest problems have to be overcome, improving nutrient and water use efficiency in rice covers quite a lot of ground towards producing quality rice in Ghana, which would compete favourably with quality imports.

Above: A group of houses in a Nigerian village.

Farmers Embrace AflaSafe™, the First Indigenous Aflatoxin Biological Control Product in Africa

The AATF, IITA, USDA-ARS and other partners have developed an indigenous biological control technology, named AflaSafe™, to mitigate aflatoxin contamination in maize and groundnuts. In 2009, nearly two tonnes of AflaSafe™ was deployed to 86 farmers in five zones in the Kaduna and Oyo States of Nigeria. The farmers embraced the technology and remarkable differences were observed in maize and groundnut crops.

In many countries of Africa, high levels of aflatoxin – a highly toxic, carcinogenic poison produced by a few species of *Aspergillus* – are found in food grains including maize, cassava, sorghum, yam, rice, groundnut and cashews. Most smallholder farmers are unable to prevent aflatoxin contamination during the production and storage of their crops. Moreover, as is the case in many developing countries, African governments often lack cost-effective ways to test for these poisons. As a result, many people in Africa may be chronically exposed to aflatoxins in their diets, putting their health and lives at severe risk. In addition, African countries lose millions of dollars each year due to the rejection of commodities that fail to comply with food safety and quality standards.

The International Institute of Tropical Agriculture (IITA) has been researching new, cost-effective bio-control methods that can reduce the threat posed by aflatoxins to consumers across Africa. This approach involves establishing benign strains of selected *Aspergillus* strains in the soils around crops as they grow. The goal is that the benign strains will out-compete and largely eliminate the aflatoxin-producing strains of the fungus. Based on successful laboratory and on-station field trials, AATF, IITA and the United States Department of Agriculture Agricultural Research Service (USDA-ARS) have established a project for the development and dissemination of a locally adapted microbial for controlling aflatoxin in maize and groundnuts. The objectives of this initiative include obtaining regulatory approval and gathering more efficacy data of the biocontrol product through farmer-scale evaluation, prior to commercialisation.

AflaSafe™ – first indigenous aflatoxin biocontrol technology in Africa

In 2009, IITA and USDA-ARS developed an indigenous biological control product, named AflaSafe™, which contains a mixture of four atoxigenic strains originating from Nigeria on sorghum grain as a carrier.

As with any new product, much documentation was required before AflaSafe™ could be deployed in farmers' fields. Through the services of a trademark and patent lawyer hired by IITA and working with an IITA consultant, a trademark approval for AflaSafe™ was obtained from the Nigerian Trademark Registry Office in Abuja. Due to time limitations, the partners decided to seek a 'listing' status for Aflasafe™, pending full registration, from the apex Nigerian regulatory body, the National Agency for Food and Drugs Administration and Control (NAFDAC). A 'listing' status enables the testing

Alhaji Sanusi

My name is Alhaji Sanusi and I am a farmer from Zaria, Nigeria. I have been farming for ten years now, mainly cultivating maize. For a long time, like many other farmers in my region, I considered the lack of implements, such as fertiliser, to be the main constraint in my efforts to grow this important cereal. Infact, for a long time I was not totally aware of aflatoxins.

Although I would observe the fungi on the maize grains, I did not have proper understanding of its dangers. I can say that I did not take the problem seriously enough. A few years ago, I heard that the IITA researchers were conducting research in a nearby farm. I got interested in what they were doing and I invited them to visit my farm. When they came to my farm, they were impressed by the efforts I had put in. Since then, we became good friends and they have been providing me with advice from time to time on many farming issues.

IITA researchers then invited me to a workshop on aflatoxins held at their centre in Ibadan, that is when I learnt about the profound effects of aflatoxins on people's health as well as economically. When IITA developed AflaSafe, my farm was selected as a site for the trials. As a matter of fact, mine was the first farm in the whole of Nigeria to be applied with the product. My workers and I have been keenly observing the progress of the maize on the plot where AflaSafe has been applied. We are encouraged by the improvement, as we have so far not noticed any fungi on the grain. My wish is that the product will be made readily available to all maize farmers in the region.

Left: A farmer spreading AflaSafe™ in a maize field in Nigeria.

of the technology in up to 100 hectares of farmers' fields, under 'real life' situation, thereby allowing the manufacturing and testing of AflaSafe™ so as to gather more efficacy data.

Enthusiastic response from farmers

During June and July 2009, nearly two tonnes of AflaSafe™ was produced in IITA using a laboratory scale manufacturing protocol. A packaging system, comprising product labels and safety instruction sheets, was then developed. This enabled the transportation of the innoculum safely to northern Nigeria, where, in collaboration with the Kaduna State Agriculture Development Project and United Nations Development Programme (UNDP) Pampaida Millennium Villages Project, AflaSafe™ was deployed to 86 farmers in five zones in the Kaduna and Oyo states.

The deployment of AflaSafe™ commenced on 11 August, in collaboration with partners in Maigana, Lere and Birnin-Gwari zones, a cluster of several villages under the Pampaida project, all in Kaduna State, and one village in Ogbomosho Local Area Government in Oyo State.

Of the 70.6 hectares treated with AflaSafe™, 95%, belonging to 80 farmers, was under maize cultivation while the remaining 5%, owned by 6 farmers, was planted with groundnuts. Prior to treatment with AflaSafe™, soil samples were taken from the plots to measure the native population structure of *Aspergillus flavus*. Soil and grain samples were taken at harvest to determine the extent of changes in the *Aspergillus* community structure in favour of the applied biocontrol strains. For each treated field, an adjacent field where AflaSafe™ was not applied served as control to allow pair-wise comparison of the efficacy of the biocontrol technology. A total of 40 hectares was set aside for this purpose. The crops were treated at various growth stages with different dosage rates to determine the optimal time and dosage for treatment. In almost all the fields, the atoxigenic strains began to sporulate on the carrier sorghum grains within three days after application.

In all the trials areas, presentations were made to the farmers on aflatoxin and its management, with special attention to biocontrol. Several extension officers were trained on how to treat farmers' fields with AflaSafe™ before they proceeded to their respective constituencies to carry out the exercise initially under the supervision of IITA staff. Officials from NAFDAC monitored the deployment of AflaSafe™ in one of the fields in Ogbomosho, harvesting in three fields in Kaduna State, and sample collection. The officials were satisfied with the procedures followed for the deployment of AflaSafe™.

Private sector partnership

AATF and partners appreciate the crucial role of the private sector in ensuring that the full benefits of AflaSafe™ are realised. On 14 July, IITA, USDA-ARS and AATF held a meeting with Nigeria's Federal Minister of Health, Prof Babatunde Osotimehin, to discuss the health and trade impact of aflatoxins and the need for its management. The partners presented the minister with a jointly-developed concept idea on the management of aflatoxin. Prof Osotimehin then asked for a project proposal for inter-ministerial consultation with the Agriculture Ministry. It was agreed that public-private partnerships for up-scaling AflaSafe™ would be one of the components of the proposal.

In addition, the Pampaida project has contacted three food and feed manufacturers in an effort to link farmers to the manufacturers. It is anticipated that the farmers will be able to sell their high quality product at a premium to the manufacturers.

Challenges

One of the key challenges that the partners faced in the process of deploying and testing the efficacy of AflaSafe™ was an underestimation of the time and effort required for preparing the dossier for registration. They also encountered lack of clarity in registration procedures since NAFDAC had not registered any biopesticide before AflaSafe™. Some of the protocols and documentation requirements for registration were therefore new to both NAFDAC officials and project partners. The partners were able to overcome these hitches by building a good relationship and rapport with various officials in NAFDAC through two workshops. The first was the Biopesticides Registration Training Workshop co-organised in 2008 with the USDA–Foreign Agriculture Service. The second was a stakeholders' workshop in March 2009, where NAFDAC, project partners and other stakeholders discussed the potential of the biocontrol technology.

The demand from farmers to treat their fields with AflaSafe™ was way beyond the amount of inoculum that could be supplied from the lab-scale manufacturing process. In the Pampaida area alone, over 80 farmers wanted to treat their fields but the Pampaida Millennium Village project handling the deployment decided to restrict testing to 10 farmers and only five hectares.

Additionally, although the private sector has been supportive of the project, it is not clear if companies, except Nestlé, are willing to pay a premium for aflatoxin-safe maize and groundnut.

Next steps

In 2009, AflaSafe™ was supplied free of cost to the farmers who participated in testing its efficacy. It is not possible to continue supplying the technology free of cost in the future. It is therefore necessary to determine the farmers' willingness to pay for the product and so a business plan for AflaSafe™ is needed including commercial scale production of AflaSafe™.

NAFDAC has provided provisional registration of AflaSafe™ for a period of two years. During this period, on-farm data to demonstrate the efficacy of AflaSafe™ in reducing aflatoxin will be gathered and NAFDAC will monitor activities during the testing process. Therefore, a report on efficacy trials will be submitted to satisfy documentation requirements for full registration. Certification for the manufacturing facility will be sought from the Inspectorate Services of NAFDAC.

Above: A traditional house in Tanzania.

Right: A lady farmer in her sorghum farm in western Kenya

Product Concept

Striga *Control in Smallholder Sorghum Fields in Sub-Saharan Africa*

The constraint

Sorghum is Africa's second most important cereal. The continent produces about 20 million tonnes of sorghum per annum, about one-third of the world crop. The potential for sorghum to be the driver of economic development in Africa is enormous. However, sorghum yields in SSA remain low because of factors such as poor agronomic practices, lack of commercialisation of the crop resulting in low use of productivity enhancing technologies, and *Striga* which affects most sorghum growing areas of SSA.

There are two *Striga* species that attack sorghum, *Striga hermonthica* and *Striga aspera* with *hermonthica* being the most widespread and most damaging to sorghum. Studies have shown that sorghum is the major host for *Striga* reproduction, thus perpetuating the spread of the parasite in the farming systems. The weed is widespread and destroys 40%–100% of a season's crop in Africa.

A recent feasibility study carried out by AATF on the potential benefits of developing HR sorghum shows an estimated loss of US$7 billion per annum caused by *Striga*. There is overwhelming evidence that despite advances in *Striga* control methods in sorghum, the weed continues to contribute to high levels of production losses.

The strategy

Herbicide (imidazolinone) resistant maize varieties have recently been found to be successful in combating *Striga* infestations in maize. The technology has been shown to have potential for application in sorghum. Coating sorghum seeds with herbicide could therefore be used as part of an integrated approach to prevent damage from parasitic *Striga hermonthica*.

Proof of concept has shown that HR sorghum has potential to protect sorghum against *Striga*, reduce *Striga* seed colony in the soil and improve sorghum

yields. The feasibility study carried out by AATF on the project in Ethiopia, Mali and Nigeria indicates potential benefits include higher yield gains and farm incomes from use of HR sorghum varieties that will range from US$11 million to US$83 million. Its success will depend on a well networked partnership for effective technology development and deployment.

AATF is exploring a partnership project with DuPont, Kansas State University, Purdue and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to develop herbicide resistant (HR) sorghum for *Striga* weed control in sorghum. The project will build on existing knowledge on *Striga* control to increase cereal production in the arid and semi-arid areas where sorghum is the flagship cereal crop in Sub-Saharan Africa (SSA).

Above: The lush terrain of Uganda, with a traditional homestead in the foreground.

Top right: Greenhouse at a village in Henan Province, China.

Bottom right: Tomatoes in a green house in China.

Chinese Agricultural Technologies Could Provide New China-Africa Mode of Engagement

In 2009, AATF, in collaboration with a team of consultants, produced the first comprehensive report on the relevance of Chinese agricultural technologies in smallholder farming systems in Sub-Saharan Africa (SSA). The study, which was commissioned by the Rockefeller Foundation in preparation for the 2009 Forum on China-Africa Co-operation (FOCAC) meeting held in Egypt, provides an opportunity for a new mode of engagement between China and Africa.

Background

In 2008, in preparation of the fourth Forum on China-Africa Co-operation (FOCAC) meeting, AATF was commissioned by the Rockefeller Foundation to conduct a study on the relevance of Chinese agricultural technologies in smallholder farming systems in Sub-Saharan Africa (SSA). FOCAC is the main mechanism for structured dialogue between China and Africa, and the 2009 forum offered an opportunity for catalysing new thinking on Chinese-African engagement.

The project objectives included carrying out an assessment of the productivity constraints faced by smallholder farmers in SSA; the level of Chinese

involvement in African agriculture; investigating the agricultural technologies that are available to Chinese smallholder farmers which can be used within the African smallholder farming community to address productivity constraints; identifying the criterion for selecting Chinese agricultural technologies that are suitable for smallholder farmers in SSA; and detailing the strategies for the access and transfer of such technologies to smallholder farmers in SSA.

Research in Africa

To highlight the constraints faced by smallholder farmers in SSA, the research was conducted in nine countries: Kenya, Ethiopia, Tanzania, Ghana, Burkina Faso, Nigeria, Malawi, Mozambique and Zambia; representing east, west and southern Africa. Information was sourced from National Agricultural Research Systems (NARS), government departments of the various countries, continental and regional bodies such as the East African Community (EAC), the Economic Community of West African States (ECOWAS), the New Partnership for Africa's Development (NEPAD), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the South African Development Community (SADC) and Le Conseil Ouest et Centre Africain Pour la Recherche et le Developpement Agricoles (CORAF).

The team also collated data from Non-Governmental Organisations (NGOs), community-based organisations (CBOs), agricultural universities and private organisations. This investigation revealed numerous constraints to agricultural productivity in SSA, including poor soils, drought, limited access to improved varieties, lack of irrigation facilities, poor water harvesting and management, high pest and disease incidences, low mechanisation, poor research and extension, and ineffective government policy in agriculture.

Research on Chinese agricultural technologies

The technologies used in the Chinese agricultural sector were examined, and an assessment made of those that would be useful to smallholder farmers in SSA agriculture. Structured ways in which these technologies could be made available and accessible to smallholder farmers in SSA were also looked into. The study established an array of basic to cutting edge Chinese agricultural technologies that would be useful in SSA.

These included marker-assisted breeding and recombitant gene technologies, germplasm improvement

through conventional breeding and molecular techniques, pest and disease control, mechanisation, weather forecasting and information technology systems.

The study established that a number of Chinese agricultural technologies could be useful in addressing the constraints faced by African smallholder farmers. The key Chinese agricultural technologies identified include:

- improved crop varieties, such as high fertiliser use efficiency super rice hybrid, with yields as high as 13.5 tonnes per hectare that may be suitable for the rice growing regions of SSA
- varieties of multiple-disease resistant high-yielding wheat and maize
- slow release fertilisers
- dryland technologies, water conservation and harvesting techniques

Possible technologies for transfer from China included supplementary irrigation, micro-irrigation and plastic mulch. Also noted as useful for Africa were land management practices and policies; re-organisation of a moribund agricultural extension system; technologies for reducing post-harvest losses; mechanisation with appropriate technology to increase labour productivity; and integrated aquaculture farming that focuses on joint production of fish, livestock and crops.

The study recommended a strategy for the adoption of these technologies for the benefit of Africa's smallholder farmers. From the Chinese experience, the importance of facilitation through creation of an enabling environment, encompassing capacity of information systems, research and extension, farmer groups, markets and infrastructure were noted as critical in exploiting the potential impact of agricultural technologies.

The AATF report proposed that FOCAC could be used as a conduit to facilitate access and delivery of these technologies for smallholder farmers in SSA. The report further recommended that the forum should focus on invigorating agricultural production in Africa as the foundation for economic growth. In also proposes that the China–Africa Development Fund (CADFund) should be used for investment projects in agriculture. In this regard, it was noted that more awareness on the fund and how to access it was required for the mutual benefit of the African farmer on the one hand and the Chinese investor on the other.

The report proposed public-private partnerships, collaborative research and extension, policy intervention, capacity building, infrastructure development and efficient markets as options for transferring the Chinese agricultural technologies. However, the report cautioned that the success of such efforts is dependent on certain environmental and infrastructural prerequisites. For instance, a quick review of the agrarian reform in China suggested that the policy environment, which enabled agricultural growth in China, is far removed from the

situation in Africa today. If the agricultural production in SSA is to move beyond subsistence for the farmers, it is imperative that the market infrastructure is developed to bring positive change in the socio-economic circumstances of the smallholder farmers in SSA.

The AATF report provided an opportunity to introduce a new mode of engagement between China and Africa. In addition to trade, any investments by China could be supplemented by access to relevant Chinese agricultural technologies to stimulate African agricultural development for the purpose of alleviating poverty and attaining food sufficiency. The project therefore helped to mainstream agriculture as a priority in the China-Africa economic and technological cooperation. While Africa boasts abundant agricultural resources, China is a large agricultural country with mature and applicable agricultural technologies.

The research highlighted the progress, challenges and lessons in the implementation of the Chinese agricultural commitments made during the 2006 FOCAC meeting, which is crucial for policy makers. It also underscored the current productivity constraints affecting agricultural productivity in SSA. The report catalogued the available Chinese agricultural technologies that can be harnessed to transform African agriculture through public-private partnerships. It also opened up dialogue between heads of states from African countries and China in terms of identifying areas of beneficial agricultural investments from an informed viewpoint. The report will also increase awareness among African decision-makers of new areas where China could make contributions to Africa's agricultural development, and highlight the role that AATF could play in facilitating access to, and delivery of these technologies to smallholder farmers in Africa.

The study contributed to AATF's mandate of scouting for agricultural technologies for the benefit of African smallholder farmers. As a result, a number of proprietary agricultural technologies have been identified and plans for their access will be formulated in due course.

The report was disseminated during the FOCAC meeting, held in Cairo from 6 to 8 November 2009, to representatives from SADC, EAC, CORAF/WECARD countries, the African Union (AU), ECOWAS, the Food and Agricultural Organisation (FAO) and the China Africa Summit.

Next steps

AATF has commenced plans leading to the acquisition of identified proprietary agricultural technologies, including the development of concept notes for possible projects.

The information from the study will be shared with policy makers who will be dealing with China to ensure that they enter into negotiations from an informed position for the benefit of African countries.

Left: A group of houses in Tanzania, surrounded by farmland.

Right: Greenhouse for horticulture.

Above: A traditional homestead in Kenya.

Right: Some participants during the OFAB Nigeria chapter launch in April 2009.

OFAB: Creating Awareness for Advanced Agricultural Technologies

The need for application of advanced agricultural technologies to overcome the biotic and abiotic stresses that continue to ravage African agriculture is growing. As this need grows so does that of creating awareness and public acceptance of novel technologies such as those from biotechnology. The Open Forum for Agricultural Biotechnology in Africa (OFAB) initiative has continued to play this crucial role.

An initiative of the AATF, OFAB is currently operational in four countries in Africa, bringing together a wide range of stakeholders in African agricultural development. The forum enables interaction among scientists, journalists, industrialists, representatives from civil society organisations, lawmakers and those who formulate and decide upon policies affecting agriculture. The Forum provides opportunities for these groups to share their knowledge and experience, exchange information, make new contacts and explore new ways of bringing the benefits of biotechnology to Africa's smallholder farmers. At the same time, it affords participants the opportunity to raise concerns and deliberate on issues relating to the safety and perceived risks of biotechnology and especially genetically modified organisms (GMOs).

The past one year saw the number of countries hosting OFAB chapters increase from two to four. New chapters were launched in Nigeria and Tanzania to complement the Kenya and Uganda ones. OFAB Nigeria is a partnership between AATF, Nigeria's National Biotechnology Development Agency (NABDA) and the Agricultural Research Council of Nigeria (ARCN). It was launched in April 2009 in Abuja, Nigeria. The Tanzania chapter was launched in May 2009 in Dar es Salaam and is a partnership between AATF and the Tanzania Commission for Science and Technology (COSTECH).

The monthly lunch hour OFAB meetings continued during the year in the four countries with a variety of topics for discussion. In Uganda, topics presented and discussed included the role of biotechnology interventions in banana and coffee wilt diseases and in the livestock and cotton sector. The forum continued to provide an avenue for deliberations and discussions of the proposed Biosafety Bill whose formulation process is still ongoing.

The launch of the Nigeria chapter was received with a lot of enthusiasm. Each meeting was attended by representatives from the media, scientists and key government officials from the ministries of science and technology, information and communication, commerce and industry and environment. Other decision makers including members of the parliamentary committees on agriculture also attended the meetings. The highlight of the chapter's activities was the November forum that was hosted specifically to create awareness and prepare stakeholders for the public hearing of the Biosafety Bill that was to be held in December.

OFAB Tanzania was welcomed as one of the avenues that would improve understanding of biotechnology among the public. This was especially important to Tanzania because of the low public awareness and understanding of biotechnology in the country and recognition of the great implication that has not only brought in successful application of biotechnology in research for development, but also on the acceptance of the products. During the launch of the chapter, Tanzania's Minister for Agriculture, Food Security and Cooperatives, Hon Stephen Wasira, highlighted the government's 'Green Revolution Programme', which he said was aimed at addressing agricultural constraints and increasing productivity. The green revolution, he said, will be achieved through use of innovative and modern agricultural technologies that may include both conventional methods as well as modern biotechnology.

Some of the key presentations and discussions at OFAB Tanzania were around the possible contribution and success of genetic engineering of cassava against diseases and a public lecture on the evolution of the biotechnology industry from research, product development to commercialisation.

OFAB Kenya chapter continued to grow and improve on the variety of discussion topics. One of the most attended and interactive session was led by a theologian on the theological perspectives of biotechnology who touched on the ethical concerns around biotechnology especially concerns that biotechnology was 'playing God'.

The interactive platform provided by OFAB in the countries has proved to be an effective avenue of involving the various publics in discussing agricultural biotechnology and its usefulness in Africa. It has also provided an ideal avenue for the media to interact with scientists and contribute towards creating awareness on biotechnology.

Above: Traditional homes in a rural village in South Africa.

Financial Report

This audited Financial Statement covers the period from January 2009 through December 2009 and provides comparative data for the two previous accounting periods (2008 and 2007).

Income

Total income for the period was lower than 2008 due to an unexpended grant amount of about $5,000,000 whose receipt was deferred to year 2010. The AATF donor base changed slightly during this period due to a change of strategy by the Rockefeller Foundation in 2008 and a decision not to renew their grant to our organisation. AATF however continued to receive the Foundation's support and commitment through other initiatives. We convey our great appreciation to all our donors for their continued confidence and support.

Expenditures

An overview of the expenditures for the period compared to last year shows a 24% decrease on project expenditures and a 23% increase in management and general expenses. The low 2009 project expenditure resulted from unspent balances by the WEMA project at the end of 2008 which caused a reduced disbursement of funds to partners in 2009. The management and general expenses generally remained at the same level as 2008 and the increase noted in the financial statement resulted from a loss on foreign exchange.

The year's allocations are in line with the AATF model of working through partnerships. Out of the total $10,530,811 spent, $6,473,625 (72%) was for outsourced research activities, 3% more than in 2008 when the percentage was 69%.

Deficit

The financial statement shows a deficit of about $1,000,000 meaning that the expenditure for the year is higher than the income for the same period. This deficit is due to the deferment to 2010 of the disbursement of about $5,000,000. The excess expenditure was funded from a surplus carried forward from 2008.

The tables below summarise the statement of activities and the statement of financial position.

Summary statement of activities (abridged version) for the period January–December 2009

	2009 (US$)	2008 (US$)	2007 (US$)
Income			
Grants	9,514,286	14,794,436	3,508,692
Other income	2,802	189,267	83,905
Total income	**9,517,088**	**14,983,703**	**3,592,597**
Expenditures			
Project related expenses	8,977,526	11,827,954	2,920,759
Management and general expenses	1,553,285	1,258,017	711,131
Total expenditure	**10,530,811**	**13,085,971**	**3,631,890**
Surplus/(deficit) for the period	**(1,013,723)**	**1,897,732**	**(39,292)**

Statement of financial positions (abridged version) as of 31 December 2009

	2009 (US$)	2008 (US$)	2007 (US$)
Assets			
Non-current assets			
Equipment and motor vehicles	157,634	76,061	30,911
Intangible assets	1,359	-	-
Total non-current assets	158,993	76,061	30,911
Current assets			
Bank and cash	2,176,994	541,840	388,538
Call deposit	4,000,000	-	-
Fixed deposit	-	1,283,669	1,042,076
Accounts receivables	494,015	950,726	323,122
Total current assets	6,671,009	2,776,235	1,753,736
Total assets	**6,830,002**	**2,852,296**	**1,784,647**
Liabilities and fund balances			
Current liabilities			
Unexpended grants payable	5,109,739	-	1,000,000
Accounts payable and accrued expenses	304,874	423,184	253,267
Total liabilities	**5,414,613**	**423,184**	**1,253,267**
Fund balances			
Restricted	797,789	1,283,731	165,528
Unrestricted	617,600	1,145,381	365,852
Total fund balances	**1,415,389**	**2,429,112**	**531,380**
Total liabilities and fund balances	**6,830,002**	**2,852,296**	**1,784,647**

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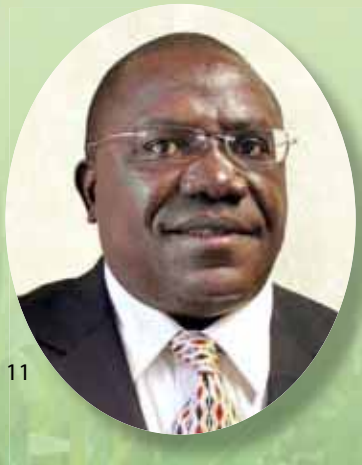
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3 • Moussa Elhadj Adam • Administration and Finance Manager
4 • Richard Boadi • Legal Counsel
5 • Alhaji Tejan-Cole • Legal Counsel
6 • Francis Nang'ayo • Regulatory Affairs Manager
7 • Gospel Omanya • Seed Systems Manager
8 • Nancy Muchiri • Communications and Partnerships Manager
9 • Nompumelelo H Obokoh • Project Manager Cowpea
10 • George Marechera • Agribusiness Specialist
11 • Sylvester Oikeh • Project Manager, WEMA
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13 • George Obanyi • Communications Officer
14 • Peter Werehire • Publications and Website Officer
15 • Grace Wachoro • Project Communications Officer
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17 • David Tarus • Programme Assistant
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22 • Fatuma Wario • Administrative Assistant/Events Coordinator
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24 • Joan Abila-Oballa • Events Coordinator
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26 • Gordon Ogutu • Protocol and Liaison Assistant
27 • George Njogu • Driver


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