Africa's Granary Plundered:

Privatisation of Tanzanian Sorghum Protected by the Seed Treaty

By Edward Hammond

african centre for biosafety

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The African Centre for Biosafety (ACB) is a non-profit organization, 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

ARIPO	African Regional Intellectual Property Organization
CIAT	*Centro Internaciónal de Agricultura Tropical* (International Center for Tropical Agriculture)
CGIAR	Consultative Group on International Agricultural Research
Embrapa	*Empresa Brasileira de Pesquisa Agropecuaria* (Brazilian Agricultural Research Corporation)
FAO	United Nations Food and Agriculture Organization
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
INTSORMIL	International Sorghum and Millet Collaborative Research Support Program
IS	International Sorghum (formerly Indian Selection), a designator for sorghum accessions used by ICRISAT
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
OAPI	*Organisation Africaine de la Propriété Intellectuelle* (African Intellectual Property Organization)
ORSTOM	*Office de la Recherche Scientifique et Technique d'Outre-Mer, now L'Institut de recherche pour le développement* (Institute for Development Research - IRD), a French government agency
SbMATE	*Sorghum bicolor* Multidrug and Toxic compound Extrusion transporter
SC	Sorghum Conversion, a designator for sorghum accessions used by Texas A&M
Texas A&M	Texas Agricultural & Mechanical University
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

Introduction

A gene recently isolated from a Tanzanian farmers' variety of sorghum may yield tremendous profits for multinational companies and government researchers in the United States and Brazil. Called SbMATE, it is not only useful in sorghum; but also may be used in other crops, including genetically engineered (GE) maize, wheat, and rice as well as GE tree plantations.

Government researchers from the United States Department of Agriculture (USDA), the Brazilian Agricultural Research Corporation (Embrapa) and the Texas A&M University (US) have patented the gene in the US. They have also filed an international patent application in which they state that they will seek patents on the Tanzanian gene across the world, including in Africa.

The commercial potential of the gene is strong. Although it was only recently identified, the giant multinational Dow Chemical is already negotiating with the US government to license it. Japan's second largest paper products company has also expressed interest in buying access to it.

The patenting of the SbMATE gene is a new chapter in a long history of appropriation of African sorghum diversity by foreign interests. A recent external review of one US Agency for International Development (USAID) program operating in Africa concluded that sorghum varieties released by the program to US plant breeders benefit the US economy by US $680 million per year.

Sorghum is a crop that is covered by Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and the Tanzanian farmers' variety, which was collected decades ago, is held in trust under that Treaty by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. The Treaty prohibits patent claims on the varieties and genes of plants that are held in trust. This raises questions about the legality of the patent claims. If ICRISAT and the ITPGRFA are found to be derelict in their obligations to protect the Tanzanian gene and generally, germplasm held by them in trust, the legitimacy of these institutions as stewards of the world's crop biodiversity will be called into serious question.

Sorghum

Source: http://trendsupdates.com/genetics-of-sorghum-secrets-no-more/ (image: http://www.kfar-masaryk.org.il/privet/gadash/crops/sorghum.jpg)

This paper, the first of two African Centre for Biosafety publications on new foreign claims over African sorghum (the second being in progress), begins by providing some background information on the tremendous contribution made by sorghum developed by African farmers, to the sorghum industry in the United States. It then explains the problem of aluminium toxicity in acid soils, how the Tanzanian gene may help overcome this problem in sorghum and other crops, and commercial interest in using the gene in sorghum and GE crops and trees. In conclusion it discusses issues of equity and biopiracy raised by the patent claims.

African Sorghum in the United States[1]

Sorghum is a grass of African origin that was domesticated by African farmers thousands of years ago. Different types of sorghum (sweet, grain, forage, etc.) crossed the Atlantic Ocean many times. An African crop that people all over the world have adopted, sorghum moved via many routes. Some seeds first stopped in Europe, Asia, or other parts of the Americas, while others came to the US directly from Africa.

Important early introductions included 16 varieties of syrup sorghum brought to the United States in 1853 from Natal, South Africa. Like sugar cane, a relative of sorghum, syrup sorghums are grown for the sweet juice produced in their stalks. These South African varieties supplemented other so-called "guinea corn" seeds that were already grown in the United States and are thought to have been brought on slave trading ships. The South African varieties from the 1850s are key ancestors of sorghum varieties cultivated in the US to the present day.

Grain sorghum is thought to have arrived by the 1820s via the West Indies, also brought by the slave trade, although the history is somewhat obscure. One popular early grain sorghum was introduced in the US from Colombia in the 1840s. It had arrived in South America from Africa years before, perhaps also carried there by slaves..

These and other early introductions were supplemented in the late 1800s by other varieties from Sudan, South Africa, Egypt, and elsewhere.

While a wide variety of sorghums can also be found in India,[2] African sorghums have historically dominated the US gene pool. A South African variety introduced in 1876, called "Blackhull Kafir", proved so popular that it remained the most widely grown sorghum variety in the US for at least fifty years. In summary, it is estimated that about 30 mainly African varieties formed the genetic base of most of the sorghum grown in the United States through the mid-20th Century.

By the 1920s and 30s, in addition to pest and disease resistance imperatives, US grain sorghum breeders sought to adapt the crop to mechanized agriculture. Breeders focused on developing shorter "dwarf" and straighter "stiff necked" varieties for mechanical harvesting on the vast plains of several states, including Texas, Oklahoma, Kansas and Nebraska, where most US sorghum was (and still is) grown. They also identified male sterile types to facilitate breeding and hybrid seed production.

In the 1940s, sweet sorghum breeding in the US received a major boost through the plant collecting efforts of C.O. Grassl, a US Department of Agriculture plant breeder. Grassl travelled through Africa in 1945 and 1946, collecting farmers' varieties. When he came back to the United States, he deposited

1. Except as noted, this and the following section *(The US Again Turns to Africa)* draws from C.W. Smith and R.A. Frederikson's chapter "History of Cultivar Development in the United States: From 'Memoirs of A. B. Maunder – Sorghum Breeder' ", pp. 191-224 in Smith and Frederikson (eds.) 2001.
2. Cultivated sorghum is thought to have spread from Africa to India 4-5000 years ago, long before it reached the Americas. In India, it was widely adopted and many farmers' varieties were developed. Trade between Africa and India has resulted in exchange of sorghum varieties between the regions for millennia, and in India becoming a source of sorghum germplasm whose importance is only surpassed by Africa itself.

Sweet Sorghum

Source: http://newcropsdatabase.com/assets/cropphotos/5055571C-1D09-2FEC-B6101E8C581B7B6A.jpg

over 500 seed types in the US national collection, most of which were collected in East and Southern Africa.[3]

Still more African sorghums proved their value to US farmers. “Sart”, a Sudanese sorghum introduced to the US in 1951, provided resistance to foliar disease and was both directly planted and used as a parent line to confer resistance to other varieties. “Kaura” sorghums from Nigeria contributed to improved grain quality and drought resistance, and were widely incorporated into breeding programs.

The US Again Turns to Africa

By the middle of the last century, US breeders recognized the shortcomings in the genetic base of their sorghum varieties. At about the same time, the Rockefeller Foundation had begun investing heavily in international agricultural research, laying the groundwork for what would later become the Consultative Group on International Agricultural Research (CGIAR). The two projects, one overtly born from the needs of domestic industry and the other, stemming from philanthropy, mixed with Cold War-tinged socio-political concerns, became deeply intertwined and remain so to this day.

One of Rockefeller’s early agriculture projects, started in 1959,[4] was to acquire a global collection of sorghum varieties. Based in India and with operations in Mexico City and elsewhere, it assembled more than 11000 sorghum accessions that were eventually passed to the CGIAR in 1974.

The Rockefeller accessions that went to the CGIAR were supplemented by sorghums from ORSTOM (the French overseas development research agency) and other sources to form part of the World Sorghum Collection,[5] which now numbers over 25000 accessions. These also included a copy of

3. USDA. ARS-GRIN. Search on C.O. Grassl as collector of Sorghum accessions, performed 23 Nov 2009.
4. House, 1995.
5. Guiragossian, V. and Mengesha, M. World Sorghum Collection and Conservation, chapter in Gourley (ed.), 1987.

the entire Ethiopian national collection of 5000 accessions. The World Sorghum Collection is now managed by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), a CGIAR centre in Patancheru, India.

In parallel to the development of the World Sorghum Collection, the United States was working to introduce new diversity to its own sorghum varieties. In 1963,[6] the US government began to fund researchers from Texas Agricultural & Mechanical University (Texas A&M) to provide new sorghum germplasm to US plant breeders.

Texas A&M turned to the World Sorghum Collection to do this. It began identifying seeds from the collection with traits of interest to the US. The program remains active today and, since its founding, has released over 800 breeding lines.[7] These mainly African seeds are unequivocally the foundation upon which the modern US sorghum industry is based.

Because US sorghum is grown at higher latitudes than most African sorghums, photosensitive[8] African varieties must be "converted" to tolerate the long summer days further north. Since 1963, conversion has been done at a USDA experiment station in Puerto Rico and in Texas.

Conversion is an uncomplicated process of crossing an African type with a standard US-bred dwarf. This cross is then bred back with the African parent over several generations with the goal of retaining as many African traits as possible. The resulting seed is genetically about 90% African but adapted to North American conditions – the plants are typically less photosensitive, have shorter stature (for combine harvesting), and are earlier yielding (for shorter growing seasons).

(The Texas A&M conversion project and other programs have led to a confusing nomenclature for sorghum breeding lines, in which many names can be used for identical or near-identical seeds.)[9]

By the 1980s and 90s, newly introduced African seeds were paying off handsomely in the US. Among the successes:

- One of the most important male parents used in new varieties in the 1980s was IS 2661, a mildew resistant sorghum from Ethiopia.
- Another Ethiopian sorghum, IS 12555, provided a drought resistance trait called "stay-green".[10] In US experiments, sorghum hybrids with the "stay-green" gene yielded 56% more than other hybrids under drought conditions.[11]
- A third Ethiopian sorghum, IS 3758, provided resistance to the disease fusarium stem rot.
- IS 2816 from Sudan, yet another seed from the World Sorghum Collection, boosted yields in white grained sorghum types.[12]

6. Sometimes reported as 1962.
7. Casa, 2008.
8. Photosensitive plants are adapted to the year-round, 12 hour days of equatorial regions. The longer summer days of higher latitudes stunt the growth of photosensitive varieties.
9. "Converted" sorghum seeds from Texas A&M are typically assigned a name beginning with SC ("sorghum conversion"). SC sorghums, however, also have a different name assigned by CGIAR, usually beginning with IS. The photoperiod converted form of an IS sorghum usually has the same ICRISAT designation as the unconverted form, except for a trailing "c" in the accession identifier. The IS designation used by ICRISAT now refers to "International Sorghum"; but originally indicated "Indian Selection", a name from Rockefeller Foundation-supported sorghum nurseries that operated in India prior to the founding of ICRISAT.

    When preserved in gene bank records, IS/SC type also have an African variety name or, in some cases, the place where it came from is recorded and/or a national genebank accession number (e.g. "SU XXX" from Sudan).

    Other commonly-used designations include "MN", a name assigned by a now closed US breeding program in Mississippi. Sorghums are also often referred to by their United States Department of Agriculture PI ("plant introduction") number. PI numbers may be consulted in the ARS-GRIN database and (fortunately) are usually cross-referenced with ICRISAT (IS) and Texas A&M (SC) identifiers.
10. Subudhi, 2001, p. 136.
11. INTSORMIL 2006, p.
12. Texas A&M 1999, p. 1.

INTSORMIL: An Aid Project for the US Sorghum Industry

In addition to the Texas A&M and USDA sorghum conversion program, there has been a US government funded project that collaborates directly with African countries, which is designed to bring additional new African sorghums to the United States.

Known as the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL), it is sponsored by the US Agency for International Development (USAID), and based at the University of Nebraska. Since its founding in 1979, INTSORMIL activities have blended with the USDA-sponsored program at Texas A&M to "convert" and introduce African sorghums in the US.

The program links US scientists with counterparts in Africa and, currently, Central America. INTSORMIL has provided benefits for Africa and, to a lesser extent, other world regions where it is active. It is, for example, a source of direct agricultural development aid and it typically trains several dozen African scientists each year in plant breeding and related disciplines.

INTSORMIL is not, however, a charity program. It is designed to benefit US industry and, from that perspective, it has been a very profitable investment. A 2006 external review quantified INTSORMIL's critical role in the US sorghum industry:[13]

- INTSORMIL grain sorghum germplasm contributes US $680 million per year to the US economy.
- INTSORMIL breeding lines released by Texas A&M are one or both parents of 60% of the sorghum hybrids sold in the US.
- From 1996 to 2005, Texas A&M gave private US seed companies 213 sorghum breeding lines developed from INTSORMIL germplasm.

Texas A&M University has been the leading breeder of sorghum varieties in the INSTORMIL program. It uses converted World Sorghum Collection varieties as well as newer African and other sorghum collections acquired through INTSORMIL relationships with African institutions and scientists.

The Rapid Advance of Sorghum Genomics

In the past decade, genomic studies of sorghum have rapidly advanced. By early 2009, the entire genome of sorghum was sequenced, well before that of many other crops. The rapid development of sorghum genomics is in part due to considerable interest in sorghum as a source of ethanol for biofuels.[14]

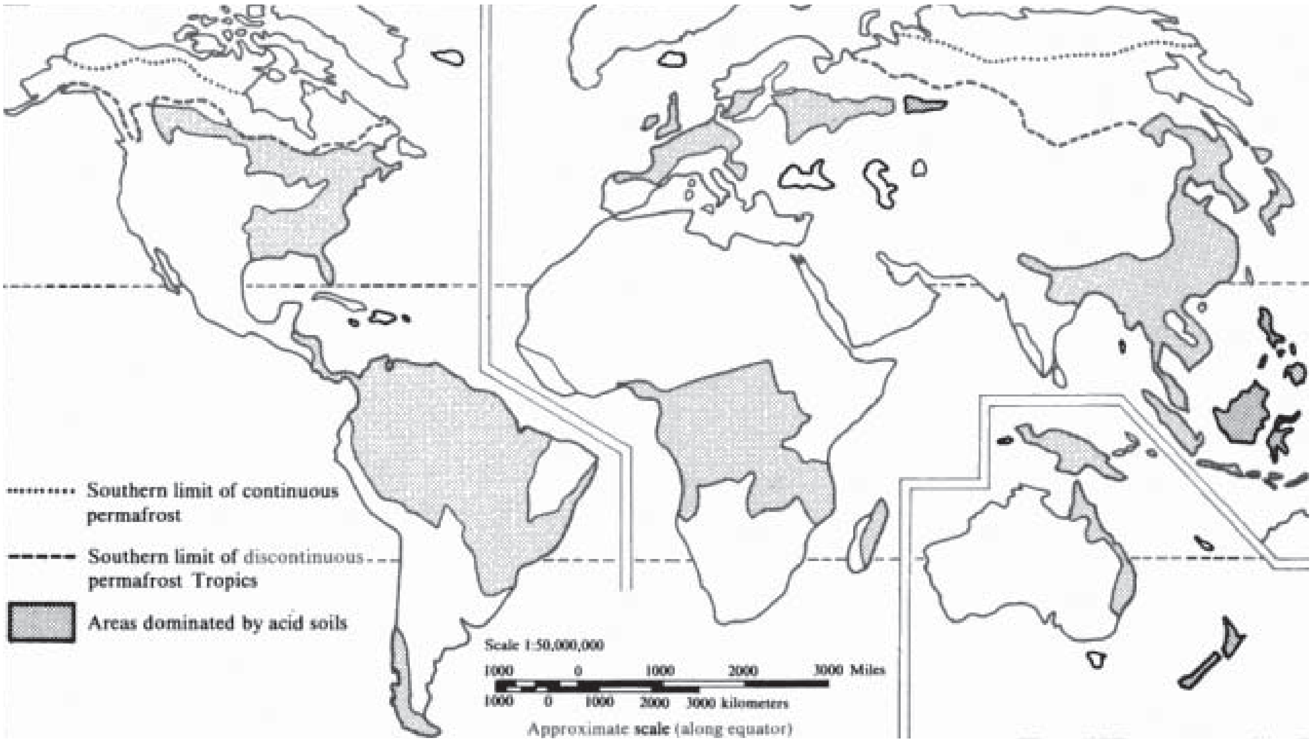
Plant breeders are using genomic tools to examine the genetic base of US sorghums, performing comparative analyses on the parents of contemporary hybrids. A series of new studies[15] has again underscored the irreplaceable contribution of African farmers' varieties – both old and new introductions – to the US sorghum industry.

These studies pinpointing gene functions and developing sets of genetic markers are opening new possibilities for development of sorghum varieties - as well as of crosses of sorghum (both natural and by genetic engineering) with related plants.

13. INTSORMIL 2006, p. 2.
14. Rutgers University, 2009.
15. See Perumal 2007, Murray 2009, Casa 2008.

Aluminium Toxicity in Soils

Acid Soils Worldwide[16]



Aluminium is commonly found in soils across the world. In acidic soils with available aluminium, the metal takes a chemical form that is toxic to the roots of many food crops, including wheat, rice, and maize. This aluminium toxicity stunts the growth of crop plant roots and inhibits their uptake of key minerals.

Aluminium toxicity in acid soils is a significant constraint on agricultural production and is estimated to affect more 20% of the arable land of Sub-Saharan Africa and East Asia. In Latin America and Southeast Asia, the figure is over 30%. As a result, aluminium tolerance is a major breeding goal for a number of important crops that are often aluminium sensitive, including sorghum, maize, and rice.

Breeding for Aluminium Tolerance

In the early 1980s, the CGIAR, working with INTSORMIL, began a push to research acid-aluminium tolerance in sorghums for Latin America. Much of the research was conducted by CGIAR's International Center for Tropical Agriculture (CIAT) in Colombia, with a focus on developing sorghums for South American tropical savannas, such as the llanos of Colombia and Venezuela and the cerrado of Brazil.[17]

In 1983, field trials involving more than 1400 sorghum breeding lines began in Colombia. A 1984 CIAT paper identified the Nigerian sorghum IS7254 and the Tanzanian sorghum IS7173 as parents of the best-performing types on acid soils in the Colombian llanos (plains).

17. Gourley (ed.), 1987, introduction.

The Tanzanian and Nigerian sorghums were crossed with grain sorghum lines from ICRISAT's Sorghum Elite Progeny Observation Nursery.[18] The decision to use the Tanzanian and Nigerian lines in Colombia appears to have been based on encouraging findings at the Brazilian Agricultural Research Corporation[19] (Embrapa), which began screening sorghums for aluminium tolerance in 1974.[20] Embrapa obtained its screening materials from Hugh Doggett (see box), a sorghum breeder based in Uganda, and Texas A&M,[21] which was converting the Rockefeller germplasm.

Twenty years later, with acid-aluminium soils still a major constraint on agriculture, scientists led by the US Department of Agriculture began to use gene sequencing to better understand the valuable aluminium tolerance exhibited by a few farmers' varieties of sorghum. Working with scientists from Embrapa and Texas A&M, they focused genetic tools on the same African types that performed well in Colombia and Brazil two decades before.

The group discovered that a single area of the sorghum genome (a "locus") called AltSB appeared related to aluminium tolerance. Using AltSB genetic markers, they tracked the inheritance of aluminium tolerance by crossing the Tanzanian variety with an aluminium sensitive Brazilian sorghum line.[22]

The Sorghum Aluminium Tolerance Gene Patent

Once the USDA / Embrapa / Texas A&M team had the right genetic markers, it didn't take long to identify and sequence the precise DNA that makes the Tanzanian farmers' variety aluminium tolerant. They did so, and called the gene "SbMATE".[23]

They took IS7173's SbMATE sequence and genetically engineered it into the experimental plant *Arabidopsis*. When the transgenic *Arabidopsis* became aluminium tolerant, they knew they had found what they were looking for.

In simple terms, the SbMATE gene works by causing sorghum plants to exude levels of citrates (a form of citric acid) in their root tips that neutralise the toxic effects of aluminium. With the aluminium neutralised, the plant roots grow and absorb nutrients normally, even on aluminium toxic acid soils.

In May 2007, the research group published its results in *Nature Genetics*;[24] but not before first filing for a patent.[25] The patent claims the Tanzanian gene itself, including its promoter sequence (which is activated by aluminium) and related regulatory sequences. The group also claimed any other DNA that is 95% or more similar[26] to the Tanzanian gene and which has the same aluminium tolerance effect, as well as the molecules that the DNA encodes.

Also claimed by USDA, Embrapa, and Texas A&M are genetically engineered plants of any species that express the Tanzanian tolerance gene. Specifically claimed are wheat, maize, sorghum, and rice plants with the SbMATE gene.

18. Torregroza, C. 1984. Sorghum Production in Colombia and its Perspectives in the Acid Soils of the Eastern Plains, pp. 35-42 in Gourley (ed.), 1987.
19. The *Empresa Brasileira de Pesquisa Agropecuaria*, a government agency, is best known by its Portuguese acronym, Embrapa.
20. Borgonovi, R.A. et al. Breeding Aluminum Tolerant Sorghums, pp. 271-292 in Gourley (ed.), 1987.
21. Gourley, L.M. Finding and Utilizing Exotic Al-Tolerant Sorghum Germplasm, pp. 293 – XXX in Gourley (ed.), 1987.
22. Magalhaes et al, 2004.
23. SbMATE is a complicated acronym. It stands for *Sorghum bicolor* ("Sb") and (m)ultidrug (a)nd (t)oxic compound (e)xtrusion transporter ("MATE"). MATE is a scientific name for the general family of plant compounds to which the chemical encoded by the gene belongs.
24. Magalhaes et al, 2007.
25. Kochian et al, 2009.
26. It is common for patent applicants to seek claim to genes with sequences similar to those submitted to the patent office. In this case, a claim of 95% similarity was granted by the US Patent and Trademark Office. The international patent application contains claims for any aluminium tolerance gene 80%, 85%, 90%, or 95% similar to the Tanzanian one. The allowable amount of genetic divergence from the IS7173 sequence may vary by jurisdiction granting the patent.

The research group followed up their 2007 US patent application with an international claim on 9 May 2008.[27] The lead applicant is the United States government, followed by Embrapa and Texas A&M. On 1 September 2009, the US patent was issued.

Applications in other countries are pending. According to the international patent application, the group intends to seek national or regional patents in more than 100 countries. In Africa, the member states of OAPI and ARIPO are declared,[28] the latter including Tanzania itself, as well as South Africa, Egypt, Libya, Morocco, and others. At time of writing, international databases maintained by the World Intellectual Property Organization (WIPO) and the European Patent Office (EPO) have no more specific information on the progress of national and regional patent claims.

The Unknown Origin of Msumbji (IS7173)

The historical information available on African sorghum varieties in international gene banks can be limited. Sources agree that IS7173 came from Tanzania. The seed's name is recorded as Msumbji. Further details of where Msumbji came from, how it was collected and by whom, and other information may never be recovered.

Germplasm curators at both ICRISAT and the USDA report that they have little more information about IS7173's origin than that it is of Tanzanian origin and, according to USDA, it was used in Rockefeller seed trials in India as early as 1963.*

Circumstantial evidence, however, suggests that Hugh Doggett, a sorghum breeder who spent much of his professional life in Africa, collected IS7173 himself or at least provided it to the Rockefeller Foundation and, thence, ICRISAT.

In 1946, Doggett was appointed government botanist at a research station in Tanzania, then the British colony of Tanganyika. He became fascinated by sorghum, "*because nobody seemed to be paying much attention to sorghum and it was very widely grown in that area*." Doggett began studying sorghum six days a week. **

Sorghum occupied much of the rest of Doggett's career. For 11 years in the 1960s and 70s, he bred sorghum varieties at the Serere Research Station in Uganda. In 1970 he wrote a lengthy book simply titled *Sorghum*. Later in the 1970s he helped establish ICRISAT's sorghum research program. He ended his career with Canada's International Development Research Centre, from which he retired in 1985.

Doggett collected sorghum for his own work and, in an age when plant varieties were held to be "the common heritage of mankind", he supplied what came from African farmers to researchers on other continents. With associations with Tanzania, ICRISAT, plant collecting, and a lifelong dedication to international sorghum research, it is plausible that Hugh Doggett placed IS7173 into the World Sorghum Collection.

* Erpelding, J. and Spinks, M. 2009. USDA Plant Genetic Resources Unit, Pers. Comm. and Upadhyaya, H.D. 2009. ICRISAT Gene Bank, Pers. Comm.

** Fischer, 1986.

27. Kochian et al, 2008.
28. OAPI is the *Organisation Africaine de la Propriété Intellectuelle* with member states Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Senegal, and Togo. ARIPO is the African Regional Intellectual Property Organization with member states Botswana, the Gambia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

Commercial Interest in the Tanzanian Gene: GE Maize, Sorghum, and Trees

For those that promote widespread use of genetically modified plants, the SbMATE gene has the potential to unlock new agricultural productivity on aluminium toxic soils that cover a large proportion of the world's arable land. While the gene has been demonstrated to work in principle, the research is still in its relative infancy. Widespread commercial use is years away, particularly in the non-sorghum crops into which the gene would have to be genetically engineered.

While the eventual impact of SbMATE will only become clear in the ensuing years, for the time being, the commercial potential is clearly significant. It is thus not surprising that big corporations are seeking to license the gene for use in their research programs.

Documents obtained under the open records law of Texas (applicable to Texas A&M, a public university) confirm that the multinational giant Dow Chemical is seeking to license SbMATE in order to use it in maize and sorghum.[29] The Japanese company Oji Paper has also expressed interest in a license.[30]

Based in Tokyo, Oji Paper is Japan's second largest producer of paper products and has US $20 billion in assets. Oji Paper employs 4300 people and owns over 150,000 hectares of tree plantations in China, Vietnam, Laos, Australia, New Zealand, and Brazil. It is working to expand these holdings to 300,000 hectares.[31]

Oji operates a forestry research laboratory that focuses on eucalyptus trees for pulpwood plantations, including eucalyptus varieties adapted for acid soils.[32] Oji researchers have also collaborated with USDA on aluminium tolerance research.[33]

Oji's interest in licensing the SbMATE gene thus appears to relate to the company's interest in genetically modified eucalyptus trees for its plantations.

Dow, based in the United States, is the second largest chemical company in the world, with 46000 employees and US $57.4 billion in 2008 sales.[34] In the agriculture sector, Dow produces a wide range of pesticides, herbicides, fungicides, and other crop protection chemicals sold worldwide.

Dow also sells maize, soya, sorghum, sunflower, alfalfa, and canola (oilseed rape) seeds through a variety of brands, including Dow Agro, Mycogen, Pfister, Phytogen, Dairyland, and Brodbeck. Dow told Texas A&M that licensing the Tanzanian gene is "*in line with a couple of our research goals*."[35]

29. Electronic mail from Darin Lickfeldt, Dow Agrosciences to Patricia Klein, Texas A&M University, 4 November 2008. Obtained by Texas Public Information Act request to Texas A&M University, Request ID 09-437 (21 August 2009).
30. Electronic mail from Leon Kochian, USDA to Patricia Klein, Texas A&M University, 4 November 2008. Obtained by Texas Public Information Act request to Texas A&M University, Request ID 09-437 (21 August 2009).
31. Oji Paper. 2009. **About Oji Paper Group** (website). http://www.ojipaper.co.jp/english/group/overseas/index.html (accessed 30 November 2009)
32. Nissan Science Foundation. 2008. **Woody Plants Biotechnology Symposium** (program). http://www.kuba.co.jp/woody-plants/program.html (accessed 30 November 2009)
33. Kobayashi, 2007.
34. Dow Chemical. 2009. **Our Company – Corporate Profile** (website). http://www.dow.com/about/aboutdow/profile/corp.htm (accessed 30 November 2009)
35. Electronic mail from Darin Lickfeldt, Dow Agrosciences to Patricia Klein, Texas A&M University, 4 November 2008. Obtained by Texas Public Information Act request to Texas A&M University, Request ID 09-437 (21 August 2009).
36. Partial list of accessions showing highest tolerance to aluminium in a 1988 sorghum trial conducted by USDA. See: http://www.ars-grin.gov/cgi-bin/npgs/html/eval.pl?388007 (accessed 30 November 2009)

Other Potential African Sources of Aluminium Tolerance Genes

IS7173, or Msumbji (its Tanzanian name), has repeatedly been identified as a highly aluminium tolerant variety. Studies have, however, identified other aluminium tolerant sorghums from several areas of Africa. These other sorghums may contain genes that are similar to IS7173. If so, they are likely to be encompassed by the US government patent claims. Alternatively, they may have acquired aluminium tolerance through other mechanisms.

The following varieties, all of which are held in-trust under the ITPGRFA by ICRISAT, have been noted for their aluminium tolerance:[36]

ICRISAT Accession	Other names	Country of Origin
IS12609	No. 4 Gambela, SC109	Ethiopia
IS3723	No. 115 Aba Yase, SC508	Ethiopia
IS7193	Nadjada Salamat, SC694	Nigeria
IS12605	Mur Ban, SC100	Nigeria
IS7254	M 1, SC566	Nigeria
IS7542	PL 6 Mori, SC408	Nigeria
IS12569	Kodilik, SU839, MN831	Sudan
IS2579	Nyithin, MN879	Sudan
IS12570	Kokla, SU840, MN833	Sudan
IS2662	C-25, SC114	Uganda
IS12219	Mashica, SC991	Uganda

Ethical and Legal Questions I: Impact on the CGIAR and ITPGRFA

To whom does the SbMATE gene belong? Not long ago, it seemed like the question was settled in favour of farmers and citizens of developing countries.

First, through the 1994 In Trust Agreement between CGIAR and FAO, and then by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (2001), it was established that the vast collection of farmers' germplasm held by the CGIAR could not be patented. This prohibition on intellectual property claims was in furtherance of CGIAR's mission "*to achieve sustainable food security and reduce poverty in developing countries through scientific research…*"

The SbMATE patent and negotiations to license the gene to the private sector, however, are in obvious contradiction to the Treaty and to the goals of sustainable food security and reduced poverty in developing countries. The patents aim to bring private profits to government scientists and multinational corporations of wealthy countries by exerting ownership over an in trust gene. To make matters worse (and more complex), two patent claimants are government institutions from countries that are committed to obeying the ITPGRFA: Brazil, which has ratified the treaty, and the United States, which has signed it.[37]

37. Brazil signed the treaty on 10 June 2002 and ratified it on the 22 May 2006, while the U.S.A. signed the treaty on 1 November 2002. See: http://www.fao.org/Legal/treaties/033s-e.htm (accessed 1 December 2009)

Sorghum bicolor

Source: http://commons.wikimedia.org/wiki/file:sorghum_bicolor_Bild0902.jpg

What meaning does the ITPGRFA and in trust status have if governments say they will follow the treaty, and then proceed to ignore its provisions, pillaging the coffers of CGIAR and selling them to Dow Chemical and other wealthy country concerns? Permitting the SbMATE patent to stand, and for the private sector to profit from it, would signal a new open hunting season on privatization of the vast collection of farmers' varieties of food crops held by the CGIAR. As such, and particularly because the claims are lodged by the powerful governments of the United States and Brazil, the SbMATE patent poses a grave challenge to the ITPGRFA and CGIAR.

Prior to publication of this paper, the African Centre for Biosafety contacted Embrapa and requested its comment on these issues. Embrapa replied that it required internal consultations and that it would be unable to reply by the publication date.[38]

Ethical and Legal Questions II: Taking from African Farmers to Spread GE Monoculture

It is unlikely that Dow Chemical, Oji Paper, or other potential licensees of the SbMATE gene fully appreciate the irony – and injustice - of using a trait from a farmers' variety of sorghum from Tanzania for their corporate purposes.

Dow sells maize, sorghum, and other seed for use in genetically uniform and often genetically engineered high-input agriculture. Oji Paper is clearly seeking the development of genetically engineered plantation monocultures of eucalyptus trees and sees a potential role for SbMATE in that effort. The patent owners have certainly anticipated this, and seek to profit from it, by claiming

38. Carvalho Alves, V.A. Embrapa Maize & Sorghum. Pers. Comm. 24 November 2009.

all manner of plants with the SbMATE gene in which SbMATE can only be used through genetic engineering, such as GE rice or GE wheat.

These forms of agriculture are not designed or suited for the vast majority of African farmers, nor do they serve to respect the genetic diversity that African farmers have developed. In fact, the effect of commercial use of the SbMATE gene could prove antagonistic to the conditions that created it by encouraging replacement of diverse farming systems and forestlands with crop and tree monocultures, including GE varieties, quite apart from the huge biosafety risks these will pose to human health and the environment.

Conclusion

The SbMATE gene does not rightfully belong to the USDA, Embrapa, or Texas A&M, and those institutions must abandon their unjust claims to the Tanzanian gene. The institutions that are charged with protecting this resource, CGIAR and IRPGRFA, must act to protect IS7173 and other in trust plants and genes from such claims.

The genius of African farmers that is locked up in the vaults of the CGIAR and other seed banks cannot be allowed to be used to undermine diverse farming systems and earn profit for multinational corporations. These seed collections should rather serve the interests of African farmers, sustainable food production systems and the preservation and development of in situ genetic diversity. This does expressly not include the packaging of in trust genes and plants into patents and selling them to the highest bidder.

Sorghum came from Africa and it remains vital for food security on the continent today. African sorghums have also historically, and to the present, been the foundation upon which the sorghum industries of the United States and other countries have depended. In this first of two African Centre for Biosafety publications on sorghum, the misappropriation of a Tanzanian sorghum has been highlighted. The next publication will expand on a related theme, exposing how the emerging biofuels industry is appropriating African germplasm to create “biofuel sorghum”, a misguided market strategy with negative food security implications for Africa.

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