GM cotton

set to invade West Africa

Time to act!

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About this briefing

This briefing is the result of research undertaken by GRAIN in collaboration with several national and regional partners in Benin, Burkina Faso, Mali and Senegal. GRAIN interviewed dozens of scientists, farmers and representatives of professional organisations from the cotton sector in each of these countries, and spent time with them reflecting on the significance of Bt cotton for their communities, their countries and West Africa in general. The briefing also draws heavily on the experiences of other countries where Bt cotton has already been introduced, such as India and South Africa. This briefing is designed to help farmers and local communities, researchers, NGOs, policy-makers and media people understand the implications of Bt cotton for West Africa.

Several non-governmental organisations (NGOs) active on cotton or sustainable agriculture issues participated in the editing of the document. These include:

- OBEPAB: Organisation Béninoise pour la Promotion de l'Agriculture Biologique (Benin),
- REDAD: Réseau pour le Développement Durable (Benin)
- GIPD: Projet de Gestion Intégrée de la Production et des Déprédateurs (Mali)
- PAN Afrique: Pesticides Action Network (Senegal)

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GRAIN is an international non-profit organisation which promotes the sustainable management and use of agricultural biodiversity based on people's control over genetic resources and local knowledge. To find out more about GRAIN, visit our website at www.grain.org

1. Introduction

West African farmers once produced cotton for dynamic local markets and a thriving local textile industry. In their fields, they grew a diversity of cotton varieties, adapted to local ecologies and cultural preferences, which they integrated into the production of other crops and which they only harvested when the market price was right.[1]

Traditional cotton production changed dramatically with colonialism. Cotton was the engine of imperial expansion, and the European powers, thirsty for alternative sources of "white gold" that could lessen their dependence on the United States, set their sights on Africa. West African farmers resisted, but France and the other European imperial powers used a range of tactics—forced labour, regulations, targeted subsidies, destruction of local markets, etc—to overwhelm them and reorganise the various local cotton production systems into an intensive, export-oriented system serving the interests of their own cotton industries.

In the French controlled areas of West Africa, all production was controlled by the *Compagnie Française de Développement Textile* (CFDT), the cotton company of the French state. The CFDT set-up highly integrated, vertical production systems in each country, which were supported by a regional research centre tied to the French national research agency, now known as the *Centre Français de Coopération Internationale en Recherche Agronomique pour le Développement* (CIRAD). With farmers having little choice but to accept the package of chemical inputs and seeds distributed by the company, traditional cotton varieties rapidly gave way to "modern" varieties designed to meet the needs of the global cotton industry, which preferred American cotton varieties. After independence, the CFDT was dissolved into national companies, but the French firm maintained an influential position within the national companies and the production model it established remained intact.

Some see the development of the export-oriented cotton industry in West Africa as a great success. West African cotton farmers are highly competitive and known for the quality of their cotton, and cotton is one of the few crops with a functioning production and marketing chain that farmers can earn income from. Today cotton dominates the economies of the countries of the region, accounting for 75% of export earnings in Benin, 50% in Mali and 60% in Burkina Faso.[2] Yet, "white gold" has not brought riches to West African farmers. The profits that farmers made during the early years of the national cotton companies have largely disappeared, while the associated costs of cotton production continue to increase—deforestation and soil degradation, social dislocation, pesticide poisonings, debt, low and unstable market prices, and the neglect of food crops.[3]

[1] Allan Isaacman & Richard Roberts, eds., *Cotton, Colonialism, and Social History in Sub-Saharan Africa*, James Currey: London, 1995.
[2] Amath Soumare, «Le Coton et l'Afrique : Subventions et Commerce», *Sopel International*, 16 Septembre 2003 : http://www.sopel.org/readart.php?idart=233
[3] Mamadou Ouologuem, «Impact de la culture du coton sur l'environnement et la société au Mali», Master's thesis in Environmental Sciences, Université du Québec à Montréal, 2003. For more information contact the author at: ouologuem@hotmail.com .

West African farmers are trying to change this situation. They have organised independent farmers' unions that can voice the interests of their members, counter the power of the cotton companies and improve conditions for farmers. At the international level, they are leading a campaign against US and European cotton subsidies. Back home, some farmers' unions have begun to look more critically at the dominant model of cotton production, questioning the need for chemical inputs and looking for means to reduce their dependence on cotton. Researchers and farmers are successfully rebuilding agricultural practices based on farmer knowledge and local resources that greatly reduce the use of pesticides. Through determined struggle, many farmers' unions now have a powerful position at the table with respect to national cotton policy.

But these achievements are not assured. Farmers may have carved out a certain amount of political leverage in their national cotton structures, but the context is changing rapidly, and foreign transnational corporations (TNCs) now have their sights set on West African cotton production. Their most visible entry point is through the World Bank's aggressive efforts to privatise the national cotton companies. But there is another way for corporations to control and profit from cotton production that is equally dangerous to farmers: taking over the seed.

The very transnational corporations that brought these hazardous and costly chemicals to the region are now promoting a new set of technologies that they claim will resolve the problems created by the old. Monsanto, an American pesticide corporation, is now promoting a genetically modified (GM) cotton variety called "Bt cotton", which it claims will reduce pesticide use, increase yields and increase income.[4]

Farmers are the people who will be at the sharp end of introducing GM crops to the region and should be central to making such decisions. But Bt cotton is moving into the region without the approval or even the awareness of the vast majority of West African farmers and their organisations. Bt cotton is the first of many GM crops set to be introduced in the region and it is essential for farmers and their organisations to take informed positions immediately, especially with such an important crop like cotton. This study seeks to make a contribution in this regard, by providing farmers with a critical and accessible analysis of Bt cotton.

The study begins with an assessment of the principal claims made by the promoters of Bt cotton: that Bt cotton will 1) reduce the use of insecticides; 2) increase yields; and 3) increase incomes for farmers. The second part of the study examines four of the consequences of Bt cotton: 1) the criminalisation of traditional farming practices; 2) genetic contamination; 3) the development of pest resistance to Bt cotton; and, 4) the effects on Bt cotton quality. This study does not deal directly with the biosafety issues relating to Bt cotton (environmental and health impacts), because these issues go beyond the scope of this study. We hope that others will take up these important questions.

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[4] Monsanto is not the only corporation currently seeking to introduce Bt cotton in West Africa. Syngenta, a Swiss pesticide company established through the merger of Zeneca and Norvartis, is alse trying to introduce a genetically modified cotton variety. But since Monsanto controls nearly 100% of the current GM cotton market, this study focuses on Monsanto's Bt cotton varieties.

2. What is Bt cotton?

The letters "Bt" stand for *Bacillus thuringiensis*, a toxin-producing bacterium found naturally in soils that farmers use to control insect pests, particularly caterpillars. Scientists have isolated certain genes responsible for the production of these toxins, most commonly the Cry1Ac or Cry2Ab toxins, and have then used genetic engineering techniques to insert them into cotton. The resulting cotton plants produce the Bt toxins and susceptible pests die when they eat them.

In 2002, Bt cotton was planted on 4.6 million hectares worldwide, approximately 13% of the global cotton area.[5] Almost all of this Bt cotton acreage was sown to Monsanto's "Bollgard" variety. Bollgard is genetically modified to produce the Cry1Ac toxin of *Bacillus thuringiensis*. Monsanto has developed a second Bt cotton variety, "Bollgard II", which produces two different toxins, Cry1Ac and Cry2Ab. In 2004, Dow Agro-sciences hopes to introduce "Widestrike", another Bt cotton producing two toxins (Cry1Ac and Cry1F), while Syngenta is trying to introduce its Bt cotton, "VIP Cotton" (see Table 1).[6]

Table 1. Companies producing Bt cotton

Company	Bt cotton variety
Monsanto (USA)	Bollgard Bollgard II
Dow Agrosciences (USA)	Widestrike
Syngenta (Switzerland)	VIP cotton

[5] Clive James, "Preview: Global Status of Transgenic Crops: 2002", *ISAAA Briefs* No. 27, ISAAA: Ithaca, NY, 2002.
[6] Jeremy Greene, "How Bollgard II cotton fits," Delta Farm Press, 6 June, 2003.

3. Can Bt cotton offer advantages for West African farmers?

The promoters of Bt cotton maintain that it provides farmers with three principal advantages. Each of these is discussed below.

a) Will Bt cotton reduce the use of insecticides?

Bt cotton does not eliminate the use of pesticides; and there is little evidence for significant reductions in overall pesticide use. The Bt toxins expressed by Bt cotton only target lepidopteran pests (caterpillars) and some lepidopteran pests are more susceptible than others. Bt cotton has been shown to be effective against the tobacco budworm (*Heliothis virescens*) and the pink bollworm (*Pectinophora gossypiella*), but less effective in controlling cotton bollworms (*Helicoverpa zea* and *Helicoverpa armigera*), an important cotton pest in West Africa.[7] This is why farmers growing Bt cotton continue to use pesticides against bollworms and continue to experience damage from these pests. In the US, despite the use of supplementary insecticides, farmers growing Bt cotton lost around 7.5% of their crop to cotton bollworms in 2002. During that year, 36% of the Bt cotton fields in the US were sprayed with insecticides specifically targeting bollworms and other caterpillar pests. Farmers outside the US have had similar experiences. In the Indian state of Andhra Pradesh, where Bt cotton was cultivated for the first time in 2002, Monsanto's Bollgard cotton failed to control cotton bollworms.[8]

Monsanto claims that its new Bt cotton, Bollgard II, enhances its control of bollworms and other caterpillars, but its effectiveness has yet to be seen. The available data supporting such claims are on studies of small, isolated fields, and definitive predictions about Bollgard II's effectiveness against bollworms on a large-scale cannot be made.[9] Moreover, in these small-scale studies significant numbers of cotton bollworms are still found to survive on Bollgard II. [10] As noted by University of Mississippi entomologist Blake Layton, under heavy population pressure bollworms will cause significant damage, even in fields of Bollgard II.[11]

There are many important cotton insect pests for which Bt cotton offers no control, such as sucking pests like aphids and jassids. These secondary pests can result in significant crop damage on Bt crops, which helps to explain why insecticide use remains high in Bt

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[7] Secretariat for the 61st Plenary Meeting of the International Cotton Advisory Committee, *Report on Production Practices*, Cairo, Egypt October, 2002; and Leonard Gianessi *et al*, "Plant Biotechnology: Current and Potential Impact for Improving Pest Management In US Agriculture: An Analysis of 40 Case Studies," National Center for Food and Agricultural Policy, Washington DC, June 2002.

[8] Abdul Qayam and Kiran Sakkhari, "Did Bt Cotton Save Farmers in Warangal? A season long impact study of Bt Cotton - Kharif 2002 in Warangal District of Andhra Pradesh," AP Coalition in Defence of Diversity and the Deccan Development Society, Hyderabad, June 2003: www.ddsindia.com

[9] J Gore e*t al*, "Bollworm (Lepidoptera: Noctuidae) Survival on 'Bollgard' and 'Bollgard II' Cotton Flower Bud and Flower Components, *J. Econ. Entomol*. 94 (6): 2001: http://konstanza.esa.catchword.org/vl=11035349/cl=23/nw=1/rpsv/cw/esa/00220493/v94n6/s17/p1445

[10] Ibid.

[11] Victoria G. Meyers, "Bollgard II: The next generation," *Progressive Farmer,* March 2003: http://www.progressivefarmer.com/farmer/magazine/article/0,14730,424267,00.html

cotton fields. In Australia, pesticide use against bollworms has declined, but farmers still spray their Bt cotton fields with insecticides 4.6 times per year.[12] The adoption of Bt cotton may even increase problems with secondary pests. In the Indian state of Andhra Pradesh, farmers growing Bt crops had to spray more against aphids than farmers growing conventional crops.[13] In the US, where insecticide use against bollworms has dropped by half since the introduction of Bt cotton, total insecticide use has remained stable due to the growing importance of secondary pests.[14]

In West Africa, cotton farmers have to manage a diversity of pests and many of the more important pests would either not be controlled or be only partially controlled by Bt cotton (see Table 2). Bt cotton is toxic to a few important cotton pests in West Africa. But growing Bt cotton does not automatically translate into a reduction in pesticide use and damage from pests. The vast majority of West African farmers spray their cotton fields with broad-spectrum pesticides according to a calendar method, which begins with 2 treatments of an organophosphate pesticide or endosulfan, followed by 3 or 4 treatments of a mixture of organophosphates and pyrethroids.[15] These pesticides are used to control all cotton pests, not simply those targeted by Bt cotton. Simply cutting back on pesticide use will mean greater problems with pests not controlled by Bt cotton, as cotton farmers in the US have experienced.[16] In order to reduce pesticide use with Bt cotton, farmers must adopt more complicated and targeted pesticide practices.

There are already several efforts underway in West Africa to help farmers adjust their pest management practices and reduce the use of pesticides. The longest-standing programme is called targeted application management, *lutte étagée ciblée* (LEC) in French.[17] National cotton companies and the national research institutes began experimenting with LEC in the early 1990s in response to the growing evidence of harm to people and the

[12] Secretariat for the 61st Plenary Meeting of the International Cotton Advisory Committee, *Report on Production Practices*, Cairo, Egypt, October 2002.
[13] Abdul Qayam and Kiran Sakkhari, "Did Bt Cotton Save Farmers in Warangal? A season long impact study of Bt Cotton - Kharif 2002 in Warangal District of Andhra Pradesh," AP Coalition in Defence of Diversity and the Deccan Development Society, Hyderabad, June 2003: www.ddsindia.com
[14] Charles M. Benbrook, GMOs, "Pesticide Use and Alternatives: Lessons from the U.S. Experience," Delivered at the Conference on GMOs and Agriculture, Paris, France, June 20, 2003: http://www.biotech-info.net/lessons learned.pdf
[15] Secretariat for the 61 st Plenary Meeting of the International Cotton Advisory Committee, *Report on Production Practices*, Cairo, Egypt, October 2002.
[16] Brad Haire, "Bug gang strikes Georgia cotton crop: New technology gives certain bugs opportunity to thrive," Georgia FACES, July 31, 2003: http://georgiafaces.caes.uga.edu/storypage.cfm?storyid=1913 ; Ronald Smith, Professor and Extension Entomologist Auburn University, "Stink Bugs: New Economic Pests Of Cotton" September 1994 : http://www.aces.edu/department/ipm/stinkbugs.htm; MB Layton *et al*, "Performance of Bt Cotton in Mississippi", 2002, Proceedings from the 2003 Beltwide Cotton Conference, CD-ROM, National Cotton Council, Memphis, TN.
[17] Bruno Michel *et al*, "La lutte contre les ravageurs du cotonnier au Mali : problématique et évolution récente", *Cahiers d'études et de recherches francophones / Agricultures*, vol. 9, numéro 2, March –April 2000, pp. 109-115.

Table 2: Principal insects pests of cotton in certain countries of West Africa and their susceptibility to Bt cotton

Country - region	Early season pests (in order of importance)	Control by Bt cotton*	Late season pests (in order of importance)	Control by Bt cotton*
Benin-North	*Helicoverpa armigera*	○	*Helicoverpa armigera*	○
	Sylepta derogata	?	*Earias spp.*	○
	Aphis gossypi	X	Other bollworms	○
Benin – South	*Polyphagotarsonemus latus*	X	*Polyphagotarsonemus latus*	X
	Sylepta derogata	○	*Cryptophlebia leucotreta*	?
	Helicoverpa armigera	○	*Pectinophora gossypiella*	●
			Exocarpic pests	○
Ivory Coast	*Aphis gossypii*	X	*Pectinophora gossypiella*	●
	Empoasca facialis	X	*Polyphagotarsonemus latus*	X
	Polyphagotarsonemus latus	X	*Cryptophlebia leucotreta*	?
	Sylepta derogata	○	*Earias spp.*	○
	Lygus vosseleri	X	*Helicoverpa armigera*	○
Mali	*Aphis gossypii*	X	*Helicoverpa armigera*	○
			Sylepta derogata	○
			Spodoptera littoralis	○
			Diparopsis watersi	○
			Earias spp.	○
Senegal	*Diplopodes*	?	*Helicoverpa armigera*	○
	Aphis gossypii	X	*Earias spp*	○
	Amsacta moloneyi	○	*Diparopsis watersi*	○
	Sylepta derogata	○	*Aphis gossypii*	X
	Cosmophila flava	○	*Bemisia tabaci*	X
Togo – Kara	*Sylepta derogata*	○	*Sylepta derogata*	○
	Aphis gossypii	X	*Aphis gossypiella*	X
	Amrasca spp.	X	*Amrasca spp.*	X
	Diparopsis watersi	○	*Diparopsis watersi*	○
			Dysdercus spp.	X
Togo - Central	*Polyphagotarsonemeus*	X	*Polyphago. Latus*	X
	Aphis gossypii	X	*Pectinophora gossypiella*	●
	Amrasca spp.	X	*Helicoverpa armigera*	○
	Sylepta derogata	○	*Earias spp.*	○
			Dysdercus spp.	X

* Based on the experiences of countries where Bt cotton has been introduced
● = complete, ○ = partial, X= none, ? = unknown
(Modified from Secretariat for the 61st Plenary Meeting of the International Cotton Advisory Committee, Report on Production Practices, Cairo, Egypt, October 2002).

environment caused by pesticide use on cotton. LEC only slightly deviates from the calendar method by encouraging farmers to adjust the dosage of their pesticide treatments according to pre-determined pest threshold levels. This may sound simple enough, but, given the rampant illiteracy in the countryside, LEC projects have had to integrate literacy programmes in parallel in order to be effective.

In Mali, the national cotton company, the *Compagnie Malienne pour le Développment des Textiles* (CMDT), launched an LEC programme in 1993 in collaboration with the main cotton farmers' unions and the national agricultural research service, the *Institut de l'Économie Rurale* (IER). It was an immediate success, causing the project leaders to explore ways to reduce pesticide use even further. In the 2000-2001 season, they launched a new programme called threshold application management, in which farmers make an initial pesticide application and from then on only spray if pest damage reaches a certain economic threshold. Farmers reduced their use of pesticides by 70% compared to the calendar method, without diminishing their yields.[18] Farmers participating in the project near to the Fana CMDT station only make one pesticide application per season.[19]

Pesticide reduction projects have had similar success in Benin. Here, the LEC programme is part of a larger project to improve and diversify agriculture, called *Projet d'Amélioration et de Diversification des Systèmes d'Exploitation* (PADSE). During the first three years of the project, farmers practising LEC increased their yields by 10% and saved 45% on pesticide expenditures.

These projects show that there are no technical constraints to reducing pesticide use on cotton in West Africa. However, despite the success of LEC and the threshold application management projects, these projects only extend to a minority of farmers. In Benin, LEC was practiced on less than 3% of the entire cotton area during the 2002-2003 season. In Mali, LEC and the threshold application management programmes were practised on less than 10% of the national cotton area. Only 787 farmers on 2,500 ha practised threshold application management during the 2002-2003 season. The big problem holding these projects back is the lack of resources and political will to implement them. In Mali, the CMDT's plans to expand its projects were abruptly constrained by the implementation of a privatisation programme called for by the World Bank that led to massive cutbacks to its extension services.

[18] Interview with Boubacar Sékou Soumaré, Chef de la Division Liaison – Recherche Développement, CMDT, 1 July 2003, Bamako, Mali.
[19] Interview with Abdoulaye Bamba, Director of the Agicultural Production Division, CMDT, Fana, Mali, 3 July 2003.

Local alternatives to reduce pesticides

There are new initiatives afoot to reduce pesticide use in cotton that look more promising for West African farmers than Bt cotton. In 2001, the FAO launched its Integrated Pest and Production Management (IPPM) Programme in the region. The programme was initiated in Mali, where it is carried out in collaboration with the CMDT, IER and the principal cotton farmers' organisations. Contrary to previous pesticide reduction projects, under IPPM farmers are the central actors, while the researchers and extension agents serve merely to facilitate the process and encourage farmers to take autonomous decisions. The project encourages farmers to maximise the use of local resources and knowledge and to minimise off-farm inputs, such as pesticides and fertilisers. The project operates through Farmer Field Schools, where farmers and scientists work together to develop pest management and production practices.

During the first season of the programme, participating farmers were able to completely eliminate the use of pesticides without reducing their yield. Instead of using chemical pesticides, farmers used neem, a local plant with insecticidal properties, and traditional pest management practices that they had long neglected. The results from the 2002-2003 season, involving 375 farmers, are even more encouraging. The average yields for farmers practicing IPPM were 25% higher and their average net revenues were 49% higher than farmers using conventional practices, and they used 70% less pesticides.[20] Researchers that were once sceptical about the project's potential have changed their minds. "At the beginning we didn't believe it was possible, but today it's a reality," says IER entomologist Mamoutou Togola. Farmers from other countries in the region have visited the project and are keen to start the programme in their own localities. In 2003-2004, IPPM projects were launched in Senegal and Burkina Faso, and plans are underway to establish projects in Mauritania, Guinea, Niger and Benin in 2005.

Table 3. Pesticide reduction projects in Mali, 2002-2003

Project	Pesticide use compared tc calendar method	Area covered by the projec 2002-2003	Percentage of the total cottor area
LEC	50%	28 980 ha	7%
TAM*	70%	2 515 ha	1%
IPPM	100%	-	-

* Threshold application management (*Source: CMDT and GIPD Programme– Mali*)

Farmers and agricultural organisations in West Africa are increasingly turning to organic production. Two organic cotton projects began in Senegal in 1995—one organised by Enda Pronat and the Pesticide Action Network-UK in the region of Tambacounda and the other by the *Groupement d'Intérêt Économique* (GIE) in the region of Kolda. These two projects produced around 500 tonnes of cotton in 2001. Organic cotton production began in Benin in 1996 and there are now projects in the zones of Kandi, Djidja, Dassa-Zoumè, Aklampa and Doumè.[21] The number of farmers participating in these projects, which are led primarily by the *Organisation Béninoise pour la promotion de l'Agriculture Biologique* (OBEPAB), the *Projet d'Appui au Développement Institutionnel de la Circonscription Urbaine de Kandi* (PADIC) and, more recently, the Swiss organisation Helvétas, increased from 57 in 1996 to 367 in 2001.[22] The first organic cotton project in Mali was launched in 1996 by Helvétas.[23]

b) Will Bt cotton increase yields?

[20] Souleymane Coulibaly (Coordinateur Technique, GIPD-Mali), "Résultats des Champs Ecoles réalisés en 2003 par le Programme de GIPD-Mali,"

[21] PAN Africa, « Lutte contre les ravageurs, sécurité alimenaire et coton biologique au Sénégal », PAN UK : London, August 2002.

[22] Organisation Beninoise pour la Promotion de l'Agriculture Biologique, «Le coton au Bénin : rapport de consultation sur le coton conventionnel et le coton biologique au Bénin», PAN UK: London, August 2002.

[23] Helvetas-Mali, « Résultats de la recherche-action sur le coton biologique au Mali 2001 », February 2002 : http://www.helvetas-mali.org

Bt cotton is genetically modified to produce a toxin that kills certain insects, not to increase yields. Claims made about Bt cotton's ability to increase yield relate to its capacity to reduce damage caused by insects. So where farmers are already successful in keeping damage from pests at low levels, there is little potential for Bt cotton to increase yields.[24] This is the case in most of West Africa, as current pest management practices are able to effectively control cotton pests.[25]

It is, however, possible for Bt cotton to decrease yields. The imprecise process of genetic modification can have unintended consequences on plant varieties. In India, for example, a comparative study of Bt and non-Bt cotton grown in the states of Maharashtra and Andhra Pradesh found that bolls on the non-Bt cotton plants were bigger and more plentiful. The non-Bt cotton had 95 bolls per plant on average and the Bt cotton had only 50.[26] Another study of 225 farmers from the Warangal District of Andhra Pradesh, India, found that Bt cotton yields were on average 35% lower than non-Bt cotton crops. Both studies also found that the conventional cotton had a better quality fibre, resulting in a better price in the market. According to the authors of the Warangal study,

> *"In Warangal, all the farmers who had grown Bt crop witnessed a drop in the price for their produce as well as less preference by the traders. So they had resorted to mixing of both Bt and non-Bt seed cotton to offset the drop in the price as well as to push their Bt produce under the cover of non-Bt seed cotton. Another important reason for mixing Bt and non-Bt was the shorter staple length of the Bt seed cotton. As Bt seed lint was attracting less price and preference from the market, they had mixed the two before taking their produce to the market."*[27]

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[24] Leonard *et al, Plant Biotechnology: Current and Potential Impact For Improving Pest Management In U.S. Agriculture: An Analysis of 40 Case Studies,* National Center for Food and Agricultural Policy, June 2002; M Qaim and D Zilberman, "Yield effects of genetically modified crops in developing countries," *Science*, *299*, 2003, pp. 900-902; B Shankar and C Thirtle, "Pesticide Overuse and Bt Cotton," Paper presented at the 7th ICABR conference, Ravello, June 30 – July 3, 2003; and Matin Qaim *et al*, "Agronomics and Sustainability of Transgenic Cotton in Argentina", *AgBioForum*, July 2003.

[25] Interview with Mamoutou Togola, IER, 2 July, 2003, Sikasso, Mali.

[26] Suman Sahai and Shakeelur Rahman, *Performance of Bt cotton in India: Data from the first commercial crop,* Gene Campaign, India, Aug 2003: http://www.genecampaign.org/btcotton.html

[27] Abdul Qayam and Kiran Sakkhari, "Did Bt Cotton Save Farmers in Warangal? A season long impact study of Bt Cotton - Kharif 2002 in Warangal District of Andhra Pradesh," AP Coalition in Defence of Diversity and the Deccan Development Society, Hyderabad, June 2003: www.ddsindia.com

c) Will Bt cotton increase income for farmers?

Given current market prices around the world for Bt cotton and the average cost of pesticides for cotton farmers in West Africa, there is no way that Bt cotton can provide an economic advantage to the average West African cotton farmer. The costs for pesticide use on cotton in West Africa are relatively low compared with other parts of the world; West African farmers spend an average of around $68 US .[28] As a result, the high cost of the Bt cotton seed cannot be compensated for by lower pesticide costs.

One of the reasons that Bt cotton seed is so expensive is because when farmers purchase Bt cotton seeds they have to pay a "technology fee" to Monsanto on top of the price of the seed. The technology fee is either included in the price of the seed or charged separately and the fee varies from country to country and from technology to technology (see Table 5). The technology fee for Bollgard II, which Monsanto is working on introducing in West Africa is much higher than that for Bollgard.

Table 5. Technology fees for Bt cotton around the world

Country	Technology fee for Bollgard	Technology fee for Bollgard II
United States	79 $US/ha	99 $US/ha
Australia	98 $US/ha	-
Argentina	78 $ US/ha	-
China	60 $US/ha (approx.)	-
India	60 $US/ha (approx)	-
South Africa	50 $US/ha (approx.)	-

Sources: Elton Robinson, "Bollgard II advances technology," *Delta Farm Press*, November 15, 2002; Richard Haire, "Meeting the challenges facing Australia's agribusiness sector Cotton's Future," A presentation to the Australian Rural Leadership Foundation, 2003: www.qcotton.com.au/investor/reports.htm; Johann Kirsten and Marnus Gouse, "Bt Cotton in South Africa: Adoption and impact on farm incomes amongst small- and large-scale farmers," *ISB News Report*,
October, 2002; Jikun Huang *et al*, "Bt Cotton Benefits, Costs, and Impacts in China", AgBioForum 5(4), 2002; Abdul Qayam and Kiran Sakkhari, « Did Bt Cotton Save Farmers in Warangal? A season long impact study of Bt Cotton - Kharif 2002 in Warangal District of Andhra Pradesh », AP Coalition in Defence of Diversity and Deccan Development Society, Hyderabad, June 2003: www.ddsindia.com; Rafi Chaudhry, Head, Technical Information Section, International Cotton Advisory Committee, "Cotton Tomorrow," Presented at the International Technical Seminar on Cotton, Bogota, Colombia, August 8-9, 2003.

Given the cost of the technology fees for Bt cotton in other countries, we can assume that farmers in West Africa will have to pay at least a $60 US/ha technology fee for Monsanto's Bollgard II cotton. With the cost of pesticides averaging $68 US/ha, Bt cotton would have to completely eliminate the use of insecticides to be potentially economic for West African farmers. As we have shown, this is not going to occur; Bt cotton will, at best, only slightly reduce the amount of insecticide used. So, overall, Bt cotton will increase costs for West African farmers.

[28] Secretariat for the 61st Plenary Meeting of the International Cotton Advisory Committee, *Report on Production Practices*, Cairo, Egypt, October 2002.

4. Counting the costs: some of Bt cotton's consequences for West African farmers

Debate over Bt cotton tends to focus on the promised advantages, while far too little attention is paid to the potential negative consequences. This is a serious omission in West Africa, where Bt cotton puts the livelihoods of much of the population at risk.

a) The criminalisation of farmer practices

Most cotton seed in West Africa is not sold; the cotton companies either provide seed to farmers for free or for a modest fee that they deduct from the price they pay for the farmer's harvest. The fee is supposed to reflect the costs of de-linting and cleaning the seeds. West African farmers have consistently opposed any attempts to charge more for seeds. As they see it, the seeds belong to them, since they produced the seeds and they paid for the plant breeding that went in to developing the seeds. Although seed saving has dwindled with the growth of the national cotton companies, farmers continue to share and exchange seeds with family members and neighbours, and the practice of seed saving could easily recommence if seed prices were to rise.

The introduction of Bt cotton will deeply affect seed practices in the region. Bt cotton will be sold by the national cotton companies under license to Monsanto and the national cotton companies will be responsible for collecting Monsanto's technology fee. This will leave the national companies with two options:

The first option is that they would sell the Bt cotton to individual farmers under Monsanto's infamous grower contracts, which is how Bt cotton is sold in most of the world. Monsanto's contracts specify that:

- The farmers cannot save seeds for replanting
- The farmer cannot share or exchange seeds with anyone else
- The farmer has to pay 120 times the technology fee plus any legal fees incurred by Monsanto if the farmer does not respect the terms of the contract
- The farmer has to comply with any inspectors Monsanto sends to his or her fields

Monsanto takes its contracts seriously. In the US it has a team of 75 employees with an annual budget of $75 million to enforce and supervise the contracts.[29] The company has taken 73 farmers to court over the past five years and, in May 2003, an American cotton grower was sent to jail for 8 months. Monsanto keeps lists of those growers that purchase its seeds and it monitors them closely, even in the countries of the "South" where it sells its Bt cotton, such as Mexico and Argentina.[30]

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[29] Peter Shinkle, "Agriculture giant has won millions in suits against farmers", *St-Louis Post-Dispatch*, 12 May 2003.

[30] International Cotton Advisory Committee, "Technology Protection Systems", *ICAC Recorder*, March 1999.

It's hard to imagine how the national cotton companies will be able to enforce these contracts and prevent farmers from saving seeds, sharing seeds with neighbours or even developing their own Bt varieties. With the high level of illiteracy in the countryside, farmers won't understand the contracts they are signing and the lack of a visible difference between Bt cotton and non-Bt cotton will only make the situation more complicated. In India, where the context is somewhat similar, the situation is out of control with widespread mixing of Bt and non-Bt cotton and the emergence of a huge black market in "generic" and non-regulated Bt cotton varieties.[31]

Under these circumstances it is much more likely that the West African cotton companies and Monsanto (and other Bt cotton corporations) will turn to a second option. Under this second option, the cotton companies will charge farmers royalties once they bring in their harvests. They may test the cotton that farmers drop-off to see if it is Bt cotton and then force farmers to pay the technology fee if they detect the presence of Bt cotton. This is the strategy that Monsanto is pursuing with its GM soybeans in Brazil. The problem, however, is that with the widespread contamination that is bound to take place, many farmers will unknowingly have Bt cotton present in their harvest and will be forced to pay a fee to Monsanto or risk a much larger fine or even imprisonment (see Contamination section below). Alternatively, the national cotton companies may decide to provide farmers with no option but to grow Bt cotton and to deduct a technology fee from the harvest of every cotton farmer in the country. This second possibility would conform to the traditional operations of the national cotton companies, where all farmers are expected to use the same package of inputs. But it would not only hurt farmers financially; it would put an immediate end to the promising efforts, already well underway, to reduce or eliminate pesticide use and the dependence on expensive, foreign technologies.

b) Bt cotton and contamination: Opening Pandora's box

Co-existence between conventional and GM cotton is not possible. If Bt cotton is introduced in the region, the contamination of non-Bt cotton is inevitable. As there is no way to easily distinguish between Bt cotton and non-Bt cotton, Bt cotton will easily end up being mixed into the conventional cotton supply when farmers drop off their harvests, when the cotton is transported, or when seeds are cleaned and distributed. Contamination will also take place in the fields through cross-pollination, either by way of wind or, more likely, by way of insect pollinators.

This contamination will be a serious problem for West Africa:

-First, genetic modification is a new technique that is far from fully understood and the impacts on the environment and human health could take years to appear. But, once GM crops are introduced it is difficult, if not impossible, to take them out of the environment, especially for poor countries with few resources, like those of West Africa.

[31]"Scientists Find Bt Cotton Mixed With Other Varieties", *BharatTextile.com,* September 29, 2003.

-Second, Monsanto and other transnational corporations hold patent rights over the transgenic genes in GM crops and they claim that their rights extend to any plants that contain those transgenes, even if these plants incorporated the transgenes through contamination. In other words, if a farmer's crop is contaminated with Monsanto's Bt cotton, then that crop becomes Monsanto's property and the farmer will have to pay Monsanto royalties on it. This is precisely what happened to Canadian farmer Percy Schmeiser. Monsanto inspectors discovered that his canola crop was contaminated with a transgene patented by Monsanto that makes plants resistant to Monsanto's Roundup herbicide. Even though Schmeiser says that his fields were probably contaminated by neighbouring GM canola fields, Monsanto accused Schmeiser of acquiring its GM canola illegally and sued him for loss of royalties. While the court could not determine if Schmeiser had deliberately acquired Monsanto's GM technology or benefited from it, the court ruled in favour of Monsanto, forcing Schmeiser to pay Monsanto over $200,000 in royalties and legal fees.

-Third, Bt cotton can contaminate local cotton varieties and their relatives, leading to consequences for the local ecology and breeding programmes. For these reasons, Bt cotton is prohibited in the US states of Hawaii and and Florida where there are local cotton varieties and wild species of cotton.[32] In West Africa, there are important varieties of local cotton (*G. arboreum* and *G. herbaceum*) and several wild species of cotton that exist throughout the region. Moreover, cotton is part of the Malvaceae family, which includes many plants and trees common to West Africa, such as hibiscus, baobob and cola.[33]

-Finally, Bt cotton contamination could destroy the emerging organic cotton production sector in the region. Organic cotton farmers receive higher prices for their cotton, but their practices have to conform to stringent certification requirements. In general, these requirements prohibit genetically modified organisms (GMOs). Under the "Basic Standards for Organic Production and Processing" of the International Federation of Organic Agricultural movements (IFOAM): "The use of genetically engineered organisms or their derivatives is prohibited… Organic processed products shall not use ingredients, additives or processing aids derived from GMOs."[34] West African organic cotton farmers, therefore, could lose the organic status of their cotton if their fields are contaminated by neighbouring Bt cotton fields or if their seeds (which are currently provided by the national cotton companies) are contaminated.

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[32] US Environmental Protection Agency, Bt plant-pesticides biopesticides registration action document 11C1 C. environmental assessment, 2001: www.epa.gov/scipoly/2000/october/brad3_enviroassessment.pdf

[33] Wild species from West Africa include *G. anomalum anomalum, G. anomalum senarense, G. triphyllum, G. benadirense, G. bricchettii, G. trifurcatum, G. vollesenii, G. longicalyx.* (Personnel Participating in Regional Research Project, "Preservation and Utilization of Germplasm in Cotton 1981-1992," Mississippi State University Southern Cooperative Series Bulletin, September 1997: http://msucares.com/pubs/southerncoop/scsb386.htm

[34] "IFOAM Basic Standards for Organic Production and Processing," approved by the IFOAM General Assembly, Victoria, Canada, August 2002: http://www.ifoam.org/standard/norms/cover.html

West African governments are in no position to prevent contamination by managing the co-existence of GM and non-GM crops. The current regulatory situation in the region is chaotic. As this article goes to print, none of the countries in the region have put biosafety legislation into practice. Nevertheless, while no GM varieties have officially been commercialised, Burkina Faso has started field tests of GM cotton and there is a growing list of GM varieties in the pipeline for the region (see table 7). Behind closed doors, regulatory officials and scientists say that GM crops are already in their countries and some even claim to know where they are grown.

Table 6. GM crops introduced in West Africa

Country	GMO
Senegal	Monsanto Bollgard Cotton (Field testing by SODEFITEX)
Burkina Faso	Syngenta VIP Cotton (Field tests in two locations by INERA, SOFITEX and UNPCB)
	Monsanto Bollgard II cotton (Field tests in two locations by INERA, SOFITEX and UNPCB)

Table 7. Planned introductions of GM crops in West Africa

Country	Crop	GM trait	Institution
Benin	Coton	Bt	Monsanto
Cameroon	Cocoyam	Resistance to cocyam root rot	JP Johnsson Biotech Laboratory
Côte d'Ivoire	Cotton	Bt	Monsanto
	Rice	Resistance to rice yellow mottle virus	WARDA
Nigeria	Cassava	Resistance to cassava mosaic virus	IITA
	Maize	Modified to produce vitamin A	IITA
Mali	Cotton	Bt	Monsanto

(Source: GRAIN; Walter Alhassan, "Agrobiotechnology Application in West and Central Africa (2002 Survey outcome)", International Institute of Tropical Agriculture: Ibadan, Nigeria, 2003)

This is not to say that West African governments are not working towards the establishment of biosafety legislation. Most are moving to implement legislation in line with the Cartagena Protocol on Biosafety of the Convention on Biological Diversity and the Model Law on Biosafety of the Organisation for African Unity. Benin has even established a five-year national moratorium on the importation, commercialisation and utilisation of all GM products or products derived from GMOs to give the country time to effectively debate, develop and implement national biosafety legislation.

But these national processes are being undermined by the on-going efforts to push Bt cotton in the region. Monsanto and the national cotton company of Senegal, SODEFITEX, have already undertaken field trials of Bt cotton in the Valley of the Senegal River, without any regulatory approval or oversight. The company abandoned the trials after one year, as the Bt cotton failed to significantly reduce insect damage.[35] In Mali, a document leaked to the public in February 2004 revealed that the national agricultural research service, the IER, was in the final stages of negotiating a five-year contract with USAID, Monsanto, Syngenta and Dow Agrosciences to develop and commercialise Bt cotton. Under the proposed terms of the agreement, field trials of Bt cotton are set to begin in the 2004 cotton season. In Burkina Faso, in June 2003, the national agricultural research service, INERA, began field trials of Bt cotton, as part of a research project with Monsanto and Syngenta. The field trials commenced while the national biosafety committee, which brings together relevant government agencies and representatives of non-governmental organizations, farmers' organisations, and industry, was still preparing national biosafety legislation. INERA chose not to formally consult with the committee and the committee has still not seen the terms of the contract agreed to by INERA, Monsanto and Syngenta.[36] It seems fairly clear that Bt cotton is being used as a Trojan horse to open West Africa completely up to GM agriculture.

c) Resistance Management? Not for West Africa

One of the major concerns with Bt cotton and other genetically modified Bt crops is that the target pests could rapidly develop resistance to the Bt toxin, leading to increased pest problems in farmers' fields and destroying the effectiveness of Bt as an insecticide, not only in GM crops but as a natural insecticide as well.[37]

At least 26 insect pests, including cotton bollworms, are known to have the capacity to develop resistance to Bt toxins. Researchers in Australian found that cotton bollworms can rapidly develop resistance to Bt toxins: they determined that the 21st generation of a cotton bollworm population was 50 times more resistant than the first 12 generations and 300 times more resistant than a susceptible laboratory population, when the population was continuously exposed to Bt toxins. The researchers predict that resistance in the field would become a problem after 16 cotton bollworm generations, meaning 4-5 cotton seasons, if measures are not taken to prevent the development of resistance.[38] Chinese researchers came to a similar conclusion. They determined that Bollgard cotton would lose its effectiveness in seven years if cultivated in Northern China without resistance management practices.[39]

In light of these concerns, farmers in the US and Australia must adopt specific resistance management plans if they grow Bt cotton. Farmers in these countries have to leave part

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[35] Interview with Ahmed Bachir Diop, Director General of SODEFITEX, Dakar, Senegal, 7 July 2003.
[36] Interview with Hamidou Boly, Director General of INERAB, Ouagadougou, Burkina Faso, 28 June 2003
[37] Robin Jenkins, "Agricultural Biotechnology: a Case Study of Bt Crops," Association Concentropique, France, April 2000.
[38] Ray Akhurst, CSIRO Entomology, "Measuring heliothis resistance to Ingard cotton", *The Australian Cotton grower*, June 2002: www.ento.csiro.au/pdfs/articles/Heliresistance.pdf
[39] Li-jun Ru, Jian-zhou Zhao, and Chang-hui Rui, "A simulation model for adaptation of cotton bollworm to transgenic Bt cotton in North China", *Acta Entomologia*, 45(2) 2002, pp. 153-159.

of their fields as a refuge, where they can only cultivate non-Bt varieties in order to maintain populations of susceptible pests. Under the US Environmental Protection Agency's resistance management plan, farmers have to set aside 24% of their cotton crop as a refuge, and they can only treat 8% of this refuge area with insecticides.[40] Resistance management regulations are even stronger in Australia; farmers have to set aside 70% of their fields as refuge areas.

Such resistance management strategies are inappropriate and unrealistic in West Africa. The average farm in West Africa is less than 5 ha, whereas farms in the US and Australia are often on thousands of hectares. Farms in Africa are also more diverse; some farmers grow cotton alongside a number of other crops, whereas others plant their entire field to cotton, and, in some areas, small cotton fields are surrounded by other small cotton fields, creating a fairly extensive monoculture. With this farm diversity, there can be no simple one-size-fits-all strategy like that in the US or Australia.

The other major constraint is implementation. It's one thing to develop a resistance management plan; it's quite another to put it into practice, particularly in West Africa, where there are so many communication obstacles. Most West African farmers are illiterate; few have telephones and many don't even have postal addresses. With the privatisation push in the region, the national cotton companies scrapped their literacy programs and they've made deep cuts to their extension services. The national cotton companies are currently in no position to implement resistance management plans. And there's no reason to think that Monsanto is going to carry them out. The company has refused to take responsibility for resistance management in all the southern countries where it has introduced its Bt cotton. In India, neither the government nor Monsanto oversees the implementation of the resistance management plans they've drawn up.[41] In China, farmers have been growing Bt cotton without an operational resistance management plan since 1998.[42] In South Africa, Bt cotton was approved with a resistance management plan, but in practice, neither the government nor Monsanto have taken responsibility for its implementation by small farmers. Even in the US, where there is a co-ordinated management strategy with adequate financing, a recent study of Bt maize farmers found that 20% of the farmers were not following the resistance management regulations.

d) Does Bt cotton reduce fibre quality?

[40] SVS Gopalaswamy *et al*, "Development of Resistance in Insects to Transgenic Plants with *Bacillus thuringiensis* Genes: Current Status and Management Strategies," *Resistant Pest Management Newsletter*, vol. 12, no. 2, 2003.
[41] Suman Sahai and Shakeelur Rahman, *Performance of Bt cotton in India: Data from the first commercial crop*, Gene Campaign, India, Aug 2003: http://www.genecampaign.org/btcotton.html
[42] Li-jun Ru *et al*, "A simulation model for adaptation of cotton bollworm to transgenic Bt cotton in North China", *Acta Entomologia*, 45(2) 2002, pp 153-159.

In the US, where Bt cotton has been cultivated since 1996, there is an on-going debate over the Bt technology's affect on cotton fibre and quality. William Dunavant Jr, the CEO of Dunavant, one of the world's largest cotton merchants, believes that the Bt technology is reducing the quality of American cotton. "I still believe the seed is a major, major problem and I think a lot of people agree with that," he told participants to a 2002 national cotton conference in the US.[43] While Dunavant's comments are not as yet backed up by scientific studies, there are farmers and researchers in the US and Australia that share his concern that GM cotton can have a negative impact on cotton quality, especially under certain environmental stresses. This is what has happened in India, where Bt cotton was commercialised in 2002. Farmers there received a lower price for Bt cotton because it was of poorer quality.[44]

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[43] Rene Pastor, "Dunavant says US cotton quality still lags, blames seeds," *Planet Ark*, January 11, 2002 : http://www.planetark.org/dailynewsstory.cfm/newsid/14000/newsDate/11-Jan-2002/story.htm

[44] Suman Sahai and Shakeelur Rahman, *Performance of Bt cotton in India: Data from the first commercial crop,* Gene Campaign, India, Aug 2003: http://www.genecampaign.org/btcotton.html

5. Conclusion

There is no justification for the current efforts to push Bt cotton into West Africa. The potential advantages of Bt cotton are very limited and far outweighed by the negative consequences that it could bring to farmers in the region. Moreover, effective ways to reduce pesticide use in cotton already exist. The IPPM programme in Mali shows that farmers can reduce and even eliminate the use of pesticides in a sustainable manner without reducing yields and without relying on the expensive technologies of foreign corporations. Instead of introducing Bt cotton, it is time to ask why national cotton companies, governments, and the World Bank are not fully supporting the implementation of these pesticide reduction strategies.

Farmers are the most at risk from Bt cotton, so they must be at the centre of all decisions related to its introduction. But meaningful consultation can only take place when farmers are fully informed of the issue. Under the Convention on Biological Diversity, which all of the francophone countries of West Africa have ratified, it is the responsibility of governments to inform and consult with their people before allowing for the introduction of GMOs. Yet, in practice, the governments of the region are doing little to pursue serious consultations with farmers, who, for the most part, have still never even heard of genetic engineering. Farmers' organisations, then, are going to have to take the lead in bringing information to their members and in developing positions on the issue. They will also need to find ways to work together at the regional level, through networks like the *Réseau des Ortganisations Paysannes et Producteurs d'Afrique de l'Ouest* (ROPPA), because once a GMO is introduced in one country there is no stopping it from spreading to neighbouring countries.

Those promoting Bt cotton may try to claim that Bt cotton is a way to help farmers manage the on-going global cotton crisis. Nothing could be further from the truth. The cotton crisis is fundamentally a political problem, rooted in the structure of the global cotton market, colonial history and local and international power relations. The solution to the crisis can only be found through: the elimination of subsidies in the West that support export cotton production and reduce world market prices; the rejuvenation of local textile industries to decrease dependence on the global market; support for local and regional food crop markets; and the emergence of a regional food and agricultural system as opposed to the colonial system that continues to dominate. In other words, a complete reform of food and agriculture policy is required at the national level and at the regional level, within organisations such as the *Union Économique Monétaire Ouest Africain* (UEMOA) and the Economic Community of West African States (ECOWAS).

West African farmers' organisations are already struggling to head in this direction. But Bt cotton and other GMOs are new threats that they have to deal with. Once again West African farmers are confronted with a stark choice: either to follow the path laid out by neo-colonial interests and their destructive technologies or to take charge of their own destiny and pursue a pro-farmer agriculture that meets the needs of their people.