PROCEEDINGS OF THE VISIT BY MEMBERS OF PARLIAMENT TO BIOTECHNOLOGY FACILITIES AND FIELD TRIALS IN KENYA

JULY 2007

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Proceedings of the visit by Members of Parliament to biotechnology facilities and field trials in Kenya

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1 Introduction

The study tour by honourable Members of Parliament and other biotechnology stakeholders' was organised by the Kenya Agricultural Research Institute (KARI) in collaboration with the International Service for the Acquisition of Agribiotech Applications AfriCenter (ISAAA) and the African Biotechnology Stakeholders Forum (ABSF).

The tour was organised at a time when the biosafety bill is awaiting debate in Parliament. The aim was to create awareness and educate parliamentarians and other stakeholders on the institutional, technical and human capacities available in Kenya for responsible and safe research, development and application of modern agricultural biotechnologies for economic development, poverty reduction and wealth creation. It also provided an opportunity for the Parliamentarians and stakeholders to familiarize themselves with existing investments in modern biotechnology and to interact with local experts in fields of biotechnology. The delegation included MPs, drawn from various Parliamentary Select Committees – Education, Science and Technology, Health, Trade, Agriculture, Environment and Natural Resources, scientists and various stakeholders from the press and civil society. The delegates toured various biotechnology facilities including the Kenya Agricultural Research Institute (KARI) Biotechnology Centre, Tree Biotechnology Project, Jomo Kenyatta University of Agriculture and Technology and KARI-Mwea *Bt*-cotton trial site.

The members of Parliament in attendance were Hon. Daniel Karaba, Hon. Alfred Nderitu, Hon. Sammy Weya, Hon. Charles Kilonzo, Hon. Prof. Christine Mango, Hon. Prof. Ayiecho Olweny, Hon. Lucas Chepkitony, Hon. Julius Arunga, Hon. Mbae, Hon. Moffat Maitha, Hon. Kiema Kilonzo, Hon. Mutinda Mutiso and Hon. Charles Keter. The MPs were accompanied by among others, government officials from the Ministry of Agriculture, KARI, National Council for Science and Technology, the National Biosafety Committee, ISAAA, ABSF, AATF, Media and farmers.

2 Commmentaries from CEOs of orgarnising institutions

2.1 Dr. Ephraim Mukisira, Director KARI

Dr. Mukisira welcomed the honourable members of parliament and other participants to the Kenya Agricultural Research Institute (KARI) and thanked the members for taking their time to participate in the study tour. He explained the main function of KARI was to conduct agricultural research of strategic national importance and produce improved technologies, information, knowledge and approaches to support the agricultural sector. He asked the members to support KARI by pushing for necessary legislation that would enable researchers carry out research in agriculture. He added that agriculture is not just for subsistence but that KARI envisions a commercially oriented agriculture as a result of innovative technologies.

He paid tribute to scientists in the National Agricultural Research System (NARS) who had worked hard to bring biotechnology to its current level in the country. He hoped that the tour would help all the stakeholders including the 15 MPs to familiarize themselves with the current status of the existing capacity for biotechnology and potential in the country. With this background information, he hoped policy makers would spark a healthy debate on the Biosafety bill currently before Parliament leading to the enactment of the necessary Biosafety Law that would guide GM products research, commercialization and trade.

2.2 Prof. Norah Olembo, Executive Director ABSF

Prof. Olembo said that lack of legal framework hindered commercialization of biotechnology products in East Africa. She said that there was an urgent need for various stakeholders including parliamentarians, government, media scientists, farmers and the civil society to work towards a speedy enactment of a biosafety legal framework. Production of GM crops has rapidly increased in those countries which adopted the technology since its initial commercialization in 1996. Professor Olembo informed the delegates that she was working with other institutions like ISAAA, Africa Harvest, Biotechnology Trust Africa and others in pursuit for establishment of a legal framework. She then introduced the CEOs present.

2.3 Dr Margaret Karembu, Director ISAAA AfriCenter

The Director of ISAAA Africenter Dr. Margaret Karembu expressed satisfaction with the event and appreciated presence of the country's key stakeholders on biotechnology. She paid tribute to the parliamentarians present saying it was indeed a great day when all had left their comfort zones to literally showcase and affirm Kenya's capability and infrastructural capacities in the field of modern biotechnology.

To the parliamentarians, she said, "the message is very clear, the country is ready and fully prepared to apply modern biotechnology in key agricultural sectors – crops, livestock and forestry. What we urgently need is a legislative framework to ensure the technology is deployed safely and responsibly. Fast tracking the Biosafety Bill and enactment into a Law would therefore accord researchers and other stakeholders the necessary legal backing to translate this massive capacity into products for the benefit of our people. She reiterated ISAAA's commitment in sharing knowledge and international experiences on the technology to inform the decision-making process based on international best-practices.

3 Biotechnology applications

3.1 Biotechnology activities at KARI-Biotechnology Centre

3.1.1 Dr. Patrick Gicheru, Centre Director KARI-Kabete

Dr. Gicheru, the Centre Director of KARI-Kabete welcomed the delegates to the Centre and invited the Director KARI to officially welcome the visitors to the Centre. He informed the delegates that the Centre was responsible for research development programme for agricultural biotechnology, irrigation and drainage, land resource management and analytical services and crop protection.

He explained that biotechnology was a strong component of the Centre which operated various research programmes under the coordination of senior research officers.

3.1.2 Dr. Simon Gichuki, Coordinator Biotechnology Centre

Dr. Gichuki received the delegates at the Biosafety Level 2 Greenhouse laboratory where they were shown the safety procedures that are in place to avoid contamination of local and conventional varieties of Kenyan crops with the GM ones. The group was also led through the various biotechnology research projects that are going on in the centre.

Dr. Gichuki enumerated the various biotechnology achievements in Kenya. He explained that using Tissue Culture scientists have been able to produce clean planting materials for traditional crops such as cassava and bananas for the Kenyan farmer in large numbers. These materials are uniform and produce higher yields therefore ensuring food security. He explained that tissue culture products were not genetically modified.

Dr. Gichuki told the stakeholders that using the facility and the capacity already in place, KARI in collaboration with other partners was carrying out research to come up with genetically modified maize (*BT* Maize) that could resist the stem borer and the larger grain borer popularly known as *Osama*. These two pests have been reported to cause upto 14% maize crop losses in Kenya and Africa. He noted that both conventional breeding and biotechnology were in use in the breeding project but hastened to add that biotechnology was a much faster method that could lead to a new variety in five years as opposed to conventional breeding that takes up to 15 years. Dr Gichuki assured the stakeholders that the biosafety level 2 greenhouse ensured that there was no pollen losses from plants enclosed in it thereby protecting transfer of genetic matter from the test GMO in the enclosure.

KARI scientists are also carrying out an impact assessment of the GM maize, cotton, and sweet potato through long-term entomological surveys both in the laboratory and also in the confined field trials.

3.1.3 Dr. Reuben Soi, Deputy Coordinator Biotechnology Centre

Dr. Soi informed the delegates that the animal health section focused on vaccines and diagnostics for animal diseases. A quick field diagnostic test for contagious bovine pleuropneumonia was demonstrated to the stakeholders. Progress in the development of a novel vaccine for Rift Valley fever was also presented to the MPs. This novel vaccine uses a live attenuated sheep pox virus vaccine to express two genes of Rift Valley fever virus that code for two antigens that are important in inducing protection against Rift Valley fever. The recombinant vaccine would act as a bivalent vaccine for protecting ruminants against both capripoxvirus (sheep pox, goatpox and lumpy skin disease) and Rift valley fever virus.

The recombinant virus has an advantage over the presently used live attenuated Smithburn strain because it is safe to use in pregnant animals. The present Smithburn strain is not safe for use with pregnant ruminants because it is capable of causing abortion. Another advantage is that vaccinated animals can be distinguished from naturally exposed animals because vaccinates have no antibodies to the nucleocapsid protein due to the absence of the nucleocapsid protein in the recombinant virus. Further efficacy and safety trials are planned after authorization has been sought from the National Biosafety Committee. Numerous other vaccines produced at the KARI-Veterinary Vaccines Centre (VVPC) such as foot and mouth disease vaccine, Newcastle, etc were displayed.

3.1.4 Mr. David Mbugua, acting Director Kenya Forest Service

The MPs visited the Kenya Forestry Services - Tree Biotechnology Project (TBP) at Karura Forest where they were welcomed by Mr. David Mbugua, the acting Director Kenya Forest Service. The Director introduced the Vice-Chairperson of the Kenya Forest Service Management Board Mrs. Nancy Gitonga, who was present to receive the distinguished visitors. He thanked the Hon. MPs for choosing to visit Karura and emphasized that the new Forest Act 2005 under which the Kenya Forest Service has been established embraces technology as one way of establishing partnerships with the private sector. He expressed that TBP is a good example of success of a structured

private/public sector partnership in technology transfer which will be replicated across the sector in different areas.

3.1.5 Mr. Benson Kanyi, Programme Manager TBP

The MPs were briefed about the TBP by Mr. Benson Kanyi, the manager of the project. Mr Kanyi cited the project goal as to positively impact the overall economy through accelerated afforestation for a sustainable environmental resource base conducive to socio-economic development and wealth creation. The project objectives include promotion of sustainable forestry through distribution of improved varieties of trees at an affordable cost, contribute towards poverty alleviation by improved access to affordable wood products and creation of wealth at household level and make a significant environmental contribution in the form of increased forest cover in Kenya.

He informed the members that the project produces tree seedlings and clones of hybrid Eucalyptus and a few other trees for Kenyan farmers using tissue culture. The project has a capacity to produce over half a million seedlings and has produced over 13 million seedlings which have been distributed to Kenyan farmers since its inception in 1997. The project also trains and advises on silviculture in the country and is also helping in capacity building in Uganda and Tanzania.

Benson noted that despite the rapid production of high quality and improved clonal seedlings, the unit can not meet the demand of the same from farmers. The program has installed mechanized state of art equipment to hasten packaging but the demand is still growing. However, managers of the project are hopeful that they are not only providing seedlings but are participating in essential technology transfer that will soon enable stakeholders in the sector to start similar ventures to meet the increased demand in the rural areas.

3.1.6 Mr. Joseph Kibe, Chairman TBP Board of trustees

The chairman thanked the Hon. MPs and distinguished visitors and observed the important role such a visit plays in the mainstreaming of technologies through the enactment of enabling policy and legal environment. He emphasized that the success of TBP is the partnership approach and the all inclusive policy maintained throughout all its activities. He encouraged Hon. MPs to incorporate tree planting in their CDF activities and promised increased technical support as far as clonal forestry is concerned. The Chairman also paid tribute to the support extended to the programme by the Government and the financial assistance from Gatsby Charitable Foundation of UK.

In addition he thanked Mondi for the technical cooperation and ISAAA for conceptualization of the clonal forestry technology transfer. He finally thanked the traveling workshop organizers for selecting TBP as one of the area to be visited and looked forward to further institutional strengthening.

3.2 Biotechnology activities at Jomo Kenya Univerisy of Agriculture and Technology (JKUAT)

3.2.1 Prof. Nick Wanjohi, Vice Chancellor JKUAT

The Jomo Kenyatta University of Agriculture and Technology (JKUAT) began developing the tissue culture (TC) technology after it was recognized that the banana production in the country was decreasing sharply.

The main challenge at that time was the emergence of banana pests and diseases which were being reported to be destroying entire banana orchards. Scientists at JKUAT were aware that the TC protocol could eliminate the disease problem and hence Prof Esther Kahangi developed the protocol for tissue culturing banana seedlings. These TC bananas were evaluated in 1993 and were observed to be superior to the other bananas because they matured earlier, had uniform maturity, produced bigger bunches of bananas that directly resulted in higher yields. Introduction of TC banana seedlings resulted in an increase of banana yields from 10 tonnes per hectare to over 50 tonnes per hectare in farmer plots, and over 100 tonnes per hectare in research fields.

Through donor funding a pilot commercial laboratory was started in 1996. A study was later conducted to find out the best method of disseminating the TC banana seedlings to farmers around the country. This study established that the setting up of village banana nurseries was the best method of ensuring rapid and cost effective dissemination of the seedlings and as a result the university has established a number of village nurseries around the country from where farmers easily access the banana seedlings.

The banana TC project has been hugely successful and has benefited many farmers across the country. It provides an excellent example of how biotechnology could be used to directly provide farmers with superior planting material resulting in high yields without necessarily genetically manipulating the plants. Honorable Members need to appreciate that biotechnology is not only about Genetically Modified Organisms or GMOs. It also encompasses Marker Assisted Breeding, Tissue culture among other techniques. The university for example is currently involved in projects that are monitoring the diversity levels in our indigenous plants and animals with a view of ensuring that they are conserved and preserved in a sustainable manner for the future generations of Kenyans. Our scientists are using current biotechnology tools to do this. Prof Wanjohi urged the Mps to pass the Biosafety Bill and especially so because the university would be able to do more if the bill was enacted.

3.2.2 Prof. Esther Kahangi, Deputy Vice Chancellor of Research Production and Extension at JKUAT

Prof. Kahangi welcomed the delegates the Honorable members to the Tissue Culture facility. She informed the delegates that she started the tissue culture project at the university which has been hugely successful. She said that

she wholly supported the Biosafetly Bill and the University could do more if the Biosafety Bill was enacted.
Kenya needs to build its infrastructure and human capacity in order to prepare Kenyan scientists to accept this technology who would then develop our own crops for our people. Doing this would directly contribute to steming the brain drain of our top scientists because they would directly engaged in cutting edge science right here in Kenya. Prof. Kahangi urged the government to invest more in local research institutes and universities to create a good working environment for young Kenyan scientists. The government could for example commit a certain percentage of its GDP, 2-3%, directly to Kenyan research institutes and universities to build capacity, both human and research.

3.2.3 Prof. Anne Muigai, Director Institute of Biotechnology Research JKUAT

Prof. Anne Muigai informed the delegates that the Institute of Biotechnology Research (IBR) was started in 1991 to respond to threats posed to banana production by diseases and shortage of clean planting materials. The institutes' objective among others was to develop scientific techniques for rapid multiplication of disease free banana seedlings.

The delegates were informed that banana is a major food crop in Kenya that earns cash and is a food security crop. She explained that banana production is constrained by pests and diseases hence the program aims at adapting, fine-tuning, and developing Tissue Culture (TC) technology to clean existing orchards and produce clean planting materials, increase plantlet vigour with resultant yield increase, unify productivity and reduce period to maturity. Over time the institute has expanded its technology portfolio to Aloe vera and mushrooms. The delegates were taken through the TC process for bananas, aloe vera and mushroom.
Prof. Muigai called for enactment of biotechnology legal framework to guide the development of biotechnology in Kenya.

3.3 Biotechnology activities at KARI-Njoro

Members of parliament and other distinguished visitors were briefed on the biotechnology activities at KARI-Njoro by the programme head Dr Joyce N. Maling'a. Biotechnology activities include:-

3.3.1 Tissue culture of bananas, sweetpotatoes, cassava, Irish potato and oil palm

The lab produces on average 10,000 bananas annually for both research and farmer use. Existing protocols have been adopted and seedlings from a range of varieties (Cavendish, Goldfinger, Uganda green, Ngombe, Muraru and Jamaga) are been produced. Future plans are to produce farmer desired varieties.

3.3.2 Application of double haploid technique in production of wheat resistant to biotic and abiotic stresses

This technique complements conventional breeding by reducing the breeding cycle to half the time and cutting production costs. Wheat at flowering stage is crossed with viable maize pollen to initiate development of embryo. The plants are then covered with a pollination bag to exclude external pollination for 14-18 days. During this period maize chromosomes are eliminated through a natural process that does not support incompatible hybridization to leave an immature embryo that has half the number of chromosomes. The resultant embryo is then rescued and grown in artificial media under controlled environment for a month. The developing seedling is transferred to soil and at tillering stage, colchicines are applied to double the chromosomes and give a fertile plant which sets seed.

The seed of the plant has individual characters and produces a homozygous progeny. The laboratory has produced 45 double haploid lines since 2000. Of these several lines have been screened for drought tolerance and Russian wheat aphid resistance. One of the lines DH4 is in the final year of National performance trial testing for drought tolerance and is pre-released.

3.3.3 Characterization of cassava landraces for diversity studies

The study aims to characterize local cassava landraces in order to complement the breeding programme. Collections of 60 cultivars from different Research centers in Kenya have been undertaken. The material has been analyzed for biochemical properties and DNA extraction has been done. A protocol has been developed and optimized and will soon be used to assay cultivars using molecular techniques. Preliminary studies show that storing cassava samples under refrigeration gave better quality DNA than that stored under silica gel.

3.3.4 Sweetpotato regeneration studies

The study aims to produce regeneration protocols for sweetpotato landraces. Use of leaf explants to regenerate embryos was more successful than callus explants on five sweetpotato cultivars (J. tressmissino, SPK 013, SPK 004, Mugande, Zappalo).

3.3.5 Marker assisted selection breeding and finger printing of crop varieties

The study aims to develop a screening protocol to select wheat and oil seed breeding lines resistant to various abiotic and biotic stresses. The approach will result in reduced breeding time by accurately identifying potential parents for breeding. Identification of wheat lines with high molecular gluten important for quality protein wheat and identification of drought tolerance, acid soil, and stem rust and Russian wheat aphid resistance genes is ongoing. Several primers are being screened. In addition, fingerprinting of wheat and safflower is being undertaken using various markers.

3.3.6 Optimisation of diagnostic protocol for screening for Banana streak virus disease

The study aims to develop a diagnostic protocol that will enable mass screening of tissue culture bananas for banana streak virus disease. The disease affects all commercial varieties in banana growing regions particularly those developed through tissue culture. The protocol is in use and the laboratory is currently screening 30 bananas per day.

3.3.7 Mutation studies on food crops

Work on induced mutation on food crops begun in 1999 to develop food crops with various biotic and abiotic stresses. They cover wheat, cassava, sesame, rapeseed, bananas and Irish potato. The purpose is to develop high yielding crops with resistance to various stresses. One wheat mutant NJBW1 has been developed with drought tolerance and was released in 2001. Cassava mutants are being screened to select a high nutritional quality and ACMV resistant variety; sesame mutants are being screened to develop a semi-shatter variety for the Rift valley region, rape seed mutants are being screened for high oil content and yields, Irish potato and banana mutant are being screened for disease resistance.

3.4 Biotechnology activities at KARI-Katumani

Robert Musyoki introduced the biotechnology activities at KARI-Katumani citing maize as the staple food for Kenyans grown in all the agro-ecological zones. He pointed out that the main constraints to production in the ASALs of Kenya which form 70% of the country are drought and insect pests.

3.4.1 Marker Assisted Selection

To address these challenges KARI-Katumani Biotechnology programme uses MAS technique to develop drought tolerant and insect resistant maize lines. He demonstrated the use of MAS in the improvement of livelihood of farmers and community in ASALs by taking the delegates through five posters showing the MAS breeding scheme of maize and the theoretical steps undertaken for one to come up with potential lines. He also had a genetic map of maize which showed how loci are linked up in the eight chromosomes.

Posters demonstratin direct applications of breeding for drought tolerant and insect resistance maize were presented. Different steps starting from field crossing, DNA extraction to genome analysis were pointed out. Explanations were offered on how the use of MAS has facilitated a faster way of achieving results which otherwise could have taken a long time if conventional methods were used. The efficiency and reliability of the technology in science was also enumerated. KARI-Katumani is also undertaking genomic characterization of Kenyan bananas using molecular markers.

3.5 Biotechnology activities at KARI-Thika

A poster presentation by Mr. Francis Wambugu displayed the Centre biotechnology programme. The programme is concerned with development of tissue culture protocols of various horticultural crops, for different reasons in support of the KARI-Biotechnology programme and KARI's strategic goals. These crops include banana, vanilla, arabicum, lily, morbydick, gerbera, passionfruit and macadamia.

Banana, a major food security crop especially among small-scale farmers in Kenya has great potential for commercialization and hence poverty reduction, but its successful production is constrained by Fusarium wilt, sigatoka disease, weevils and nematodes. Tissue culture protocols for different introduced and locally selected farmer-preferred banana cultivars are continually being developed with resultant yield increase of about 20%, enhanced maturity and uniformity in production. A field visit of tissue culture banana orchard at the KARI-Mwea confirmed these observations. Successful dissemination of the TC banana technology has been achieved with the help of various stakeholders and development partners in various parts of the countries with several success stories.

Macadamia is the most important nut crop in Kenya is also being researched at the Center. The demand for macadamia planting materials has continued to rise with the availability of high yielding varieties and favorable producer prices, but the conventional propagation techniques are inefficient due to long nursery period of 18-24 months and graft incompatibilities. Propagation through tissue culture offers a potential channel for producing large quantities of clonal planting material of superior varieties within a relatively shorter period.

Vanilla is a newly introduced crop in Kenya that is gaining importance among small scale farmers due to the high market value of vanilla beans. With existing export market in USA, EU and Japan, demand for planting material outstrips supply. Tissue culture techniques are being developed for rapid and large-scale multiplication of disease free vines of vanilla.

Lily cut flower is an increasingly popular cut flower with a fairly steady demand in the international markets. Lilies produce one stem and one bulb thus limiting the speed by which multiplication of planting material can be achieved through bulblet formation. The programme is finetuning tissue culture protocol for for six lily varieties.

Arabicum is an up-coming cut flower that is especially gaining importance among small-scale producers in Kenya. It is conventionally propagated by use of bulbs. However, this method is constrained by high incidences of bulb rot caused by

Erwinia carotovora. A tissue culture protocol that could produce plantlets free of bulb rot and also increased plantlet multiplication rate 30-fold is being fine tuned.

Morbydick, newly selected indigenous flower with high potential in the export market is gaining popularity among small-scale farmers due to its fast growth. However, the current propagation method by seed exhibits phenotypic variations and farmers incur losses from rejects by graders. Tissue culture techniques are being developed for mass production of true-to-type plants.

Gerbera also a suitable cut flower for small-scale resource-challenged farmers due to its high market value and low production costs, takes about 18 months for crowns to mature for splitting to provide planting materials. A tissue culture protocol is being developed.

Passionfruit, a high value crop is facing major production challenges due to pests and diseases. Inadequate clean planting material is one of the main production constraints affecting the passionfruit industry. One of the major disease problems in passionfruit is the systemic viruses particularly the passionfruit woodiness virus and propagation through tissue culture is expected to offer a fast and efficient method of producing clean virus-free planting material.

3.6 Biotechnology activities at KARI-Mwea

3.6.1 Dr Waweru Gitonga, Centre Director KARI-Mwea

Dr Waweru Gitonga, the Centre Director of KARI-Mwea welcomed the delegates to the Centre and invited the Director KARI to officially welcome the visitors to the Centre. He informed the members about the importance of cotton grown by small scale farmers, as a strategic cash crop in low rain fall areas. He said that cotton could offer opportunities for poverty reduction in the marginal areas. Cotton has great potential in the creation of employment at house hold and industrial level since it is a principal raw material for the local spinning and textile industry and has great potential for export and thus foreign exchange.

The delegates were further informed of the collapse of cotton production from 70000 bales in 1985/86 to 20000 bales in 2001. The major input for cotton production goes to pest control and related activities taking up to 32% of the production costs. The African bollworm is the main pest causing damage up to 100% yield loss if no control measures are put in place. He invited Dr. Charles Waturu, the principal investigator of the *Bt*-cotton project to further expound on the Bt Cotton project.

3.6.2 Dr. Charles N. Waturu, Principal Investigator *Bt*-cotton project

Dr. Waturu welcomed the delegates to the *Bt*-cotton Confined Field Trial site and explained the biosafety features put in place to contain the transgenic cotton. He informed the members that the biosafety features were prescribed by the National Biosafety Committee and supervised and approved by KEPHIS on behalf of the NBC. He briefly informed the delegates that the transgenic *Bt*-cotton was a cotton plant genetically engineered to insert two genes from a soil bacterium making the plant toxic to bollworms. The delegates were shown the *Bt*-cotton at the farm and informed that Mosanto International of Switzerland supported the research at KARI-Mwea.

Dr. Waturu informed the delegates that *Bt*-cotton will improve pest control by directly controlling the bollworms while indirectly impacting on the control of sucking pests. This will reduce the number of sprays with pesticides hence reduce environmental pollution and minimize deleterious effect on non-target organisms and human beings. Reduced number of sprays will lead to increased income to farmers. He said that *Bt*-cotton has the potential of getting farmers out of the quagmire of poverty prevailing in the marginal cotton growing areas.

The delegates were informed that findings of first trials with Bollgard I showed that the *Bt*-cotton variety was very effective against target insects like African bollworm, but had no effect on non target parasitic wasps and cotton aphids. Dr Waturu said the current trials of Bollgard II were necessary because it was a better and more efficient technology against the African bollworm. In response to a question about the capacity for handling GMOs, Dr. Waturu said that KARI had the necessary personnel and facilities. He said that staffs have been trained in the UK and the US and well equipped laboratories were available. He informed the delegates that the cost of seeds will not be outrageous and will be affordable to cotton farmers.
Dr. Waturu said it would be in the interest of the country to have an Act that would regulate the conduct of biotechnology research and production.

4 Comments from the delegates

4.1 Hon. Daniel Karaba, MP Kerugoya/Kutus; Chairman Parliamentary Committee on Education, Research and Technology

Honourable Daniel Karaba who is the Chairman of the Parliamentary Committee on Education, Research and Technology, while introducing the members of parliament in his delegation emphasised the importance of the study tour for the legislators and other stakeholders as it will increase their knowledge and information on biotechnology developments and research in Kenya.

In this way the parliamentarians would gain knowledge and understanding on biotechnology issues such GMOs and products and indeed push appropriate legislations and policies that enable scientists to undertake their work better. According to Hon. Karaba, the country stands a good chance of winning the war on poverty through biotechnology. He said that there is need to eradicate poverty in the country and empower Kenyans economically. He informed the participants that members of his committee have in the past visited many countries including South Africa where they learnt that food production went up as a result of embracing biotechnology particularly in maize production. He said that they are looking forward to the multiplier effect of biotechnology in food production.

4.2 Hon. Alfred Nderitu, MP Mwea

Hon. Nderitu asked MPs to support the biosafety bill to pave way for revival of the cotton sub-sector and improve the country's food security situation. He said that his people are now calling on KARI to avail the seeds soon as they have seen the benefits of *Bt*-cotton. He also said that they are already growing tissue culture bananas and waiting to do the same with cotton.

4.3 Hon. Sammy Weya, MP Alego-Usonga

Hon. Weya urged the researchers to be more open and forthcoming with information on their laboratory activities, arguing that some objections to products of biotechnology were due to ignorance occasioned by lack or shortage of current and authoritative information.

He said that the habit of scientists operating in secrecy is the sole cause for the delay in enactment of the biosafety law and adoption of the novel technology as people were not aware of what they were doing in their laboratories.

4.4 Hon. David Nakitare, MP Saboti

Hon. Nakitare said that he will only be convinced that biotechlogy is the way to go if the needs of farmers are met. He said that for biotechnology to take root in Kenya there was need for biosafety issues to be addressed. His concern was contractual regarding a situation where farmers depended on Monsanto for the supply of seeds leading to dependence on the same company for the supply of chemicals. He emphasized the need for a framework that will take into consideration the interests of small-scale farmers.

4.5 Hon. John Mutinda Mutiso, MP Kilome

Kilome MP, John Mutinda Mutiso's view was that though biotechnology is yet to be domesticated in the country, the technique was safe. He said that he was confident that biotechnology will be beneficial to Kenyans and the passage of the Bill will be for the good of the farmers. He noted that biotechnology had so far succeeded through TC banana and was a novel technology for the country and it would benefit farmers in arid and semi arid areas.

4.6 Prof. George Siboe, Chairman NBC

Professor Siboe informed the delegates that exploitation of genetically modified products (GM) in Kenya is proving to be a challenging task for Kenyan researchers and farmers due to lack of relevant legislation that can protect the interest of both groups while allowing safe and responsible use of the GM technologies. He observed that whereas scientists in Kenya in collaboration with their international counterparts had done research and come up with high yielding and pest/disease resistant varieties of crops suitable for various agroecological regions of the country, the same could not be released to farmers due to lack of a comprehensive legal framework. He informed the delegates that the National Biosafety Committee had put in place guidelines for research with GMO products both in the laboratories and Confined Fields sites. Prof. Siboe told the members of Parliament that in order for Kenyan scientists to share their findings with farmers, a law on biosafety as proposed by the National Council for Science and Technology is necessary.

4.7 Dr. Florence Wambugu, CEO-Africa Harvest

Dr. Florence Wambugu, the Chief executive Africa Harvest welcomed the idea of educating the legislators in biotechnology applications in various institutions including KARI-Biotechnology laboratory in KARI-Kabete, Karura Tree Hybrid tree clonal nursery, JKUAT biotechnology program and KARI-Mwea *Bt*-cotton field trial. She reiterated that the main goal of the visit was to find out what Kenyan institutions involved in biotechnology were actually doing what is called "ground truthing" because the impression created out there, especially by anti-GM groups was that biotechnology in Kenya was externally driven by multi-national companies.

Experience gained from the field visit would be very resourceful and rewarding in terms of local institutions participation in biotechnology research and development of crops and products addressing the needs of local communities. She observed that the biotechnologies observed including Tissue Culture (TC) technologies in KARI centers (Thika Mwea, Katumani and Njoro) and JKUAT, clonal tree seedling production facilitated by ISAAA has made tremendous contribution in Kenyan agriculture particularly to poor resource farmers. She noted that ISAAA and Africa Harvest were also implementing TC-banana projects in different parts of Kenya, which were benefiting many small holder farmers in household food security.

Research with Genetically Modified (GM) crops including *Bt*-maize GM-sweetpotato and *Bt*-cotton was carried out under close collaboration with KEPHIS which had inspection responsibilities on behalf of the NBC. This ensured that scientists complied with stipulated biosafety guidelines for GM-crops transgenic field trials. She said that she was happy to note that researchers, policy makers, politicians and the general public were relatively aware of the biotechnology activities going on in the country including GM- activities and were supportive of these efforts as they believed they were for the benefit of Kenyans. She finally encouraged KARI and partners in biotechnology development to continue with the good work they were doing and bring more fruits of biotechnology including from GM- crops to Kenyans. She concurred with other speakers that for Kenya to progress, we must address science and technology, of which biotechnology was part of and for this to happen there was an urgent need for a biosafety legal framework.

4.8 Mr. Kinyua M'Mbijjewe, Corporate Affairs Director Monsanto Ltd

Mr. M'Mbijjewe said that it was a pleasure to be invited to the KARI biotechnology tour on the 13th of July. Seeing the various technologies developed for bananas, cassava, wheat, maize and cotton, gives a sense of assurance that Kenya is serious about building the technologies and products that will empower farmers to reach their potential. He said that history demonstrates that most countries only develop when agriculture is transformed into

a productive and profitable enterprise and we believe that Kenya is on this road of transformation. It will take a lot of hard work from our farmers, but also the creative partnerships that empower farmers with the tools, knowledge, improved seed varieties and fertilizer, finance, training and infrastructure they need to produce to their potential.

He said that Monsanto as a company is completely committed to farmers and to provide them with high quality seeds in maize, cotton, soya, canola and vegetables, using conventional breeding and modern biotechnology techniques. They also to provide weed control solutions like Roundup, for many decades a favorite of farmers in Kenya. Monsanto experience around the world is that farmers, who use technology, including biotechnology, reap the benefit of higher yields and incomes. Mr. M'Mbijjewe was encouraged that the Kenya government is developing biotechnology solutions, and testing Monsanto biotech cotton, which is already benefiting millions of farmers in India, China, South Africa, USA, and Argentina, amongst other countries.

Mr. M'Mbijjewe said that as a Kenyan, and a farmer, he looked forward to Kenya passing the biosafety regulations so that the fruits of research can become products in farmers' hands. He congratulated the government on its initiative regarding biotechnology, and looks forward to the accompanying requirement of biosafety becoming a reality.

4.9 Mr. Ferdinand Otwani, District Commissioner Kirinyaga

The speech by the DC Kirinyaga was read on his behalf by the DOI Mr. Abraham K. Kemboi. "The honourable MPs, Scientists, Policy Makers, Journalists, distinguished guests, ladies and gentlemen, I feel greatly honoured and privileged to be associated with KARI in collaboration with the International Service for the Acquisition of Agri biotech Applications (ISAAA) Africentre and the African Biotechnology Stakeholders Forum who are today facilitating a study tour of modern biotechnology facilities here in Mwea and other such facilities in this country for 15 honourable members of parliament, policy makers, scientists and journalists and other stakeholders. I also feel greatly honoured and privileged to be associated with and to share together with the Hon. Members of parliament the scientists, the policy makers and journalists.

I am informed that the objective of the tour is to expose the honourable MPs to the various institutional, technical and human capacities available in this country for responsible and safe research, development and application of modern agricultural biotechnologies for economic development poverty reduction and wealth creation. The tour as you may be all be aware is to accord the participants and all of us an opportunity to familiarize ourselves with existing cutting edge investments in

modern biotechnology and also to closely interact with leading local experts in the area.

We in the district trust and believe that such a study tour will go along way in uplifting the development of our people through the process of developing and deploying biotechnology products although I know this is still a new area that is very sensitive and may still need a lot of discussion and policy formulation. The policy makers are here. Without saying much let me welcome all the honourable participants to this district, the scientists, the policy makers and all of us. Please feel comfortable and when you go please come back another day. With those few remarks thank you very much and may God bless you."

4.10 Mr. Daniel Mugo Magondu, Farmer, Kirinyaga District Cotton Development Committee Chairman

Mr. Magondu said that he was conversant with biotechnology crops as his farmers grew TC bananas and the benefits were higher than with conventional bananas.

Mr. Magondu's concern was in IPR issues where he was worried about Monsanto dominating at the expense of the farmer. He was however confident that Bt-cotton would be beneficial to farmers since it is pest resistant and production is higher than conventional cotton. He noted that farmers problem in cotton production comes at flowering when the African bollworm start affecting the squares. To control the bollworm farmers are required to apply expensive chemicals and Mr. Magondu felt that *Bt* would reduce all this increasing farmers' income. He noted that *Bt*-cotton would reduce cost of production. With the introduction of *Bt*-cotton, farmers would only be left to control red spider mites, aphids and cotton stainers.

Mr. Magondu thanked the Government for the research going on with *Bt*-cotton because the farmer will be able to produce cotton with fewer expenses. He also thanked KARI researchers for their hard work to save cotton farmer from application of expensive synthetic chemicals.
Mr. Magondu supported the enactment of a biosafety legal frame to hasten availability of the *Bt*-cotton to farmers.

5 Annexes

5.1 Participants

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9	Hon Mutinda Mutiso	M	,,	bunge@swiftkenya.com
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58	David Gichuru	M	Kenya Times	0724-603222
59	Leaky Sonkoyo	M	Biosafety News	0723-430348
60	Ebby Nanzala	F	Biosafety News	0721-771657
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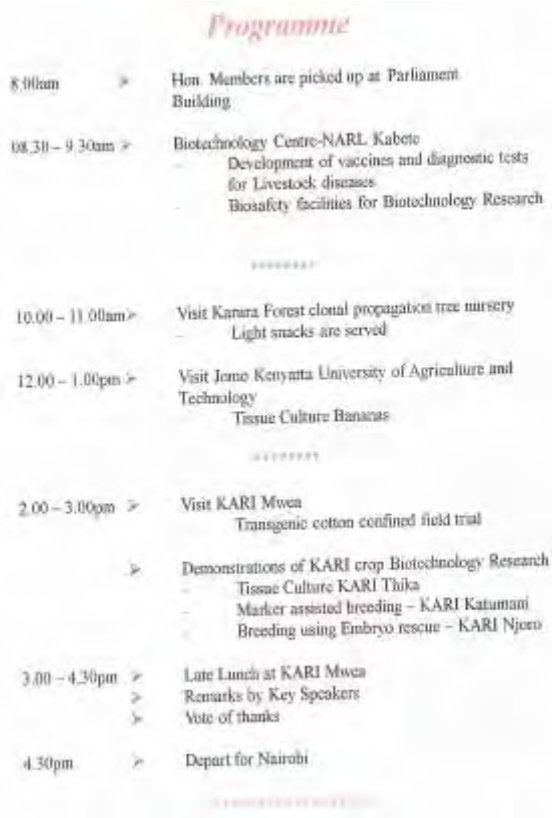
75	Peter Kamau	M	Farmer	
76	Peter Kamau	M	Farmer	
77	Waita Joseph	M	Farmer	
78	Haron Karwigi	M	Farmer	
79	Joyce W. Njoroge	F	Farmer	
80	Rachel Kariithi	F	Farmer	
81	Jackson Mwai	M	Farmer	
82	Mugo Makanga	M	Farmer	
83	Peter Kuria	F	Farmer	

5.2 Programme



Programme

8.00am	Hon. Members are picked up at Parliament Building
08.30 – 9.30am	Biotechnology Centre-NARL Kabete - Development of vaccines and diagnostic tests for Livestock diseases - Biosafety facilities for Biotechnology Research
10.00 – 11.00am	Visit Karura Forest clonal propagation tree nursery - Light snacks are served
12.00 – 1.00pm	Visit Jomo Kenyatta University of Agriculture and Technology Tissue Culture Bananas
2.00 – 3.00pm	Visit KARI Mwea Transgenic cotton confined field trial
	Demonstrations of KARI crop Biotechnology Research - Tissue Culture KARI Thika - Marker assisted breeding – KARI Katumani - Breeding using Embryo rescue – KARI Njoro
3.00 – 4.30pm	Late Lunch at KARI Mwea Remarks by Key Speakers Vote of thanks
4.30pm	Depart for Nairobi

5.3 KARI-Biotechnology Programme

5.3.1 Introduction

In Kenya, agricultural productivity is facing major challenges of declining farm sizes, drought and low soil fertility, lack of markets, weeds, pests, diseases and costly inputs.

For the last several decades KARI has used conventional plant breeding methods to develop high yielding crop varieties resistant to common diseases and pests that are also suitable in diverse agro-climatic zones. But these approaches have been expensive in terms of resources and time. For example, it may take more than 15 years to develop new crop varieties. There is therefore a great need to increase innovativeness in technological development to complement these traditional methods in an effort to hasten agricultural development in the country. Biotechnology offers an alternative strategy to address these afore mentioned constraints, saving on time and on the limited resources.

Biotechnology activities commenced in KARI in the early 1990s and culminated in the formal launching of a fully fledged Biotechnology programme in 1997 to address both crops and livestock related constraints. The Programme has since its inception continued to build capacity in an effort to address the challenge of improving agricultural productivity. The outputs from this programme have continued to interest the public as demonstrated by the increasing demand of the tissue culture banana seedlings.

The impact of biotechnology on the economy of this country in the coming decades could be profound and is expected to expand progressively as its benefits begin to be appreciated by the public. With this realization, KARI has continued to invest heavily in various components of the programme, notably infrastructure development (screen houses, laboratories and specialized equipment), human resources development, and in establishing effective linkages with development partners and other public and private institutions. KARI's demonstrated capacity to conduct modern biotechnology research has been applauded throughout the African continent.

5.3.2 Objectives of Biotechnology Research

The main objectives of biotechnology research in KARI are:

- To develop, evaluate, and utilize appropriate agricultural biotechnological technologies for improved productivity contributing to food security, income generation, and basis for industrialization.
- To seek strategic partnerships with NARLs, IARLs, Universities, IARCS, foundations, NGOs and the private sector in development and dissemination of biotechnological technologies.
- To work with other key stakeholders in Kenya to create an enabling environment backed by appropriate biosafety and IP regimes for Biotechnology development in the country.

- To create, sensitize and advocate for the integration of biotechnology in the agricultural system through collaboration with key stakeholders in developing communication packages targeting different segments of society such as farmers, consumers, scientists, policy makers, and legislators.
- To monitor, evaluate and where possible influence the policies impacting on biotechnology, biosafety, biodiversity, germplasm exchange and intellectual property rights.
- To develop the necessary range of skills and infrastructure to allow integration of biotechnology in research and to equip KARI laboratories to carry out modern agricultural biotechnology research.
- To establish sustainable funding initiatives.

5.3.3 Achievements of the Programme

Since its inception the KARI-Biotechnology program has made significant progress in Biotechnology research.

5.3.4 Tissue Culture

Kenyan farmers have benefited from the use of tissue culture technology in commercial production of planting material of banana, flowers, sweet potato, cassava and potato.

Banana: is a major food crop in Kenya. In addition to cash earnings, it is also a food security crop among small-scale farmers but its successful production is constrained by Fusarium (Panama disease), Sigatoka, Weevils, Nematodes; Hence the need for clean planting material. The programme aims to adapting, find tuning and developing tissue culture technology to clean existing orchards and produce clean planting material, increase plantlet vigor with resultant yield increase, unify productivity and reduce period to maturity. Protocols for seven (7) ripening varieties namely Williams, Chinese Cavendish, Giant Cavendish, Dwarf Cavendish, Valery, Paz, Lacatan, one (1) cooking type namely Ugandan Green and one (1) dual purpose type namely Gold finger have been fine tuned and commercial production is in progress. Fine tuning of protocols for up-coming new varieties identified by farmers such as Ngombe, Grade, Kisii Uganda green (Western Kenya), Solio and Pelipita (Central Kenya) almost finalized.

Floriculture: ranks second after tourism in terms of foreign exchange earning in Kenya. The lily flower is an attractive cash crop to many small scale farmers without the use of expensive growing structures. However, it produces one stem and one bulb under conventional methods thus limiting the speed by which multiplication can be achieved. For, Arabicum, conventional propagation is constrained by high incidences of bulb rot. *Gerbera* or the Barberton daisy is a popular ornamental flower grown by small-scale farmers but takes too long to maturity when grown from crowns (18 months). Morbydick, a newly selected indigenous flower with high potential in the export market has the constraint of variation in boll color as a result of propagation through seeds. The project has aimed at tissue culture protocol development to produce large numbers of clean planting material within a relatively

short time. Protocols for shoot initiation from leaf scale explants of lily variety Snowqueen and multiplication of Arabicum have been developed. Protocol development of the other flowers mentioned above is in progress.

Sweetpotato and cassava are important food security root crops in many parts of Western, Nyanza, Central and Eastern Kenya. However, their production is constrained by pest and disease particularly the virus diseases. Protocols for virus elimination and rapid multiplication of planting materials of the two crops have been developed.

Vanilla (vanilla fragrans) is one of the flavourants that has been used in the confectionery industry for years. It has gained a lot of importance in Kenya in the recent years and farmers including small-scale farmers are now going into vanilla production. Use of cuttings as source of planting material poses a risk of perpetuating viral. A shoot proliferation and rooting protocol for vanilla has been developed and is ready for commercialization. Tissue culture protocols for multiplication have been developed.

5.3.5 Molecular Markers

The application of molecular marker-assisted technologies for selection and identification of markers in plants, pests and other diseases was recently adopted in Kenya. This approach is especially useful in reducing considerable the time required for developing a variety and KARI is using the technology to develop maize varieties and lines that are resistant to stem borers, maize streak virus and tolerant to drought. The markets are also useful in determination of genetic diversity and establishment of core germplasm collections.

5.3.6 Genetic Engineering

In the field of genetic engineering, the program leads in sub-Saharan Africa in projects that are aiming at developing crop varieties that are resistant to major pests and disease for key staple crops. The Development of Transgenic Cassava project aims at developing cassava varieties that are resistant to Cassava Mosaic Disease. This is a disease that has caused significant reduction in cassava production in western Kenya. A similar disease, sweetpotato virus disease, is also being addressed by the Development of transgenic sweetpotato project.

The maize stem borers are responsible for about 15% of maize loss worth KShs.5.7 billion annually. The 'Insect Resistant Maize for Africa (IRMA)' project is a collaborative effort between Kenya Agricultural Research Institute (KARI) and the International Maize and Wheat Improvement Center (CIMMYT) whose main objective is to increase maize production through the development and deployment of insect resistant maize to reduce losses due to stem borers. An integrated pest management strategy which includes use of resistant varieties would be the most desirable in management of cotton pests. The '*Bt*-cotton' project at KARI-Mwea demonstrated that *Bt*-cotton is effective against the target insects, African bollworm, but had no effect on non-target parasitic wasps and cotton aphids. Similar results have also been obtained for *Bt*-maize.

At present no GM crops have been released by KARI or its collaborators for production by Kenyan farmers. All GM work is still at research level.

5.3.7 Novel Vaccines

Livestock diseases are a constraint to animal production through deaths or reduced productivity, for example, Rift Valley Fever (RVF) causes abortion, high mortality and is zoonotic. Conventional live attenuated vaccine for RVF is protective but is abortigenic and causes fetal deformities and needs repeated application before protection.

To circumvent the abortigenic effects of the live attenuated RVF vaccine and to improve on the less immunogenic inactivated vaccine, KARI has developed a recombinant sheep pox vaccine for RVF. The recombinant vaccine is not abortigenic and it has been evaluated in and found effective in contained trials. Limited field trials are now planned.

A recombinant vaccinia/rinderpest vaccine has been evaluated in the laboratory and limited field evaluations are planned. A similar recombinant vaccine based on sheep pox is being developed and may be introduced for evaluation.
Conventional live attenuated vaccines to CCPP and CBPP are ineffective and are heat sensitive. In addition, they cause severe reaction leading to swelling and exudation at the site of inoculation. Work is underway to identify genes that code for protective proteins of CCPP and CBPP and use them in the preparation of novel vaccines. Live attenuated vaccines against New Castle disease are effective but are heat sensitive. Heartwater has no effective vaccine at present and plans are under way to identify genes that can be used in the construction of novel vaccines.

5.3.8 Diagnostics

An ELISA test for RVFV has been developed and is being evaluated in the Laboratory. This test would be useful in large scale screening of sera for RVFV antibodies. Monoclonal antibodies to heartwater are being grown for use in screening for antigens that have potential in rapid diagnosis of the disease.
The use of hybridoma technology in the rapid diagnosis of Newcastle disease is also being developed. RT-PCR is being evaluated for use in the rapid diagnosis of RVF and Newcastle disease. A latex agglutination test for rapid field diagnosis of CBPP has been developed and is going to be evaluated in the region. The Centre in collaboration with National Veterinary Research Centre, Muguga is developing and evaluating diagnostics against Rinderpest, Theileriosis, Malignant Catterhal Fever, Hemonchosis, T. saginatta Cysticercosis, Lumpy Skin Disease and Rabies.

5.3.9 Socioeconomics and Environmental Impact Studies

Alongside this crop and livestock development research, the KARI-biotechnology program has also collaborated with the crop protection and socioeconomics programmes of KARI to address other major concerns on deployment of biotechnology by farmers and consumers. KARI scientists are carrying out environment impact studies as well as integrated resource management studies on

the potential impact of biotechnology products on the environment. Socio-economics studies being conducted are looking at the potential effects of biotechnologies on the livelihoods of Kenyans.

5.3.10 Regulation of Biotechnology Research in Kenya

The processes and product of biotechnology are so diverse that for purposes of regulatory oversight, KARI has established an Institutional Biosafety Committee (IBC0 to review and advice on development of bio-safety and biotechnology. This is in conformity with the Biotechnology and Biosafety guidelines by the National Council for Science and Technology (NCST). The recommendations of the IBC on proposed trials originating from scientists within the Institute are further discussed by the multi-sectoral National Biosafety Committee (NBC).

The NBC which is coordinated by the NCST has powers of vetting recommendations by the IBC. In this way, only biotechnology projects that are sound can be implemented. All plant experiments are conducted under the supervision of the Kenya Plant Health Inspectorate Service (KEPHIS) and for Livestock by the Directorate of Veterinary Services (DVS0 on behalf of the NBC. Key aspects of concern to the regulators is that all experiments are conducted in approved biosafety laboratories, greenhouses and open quarantine field sites and managed by qualified personnel. All KARI's biosafety facilities are approved and meet international standards. Competent inspectors closely monitor all the tests.
All the trials carried out by KARI have always conformed to the biosafety requirements to the letter without exception.

5.3.11 Capacity Building in Biotechnology

The recent rapid increase in the application of biotechnology in the Institute's research programmes and the increasing number of KARI professional staff highly trained in molecular biology techniques has provided a strong base and encourage the foundation of a genetic engineering research infrastructure in KARI.

It is out of this recognition and need that the institute has created a Biotechnology Centre at the KARI-Kabete. The centralization of the genetic engineering initiatives is based on the need to make the maximum use of the few available expensive molecular biology instruments, to consolidate a critical mass of scientists highly qualified in gene technology, and to meet the needs of KARI-Biotechnology Centre for proximity to the beneficiary programmes and sites with modern information exchange and communication systems.

5.4 Tree Biotechnology Project

5.4.1 Goal

- To positively impact the overall economy through accelerated afforestation for a sustainable environmental resource base conducive to socio-economic development and wealth creation.

5.4.2 Objectives

- Promote sustainable forestry through distribution of improved varieties of trees at an affordable cost
- Contribute towards poverty alleviation by improved access to affordable wood products and creation of wealth at household level.
- Make a significant environmental contribution in the form of increased forest cover in Kenya.

5.4.3 Partners

- TBP — Project Implementation
- ISAAA — Facilitation
- Kenya Forest Service — Policy support & extension
- KEFRI — Research and IPM
- K-REP Group — Micro-credit
- KGT — Grant Management and BDS
- Mondi — Hybrid clones & backstopping
- FABI — Diagnostics and Biotechnology
- Gatsby & Kilimo Trust — Financial grant

5.4.4 Milestones

- Over 13 million improved seedlings and clones distributed;
- Clonal forest trees nursery annual capacity of 3 million clones and 2.5 improved seedlings;
- 21 clonal field trials established in major agro-climatic zones for gene*environment interactions;
- 10 extension training workshops in all the 8 provinces for government and non-government agents with over 680 staff sensitized on clonal forestry;
- 3 Regional distribution Center established and in operation in Eldoret, Gede / Malindi and Meru;
- Over 14,500 visitors received at Karura and regional centers;
- Over 10,149 growers across the country have adopted clonal forestry;
- Material Transfer Agreement signed between Mondi and Ministry of Environment and Natural Resources for research germplasm access;
- CAMCORE membership for Kenya, Uganda and Tanzania with two elite Pinus spp. seeds for seedlings raised at TBP for trials in East Africa;
- Technical backstopping to Uganda and Tanzania as part of East Africa cooperation.

5.4.5 The specific objectives

- Build capacity in clonal propagation through downstream diffusion of technology,
- Evaluation of Mondi and local clones,
- Enhancing delivery streams for expanded National out reach,

- Financially enhance local propagators / entrepreneurs through micro-credit opportunities,
- Develop a marketing strategy for tree seedlings and end-products.

5.4.6 Implementation Process

- Capacity building: tunneling technique & green house technique where appropriate;
- Additional Regional demonstration centers as community training nodes;
- Entrepreneurs nurseries commercially managed to meet localized demand;
- Micro-credit model to improve liquidity for start-ups and growth;
- Marketing and extension support for sustainability and harmonized approaches.

5.5 Stakeholder consultation on *Bt*-maize in Kenya

Stakeholder Consultation on Bt Maize in Kenya

KARI

CIMMYT

INTRODUCTION

Genetically modified (GM) crops have seen a tremendous increase in area grown since their introduction in 1996. The technology has generally been accepted in North and South America.

Sub-Saharan Africa is caught in the middle, even though this region could gain substantially benefit from this technology.

Consumer acceptability of GM food might drive the adoption of the technology in sub-Saharan Africa.

METHODOLOGY

Six hundred maize consumers were randomly selected and interviewed at three types of outlets: posho (maize) mills, kiosks and supermarkets, in Nairobi.

In rural areas farmers were randomly selected in two districts, Machakos and Kericho.

Consumers were then asked if they would like to buy GM maize at current prices. If the answer was no, a lower price was offered, if the answer was yes, a higher price.

To determine consumers/Millers/Processors attitudes towards GM food, they were asked if they agreed with statements on GM crops and food, concerning their benefits, health risks, environmental risks, and ethical and equity concerns.

Every year stakeholders are invited to meet with the project teams. Stakeholders invited include those in the seed sub-sector, NGOs, farmers, scientists, consumers, the press, Ministry of Agriculture etc.

RESULTS

Awareness and attitudes towards GM

Over a third of consumers (38%) were aware of GM crops while half (48%) were aware about biotechnology in Nairobi while in rural Kericho only 13.2% were aware of GM crops.

Awareness is highest among consumers at supermarkets and lowest among those at kiosks, reflecting the higher education and income levels.

Attitudes of maize consumers and farmers towards GM crops are generally positive with 82% and 96% respectively agreeing that GM crops can increase productivity.

Many, however, have some important concerns: more than half the consumers agree that GM crops can cause death of untargeted insects. While 38% and 18% of the farmers in rural areas agreeing that it could have a negative impact on local varieties and environment respectively.

Table 1. Attitudes towards GM food (% respondents)

Type	Statement	Agree	Disagree	Neutral
Benefit	GM technology increases productivity	81	12	7
Environment	Insect resistant GM crops may kill untargeted insects	51	36	14
Health	Consuming GM foods can damage ones health	37	48	15
Ethics	GM is tampering with nature	48	45	7
Equity	GM products only benefit multinationals making them	30	65	5

Willingness to pay for GM maize meal

Of all consumers, 68% would be willing to buy GM maize meal at current prices (KShs 50.97) (1US$=KShs 75). In rural Western Kenya 89% of the farmers were willing to pay for GM maize meal at the current price.

Annual Stakeholder Meetings

Stakeholders are usually very interested but they indicate the need for good scientific evidence and that concerns for the environment (with biodiversity) be addressed urgently and food safety and regulations be respected.

CONCLUSIONS

- Consumers' attitudes and WTP for GM crops are generally positive, indicating that the technology can play a role in helping to provide food security in Kenya.
- Regular discussions with farmers, consumers and institutions during annual stakeholder meetings, group discussions and other fora, reveal that farmers are generally very enthusiastic about Bt maize, while scientists, consumers are cautiously optimistic.
- The public should further be educated, so that consumers can distinguish between real and unsubstantiated risk, and make a more informed decision whether to accept GM food or not.

CIMMYT

Debunking the Myths of GM Crops for Africa: the Case of Bt Maize in Kenya

KARI

Hugo De Groote, Stephen Mugo, David Bergvinson, and Ben Odhiambo

Extended Abstract of a Presentation at the Annual Meetings of the American Agricultural Economics Association (AAEA), Denver, Colorado, August 4 2004

BACKGROUND

GM crops have been highly successful in developed countries, increasing yields and profits without negative health or environmental effects. However, the technology has generally not been well received in Europe, where environmentalists and green activists are worried about irreversible environmental damage. Moreover, European agriculture has a consistent overproduction problem, so yield enhancing technologies are not their first priority; the powerful farmers' organizations would rather protect their markets from external competition. Expected benefits to the European consumer are also small. Therefore, Europe has accepted the precautionary principle, which imposes very stringent regulations and requirements of risk assessment on GM crops, basically banning them for the time being. In 2004, Europe approved the importation of the first GM maize food, but use of GM maize seed is generally not allowed.

African countries are caught in between: should they embrace the technology to help feed their hungry people, or rather protect them from potential dangers? Potential advantages of the technology include: increased yield (for the only continent that has benefited little from the Green Revolution), increased food security (for the only region in the world where the percentage of malnourished children is expected to rise during the next 20 years), and a technology easy to disseminate (for a region where extension services have collapsed and liberalization is lagging).

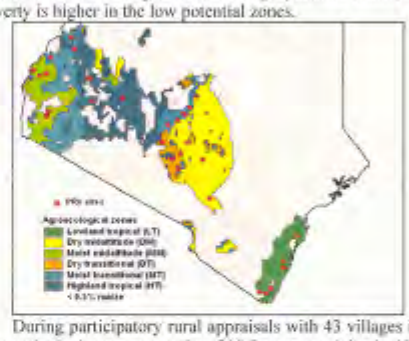
Despite these potential benefits, deployment of GM crops in Africa remains highly controversial. Among the arguments against them are: GM crops would not respond to small farmers' priorities, their traits would not reply to a particular demand, and seed would be expensive. GM technology would only be beneficial to the agro-business, who can protect their interests through Intellectual Property Rights (IPR) and terminator genes, and make farmers dependent on new varieties while they loose biodiversity of their old ones. Further, GM crops could pose serious risks to the environment through the development of resistance in the target insects, gene flow into weeds and local varieties, and from the disruption of non-target organisms. Moreover, African countries might not be sufficiently equipped with the appropriate bio-safety regulations to make an informed choice. Finally, it is argued that poor people, if given a choice, would not necessarily opt for GM crops but might prefer other solutions.

We argue that African farmers and consumers have the right to choose their own technologies, based on the best available knowledge. African scientists need to develop and test GM crops on the alternative precautionary principle: poor farmers and consumers risk being denied a chance to improve their livelihood based on an academic debate in which they cannot participate. On this principle, the Insect Resistant Maize for Africa (IRMA) project was launched in 1999, using both conventional breeding and biotechnology, and combining the best available science, bio-physical as well as social. After five years of research in the first phase, it can be shown how most, but not all, concerns against Bt maize can be answered.

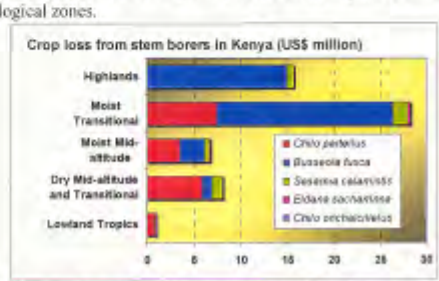
RESULTS

Demand for Bt maize

Demand for Bt maize is likely to be high. Maize is the major food crop in Kenya but, after progress in the 1960s and 1970s, maize yields and production have stagnated while production per capita has decreased. While more maize is grown in the high potential zones, the level of poverty is higher in the low potential zones.



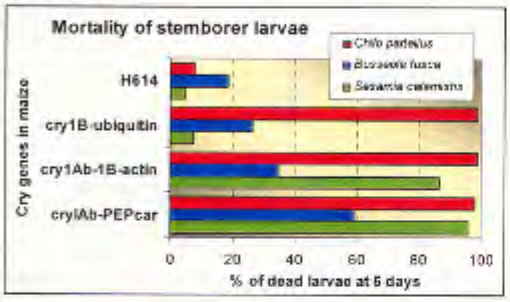
During participatory rural appraisals with 43 villages in all maize agroecological zones, more than 900 farmers explained which varieties they grow and why, and expressed the constraints and pest problems they face. Most farmers grow local varieties, except for the high potential zones. The two major criteria for variety selection are early maturity and yield, with three other important traits: tolerance to drought, field pests and storage pests. The three major constraints to maize production were cash constraints, lack of technical know-how and extension, and problems with maize seed: high cost, poor quality and low availability. Pest problems are usually found in the top six constraints. The two most important pest problems farmers encounter are stem borers and weevils, which rank in the top three in all agro-ecological zones.



Yield losses due to stem borers were calculated based on farmers' estimates from a survey of 1400 farmers, and resulted in a first estimate of 12.9%. These losses were higher in the low-potential zones (15–21%) than in the high-potential zones (10–12%). Next, yield losses were measured in 150 farmers' fields using a simple experiment comparing protected and unprotected maize, leading to an estimated loss of 13.5%, totaling 0.4 million tons annually, valued at US$ 80 million.

Supply of Bt maize technology

Supplying the Bt technology for Kenyan maize production does not pose major technological problems. IRMA, working within the regulatory system, introduced several samples of maize leaves with different Bt genes (one per plant) for bio-assays. Effective Bt genes were found against all major stem borer species, except for one, Busseola fusca, which dominates in the higher altitudes and is economically more important. In bio-assays of multiple genes per plant, higher levels of efficacy were found. These events will now be tested in the recently approved biosafety greenhouse, followed by trials in an open quarantine facility. Moreover, a review of relevant Intellectual Property Rights, including a Freedom to Operate review, concluded that there are no patents filed in Kenya that would restrict the use of Bt genes in maize. Finally, local seed companies have shown great interest in adopting the technology, as long as the costs are reasonable.



Economic Analysis

The estimated demand and supply were combined in an economic surplus model, which calculated a modest profitability with the currently available Bt genes. The project would be highly profitable if a gene or combination of genes can be found against B. fusca. More than two thirds of the benefits would go to the consumer through a reduction in prices.

The Environment

Demand and supply need to find one another through markets, within the regulatory framework. Biosafety guidelines were established and Institutional and National Biosafety Committees set up to implement these. These committees have, over the years, become experienced and efficient in dealing with bio-safety applications, partially due to the experience and interaction with IRMA. An analysis of the seed sector found that liberalization has increased the number of companies and varieties dramatically, but overall markets are still dominated by one company and a limited number of varieties, especially in the highlands. Moreover, the amount of improved maize seed sold has not increased over the years.

The PRAs also showed that farmers often recycle seed, including hybrids, and that they mark selected plants for this purpose. A study of the credit sector showed that formal agricultural credit has basically collapsed, and has been replaced by small, informal finance groups. Farmers who have access to this type of credit use half of it for agriculture, which allows them to double their use of improved maize seed. Regular discussions with farmers, consumers and institutions during annual stakeholders meetings, group discussions and other fora, reveal that farmers are generally very enthusiastic about Bt maize, while scientists, consumers and the general audience are cautiously optimistic.

During a survey in Nairobi, few consumers objected to the use of GM crops for food, although they have concerns about risks for environment and for biodiversity. Interestingly, upon learning that the Bt gene is dominant (and can therefore be recycled) farmers requested that the project also consider transformation of their local varieties.

Farm surveys showed that most areas have enough alternative hosts that form natural refugia, and prevent the build-up of resistance against the toxins. No relatives of maize exist in Africa, so the gene cannot cross into weeds. Farm surveys and PRAs also indicate that biodiversity does not decrease with agricultural intensification. Although the number of local varieties does decrease with intensification, the total number of varieties does not. In the high-potential areas, farmers typically use more varieties than in the low-potential areas, so that their biodiversity indices are higher.

CONCLUSIONS

The results of the different studies clearly show how most objections to Bt maize are based on myths and can easily be debunked. First, it is indispensable to work with Bt maize and introduce it in an experimental setting so that farmers, consumers and policy makers can make informed decisions. The first results, moreover, indicate that Bt maize responds to an important constraint and that farmers are very interested. Consumers are likely to benefit too, and they do not express strong objections. The poorer farmers in the low-potential areas will benefit relatively more, since they have relatively higher losses, and poor consumers will benefit relatively more since they spend more of their income on maize. Bt maize is likely to be commercialized by local companies, since there are no restrictive IPRs involved, and so extra costs will be low. Because the Bt genes are dominant, farmers will not become dependent on the seed industry since they can recycle their seed with the genes. Their recycling methods, moreover, are likely to select for the Bt gene and, over time, incorporate the gene into local varieties.

However, local varieties are likely to become contaminated, and this process could be irreversible. IRMA has taken samples of all local varieties in the different zones to deposit in the National Genebank. Further, natural refugia might be insufficient in certain areas. This could to be countered by pyramiding several Bt genes in appropriate varieties, or mixing seed with sufficient amounts of non-Bt maize. The study of the effects of Bt maize on non-target organisms has not yet been initiated, but identification of these organisms has started and comparative studies will start immediately with the field trials.

Further reading

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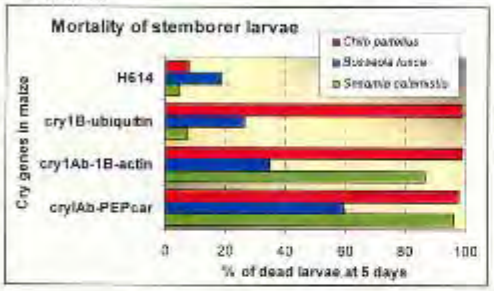

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5.6 Institute for Biotechnology Research

Aloe vera
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-for cosmetic use

Pineapples
-for commercial purposes
-for juice
-for fruits

Calla Lilies
-for commercial purposes

Mushrooms
-Spawn Production
-Seed multiplication
-Medicinal Mushrooms

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-Organic compost
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Should you require more information about the Institute please contact

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5.7 About yield (*Bt*-maize)

OBJECTIVES OF THE INSTITUTE

1. Teach Biotechnology at the diploma, undergraduate and postgraduate level.
2. Conduct and co-ordinate all research related to Biotechnology at the university.
3. Conduct technical training in tissue culture techniques for laboratory technicians and other interested persons outside the university.
4. Establish collaboration with other organisations involved in Biotechnological research/work.
5. Conduct and participate in seminars and workshops related to Biotechnology.
6. Establish a resource centre to provide information based on scientific journals, video tapes and texts for reference and education purpose.
7. Establish an extension centre available to farmers and industry.
8. Conduct research on gene technology to produce novel crops.
9. To provide consultancies to private flowers growers to guide them to establish tissue culture laboratories.
10. To produce one patent every year.

The institute effectively developed scientific techniques for rapid propagation of disease-free banana seedlings. The project attracted international funding with a view to improving banana production in Kenya, East and Central Africa.

ACTIVITIES OF THE INSTITUTE FOR BIOTECHNOLOGY RESEARCH

1 Plant Biotechnology
2 Animal Biotechnology
3 Food Biotechnology
4 Environmental Biotechnology
5 Molecular and Cellular Biology
6 Organic Compost Fertilizer making
7 Mushroom Production
8 Tissue Culturing of plants.
9 Rhizobium legume inoculant-biofertilizer.
10 Bio organic demonstration farm for both organically produced and synthetically produced crops.

TRAINING

-MSc. Biotechnology
-Short Courses

1. Basic Microbiological Techniques
2. Basics of Molecular Biology
3. Introduction to Bioinformatics
4. Introduction to Plant cell, Tissue and Organ Culture
5. Risk Assessment and Bio safety

PRODUCTS
Plant Tissue Culture of

Orchids
-for Ornamental use
-for commercial purpose

Hybrid Eucalyptus
-for fuel wood
-for poles
-for timber

5.8 About Bollgard (*Bt*-cotton)

5.9 Biosafety news in the media: Sunday Standard 22 July 2007

8 BIOTECHNOLOGYWATCH

BIZBYTES
THE SUNDAY STANDARD • JULY 22, 2007

MPs back Biosafety Bill

AUGUST HOUSE
The Biosafety Bill may come up for debate this week

A CROSS section of Kenyan parliamentarians have called for speedy enactment of the recently published Biosafety Bill 2007 to give legal backing for biotechnology research and development activities that are on-going in the country.

They argue that the country has developed adequate institutional, technical and human capacities for development and application of modern agricultural biotechnologies.

They also feel that the regulatory mechanisms and biosafety measures put in place can effectively guard against any possible health and environmental threats arising from research and commercialisation of genetically modified (GM) organisms in Kenya.

The MPs made the observations during a tour of various biotechnology facilities to assess the country's ability to develop and commercialise genetically modified products.

The MPs, drawn from various Parliamentary Select Committees — Education, Science and Technology, Health, Trade, Agriculture, Environment and Natural Resources — urged the Minister for Science and Technology to table the Bill in Parliament as soon as possible so that it could be debated on and passed into law to enable scientists to harness the "immense potential of biotechnology to improve agricultural productivity and industrial development".

The MPs, who toured various biotechnology facilities such as the Kenya Agricultural Research Institute (KARI) Biotech Centre, Tree Biotechnology Programme Trust, Jomo Kenyatta University of Agriculture and Technology and Kari-Mwea Bt cotton trial site, included Mr Charles Kilonzo, Mr Julius Arunga, Prof Christine Mango, Mr Sammy Weya, Mr Alfred Ndiritu, Prof Ayiecho Olweny, Mr Daniel Karaba, Mr Moffat Maitha, Mr Mutinda Mutiso, Mbae, Mr Charles Keter, Mr Kiema Kilonzo and Mr Lucas Chepkitony.

And it appears the debate on the Bill may not be as stormy as had been expected considering that some of the MPs who had in the past expressed opposition to modern biotechnology like David Nakitare — whose Bill ban handling of GM organisms and their products was rejected in parliament — were also in attendance.

Since the launching of a fully fledged biotechnology programme in 1997 to help address both crops and livestock related constraints, Kari has continued to invest heavily in various components of the programme. For instance, it has put in place screen houses, laboratories and specialised equipments. Human resources development and establishment of effective linkages with development partners have also been prioritised.

"Biotechnology development in the country is currently being challenged by lack of legislation that has hindered the work of scientists as the country has what it takes to undertake biotechnology development," said Kari Director, Dr Ephraim Mukisira, who accompanied the parliamentarians on the fact-finding mission.

The director said that with 30 well-equipped centres spread countrywide and well trained personnel on biotechnology, Kari was prepared to provide leadership on application of biotechnology products, should the bill be passed into law.

He informed the MPs that Kari had established an Institutional Biosafety Committee (IBC) to review and advice on developments of biosafety and biotechnology, in conformity with the Biotechnology and Biosafety guidelines set by the National Council for Science and Technology (NCST) and the National Biosafety Committee (NBC) that has powers of vetting biotechnology activities in the country.

The NBC is composed by various government departments, including the Kenya Plant Health Inspectorate Service, Public Health, Kenya Bureau of Standards, National Environment Management Authority, and Kenya Intellectual Property Institute.

Mukisira said the decision to apply biotechnologies to agriculture had been necessitated by numerous challenges facing the agriculture sector, including declining farm sizes, persistent drought, low soil fertility, stubborn weeds, pests, diseases and high cost of farm inputs, leading to low productivity.

Although conventional approaches were solving some of the problems, he said that modern biotechnology was needed to handle intractable ones. However, he emphasised that biotechnology was not the only solution to the problems but a combination of many factors, such as good policies and conventional breeding.

Dr Charles Waturu, Kari-Thika Centre Director and the lead researcher on Bt cotton at Mwea, told the MPs that the findings of first trials on Bollgard I showed that the Bt cotton variety was effective against target insects like African bollworm, but had no effect on non target parasitic wasps and cotton aphids.

Waturu said the current trials of Bollgard II were necessary because it was a better and more efficient technology against the pest.

The head of Kari Biotechnology Centre, Dr Simon Gichuki, informed the legislators that research on a genetically modified Rift Valley Fever vaccine was almost complete and was expected to benefit farmers as it was a more cost effective protection against the decision.

He said since its inception, the biotechnology programme had made significant progress in biotechnology research in tissue culture bananas, maize, flowers, sweet potato, citrus, trees, cassava and vanilla, among others.

So far, he said, researchers at the centre have also deployed to farmers better seeds developed using molecular, marker assisted technology.

Mr Benson Kanyi of the Tree Biotechnology Programme at Karura Forest said the programme, which is propagating fast-growing eucalyptus trees using clones imported from South Africa, intends to improve the tree cover in that country to at least 10 per cent from about 1.7 per cent currently.

He said the programme had so far sold 13 million eucalyptus seedlings locally and also to Tanzania and Uganda. "At the moment we are in the process of experimenting on other trees."

Biotechnology capacities also exist in all the public universities such as the University of Nairobi (UoN), Kenyatta University (KU), Egerton University and Jomo Kenyatta University of Agriculture and Technology (JKUAT). KU and UoN have modern biotechnology and biosafety labs and screen houses and have trained several scientists in modern biotechnology.

Prof Esther Kahangi of JKUAT told the MPs that the tissue culture project she had started at the university several years back was hugely successful, as it had benefited many farmers across the country.

For instance, she said farmers in Maragua District earned Sh300 million in 2005 from TC Bananas, compared to Sh70 million that they got from coffee in the same year. She added that the University could do more if the Biosafety Bill was enacted.

The chairman of the Parliamentary Committee on Education, Science and Technology, Mr Daniel Karaba, who is also the MP for Kerugoya Kutus, vowed to ensure that the Biosafety Bill 2007 was debated and passed.

Welcoming suggestions to improve the Bill, Karaba stated that it was urgently needed to allow the country to apply biotechnology as a means of boosting food security in the country.

Alego-Usonga legislator, Mr Sammy Weya urged the researchers to be more open and forthcoming with information on their lab activities, arguing that some objections to products of biotechnology were due to ignorance occasioned by lack or shortage of current and authoritative information.

"Your habit of operating in secrecy is the sole cause for the delay in enactment of this novel technology as people were not aware of what you were doing in your laboratories," he said.

Kilome legislator, Mr Mutinda Mutiso said biotechnology had so far succeeded through TC banana and was a novel technology for the country, as it would benefit people and more so farmers in arid and semi arid areas. Mwea MP Mr Alfred Ndiritu asked MPs to support the Bill to pave way for revival of the cotton sub-sector and improve the country's food security situation.

"My people are now calling on Kari to avail the seeds as soon as possible as they have seen the benefits of Bt cotton," he said.

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Biosafety news in the media: Monday Daily Nation 23 July 2007

DAILY NATION
Monday July 23, 2007

BIOTECHNOLOGY
Farmers long for biotech seed cotton

By VITALIS OTIENO

Daniel Mugo Mang'ondu is anxiously looking forward to the day biotechnology cotton seeds will be available in the market. Like other farmers who grow cotton in Kirinyaga district, the farmer who is also the chairman of Kirinyaga District Cotton Development Committee says he is spending a lot of money on pesticides on the traditional crop without realizing much in yields. "We expect that once the government gives the green light to use of biotechnology in production, we will be able to grow biotechnology cotton and increase production at comparatively less cost," he says.

Mr. Mang'ondu is one of the scores of farmers who turned up at KARI Cotton and Rice Centre in Mwea to interact with the experts and familiarized himself with the latest on modern biotechnology. The occasion was a tour of modern biotechnology facilities organized for Members of Parliament, policy-makers, scientists and journalists, to expose them to the various institutional, technical and human capacities available in the country for research, development and applications of biotechnology. A total of 15 MPs turned up.

The first stop for the entourage was the Biotechnology Centre at the National agricultural Research Centre at Kabete. It then moved to Karura Clonal Forestry Propagation Nursery then proceeded to Jomo Kenyatta University of Agriculture and Technology before winding up at KARI Mwea.

The tour, organized by Kenya Agricultural Research Institute (KARI) in collaboration with the International Service for the Acquisition of Agribiotech Applications (ISAAA) and the African Biotechnology Stakeholders Forum (ABSF), comes against a backdrop of the much-anticipated debate on Biosafety Bill, 2007. Health and safety concerns and capacity issues are likely to dominate when debate on the Bill gets underway.

However, a cursory review of the Bill shows that once enacted, it will regulate activities in biotechnology organisms and establish a National Biosafety Authority to police transfer, handling and use of GMOs with a view to ensuring safety of human health, provision of adequate protection of the environment and act as the principle adviser to the government on matters of biosafety. What this means is that the debate may not be as protracted. Biotechnology, broadly defined as any technological application that uses biological systems, living organisms, or derivatives to make or modify products or processes for specific use, has been billed by some scientists, as a panacea to third world's food insecurity problems.

Biotechnology has applications in four major industrial areas, including health care, crop production and agriculture, non food uses of crops and environmental uses. However, it is in agriculture where its applications appear to have found enthusiasts.

There are many applications of biotechnology in agriculture. One is improved yield from crops. Another is the reduced vulnerability of crops to environmental stresses. Researchers have also created transgenic rice plants that are resistant to rice yellow mottle virus (RYMV).

Researchers have created rice plants that are resistant to rice yellow mottle virus.

In Africa, this virus destroys majority of the rice crops and makes the surviving plants more susceptible to fungal infections. Use of biotechnology can also lead to reduced dependence on fertilizers, pesticides and other agro-chemicals and improved taste, texture or appearance of food and increased nutritional qualities of food crops.

Like in other countries in Africa, food security is a critical issue in Kenya. The consequences of food shortage are evident in prevalence of hunger and malnutrition in many parts of the country. Official figures show that as in 2005, some 1.6 million Kenyans were in dire need of food. The good news is that the Kenya Government is increasingly acknowledging that part of the solution lies in use of biotechnology.

Early last year, the government took probably one of the most strategic steps as far as biotechnology is concerned, when it adopted a national policy that would guide research, development and trade in biotechnology products. To farmers, businessmen environmentalists, among others, the move would not have come at a better time. In agriculture, the policy pays attention to the development of new varieties with beneficial traits for pests and disease resistance. In animal production, it focuses on artificial insemination, embryo transfer, and genetic improvement of local breeds, among others. And in environmental technology, the policy calls for adequate level of protection in the field of safe transfer, handling and use of GMOs.

The National Biotechnology Development Policy – as it is called – was the result of several years of deliberations between major biotechnology stakeholders in the country and the relevant government departments. In adopting the policy, the government hopes to explore the use of biotechnology for the benefit of Kenyans and to ensure that the country becomes a major participant in the international biotechnology enterprise within a decade.

What now remains is a biosafety legislation that will go along with the policy. However, there are dissenting voices emanating from some pressure groups.

According to the MP for Kerugoya-Kutus, Daniel Karaba, the country stands a good chance of winning the war on poverty through biotechnology. "We need to eradicate poverty in the country and empower our people economically," said Mr. Karaba, who is also the chairman of the Departmental House Committee on Science, Technology and Education.

"My committee has visited many countries in the past. In South Africa, for example, we learnt that food production went up as a result of embracing biotechnology in maize production. What we are looking forward to is the multiplier effect of biotechnology."

Kilome MP, John Mutinda Mutiso's view was that though biotechnology is yet to be domesticated in the country, the technique was safe.

"We are confident that it (biotechnology) will be beneficial to us and the passage of the Bill will be for the good of our farmers." Mwea MP, Alfred Nderitu said farmers in Mwea were already growing tissue bananas and were waiting to do the same with cotton.

But there were those who had divergent views. Saboti MP, David Nakitare, who has in the past raised issues with GMOs, said, "I will only be convinced that biotechnology is the way to go if the needs of farmers are met. For biotechnology to take root in Kenya, we need the accompaniment of biosafety. My concern is contractual: When you depend on Monsanto for the supply of seeds, you also have to depend on them for chemicals. We need a framework that would accommodate small scale farmers."

Even so, the experts did manage to convince the politicians that the country has the capacity to develop, deploy and regulate biotechnology. "We have the personnel and we have the facilities," said KARI Director at Thika Centre, Dr. Charles Waturu.

"We have people trained in the UK and the US. We also have labs that are well equipped. Yet we are also able to transport the seeds to farmers across the country."

He said agricultural research institutions in the country also boast an elaborate system of information dissemination through the Ministry of Agriculture. "Biotechnology will reduce the cost of production. For example, if a farmer does not control ball worms he may loose 100 per cent of the crop. However, with biotechnology, farmers will be able to cut back on spraying from 10 to three times – meaning they will have more money in their pockets."

With reduced costs, Dr. Waturu predicts that farmers will generate more income to buy biotech seeds which he reckoned will be priced competitively.

"The cost of seeds will not be outrageous and will be about the same price with what is being charged for biotechnology maize and beans, he said on affordability of biotechnology cotton seeds.

KARI Director, Dr. Ephraim Mukisira, said research had shown that the use conventional breeding methods took close to 15 years to yield fruits while the use of biotechnology took only three.

Hence, food security could only be overcome by biotechnology, he said.

"At KARI, we have an ambitious project called Kenya Agricultural Productivity Project which emphasizes shift from subsistence to commercial farming," he said."

However, this shift could take a long time if we continue using traditional methods. What we need is modern technology."

The head of biotechnology at KARI, Dr. Simon Gichuki said the institute was yet to produce a GMO product for the country, although trials are currently ongoing.

He said that the institute routinely conducts environmental impact assessment, besides the core research work. Such assessments, he said are done in areas where the institute conducts field experiments. KARI was involved in the initial stages of the preparation of Biosafety Bill. The institute participated in the sensitization workshops - educating stakeholders, including the MPs on the Bill. Dr. Waturu said it would be in the interest of the country to have an Act that would regulate the conduct of biotechnology research and production.