

## Invited Address

### THE NEED FOR AGRICULTURAL BIOCONTROL IN AFRICA

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May I start by giving very special thanks, especially to Tim Murray, the President of the SA Sugar Technologists' Association, for this opportunity to talk to you about biotechnology; not just biotechnology, but the role it could play and, I believe, it is playing in terms of economics as well as agricultural production. You are very brave to have me here to talk about biotechnology, because I become very controversial on this subject. There is a huge amount of research being done on pharmaceutical vaccines and the use of recombinant DNA, but that is not what we are going to talk about. I see that the two major pointers for the future are communication and biotechnology playing a major role in terms of global economics. I consider this an opportunity to share my experiences, and also learn from you, about the role biotechnology can play in promoting the economy of Africa.

For 20 years I have been working on this, starting with the Kenyan Agricultural Research Institute, and I have summarised my 20 years of experience in a very simple book illustrating how biotechnology can address food security in Africa. I have put together case studies for Africa, what we are doing in Kenya and how this can be applied elsewhere. This is no book promotion, it is information that does not exist anywhere else. The local controversy about biotechnology has been extreme, especially with the Green lobby saying that biotechnology cannot make any impact on food security for the poor in Africa, that it is just big companies pushing over. This is not true. On the other side the big companies are saying biotechnology will solve all the problems of the world. Again, this is not true. The truth is somewhere in between, and I have captured that and would encourage you to go to the website, and to look as well at the information in my book.

I see biotechnology as a tool, not just as a need in itself, but as a tool in addressing food supply and economic growth. I will start by looking at where it fits into the global picture. First and foremost, the global challenges of feeding the world are major. If you look at the year 2025, we have a population increase that is going at speed, and you have to realise that this greatest increase is taking place in countries that are food insecure, like Africa. If you look at the year 2020, we are going to have to feed two billion more people. This means that world food production must increase by 30 to 50% in 25 years, if we are not going to have major food problems. If you look at global food production trends today, and compare Africa with the rest of the world, you begin to find why Africa is food insecure. In South Africa you probably have not suffered hunger and famine, but remember in Africa it is very dismal; there are people who are starving as we speak. Sugarcane is doing very well, thanks to South Africa and Mauritius, and this is because a lot of good research has been going on in South Africa. I want to congratulate this Institute, which is keeping Africa ahead in terms of sugar. When you look at crops like maize, which is the major staple crop in Africa, you find that Africa produces about 1.7 tons per hectare compared with a global average of 4.0 tons per hectare, with the optimum at 6.0 tons per hectare. So we are below half of what is being produced globally. That is a crop that feeds most of the

people. If you look at the sweet potato, which is grown mainly by subsistence and small scale farmers, the global average is 14 tons per hectare and up to 20 tons can be produced, yet Africa produces about six tons per hectare. Countries like Uganda and other major producers in Africa are producing only four tons per hectare. What this amounts to is that we are far below what we should be producing, and that is what is causing food insecurity and overall a very dismal economy.

Nominal African countries have minerals or oil, but most of the economy is based on agriculture. I am not ignoring the politics, the corruption and all the other things that are out there, but if you look at the foundation that is agriculture, we are far below in production. I am not implying that biotechnology is going solve all these problems, I am saying it is one of the pointers to where there is an opportunity for us to improve production. The food situation in developing countries, which is most of Africa and Asia, with inadequate food supply (I am talking in generalities), we have about 800 million chronically malnourished people world-wide, we have 250 million who survive on less than one dollar per day, we have 250 million children with vitamin A deficiency, we have about 100 000 people who are blind, a 54% child mortality rate caused mainly by malnutrition, and about 400 million women suffer from iron deficiency, because women lose blood more than men for various reasons, so the nourishment from iron is very important. When we look at developing countries, we have unsustainable agricultural practices. Farmers cannot stabilise yields from one year to another, and there may be drought, because they are irrigating using incorrect methods. We also have poor funding for research from the public sector, and research forms less than 0.5% of the national budget. South Africa is doing better than most African countries in terms of putting money into research, and money into research is an investment in the future. That is why Europe and America have surplus production. If research is funded by government, then it suffers from politics, as politicians see only up to the next time they are going to be elected. If funding comes from the private sector the picture changes.

Then we have low technology transfer. There are the producers - and we have a large part of African agriculture being done by women - who have never been trained in how to change the situation, then there are policy limitations, infrastructure limitations and limited empowerment for farmers. Overall, 70% of women in Africa have not been educated in the new technologies. Then there are unfair global limitations. We do not have control over the price of exports such as coffee, although we are sometimes told the price for tea or sugar. There are these global issues. At times you may be producing more coffee, tea or sugar, but you still do not control the price of tractors or cars, so we have been disadvantaged and fear unfair trading limitations, and we have undergone mental degradation. Here I want to mention another of the moral degradations. When crops are being produced in marginal areas, you can literally continuously degrade the environment by poor agriculture practices.

Looking at agricultural challenges in Africa, there are statistics that should be worrying us and making us decide that we have to do something. The population is increasing at an average of 3.5%, and food production is increasing at 2.5% - a whole 1% deficit. Where is this food going to come from? Some people argue that what is needed is to grow the food in Canada or America and distribute it in Africa. I do not believe that is going to work because of transport costs and local distribution. People like to eat the food they grow. There is also human pride - you cannot be waiting for food to arrive from Canada to feed your family. So I do not think this is the solution. Then there is the declining unit of land per family this is putting pressure on ecosystems. There is loss of biodiversity, not because of GM crops. People are going into the forests, into the dry areas, the marginal areas, and there is a huge loss of biodiversity. A lot of my work in biotechnology has been to address returning protection and turning

back crops and returning biodiversity. There is also a lack of technology conducive to cultural practices. In my opinion the latter is very important. If you look at statistics and the money being used by international agencies, I believe South Africa has not had a lot of exposure to this. A lot of money has been invested in Africa by ODA, DFID, USAID and Japan to try and help Africa to develop agriculture. A lot of the introduced technologies have not been conducive to adoption, so, once the donor funding finishes the project dies; there is no sustainability input. Many times the donors come with fixed ideas; they do not use local knowledge, they do not consult the local people, they push forward and, after the money goes, the project collapses. And we get that vicious cycle of nobody can help us, Africa is a bottomless pit, there is no more funding - and there is no shared blame or accountability. So who is to have the ugly face of hunger and poverty? In Kenya in June 2000, there was a major famine and people died in Turkana. This is not something that was brought from Ethiopia, and this is something to wake us up and make us think about what we can do.

I am now going to focus on genetic modifications and what is going on globally. I ask that you be open minded; I am not here to convince you that GM products are good or bad, I am just giving you information. Information is power, information is money. Your best decision making is going to be because you are informed. So my task is to give you information to empower you, information which is truthful and backed up by data, to help you to decide.

The transgenic global area up to last year was over 120 million acres. I know that some of the anti-GM lobbies are saying that there is nothing out there. But there are over 120 million acres globally, and to the best of my knowledge there is not a shred of evidence that any of these products have been a hazard or caused harm to the environment or people. When you look at the global area of transgenic crops in industrial countries and compare this with developing countries, in the same period of time, from 1996 to the year 2000, because that is when commercialisation started, you find that developing countries are way behind. I think you have South Africa being the first African country to commercialise a GM crop, that being cotton. I think the second crop is going to be maize (or corn) for animal feed. Looking at global areas of transgenic crops in 1999 and 2000 by country, you find that the USA is still in the lead, followed by Argentina - which is a developing country by the way - and then Canada, China, which has planted millions of acres to cotton, and interesting is that their cotton is exported to the UK. Then there is South Africa, and I believe a few other countries are going to come on board. If you look at the percentage increase per country you see that Argentina has the highest rate of increase in transgenic crops.

In developing countries the area under transgenic crops ranges from 15 800 hectares in South Africa to 10 million hectares in Argentina. Here I want to give general information on what is happening in the big companies with the big crops, because the major players in the biotech arena are concentrating on maize, soybean, wheat and rice because that is where they see a global market. They are not going to concentrate on a crop that is important only in Kenya, or an indigenous crop in South Africa, or sorghum, or cassava. They are focusing on the global market, so their focus is not going to affect hunger and poverty in Africa. That is why it is important for African scientists to find a way of working in partnerships to develop their own crops, to supply their own needs. What, then, is happening with maize, soybean, wheat and rice? Let us look at the major developments that have gone into these markets. Big companies are looking at biotech for processing, value added products for food, feed and industrial markets. Gene technology will work for any crop. In maize they are focusing on technologies that increase the oil, to improve the protein quality as well as improving the hardening quality. There

are many improved seeds that are on the market. And of course mealies for animal feed, increasing levels of essential amino acids, improved oil quality, increased energy content, high available phosphorus, mycotoxin resistance - because this is a major problem - and improving the starch functions.

If you look at the opportunities for adding value to wheat as animal feed, this includes increasing the energy content, improving amino acid composition, and increasing its digestibility. For the starch market there are altered starch granules, modified starch branching structure, and increased amylose content. From the milling point of view, there are increased yields of white flour. For bread making there are more stable proteins, so we are going to have bread with a lot of high quality proteins, and the functionality of these proteins will be improved. Overall yields will increase as disease control improves. I believe these are the opportunities that are going to open up the market in Europe. When some of these products were obtainable in Europe people did not see their value; the attitude was that there was already a food surplus and there was no need for increasing supply, but once we start to talk about quality traits, these people are going to see what is available to them and, despite surplus supplies, they will be more responsive.

For rice, which is a major crop in Asia, there are opportunities for increasing stability, modifying fatty acid composition, improving flavour, and altering the starch structure. Major opportunities have come about in rice, and this is one crop that is ahead in herbicide resistance, because once you have put in Roundup tolerance, you need only spray once. Then there is resistance to the main rice diseases, and the nutritional targets include putting vitamin A into rice or being able to add minerals to fit special needs. So all these products are going into the big company laboratories.

One of the projects that the organisation I work for undertook in Mexico was the modification of a potato for resistance to a virus. There was a huge argument about whether this technology would benefit small scale farmers, or whether it was for the big, rich farmers and big companies. So we did a study and used a German PhD student called Martin Klein to do an economic analysis to see who was going to benefit more. He found that, on average, the small scale farmers had a 35% loss, medium scale farmers had a 25% loss and large scale farmers lost 15% of their crops to the virus. However, with the gains due to technology, the small scale farmers got big benefits in terms of growth margin increases (142%), and the large farmers did not gain much (34%) because they were already spraying and using the correct seeds. The small scale farmers therefore benefited almost four-fold from gene technology. We have seen this consistently, even with the cotton research going on at Makhatini. We have done the same in Kenya, and looked at the sweet potato and bananas. The small scale farmers have had better gains from biotechnology and GM technology than the large scale farmers. So the argument that small scale farmers cannot improve or gain at least three-fold by using technology no longer holds.

Which biotech opportunities would have the greatest impact in Africa? This is my own opinion, my own analysis, after looking at the situation. What more could we really gain? I am looking in particular at genetic modifications. Huge production constraints are imposed by pests and diseases. Stem borers and maize streak virus cause huge losses in maize. That is why we end up with yields of 1.7 tons per hectare compared with the 4-6 tons per hectare in developed countries. We probably cannot move from 1.7 tons per hectare and go to four as there are other issues. But if we could increase yields by 1% by controlling stem borers with gene technology, we can go from 1.7 to 2.5 tons per hectare, and that is a huge increase if you look at the continent. So there is a major opportunity for disease and insect control

in Africa. And what of the other opportunities such as enhancing quality and putting vitamins and iron in maize, which is eaten by so many people? In a country like Malawi the main food is maize, so if you can put protein in maize you will have a well nourished population, and this can be done through genetic modification.

In bananas there are major production constraints from sikatoka, weevil and panama; with sweet potato the weevil and viruses; sugarcane with mosaic virus and stem borer; cassava with cassava mosaic virus and bacterial blight; cotton with bollworms. There is one technology that has a major opportunity in Africa and that is herbicide tolerance. In Kenya, over 60% of women are doing the field labour and that limits productivity as well as literally enslaving a whole population that could be doing something other than hand weeding (herbicides have not yet been used). Again, as more and more children are going to school, there are hardly any people left to do hard labour, so if we are going to increase productivity in Africa, herbicides have to factor in one way or another.

I am going to briefly look at crop biotech status of selected crops. That means we are in Africa, there is a world out there and there is a biotech status difference between the two. Are the latest technologies available to us? Can we just go and pick them off the shelf and bring them in? For maize we have a lot of GM technologies available that can be used now, like the Bt maize. Cassava is still under research and development because, as I said, the big companies have no interest in cassava. Sugarcane is ongoing, and there is some work being done with the sweet potato. I am looking at what is available, and for most crops like potato and bananas there is work in the pipeline. Soybean is available, but not in Africa. There are technologies available, but not in Africa, either because we are not part of this global network or we lack the leases to purchase.

The impact of biotech on crop production in Africa has produced successful case studies. I am going to give examples of what is going on right now. Maize streak virus is a major disease, it is a major constraint in Africa and causes a 20 to 100% yield loss per year. If the disease appears early there is no seed set, there is no corn. Over 20 years of research in Kenya there has been no impact, and I am talking about research from CGI centres like Simet, Sealad, ITA, and a lot of money from Kenya Agricultural Research Institute. This is a good example of where GM technology should be used. GM technology should not be used just for the sake of it, because it is expensive, but sometimes it is the only answer. To tackle problems like this, we have to work through networks north, south and south-south. No country has the capacity to do this on their own. Partnerships stop the fear that we cannot work with companies. Most of the companies would like to do something but they do not know what to do or where to start. I say that we should work together instead of competing and hiding the data, because we are not going anywhere alone, and we should do the research where the problem is. I found that one of the biggest problems was having research done in Mexico or in Nigeria that was supposed to have an impact in Kenya. Problems have to be solved where they are. I was able to involve big organisations like the John Innes Centre in Norwich, Novartis, who have changed their name to Syngenta, the University of Cape Town Department of Microbiology where Professors Jennifer Thomson and Ed Rybicki have been working on markers, ICIPE, which is an institution that works on insects, Kenya Agricultural Research Institute, and a number of private companies in a project on maize streak virus. Within five years, by using molecular markers and recombinant techniques, or combining them with conventional breeding, we have already come up with a hybrid that is through to the market, ten more are in national trials, and we have formed the basis for future breeding. This does

not mean we get rid of breeders, it is an interface for working together. Not only did we focus on maize streak, we also focused on all the other problems surrounding maize, like you do with sugarcane.

In 1991, after my PhD from the University of Bath, I was working for the Kenya Agriculture Research Institute when the opportunity arose to work in St Louis in the USA for three years on the sweet potato. I took varieties from Kenya and did genetic transformation for virus control, and more people were trained. This product has gone right back, as in Kenya very few are being tested, and we have a biotransformation laboratory. Our laboratories cannot cope with some of the techniques used in high level work, such as gene constructs, because, if you are using restriction enzymes and the power goes off, you lose the whole experiment. So there are areas for partnerships. Scientists are combining genes that would not combine in nature - which is true, by the way - because this way we are able to cross species, to move a gene in a way that would not happen in nature. Intellectual Property rights are a unit of controversy, because not only one gene is involved and there could be several patents. So, although the heavy level work was done in St Louis, the important thing is that we have parts of this technology that can be done in Kenya. This has really helped our country to build capacity, and we have also transferred this technology to the Vegetable and Ornamental Plant Crops Institute in Pretoria, where Johan Brink and others are working on this. We give them gene constructs and I transfer money and materials to them so that we can collaborate in South Africa. Africa helping Africa, partnerships, networking within Africa. We do not have the money to re-invent the wheel; we cannot afford to compete in this, we need to complement each other. So part of this work is being done in partnership between Kenya and South Africa. This is Kenya's first free trial on genetic modification, which started in 1991, and has gone all the way around and back to Kenya. Having the Kenyans come back from America has also been good. People get 'lost' in America because of the infrastructure and salaries and such, so getting people back is another big challenge. We expect to get 15% of the yield increase and are talking about \$41 million and food security for a million people without doing anything else. Out of this initial project we have opened up the system. We already have maize that is resistant to maize stem borers from a few testings, we have Bt cotton coming to Kenya, and the important thing is that the Kenyans are able to do it and we have a National Bio Sector Committee. One of the major limitations that we have to tackle is building capacity within our own African countries. South Africa is in the lead with about 200 trials on genetic modifications, and she needs to help other African countries and needs to network, as in the example I gave on sweet potatoes.

Bt cotton, which is a famous case as it was the first product to become commercialised, is being grown very successfully at Makhatini in Northern KwaZulu-Natal. I believe these farmers needed to spray only once for insect pests, whereas in the past they needed to spray 10 times to get any cotton out. Many African countries have not benefited from chemical technology, because the farmers are not able to read and write, and do not apply the chemicals when the weather is right. Some farmers wait until the seeds are dead before they spray, and then it is too late. Where you have technology that is packaged in the seed, anybody, my grandmother, my mother, everybody knows how to handle seeds! That means that although the high level technology is in the laboratory, everyone can benefit from it. It is user-friendly. It is in the seed. I see that as the main reason why this technology has had a major opportunity in Africa. It is in the seed. All people who know how to handle seeds benefit. In Bt cotton in South Africa you find reduced handling of hazardous chemicals, which benefits people's breathing, improved bollworm control, improved yields, reduced use of broad spectrum insecticides, which is good for environmental conservation, and savings in time, labour and costs. However, there are constraints. I am not saying all problems are solved; there are constraints of affordability, the seeds cost

more, the farmers have to know they have to work on contracts, there is limited micro-credit - and from my experience in Kenya, for the very poor to access this technology there has to be micro-credit.

Then there are the issues surrounding ownership. The farmers feel they do not own the seeds because the seeds belong to a company or someone else. The way I see it is that the hybrid seeds are not owned by the farmers, most of the seeds in North America and Europe are not owned by the farmers, they are owned by pioneers. All the hybrid seeds that have enabled surplus production in the north are not owned by the farmers, and the farmers would not care to own them because the companies they belong to are continuously improving their seeds. To them it is a business, so why do you want to tackle your seed and sit on it when a better seed is coming? So that is another mind-set we have to change. The people who gain from this technology use it as a very strong tool. However, where the farmers need to own their seeds, nobody is going to force them not to use their own seeds. I have never come across a situation where a farmer had been told to throw away his seed, but I know that in my country the only thing that prevents small scale farmers from buying hybrids is lack of capital. They know hybrid seeds are better, they know they get a better harvest from them, but nobody tells them to throw away their seeds and buy hybrids.

In developed countries, nobody owns or cares about owning their seeds; they possess them because they know they have premier prices, premium surplus. So we should not let ownership hold us hostage. When you look at Bt cotton, and we have seen similar cases in Kenya and Mexico, the adoption rate is very fast. From 1998 to 1999 we had 75 units; within this year there has been a huge increase in terms of the number of users, and the number of hectares. Why? Because the technology is proven - the farmers have seen there is high production of quality cotton, and there is less use of chemicals. There are more insects, which are there because of the biodiversity (there was a hoax about the monarch butterflies). We now realise there are 30% more insects because they are not being sprayed. So the technology is not there to wipe out the insects, in fact the insects come back because they are not being sprayed.

Barbara Hockett supplied me with information on sugarcane production constraints in South Africa and the rest of Africa. There are problems with the Lepidopteran stalk borer, head smut and mosaic virus – mosaic is also a constraint in Kenya and many other African countries. Then you have post-cutting bacterial infection, nematodes and weeds.

Biotech efforts in tissue culture (which is not controversial) to increase production is being used widely in Kenya, and is the path in terms of introducing breeding material. Before we started tissue culture in Kenya, all the breeding used to take place at the coast because that is where the sugarcane flowers. Getting this into the hands of the farmers was very difficult as there was a bottleneck of plants to introduce. But with tissue culture we were able to burst out and take many varieties. We were able to introduce about eight new varieties that are high yielding, clean and disease free, and the opportunity of tissue culture should not be lost. Then the genetic engineering for herbicide resistance, and I am not saying any of this is out in the market, it is what is going on in the laboratory, there has been work going on through Aventis. Then there is marker assisted selection for head smut. I must stress here that there are no commercialisation agreements going on; there is no GM cane in the market.

Before I go I would like to make suggestions, as I have quite a bit of experience. I believe that sugar can be improved. There are areas where you can benefit from the global status of what is going on in

sugarcane. Firstly, remember you are in a global economy, you cannot lock yourself away and say, "We shall not enter into this controversy," because the world is moving. There are 120 million acres out there. We are competitors who are going to accept GM technology, and we will out-perform you. You have to look at the future, otherwise your competitors will be ahead of you. The first thing I would advise is to get an Intellectual Property audit on on-going programmes, to determine who owns what gene construct or what part of your technology. This is one area in Africa where we are still behind; we are doing things for the public good, we are not patenting. One of the biggest problems with the large companies is that they have been over-patenting, and there are so many people with licences. So find out who owns what before taking on a product, so that you do not end up with a product you cannot commercialise.

Secondly, obtain a licence agreement on freedom to operate on selected cases. Find the products you are able to get licences of freedom or donations for before you take them on, because they are very expensive. I have had cases where some of the international centres have come up with a product only to find that what they have come up with is already patented, so they dump it or help to get donations for it to go on.

Thirdly, I would advise you to focus on proven GM opportunities. Start from the known to the unknown. There are major opportunities in Bt genes to control stem borer. This is one of the technologies that has gone way ahead. There are also viral coat protein genes for the control of sugarcane mosaic virus. In fact, there are now thousands of products available with coat protein genes and proven technology. A lot of genes you will be using have already been regulated, which means that their toxicity has been studied, so you do not have to spend a lot of time or money on that. Then there are herbicide resistant genes for weed control. A major opportunity in sugarcane and I see a major opportunity for maize, because there you can do monoculture, which has not been in hand.

Fourthly, I would advise the use of molecular markers to enhance breeding, especially as a lot of money has been put into characterisation. You can use what you have already invested in. These are the four steps I would advise for sugarcane research because, no matter what the controversy, you have too much invested and you have to provide again. The opportunities are there as well as the competitors.

South Africa has a role in agricultural biotech leadership in Africa. I believe South Africa should provide overall leadership, be it sugarcane, be it vegetable or ornamental crops here or overseas, capacity for regulatory and human infrastructure. South Africa has 42% of all sub-Saharan Africa, where else to play some type of leadership? The door has opened up in South Africa. I remember some time last year we had 20 products in Kenya; from South Africa we had one product and I think it was tea. South Africa is moving, and taking markets in Africa. At the same time you have to provide leadership. There is information and experience that needs to be shared. There is product mobilisation and commercialisation. You are the first country to commercialise, so you must have the experience to help other countries. At the same time I see partnerships between Kenya and South Africa.

We have to remember that Europe has a stand on biotechnology. There is a very, very active anti-GM lobby in Europe, Greenpeace and many others, and they have a huge amount of money. If you look on the website and see the budget for Greenpeace - we are talking about US\$100 million. So there is one big organisation with money to mobilise to do what they want. I am not saying that we should not be sensitive of their concerns; I am not saying do not support Greenpeace, all I am saying is that Africa

looks to Europe for leadership in many areas. We have a colonial legacy. Countries that were colonised in Africa still look to Europe to tell them exactly what to do, and if they refuse it is important to consider why they refused. We are not on level ground because Europe has surplus food production. If there are areas with food deficits where we see opportunities, and there is no proven problem, this is where we need to think for ourselves. Equip yourselves with knowledge and information.

Then there is trade. For example, if you have a GM product like sugar, can you export it to Europe? For the time being, the answer is no. I believe this will change in the future. Does this mean you should stop research on sugarcane using GM technology? I would say no. We are moving to a global situation; things could change in Europe, and if we stopped our research we would have nothing. For example, if Europe has done all the research on GM technology and put it under the table, and they then change their minds - and people can change their minds overnight - they will just take it out and put it on the table, and Africa will have nothing under the table. So we cannot sing the song of Europe, we have to build capacity, laboratories, train people and be equipped to get into the global market. We have to develop agencies, form partnerships, find funding for public research and we have to have regulatory systems.

Then there are the challenges. The potential and opportunities for technology are proven. The potential for positive impact has been demonstrated, we have seen increases in food and income, be it maize, sweet potato or cassava, and a variant of biodiversity conservation. I tell you, be prepared, be prepared for people who will say that anything to do with biotechnology will destroy everything. I really take a lot of exception to that because, used wisely, biotechnology can enhance biodiversity. We cannot dismiss everything. We have to see what is bad and reject it, and use that which is considered good and use it wisely. There is public acceptance of products like Bt cotton; you just have to drive to Makhatini to see that.

About 80% of biotech IP is in the private sector in the north. One of the areas where I believe the Greens have helped is to pressurise the big companies into donating the intellectual property they do not need. Organisations like the Rockefeller Foundation are putting this together and seeing where they can help in Africa with those donations. So we cannot use IP if it going to prevent us from benefiting. There is a thrust from Rockefeller for this.

There are also many challenges. We have interference from anti-GMO groups, especially from Europe. Despite this interference, let us operate; let us try it! Africa is no longer the dark continent, there is some light; let us try and make decisions from experience. We have the challenge of inadequate institutional capacity, which is very important and is about networking. We have limited land, low levels of education, a lack of balanced information, and with all these we have to literally find the information, because what you get out there is that Africa is organic farming and nothing else. There are all kind of distortions. Capital to access GM products is limited; that is where we talked about micro-finance.

The constraints to accessing GM technology in Africa include IP being locked up in the private sector, a lack of policy to protect and patent innovations, artificial trade barriers, and of course few countries in Africa have national biosafety regulatory systems. This is important. So you see we are far behind, but I think that is an advantages because the products that are coming through have been eaten for three years in America. I keep telling people they are human tested. They are coming to Africa when they

have been eaten in Canada and America. So right now it is the other way around because we are behind in technology so it may not be bad for us. I believe that GM technology and leader technology will succeed in Africa for these reasons: we are Africans, we are doing it cautiously, introducing GM products only where there are regulatory systems, we do not have product push like it has happened in Europe. In Europe there is a huge product push and that backfired. We do not have product push in Africa, for us it is one at a time. Cotton in South Africa, then we move it to Kenya, move it to Zimbabwe, one at a time. Africa is aware of the encouraging developments from countries like China and India, who are reaping the benefits, and where we can form strategic alliances. Plus, most of our focus is on accruing food security. I do not know of any country in Africa that is very concerned about products that can be exported to Europe. If it is a sweet potato, in Kenya it is food security. Feed our people first before thinking about exports. So that is an opportunity and it is major considering the food deficits. Then we have endorsements of safety from credible organisations like the World Food Organisation, World Health Organisation, FAO and OECD. I plead with you, get those documents, get to the right brands, see what the status is, what the FAO or World Health Organisation says about GM technology. When you see the headlines from Greenpeace saying GM is dangerous and it is not tested, find out what the World Health Organisation has said. They fully endorse GM technology in a beautiful document that you can get off the website. The OECD, a major European group, fully endorse GM technology. I have said it is not hazard to human development. The FAO, a food agricultural organisation, also have documents there. There is a huge amount of information, study after study after study.

I continue by saying there is support for GM technology from some African leaders like your President. He is positive and supportive. Nigeria has recently put up US\$26 million to promote biotechnology in the country. And I am really pleased to say they have invited me to go and work with them, to develop the strategy for their country. They have clearly said that, other than computer technology, they believe GM technology will have an impact in their country, and that they are going to leapfrog into the future. You know those arguments that why should Africans have GM technology when they have not developed their own infrastructure. It is like saying why should you use the cellphone? And they say why do we have internet? We are in a global community, there is room for all us to develop our country. We cannot reverse and go back to typewriters because not everybody has computer technology, or go by train because not everybody can go by air. Then there is improved public understanding, we have grassroot organisations like ABS Service, Africa Biotechnologists Forum in Kenya, others like AfricaBio and all that. Scientists are getting out of the lab and talking to farmers and communities, telling them what technology is all about. I personally was not going to be involved in this kind of talk. I am a scientist, why do I have to explain technology that I know is good? But we have changed, scientists are getting out, talking to the public. When I was invited with other scientists to talk to the parliamentarians in Kenya, our parliament wanted to know about biotechnology. We can no longer be arrogant by saying people know, we have to get out otherwise we will only have Greenpeace talking and saying this technology is dangerous. We really have to get down and talk to the public, the farmers, the players, the policy makers, explain what we are doing and how it will affect food security. Let us point to the fears, give information.

As to the way forward, I see that we need to strengthen the grassroot organizations. We must really communicate and strengthen the regulatory system. We need to test more, we need driven products, we need to look at products that help in development, and we need strategic alliances. This is one of the themes I participated in with NOVA, NOVA PBS, NOVA Frontline News, one of the United States

public television stations. The producer filmed what was done in Mexico, Kenya, India and other countries, and they brought together different people to talk about GM technology. They brought four people from a University or independent researchers, the USDA people involved in the environment, and people who were against GM technology, and then after they had gathered a huge amount of data they asked the public who they believed in terms of credibility, information. A public organisation and a private organisation did research to find out if this theme had changed peoples' minds, and I was really surprised to see that out of this huge research in Canada and the USA, I was number one. They were saying they believed it because there is a woman from Kenya or Africa, she is where the problem is, she is on the ground doing something, she is not practising hearsay. The Greens are talking from Europe and saying this and that, but that lady is where the problem is, she is working with the people, she is talking from experience, she is a real person with a real situation. You should not say that you cannot make a contribution, or let other people talk, if you believe in this technology. You have a responsibility to communicate, and what you say can make a difference. I did not believe that anything I said could make a difference, so I was surprised when I saw the data. Many people called and said that they had changed their minds and would support the technology. Not because of me, there were several of us, but from Africa and all these studies, which was huge, and the public television, I was number one. I was encouraged, and other people should also stand, and not say who am I to make a difference? You can make a difference if you are committed, and you are talking of substance and from experience.

Again, I would encourage you to get this information because information is power. We really have to modify Africa, we cannot continue to be the continent of hunger and poverty. There is a lot of potential in this country, and I see biotech playing a role. It is not a panacea, it is not a silver bullet, it is an opportunity for us.