SABIMA: an initiative for safe and high-quality GM crops

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Walter S. Alhassan

Biotechnology represents a powerful tool that augments conventional approaches to tackling the future challenge of food security. The global adoption of GM technologies in agriculture has seen phenomenal growth from 1.7 million to 160 million hectares over the period 1996–2011. Genetically modified (GM) crops have delivered substantial agronomic, environmental, health and social benefits to society at large,[1] but the rate of GM growth in Africa is low, even though it is a continent faced with food insecurity. The rate of growth of GM crops is even lower in Europe but then Europe does not presently face a comparable food security challenge.

Safety concerns

Genetic modification enables the transfer of genes artificially from one organism to another for a specific purpose (e.g. increased yield and nutritional value, protection against pests and diseases, survival in hostile environments). In this

way hereditary material (genes) can be moved to or from unrelated species in a controlled and predictable manner that supplements and extends the normal process of plant breeding. Currently the following GM crops have been commercialised: maize, soya bean, cotton, canola (rape), squash, papaya, sugar beet, tomato, sweet pepper and alfalfa. They are grown primarily in North and South America, South and East Asia.

Production of a GM crop passes through the following stages, each being subjected to stringent scrutiny: (1) laboratory, (2) containment greenhouse, (3) field-testing under strictly controlled conditions ('confinement'), (4) extensive risk assessment (multilocational trials including farmer fields, food safety testing), (5) farm release and (6) post-market surveillance. This process, including regulatory approval, is very costly, which means that in the main it is restricted to a few staple crops and can only be afforded by private, multinational companies and not publicly funded research organisations.

Science academies the world over, government studies, United Nations agencies and religious bodies have not found any new risks associated with GM crops used for human food or animal feed that have undergone the required safety checks before release. As Sir John Beddington, UK Government Chief Scientific Adviser pointed out recently, over a trillion meals have been made using GM crops in North America and there has not been a single case in the law courts of anyone suing after eating GM products.[2]

An underlying factor for the slow growth of GM crops in some continents remains scepticism over their safety to humans and the environment despite repeated assurances from respected independent bodies. In 1999 Britain's Nuffield Council on Bioethics reported: '*We have not been able to find any evidence of harm. We are satisfied that all products currently on the market have been rigorously screened by the regulatory authorities, that they continue to be monitored, and that no evidence of harm has been detected*'.[3] National academies of science in France, Germany and the UK have since reached similar conclusions (2002 and 2003). The Food and Agriculture Organization of the United Nations (FAO) said that '*to date no verifiable untoward toxic or nutritionally deleterious effects resulting from the consumption of foods derived from genetically modified foods have been discovered anywhere in the world*'.[4] Scientists in New Zealand and The Netherlands surveyed worldwide literature and concluded that GM crops had been no more invasive or persistent than conventional crops and were not more likely to lead to gene transfer (2003).

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More recently, a Study Week of the Pontifical Academy of Sciences in Rome brought together distinguished academy members and other experts who reported that '*there is a moral imperative*' to make the benefits of genetic engineering technology '*available on a larger scale to poor and vulnerable populations who want them*', urging opponents to consider the harm that withholding this technology will inflict on those who need it most (2009).

The European Commission's Directorate-General for Research and Innovation, reviewing the past 25 years, stated that biotechnology, and in particular GM crops, are no more risky than conventional plant breeding technologies.[5] Islamic scholars of modern biotechnology concluded that GM as a method of plant improvement is not intrinsically different from other plant improvement techniques from the *shariah* point of view.[6] Acceptance of GM processes and products was recommended for Muslims and members of the Organisation of

the Islamic Conference as long as the sources from which they originated were *Halal*. The only restrictions were products derived from *Haram* origin that retained their original characteristics and were not substantially changed.

Stewardship and self-regulation: a new concept in African modern biotechnology product development

Recently, an African initiative has developed a self-regulating index of responsible management or *stewardship* of modern biotechnology. This form of stewardship aims to secure GM products that have proved safe and stable over the entire product cycle – from gene discovery to seed production to market place.

This project on *Strengthening Capacity for Safe Biotechnology Management in Sub-Saharan Africa* (SABIMA) was introduced in Africa by the Forum for Agricultural Research in Africa (FARA) to fill a gap in the training of African scientists to conduct modern biotechnology research, and to develop and disseminate products to ensure that they were not only meeting regulatory compliance for safety but also addressed product quality requirements. The SABIMA project focused on stewardship training and adoption in biotechnology and in GM product development as the core objectives. Stewardship is the self-regulating responsible management of a (GM) product from its inception stage through the entire product line. For each stage of the product development, an analysis is performed (called critical control point analysis) to determine what could go wrong and pre-emptive action is taken through standard operation procedures (SOPs) to address potential challenges, if any. As a first step, the product in development, if it is a GM product, must meet the regulatory requirement for safety before the quality assurance steps are taken at each stage of the product development line.

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Adherence to best stewardship practices enjoins all individuals, from the researcher, the farmer, processor, distribution/shipping agent for seed or grain to those responsible for product discontinuation and the relaunch of new products, to practise good stewardship at their point in the product cycle to ensure product integrity or wholesomeness. Lapses in adherence to stewardship guidelines have created problems in world trade through the mixing of GM and non-GM product due to improper product segregation or separation during the handling of merchandise. Challenges can also arise in the management of GM products on the farm by not adhering to mandatory buffer zones of non-GM plants (refugia) around GM crops. Failure to meet this requirement encourages the development of resistant insect pests to the introduced gene, and such resistance can present a growing global problem.

So far six countries in sub-Saharan Africa (Burkina Faso, Ghana and Nigeria in West Africa; Kenya and Uganda in East Africa and Malawi in Southern Africa) have benefited from the SABIMA project. Thirteen FARA-certified trainers have been produced by the project and they have in turn trained 1,412 people in the six project countries. Case studies on various management challenges identified and addressed through stewardship principles learnt have been published by FARA and made available at its website.[7] One such stewardship application was in the development of GM (*Bt*) cotton in Burkina Faso by scientists at the Institute for Environmental and Agricultural Research (INERA), Ouagadougou. Here, the challenge was in avoiding the mixing of *Bt* (GM) and non-*Bt* (non-GM) cotton by farmers who must handle both crops on the same farm as well as ginnery operators who must also handle both products. Farmers, extension officers and ginnery operators had to be trained in stewardship principles by INERA scientists

who had themselves been trained in stewardship principles involving proper packaging and labelling, cleaning to avoid residual contamination and batch handling of GM and non-GM cotton at planting and at the ginnery. These are listed critical control points whose analysis determines steps to be taken to avoid the mixing of *Bt* and conventional non-*Bt* cotton. These interventions by INERA have reduced the incidence of cotton seed mixing.

In Malawi, through critical control point analysis by SABIMA project-trained stewards at the Chitedze Research Station, Lilongwe, Malawi, harvest of certified maize hybrid seed was detected as a critical point for detecting farmer adulteration of certified seed with ordinary grain. Acceptable yield levels for certified seed from farmers trained on the importance of product stewardship diminished the unwholesome practice of certified seed-grain mixing. The Malawi case is an example of the use of stewardship principles in a non-GM crop setting.

At the First Pan-African Conference on Stewardship in Agricultural Biotechnology in Ghana on 29–30 November 2011,[8] there was not only an overwhelming endorsement of the SABIMA project but a call for its outscaling to a minimum of ten more countries. FARA is the first and so far the only institution in Africa addressing training in the crucial area of stewardship in biotechnology product development and complementing other organisations addressing solely biosafety capacity-building and awareness creation/advocacy for biotechnology. FARA is currently in search of funding support to outscale the SABIMA project that ended in 2011 into a second phase that will also see its mainstreaming into university curricula.

Concluding thoughts

Despite 15 years of successful GM crop commercialisation globally, there has not been a scientifically proven adverse effect on human and animal health and the environment attributable to its release. The growing evidence is that both GM and non-GM food crops are substantially equivalent. Nevertheless GM crops are still subject to strict regulatory compliance in their development.

Stewardship, a self-regulating requirement, ensures both product safety and quality and indeed the sustainability of modern biotechnology. The SABIMA project is designed to build a culture of stewardship in GM and non-GM product development on a continuing basis. African countries are encouraged to link with private-sector organisations in crop biotechnology stewardship to continuously benefit from new trends in biotechnology stewardship. FARA's role in the maintenance of a community of practice to share stewardship best practices in Africa will be crucial.

There is a sense of growing optimism that over the next five to ten years there will be acceleration in the pace of development and use of GM products on a need basis for Africa's food security. Reasons for this include the fact that there is a pipeline of GM food products being developed in Africa by African scientists in public institutions and not by biotech companies. The food products (at confined field-trial stage) are the ones that will be largely consumed by Africans and will include *Bt* cowpea, high carotene banana, biofortified sorghum, nutrient-enhanced cassava and sweet potato, water-efficient maize and nutrient-efficient rice. The African countries involved in the research include Burkina Faso, Egypt, Ghana, Kenya, Nigeria, South Africa and Uganda. The wholly consumed African products will hit the market under country-specific biosafety regulations. Efforts are ongoing to harmonise the regulations over various sub-regions. Continuous awareness creation, transparency, investment in research and farmer support services are among the needed catalysts.

References

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Professor Walter S. Alhassan *is a consultant on biotechnology and biosafety policy issues for the Forum for Agricultural Research in Africa (FARA) in Accra, Ghana.*
FARA Headquarters, 12 Anmeda Street, Roman Ridge, PMB CT 173, Cantonments, Accra, Ghana. walhassan@fara-africa.org