GM SORGHUM: AFRICA'S GOLDEN RICE

african centre for biosafety

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Contents

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The African Centre for Biosafety (ACB) is a non-profit organisation, based in Johannesburg, South Africa. It provides authoritative, credible, relevant and current information, research and policy analysis on genetic engineering, biosafety, biopiracy, agrofuels and the Green Revolution push in Africa.

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Acronyms

AAFT	African Agricultural Technology Foundation
ABS	Africa Biofortified Sorghum project
ARC	Agricultural Research Council
ARIPO	African Regional Intellectual Property Organisation
BCH	Biosafety Clearing House
BecA	Biosciences east and central Africa
BIO-EARN	East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development
BMZ	Bundesministerium Für Wirtschaftliche Zusammenarbeit (German Federal Ministry for economic cooperation and development)
BSP	Biosafety Protocol / Cartagena Protocol on Biosafety
CBI	Confidential Business Information
CIRAD	Centre for Agricultural Research for Development
CGIAR	Consultative Group on International Agricultural Research
CORAF/WECARD	Conseil Ouest et Centre Africain Pour la Recherche et le Developpment
CRIDA	Central Research Institute for Dry-land Agriculture (India)
CSIR	Council for Scientific and Industrial Research
DSR	Directorate of Sorghum Research (India)
EC	Executive Council: GMO Act
FARA	Forum for Agricultural Research in Africa
GCGH	Grand Challenges for Global Health[1]
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IER	Institut d'Economie Rurale du Mali
INRAN	Institut National de Recherche Agronomique du Niger
INTSORMIL CRSP	International Sorghum and Millet Collaborative Research Support Programme
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ITPGR	International Treaty on Plant and Genetic Resources for food and agriculture
KARI	Kenyan Agricultural Research Institute
MAS	Marker Assisted Selection
NARS	National Agricultural Research Stations
NEPAD	New Economic Partnership for Africa's Development
NGO	Non Governmental Organisation
OAPI	Organisation Africaine de la Propriete Intellectuelle
PAIA	Promotion of Access to Information Act
PCT	Patent Convention Treaty
TNC	Trans-national Corporation
SASF	South African Sorghum Forum
SLU	Swedish Agricultural University
UN CBD	United Nations Convention on Biodiversity
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USPTO	United States Patent and Trademark Office

This paper forms part of the ACB's African Sorghum Series.

About the paper

In this paper, we critically analyse the Africa Biofortified Sorghum (ABS) project, a GM 'poster project' in Africa. We dig beneath the veneer of the project being an "African led solution" to poverty and malnutrition on the continent. We also focus attention on the myriad of sorghum research initiatives currently underway in Africa, using both genetic engineering techniques and marker assisted selection (MAS). In this regard, we pay special attention to the USAID funded INTSORMIL programme. We also provide a snapshot of the GM sorghum research being conducted elsewhere in the world.

Introduction

Sorghum was first domesticated in Ethiopia, almost 7,000 years ago.[2] Today, it is the fifth most important grain crop in the world, and the second most produced grain crop on the African continent. According to the UN Food and Agricultural Organisation (FAO), the West African sub region produced over 14 million tons of sorghum in 2008 (approximately 56% of Africa's total production), with Nigeria alone producing 9.3 million tons.

Recent scientific 'discoveries' have revealed that sorghum varieties possess many characteristics, or traits of interest to the agro-chemical industry, such as drought and aluminium tolerance. Sorghum has also been earmarked as a highly lucrative agrofuel crop.

The first GM sorghum produced through biolistic (the gene gun) transformation was back in 1993, while the first recorded agrobacterium mediated transformation of sorghum took place in 2000.[3] There are still no commercially available GM sorghum varieties in the world today, though several research projects are focussed on developing transgenic sorghum varieties, with the most high profile being the Africa Biofortified Sorghum (ABS) project.

The ABS project is funded by the Bill and Melinda Gates Foundation's (BMGF) to the tune of $18 million. The main goal of the ABS project is to improve the nutritional quality of sorghum, specifically, to increase the levels of lysine, Vitamin A, iron, and zinc, through genetic engineering. The programme is co-ordinated by the Africa Harvest Biotech Foundation International (AHBFI). AHBFI purports to be a non-profit organisation seeking to 'free Africans from poverty, hunger and malnutrition' through the use of modern technology.[4] A perusal of its board of directors reveals its close links to the biotechnology industry and its collaborating partners include almost every organisation of any significance in the industry.

A significant portion of the ABS research is taking place in South Africa, in collaboration with local partners, the Council for Scientific and Industrial Research (CSIR) and the Agricultural Research Council (ARC). To date, the Executive Council (EC), the regulatory http://www.doveshoot.net/wp-content/uploads/2008/08/p1010011 71.jpg

body that oversees biosafety in South Africa, has twice rejected the CSIR's application for greenhouse experiments involving GM sorghum on safety grounds. The go ahead was, however, given when the EC's decision was overturned on appeal.

Along with the ABS project, sorghum is the subject of numerous research initiatives in many other Africa countries. Chief amongst these projects is the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL CRSP), a consortium of US land grant universities. With the full support of the United States Agency for International Development (USAID), INTSORMIL has been heavily involved in sorghum research and breeding since 1979. INTSORMIL'S work has benefited the US sorghum industry to the tune of around US$ 680 per annum.[5] INTSORMIL places heavy emphasis on the results of its research being applied into very specific non-African commodity driven chains of production and consumption. The proliferation of sorghum research on the African continent has also spread into the area of marker assisted selection (MAS). While the biosafety risks arising from MAS are not as acute as those from other techniques of genetic engineering, it still affords the same opportunities for patenting on life forms and the 'yield obsessive' approach that characterises the Green Revolution.

The sorghum genome has been subjected to numerous patent claims from scientists, mostly associated with public and private research institutions in the United States. In a recent paper by the ACB, we noted that many recent patent claims were not even in respect of specific genes from specific varieties, but were more like 'a grab for strategic territory on the sorghum genome', akin to the 18th century European explorer claiming distant lands in the name of his sovereign merely by planting his nation's flag in the ground.

Also worrying is that many patented and privately held sorghum varieties originated from collections of public institutions, 'held in trust' for the public good.[6] In this so called 'year of biodiversity', the ACB is appalled by the rampant privatisation of the sorghum genome, done in the name of public science.

We totally oppose the release of GM varieties of sorghum. We are not alone in arguing that 7,000 years of breeding and knowledge sharing should not be reduced to a series of patented mono-crops that contribute to the coffers of the global gene-giants and nothing to Africa or her farmers.

The Africa Biofortified Sorghum Project

The Africa Biofortified Sorghum (ABS) project is the brainchild of the Africa Harvest Biotech Foundation International (AHBFI). According to its website, the AHBFI is a non-profit organisation, 'established in 2002, to promote the use of advanced science and technology products to improve agricultural productivity among Africa's farmers, and free Africans from poverty, hunger and malnutrition'.[7] A closer perusal of the AHBFI's board of directors and its partner organisations reveal its truer modus operandi. Several of its directors have previous links with the biotech industry and have been heavily involved in the implementation of biosafety policies, including Kenya's.[8] Its 'development' and 'collaboration' partners are a who's who of the biotech industry's PR machine, including: Du Pont, Syngenta, the Gates, Ford and Rockefeller Foundations, Croplife International, ISAAA, FARA, USAID, NEPAD and AfricaBio.[9] AHBFI's headquarters are in the biotech industry's citadel of Nairobi, while it has regional offices in business friendly Johannesburg and Washington DC.

The ABS project comprises of 6 components: Technology and Research; Product Development; Regulatory and biosafety initiatives; Public acceptance and communication; Intellectual property management and Management and coordination. These are dealt with below.

Technology and research

This aspect of the ABS project has perhaps received the most public attention. There are several actors involved in this phase of the project, including South Africa's Council of Scientific and Industrial Research (CSIR), University of California Berkeley[10] and Pioneer Hi-Bred, who donated the initial technology worth $4.8 million.[11] The stated aim of the research is to develop GM sorghum that contains increased levels of lysine, Vitamin A, iron, and zinc. So far, sorghum has been developed with target levels of traits in iron, zinc, lysine and improved digestibility. Known as 'ABS#2', this transgenic variety has been tested in Puerto Rico four times.[12] According to some literature, the CSIR and Pioneer Hi-Bred are still working on introducing increased Vitamin A content.[13]

The ACB has been following the ABS venture since 2006, when the CSIR applied to South Africa's biosafety regulatory body, the Executive Council (EC) for a permit to conduct laboratory and greenhouse experiments. The CSIR's first application was turned down on the grounds that insufficient proof of adequate containment facilities had been provided. The CSIR re-submitted a fresh application in September 2006. At the time the ACB was able to obtain a 'non-confidential-business-information' (non CBI) version of the CSIR's application, and was of the view that the new application did little to address the initial biosafety concerns of the EC, and that the scientific information provided was 'wholly inadequate, erroneous and unsubstantiated'.[14]

The EC had a similar opinion and again rejected the CSIR's application at its first meeting in 2008, stressing particular concern over the proposed containment facility.[15] However, the EC's decision was overturned on appeal during September 2008.[16] The ACB has been attempting to access information of the status of this project for some time now, through the Promotion of Access to Information Act (PAIA). Despite assurances that our requests are being processed,[17] to date, the information remains elusive.

However, what we have managed to ascertain is that, during 2009, Pioneer successfully backcrossed several traits of interest from 4 major African Sorghum varieties: Macia, Malisor 84-7, Tegemeo and Sima.[18] Further, the ABS team has also developed an efficient sorghum variety that can be used to further enhance sorghum by adding other desirable properties, such as weed and pest control.'[19]

The technology and research phase was originally scheduled to be completed in June 2010, though there have been no recent announcements regarding this phase. When contacted directly by the ACB, Africa Harvest indicated that their greenhouse research was still ongoing and they were not yet in a position to upscale the research to field trials. The fact that no new publications were released to coincide with the end of the technology phase[20] indicates that the current phase is set to extend beyond its initial deadline or perhaps has even run into problems?

Product development and capacity building

The product development phase of the project envisions 'putting the nutritional traits (gained through GE) in farmer-preferred and adaptable African sorghum varieties.' This will be achieved by back-crossing GM sorghum varieties with local varieties. Emphasis is also placed on establishing value chains in processed sorghum products, for example breakfast cereals and cakes.[21] This is similar to INTSORMIL's work in West Africa, discussed below.
'Capacity building' is given its usual tribute by the project literature, which boasts that Pioneer has hosted 6 African scientists in its labs in connection with the project, 5 of whom have returned to Africa to 'lead development work' towards the 'success of the Project's delivery and impact in Africa'.

Intellectual property

The ACB has recently published a briefing paper critically analysing the sorghum gene grab, which details dozens of patents applied for in respect of the sorghum genome.[22] The Intellectual Property Management Initiative (IPMI) of the ABS is driven by the African Agricultural Technology Foundation (AATF) and the West and Central African Council

http://www.au.org.au/lab/wp-content/gallery/qld-trip-march/%2020080325%20Sorgum.JPG

of Agricultural Research and Development (CORAF/WECARD). The IPMI programme conducted an audit of the project in 2007, and concluded that 'there are no major obstacles to the freedom to develop and use transgenic sorghum in Africa, and that the ABS project may be used in the 16 countries of the African Regional Intellectual Property Organisation (ARIPO)[23] without infringing the IP rights of third parties.'[24]

During 2009, the CSIR and Pioneer Hi Bred filed patent applications to the United States Patent and Trademark Office (USPTO),[25 26] under the Patent Cooperation Treaty (PCT), in respect of two novel technologies developed as part of the ABS project.[27] The first relates to the manner of recruiting somatic cells and abundant callus, converting them into cells that can grow and give rise to multiple organs of a plant and regenerate the entire plant itself - much like stem cells in an animal or human being. The second technology enables the use of agrobacterium to transfer improved sorghum genes back into another plant by activating genetic sequences in the agrobacterium that are responsible for transferring the T-DNA.[28]

Biosafety initiatives and 'public education'

The ABS regulatory and biosafety initiative is responsible for a number of activities, from developing risk assessment studies (such as for gene-flow and allergenicity) to providing 'leadership for permit application dossiers'.[29] Specialist assistance is given in this regard by the Donald Danforth Plant Science Centre, [30] a US based research institution established with a $50 million gift from the Monsanto Fund.[31]

In the wake of the first refusal by the Executive Council in South Africa to grant permission for contained trials of GM sorghum, the ABS project established a political action committee to force the issue and to 'engage the media to educate the public and policy makers about the importance of biotechnology'.[32] Tarring the discourse with an all too familiar brush, the 'Public Acceptance and Communication' team's goal is to sweep away 'the underlying challenge of ignorance' to 'improve agricultural productivity, food security and rural livelihoods'. Rather more prophetically, the ABS project 'creates an opportunity…to help define the rules by which GM projects in the region will be assessed and managed.' This included, for example, surveys on public perceptions of biotechnology in Kenya. The ACB and others have noted that public surveys on biotechnology conducted by actors with a vested interest in the promotion of the technology are often highly skewed, as they tend to ask leading questions about the hypothetical benefits of GMOs, often for traits that do not exist or are not being seriously investigated.[33]

Big tobacco, big pharma and big philanthropy

Quietly omitted from the project literature, though listed in a sublicense agreement between Africa Harvest and the University of California Berkeley, is Japan Tobacco who provided sorghum germplasm to the ABS project.[34] Japan Tobacco, the world's third largest tobacco company, has significant interests in food and pharmaceuticals[35] and holds commercial licenses for a number of genetic engineering technologies. According to the company's website, its PureIntro® technology is 'recognised worldwide as the de facto standard of monocot transformation system', and has been licensed to over 50 private and public entities worldwide.[36] The tobacco giant has been highly active in the very public philanthropic sphere of genetic engineering, having signed a 'humanitarian license agreement' with the Donald Danforth Plant Science Centre to donate its technology for GM cassava research for Africa.[37] Orynova (a joint venture between Japan Tobacco and Syngenta) was also one of the six companies involved in the fabled 'Golden Rice' project that very publically waived technology fees on patents it held that were relevant to the research. However, as has been highlighted by the NGO Grain, the terms of the free licensing agreements are ambiguous at best, appearing to only apply to research and not commercial release.[38] While marketed as royalty free, Golden Rice is still controlled by several international patents held by the biotech industry. The royalty waiver was subject to earnings from the new GM rice being below $10,000 per year and that the product is not exported. Whether small scale farmers have the administrative capacity to audit GM and non-GM sales and incomes is questionable.[39]

Experts have questioned the wisdom of imposing an 'alien' concept onto African agriculture such as the IPR and patenting regime, as being propagated by the ABS project. Further, the majority of sorghum consumption in Africa is in the form of sorghum beer and traditional fermented foods such as porridge. Malting and fermentation of sorghum increases its nutritional value, therefore, whether the enhanced nutritional claims associated with GM are needed, warranted or indeed, would ever come to fruition, is questionable. In South Africa, researchers have detected gene flow (through the dispersal of pollen) from sorghum as far as 158m from the plant and concluded that 'there is strong evidence that introgression of genetically modified (GM) sorghum into crops and wild relatives will take place once GM-sorghum is deployed'.[40] Other studies in Ethiopia and Niger,[41] and Kenya, have come to similar conclusions.[42] Surely, this calls for a greater application of the Precautionary Principle than is currently being demonstrated.

The fact that announcements such as those of the Grand Challenges in Global Health are made to gathered global elites in fortified enclaves such as Davos, is indicative of the deep asymmetries between policy makers and funders and those who they purport to represent.

Other GM sorghum research in Africa

The South African Sorghum Forum (SASF) was established in April 1997 to act as a lobby group for the sorghum industry in South Africa. SASF meets twice a year. When contacted by the ACB, the Forum said they had not heard of the ABS project.[43]

A US Department of Agriculture (USDA) funded project to genetically engineer sorghum with resistance to the parasitic Striga weed (commonly known as 'Witch-weed') is currently underway involving scientists at the University of California's Davis and Berkeley campuses and from the Kenyatta University in Nairobi. The project, which began in 2005, is currently testing GM sorghum lines in greenhouses at Kenyatta University, having first developed RNAi expression cassettes containing Striga knox genes and conducted genetic transformation of sorghum in the United States. It is not clear from the USDA website precisely when confined greenhouse trials of the GM sorghum lines began in Kenya, though it states they did take place in 2009.[44]

The USDA's Kenya agricultural biotechnology report for 2009 states that 'confined field trials' of 'fortified sorghum' took place in Kenya in 2005 and 2009. No further details are given, but the fact that the collaborators listed are all members of the ABS project indicates the research trials must be connected with GM sorghum. No explicit mention of GM research being carried out in Kenya is made in publically available literature on the ABS project. From the dearth of information available, it is extremely difficult to conclude whether the GM sorghum lines being tested in Kenya were developed within the country or GM seed was imported into Kenya for this purpose. No records of any such transboundary movement exist on the Biosafety Clearing House (BCH), the web based information protocol of the Cartagena Protocol on Biosafety (BSP).[45] The Kenyan biosafety Act was not signed until 2009,[46] meaning that Kenya had no official legislation to regulate GMOs in place for four years while it was simultaneously hosting experiments with them.

In Uganda, there is a collaboration between Makerere University, BIO-EARN and the Swedish University of Agricultural Sciences (SLU). The work with SLU is in Marker Assisted Selection (MAS) for resistance to biotic stresses. Additional research is being carried out within Uganda to develop transformative techniques using locally adapted sorghum lines.[47] In Mali and Kenya, Biosciences east and central Africa (BecA-Hub) is carrying out gene flow studies into the potential impact of the introduction of GM sorghums into the environment. Funding for the programme (which has a total budget of US$ 320,000) is provided by USAID.[48] Another USAID funded organisation, The International Sorghum and Millet Collaborative Research Support Program (INTSORMIL CRSP), is involved with GM sorghum research in West and Southern Africa. Striga resistance through either transformation methodologies or MAS is also taking place at research institutions in Eritrea, Kenya and the Sudan through funding from The Association for Strengthening Agricultural Research in Eastern and Southern Africa (ASARECA).[49]

Currently the only country in West Africa that commercially grows GMOs is Burkina Faso and it is through that country that tentative efforts have been made to introduce the Africa Biofortified Sorghum project into the region.[50]

INTSORMIL

In the ACB briefing paper, African sorghum for agro-fuels: the race is on,[51] we pointed out that INTSORMIL is a USAID funded research consortium of land-grant universities. INSTORMIL seeks to facilitate the collaboration between the African and US sorghum industries through a variety of research projects with universities and agricultural research institutions across Africa. It's 2009 annual report states that 'A major innovative aspect of the INTSORMIL program is to maintain continuing relationships with scientists of collaborating countries upon return to research posts in their countries after training. This integrated relationship prepares them for leadership roles in their national agricultural research systems and regional networks in which they collaborate'.[52] INTSORMIL's work has benefited the US sorghum industry to the tune of US$ 680 million per annum.[53] INTSORMIL has operated under rolling 5 year agreements from USAID since 1979, with the current agreement (worth $9,000,000 in funding from USAID) set to expire in September 2011.[54]

Currently INTSORMIL has ongoing research projects in both West and Southern Africa with the express purpose of genetically engineering, among other techniques, resistance to biotic and abiotic stress, improved grain quality and 'agronomic performance'. Among the West African collaborators are scientists from various US and West African research bodies, as well as USAID and DuPont Crop protection. The Universities of the Free State and Pretoria and the Agricultural Research Council are among the collaborating institutions for its Southern African programme.

As with the ABS project, INTSORMIL's GM sorghum research is embedded in a paradigm of industrialised agricultural value chains. It is envisioned that the improved sorghum varieties bred will be put to use in fully integrated processing industries, held together by long term contracts between growers, suppliers, producers and retailers. Animal feed, particularly broiler chickens, is seen as the area of biggest potential expansion, as meat consumption is expected to rise along with incomes.[55] Much of this still remains hypothetical though as, according to one senior member of the INTSORMIL programme, the current five year agreement is still focusing on research, education and technology transfer.[56]

GM sorghum research outside of Africa

Australia

Australia is among the leading countries involved in transgenic sorghum research. In November 2009, researchers at the University of Queensland confirmed they had produced the world's first GM sweet sorghum.[57] Lead investigator Professor Robert Birch was also the first to experiment with GM sugarcane.[58] Researchers in Australia say that knowledge of the sweet sorghum genome will prove to be particularly valuable as sorghum shares many gene sequences with sugarcane, which has a much more complex genome.[59] The University has previously been involved in transgenic sorghum research – collaborating with the University of California, Berkeley to improve sorghum digestibility. Judging by comments made by scientists at the University of Queensland, the primary goal of their GM sorghum research is agrofuels.[60] For example, Professor Birch expects GM sorghum "to be part of the sustainable 'green carbon' economy on a global scale into the future."[61]

India

Historians estimate that traders first took sorghum from Africa to India around 3,000 years ago.[62] Today, sorghum is India's third most important grain and is a safety net for India's poorest and most marginalised communities. India's CGIAR[63] research centre, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), is considered the world centre for sorghum improvement and holds over 35,000 accessions of sorghum.[64]

The ACB came across a number of research projects in India dealing with GM sorghum when researching for this paper. The Directorate for Sorghum Research (DSR), housed within the country's Ministry of Agriculture, is currently using transgenic techniques to produce sorghum with insect resistance and salinity tolerance. Although the DSR's website claims that research is also taking place for increased sugar content, higher biomass and 'related traits'[65], when contacted by the ACB, the Institute's principle geneticist denied that these were actually taking place.[66]

The Central Research Institute for Dry-land Agriculture (CRIDA) is involved in conferring abiotic stress to sorghum through genetic engineering. The project began in 2001 and is scheduled to finish in 2010 (though originally it had been scheduled to finish in 2007).[67] The fact that the Genetic Engineering Approval Committee (GEAC) of India gave permission for selection trials of the above project only in May 2010 would indicate that the project is set to continue well beyond 2010.[68]

Marker Assisted Selection (MAS) sorghum research

While the main focus of this paper has been on the genetic engineering of sorghum, several projects involving Marker-Assisted-Selection (MAS) are ongoing. While the biosafety risks of MAS are not as acute as other methods of genetic transformation, MAS still approaches agriculture through the narrow prism of productivity. This promotes: mono-cropping; the erosion of biodiversity; increased patenting of life and concentration of corporate profits and power.[69] The emphasis that the biotech industry has placed sorghum as a potential agrofuel stock[70] warrants, at least, an awareness of what is going on in relation to sorghum in the world of MAS.

According to its website, the Sweet Fuel Project 'intends to develop bio-ethanol production in temperate and semi-arid regions from sweet sorghum through genetic enhancement and improvement of cultural and harvest practices'. Its members include the Centre de coopération internationale en recherché agronomique pour le développement (CIRAD), http://www.kfar-masaryk.org.il/privet/gadash/crops/sorghum.jpg

the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), EMBRAPA Maize and Sorghum, and the South African Agricultural Research Council (ARC). The project officially began in January 2009 and is scheduled to run until December 2013. It is co-funded by the European Union. Interestingly, the next annual meeting of the project is set to take place in South Africa in 2011 (no further details are given). Very little information is available on the sweet fuel website at present, though it does go to great lengths to emphasise that any germplasm used 'will be exchanged with due respect to the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)', and that it will only be using MAS techniques.[71]

In Uganda, MAS research is taking place in collaboration with the Swedish University of Agricultural Sciences (SLU) with the aim of breeding sorghum tolerant to certain biotic stresses.[72] Syngenta is heavily involved in sorghum research that utilises MAS on the African continent, both through its research partnerships with the CGIAR 'Generation Challenge Programme' (GCP)[73] and work being carried out at the Biosciences east and central Africa (BecA) hub, which it has granted $5 million of core funding for the period 2009 – 2014.[74] The hub is currently hosting scientists from Eritrea, Kenya, Mali and Sudan, who are engaged in a wide variety of work ranging from gene flow studies[75] to using MAS for breeding sorghum with striga resistance and drought tolerance.[76] ICRISAT sees the BecA hub as a particularly important facility for the future for its work on sorghum in Africa. Emphasising that it 'provides capacity building on marker assisted selection and other biotechnology techniques' and that it 'enables NARS' (national agricultural research stations) participation in integration of biotechnology tools and participatory approaches'.[77] This is sadly consistent with other experiences in Africa, where 'capacity building' in agriculture is being driven by institutions that are directly funded by the biotechnology industry.

Conclusion

The Conference of the Parties to the UN Convention on Biological Diversity (CBD) in Nagoya, Japan, in October 2010, brings questions of how the world's natural resources be most equitably and sustainably used, to the forefront of international coverage. The timing is crucial in some respects, as having effectively monopolised control of the research and trade in agricultural commodities, the biotech industry has now set its sights firmly on Africa's heritage crops.

Though not widely considered an important food crop in the rich world, sorghum is Africa's second most grown grain crop. Its position at the margins of the international trade in agricultural commodities, together with several important agricultural traits that it possesses, means it is a potentially highly lucrative crop to monopolise and control for the agro-seed-chemical TNCs. Initiatives such as the ABS project, which have as much emphasis on influencing the biosafety discourse as they do on nutrition in Africa, offer an opportunity for the biotech industry to embed themselves into local Africa markets under the moniker of food production and security. Our experiences of trying to obtain information concerning the GM sorghum research being conducted in South Africa are indicative of the opaque nature of the current biosafety discourse.

At the time of the CSIR's original application to South Africa's EC, we felt it pertinent to point out that the potential for gene flow from transgenic plants to their wild relatives had been well documented in a number of studies. These studies seem to have gone undetected by many of those in the biotechnology/biosafety arena (whose boundaries are blurred at the best of times), as a plethora of research into both the genetic engineering and marker assisted selection is ongoing in Africa.

The ACB vehemently opposes the introduction of a GM plant into its centre of origin and the ensuing patenting stampede on the sorghum genome that is being carried out in the name of the public good. Once again we would like to draw attention to the conclusions of the 400 global experts of the IAASTD report, who are under no illusion that the current obsession with yield and productivity (personified in the extreme by GMOs) is no panacea for a more sustainable and equitable food system.

Annexure 1:
World Sorghum production, harvested area, yield (2008)

Country/Region	Production (000s tons)	Area harvested (000s ha)	Average yield (ton/ha)
World	65,534	44,911	1.46
Africa	25,192	27,595	0.91
Americas	25,074	6,968	3.60
USA	11,997	2,942	4.08
Asia	11,359	9,226	1.23
Nigeria	9,318	7,617	1.22
India	7,925	7,764	1.02
Mexico	6,610	1,838	3.60
Sudan	3,869	6,619	0.58
Oceania	3,075	846	3.63
Australia	3,072	845	3.64
Argentina	2,936	618	4.75
China	2,502	580	4.31
Ethiopia	2,316	1,533	1.51
Brazil	1,965	811	2.42
Burkina Faso	1,875	1,901	0.99
Niger	1,071	3,055	0.35
Mali	930	986	0.94
Tanzania	900	900	1.00
Egypt	843	148	5.68
Europe	831	276	3.01
Chad	685	873	0.78
Cameroon	500	550	0.91
Uganda	477	321	1.49
Venezuela	382	165	2.30
Yemen	376	442	0.85
Ghana	350	340	1.03
Bolivia	336	120	2.80
South Africa	269	89	3.00

Source: FAOstat

Annexure 2:

African Sorghum production, harvested area, yield (2008)

Country	Production (000s tons)	Area Harvested (000s ha)	average yield (ton/ha)
Africa	25 192	27 595	0.91
Western Africa	14 321	14 861	0.96
Nigeria	9 318	7 617	1.22
Northern Africa	4 727	6 785	0.70
Eastern Africa	4 589	4 293	1.07
Sudan	3 869	6 619	0.58
Ethiopia	2 316	1 533	1.51
Burkina Faso	1 875	1 901	0.99
Middle Africa	1 236	1 482	0.83
Niger	1 071	3 055	0.35
Mali	930	986	0.94
Tanzania	900	900	1.00
Egypt	843	148	5.68
Chad	685	873	0.78
Cameroon	500	550	0.91
Uganda	477	321	1.49
Ghana	350	340	1.03
Southern Africa	317	171	1.85
South Africa	269	89	3.00
Togo	226	230	0.98
Rwanda	190	173	1.10
Senegal	188	210	0.89
Mozambique	187	320	0.59
Eritrea	150	260	0.58
Benin	132	144	0.92

Source: FAOstat

Annexure 3:
GM/MAS sorghum research projects and funding

Country/ Region	Institution	Goal	Partners	Funders	Amount (US$)	Schedule
South Africa	CSIR, ARC	Nutrition (ABS project)	Pioneer Hi-Bred, University of California Berkeley	Gates Foundation	18.6 million*	2005 – 2010 (phase 1)
South Africa	CSIR, ARC	ABS project	Pioneer Hi-Bred, University of California Berkeley	Pionner	4.8 million**	n/a
Kenya and Mali	BecA Hub	Gene flow studies	KARI, IER, University of Bamoko, CIRAD, University of Honnenheim	USAID	320,000	n/a
West and Southern Africa	INTSORMIL	Various – includes GM biotic and abiotic stress tolerance and improved grain quality	Purdue University, INRAN, IER, USDA, Zambia Agricultural research institute, Mapuplo research centre (Mozambique), Botswana college of agriculture, ARC, University of Free State, University of Pretoria, Texas A & M university	USAID	9,000,000*	2006 - 2011
Kenya, Mali, Sudan, Eritrea	ICRISAT	Field Trials for striga resistance from MAS	University of Honnenheim, IER, ARC – Sudan, KARI, DARHRD	GTZ (Germany)	60,000	April 2009 – March 2010
Ethiopia, Kenya	BecA Hub	MAS: striga resistance, drought tolerance	NARS in Kenya, Ethiopia	Syngenta	360,000	n/a
Kenya, Eritrea, Mali, Sudan	BecA Hub	MAS: Striga resistance	NARS in Kenya, Eritrea, Mali, Sudan	BMZ (Germany)	820,000	n/a
Mali	CIRAD	MAS: drought tolerance	IER (Mali), Syngenta	CGIAR: through its Generation Challenge Programme	678,600	July 2008 – December 2013

*These figures represent the total project budgets, not funds devoted specifically to GM research

** the technology that Pioneer 'donated' to the project is estimated to be worth $4.8 million

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