GM biotechnology: friend and foe?

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Genetically modified organisms (GMOs) have received much controversial publicity in the last decade, leading to a polarized debate on GM biotechnology. As a result, the public is left either perplexed or distrustful of GMOs. This technology may hold solutions for poverty and hunger in Africa. However, there are various issues that continue to hinder its implementation. Proponents of genetic modification (GM) believe that NGOs portray an unconstructive view of GMO technology, contributing to increased public mistrust. Advocates of GM believe also that there is an overestimation of the risk posed by GMOs. There is further heated debate over whether GM and non-GM products are substantially equivalent. In addition, some perceive that the Convention on Biological Diversity impedes the implementation of biotechnology in developing countries. Other contentious issues include the various regulatory systems that govern GMOs as well as GM labelling. It is important that these issues are addressed transparently by NGOs, biotechnology companies as well as government bodies, so that the ideal of making biotechnology a 'friend' can be realized.

The opinion piece 'Biotech's defining moments' in *Trends in Biotechnology* indicates a frustration shared by many scientists.[1] This discontent stems from a perception that regulation of biotechnology in the name of biosafety is futile and research on biosafety excessive.[1,2] At the same time, advocates of biosafety are too easily branded as anti-biotechnology, unscientific and unnecessarily shortsighted. Important but contentious issues are currently being debated. These include: 1) a perception that non-governmental organizations (NGOs) stigmatize genetic modification (GM), 2) the notion that risk assessments do not make a positive contribution, 3) a belief that distinguishing between GM and non-GM products has no scientific basis, 4) the opinion that studies of coexistence between GM and non-GM crops are unnecessary, and that 5) some regulatory systems are scientific and others not, 6) that the Convention on Biological Diversity (CBD) impedes genetic engineering research as well as its promotion in developing countries, and 7) that mandatory labelling has no scientific basis.[1] As a result, the biotech community appears to be at loggerheads with itself so that, regrettably, the potential benefactors of this technology in developing countries are the losers. It is therefore necessary to depolarize the debate so that African countries can make informed decisions about introducing GM biotechnology.

Proponents of biotechnology believe that NGOs stigmatize and undermine public confidence in recombinant-DNA technology.[1] Ironically, there are as many NGOs that unscrupulously advocate that biotechnology is a 'silver bullet' to alleviate hunger in developing nations, without any scientific basis. Some of the unsubstantiated statements, referring to GM technology, include: 'The biggest threats that hungry populations currently face are restrictive policies stemming from unwarranted public fears.'[3]; 'A growing number of agricultural researchers, food experts and policymakers are pointing to plant biotechnology as a critical tool that can help increase food production and alleviate hunger without depleting natural resource.'[4]; and 'As Kenya faces yet another famine, food experts say that irrigation and adoption of genetically modified (GM) crops could be the way out of the perennial hunger problem.'[5] Antagonists, equally, express negative sentiments towards biotechnology, such as 'Genetic engineering in its present form cannot form part of the solution; it is part of the problem.'[6]; 'African countries are being targeted by the biotech industry and its lobbyists with unprecedented backing from the US government. Even food aid has been used to push GM into Africa.'[7]; and 'It is clear that GM crops offer no benefits and cannot feed the world.'[8] Propaganda on both sides of the argument therefore contributes to a skewed public perception of biotechnology, and creates confusion, mistrust and cynicism among consumers and scientists alike.

Many scientists who develop genetically modified organisms (GMOs) believe that risk assessments are unnecessary or go beyond what is required to establish a lack of risk.[1] Nonetheless, risk assessments are vital to determining human safety. For example, a transgenic soybean engineered to contain a protein from Brazil nut would have been fatal for those with nut allergies. The allergy studies performed during the risk assessment were therefore necessary.[9] Moreover, there is a case where a risk assessment may have proved vital. In 1989, the Eosinophalia–Mayalgia Syndrome epidemic in the US, caused by the GM dietary supplement L-tryptophan, resulted in 37 mortalities.[10] It is not certain whether the risk assessment performed was insufficient or whether it was undertaken at all. By claiming that risk assessments are excessive, GMO advocates unwittingly impede the progress of biotechnology by implying that the technology is above risk or that they fear scrutiny. In addition to determining health safety, environmental risk assessment is just as important. The conservation of biodiversity, including the preservation of landraces, is a global concern. A recent study in the US found that an unreleased transgenic herbicide-resistant creeping bentgrass introgressed into wild populations.[11] Risk assessments are therefore imperative and not futile if performed with diligence. However, most African countries do not have the resources or expertise to do this.

A debate continues among scientists as to whether a GMO is substantially equivalent to its non-GM counterpart. Substantial equivalence implies that a GMO, with the exception of the transgene, and the corresponding non-GMO are not significantly different. However, the recognition of intellectual property rights (IPR) makes a clear distinction between GM and non-GM products in terms of plant breeder's rights and patenting. In fact, GM and non-GM products are biologically dissimilar (one has a transgene) and the GM variety is subject to patent rights and technology fees. Patent laws are alien to farmers in Africa, especially subsistence farmers, who customarily save and share seed. Thus whether the scientific community agrees or not, the legalities of transgene technology prohibit classification of GM and non-GM crops as substantially equivalent.

The numerous examples of 'gene escape' over the last few years indicate that coexistence of GM and non-GM crops requires careful management. In Nebraska in 2002, Prodigene's pharmaceutical maize commingled with soybean and, in the same year in Iowa, cross-pollination with conventional maize occurred.[12] Prodigene's financial losses were more than US$3 million, which included fines and clean-up costs. Similar incidents of accidental transgenic entry into the food chain have occurred with Starlink maize[13] and Liberty Link rice 601.[14] Clearly, there is an urgent need for management to allow for coexistence and minimize commingling. The entry of a pharmaceutical crop into the human food chain would have devastating consequences for Africa, where maize is a staple food and resources to deal with

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such a situation do not exist. The recurring examples of gene escape suggest that more research is required to prevent this situation persisting.

A sector of the biotechnology community believes that GMOs are unscientifically over-regulated, while others consider that regulations are insufficient. In the United States, the Food and Drug Administration (FDA) procedure to regulate GMOs is not that of approval but rather a consultation process, which is voluntary. This involves an audit of a risk assessment based on information provided by the biotech company: 'During the consultation process, the FDA does not conduct a comprehensive scientific review of data generated by the developer.'[15] In contrast, the European Commission, on behalf of the European Union, requires verification of information provided and may additionally perform necessary food safety and environmental risk assessments before granting approval of a GMO.[16] In South Africa, the Department of Agriculture, through the GMO Act of 1997, also performs a risk assessment audit using independent scientific expertise.[17,18] While some regulatory systems are more stringent than others, it is uncertain which of these is more scientific. In reality, bureaucratic requirements are no indication of scientific content.

The Convention on Biological Diversity (CBD), and specifically the Cartagena Protocol on Biosafety,[19] are often seen as an attempt to hinder the spread and acceptability of biotechnology in developing countries.[1] The biosafety protocol deals specifically with the transboundary movement of living modified organisms (LMOs) and its impact on the conservation of biodiversity as well as human health. The protocol is therefore a facilitation mechanism to help countries manage the introduction of GMOs through the implementation of regulatory frameworks.[19] It would seem short-sighted of biotech companies, NGOs and scientists to view the biosafety protocol in a jaded light when the CBD has proved to be an effective enabling mechanism in developing countries, some in Africa.[20]

Mandatory labelling of GMO products is criticized as unscientific and an unnecessary expense.[1] Food products are nevertheless already being labelled with regard to potential allergens, ingredients and nutritional value. In addition, market-directed labels—such as kosher, halaal, vegetarian, fat-free, low-fat, cholesterol-free and gluten-free—are globally accepted. Thus labelling food products with regard to GM content is no less scientific than some other market-directed labels. Additional information on the GM status of a product would allow for consumer choice and possibly contribute to an awareness of GM.[21] However, to deny consumers the right of choice, between GM and non-GM, in product selection is draconian and will taint biotechnology in the eyes of economically influential consumers.

South Africa is currently the only country growing GM crops commercially in Africa. The lack of acceptance of GMOs became evident during the food aid crisis in 2002, when southern African nations initially refused to accept GM food aid.[22] Recipient countries raised concerns about the potential health effects of GM food, its impact on agricultural biodiversity and export markets.[22] Although Malawi, Mozambique and Zimbabwe finally decided to accept GM food aid after it was milled, Zambia did not, and was instead supplied with non-GM food aid. This incident highlights some of the commonly raised concerns regarding GM in Africa, including: 1) issues of food safety, especially since consumption patterns on the continent differ from those in the EU and US; 2) patents on GM products and their impact on food security; and 3) the threat of gene escape into locally adapted landraces and its consequences for food exports. In addition, African countries are unable to compete with subsidized agriculture in the EU and US and have to consider niche markets for non-GM and organic production.[22] The GM debate in Africa is thus not fickle, and countries have to consider these issues for agricultural and economic sustainability.

Biotechnology can potentially benefit developing countries but socio-economic, political and infrastructure constraints in Africa must also be taken into account.[23] To claim that starving millions will be saved and then charge a technology fee is paradoxical, especially in Africa, where a culture of seed-sharing and seed-saving has existed for generations. For GM technology to be beneficial, it is important that interested parties including NGOs, government bodies, biotech companies and scientists work proactively to resolve conflicts. Hunger alleviation in Africa can best be realized if the GM debate is depolarized and the issues addressed with transparency and forthrightness from proponents as well as opponents of recombinant-DNA technology. This would inspire public confidence and perhaps make GM biotechnology more palatable to Africa.

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