Influence of the Fast Spread of Bt Cotton on Organic Cotton Production: Examples from India and Burkina Faso

Matthias Klaiss[1], Monika Messmer[1]*, Dionys Forster[1], Rajeev Verma[2], Rajeev Baruah[2], Vivek Rawal[2], Lokendra Singh Mandloi[2], Yogendra Shrivas[2]*

[1] Research Institute of Organic Agriculture, Ackerstrasse, CH-5070 Frick, Switzerland, Matthias.Klaiss@fibl.org, Monika.Messmer@fibl.org

[2] bioRe India, Kasrawad, Madhya Pradesh, India

* Corresponding authors

1. Introduction

COTTON is grown in more than 120 countries by over 20 million cotton producers on 35 million ha in 2012 (Truscott, 2010, www.fas.usda.gov).

In 2011, around 27 million tons of cotton were produced, mostly by smallholder producers in 'developing' countries which cultivate cotton as a cash crop on their own land averaging under 2 ha in size, or as contracted workers for bigger land owners. Cotton is usually grown as a monoculture. In industrialised countries, the level of mechanisation is high, thus cotton production does not provide a lot of work in rural communities. In contrast, in developing countries, the cultivation and harvest is mostly done by hand labour and thus provides a lot of work for the rural population. Cotton, particularly as a monoculture, uses significant amounts of pesticides, fertilisers, fossil fuels and water (Truscott, 2010).

There are four commercially exploited cotton species: *Gossypium hirsutum* and *G. barbadense*, the 'New World Species', and *G. arboreum* and *G. herbaceum*, the Old World Species. Though Old World cottons are still grown in some areas of Africa and Asia, they have been almost totally replaced by New World cottons. Most dominant today are *G. hirsutum* cultivars, which are spread across 45 countries. About 90% of the annual global cotton harvest is derived from *G. hirsutum*. One negative outcome of the wide cultivation of *G. hirsutum* cultivars is the increased pest attacks, particularly by the American bollworm. Hence, cotton cultivation had a very bad reputation as the single largest user of pesticides in the world (Truscott, 2010).

In the mid-1990s, conventional cotton production posed a serious threat to the environment, farmers' health and the economy. At one stage cotton accounted for the use of 15% of the world's pesticides and 25% of the world's insecticides.

This resulted in two major responses. One response was the development of genetically modified (GM) insect-resistant cotton cultivars, which were rapidly adopted by many countries since its first commercial introduction in 1996. Approximately 82% of the world's cotton-growing area was grown under genetically modified cotton in 2011 (www.isaaa.org2).

The other response was the adoption of organic methods of cotton production by farmers who believed that holistic, earth-friendly responses, optimised crop rotation and organic fertiliser could reverse the trend of the soaring use of chemical pesticides.

The rapid spread of GM seeds in cotton has resulted in problems for the organic cotton sector, a few of which can be briefly examined, taking India and Burkina Faso as examples (Truscott, 2010).

2. Organic cotton

The production of organic cotton is more knowledge intensive than resource intensive, thus less dependent on fossil fuels and synthetic inputs. Organic farmers rely on understanding the ecology of their farm in building up and maintaining an agro-ecological balance of the complex farm system, increasing soil fertility, micro and macro fauna etc. This investment in the ecology of the farm system in turn contributes to the efficiency – and quality – of crop production.

Organic agriculture is proven to be highly suitable for small-scale farming in developing countries (Truscott, 2010, IAASTD, 2008).

Organic cotton has experienced years of unprecedented growth. In 2005 only 0.1% of global cotton production was organic, in 2010 it was already 1.1%, which is an increase of 1100% in five years (Truscott, 2010). By 2010, organic cotton was grown in 23 countries. The top five organic cotton-producing countries were India, Syria, Turkey, China, and USA (Texas). Countries in West Africa, Latin America and the Middle East are also well-established organic cotton producers. Some organic cotton producers are also certified according to fairtrade standards; particularly in West Africa and Central-South East Asia (Truscott, 2010). More than 94% of organic cotton was produced by India, Syria and Turkey alone in 2010 (Textile Exchange 2012). Neither recession nor unstable economies have put a damper on the growth of the organic textiles industry which grew 20% to an estimated $5.16 billion in 2010 (www.naturalnews.com). Several brands and retailers more than doubled their usage of organic cotton alone and plan to do so in 2012 as well. Others with large programmes are staying the course. As a result, Textile Exchange projects the global organic cotton market will increase another 20% to result in an estimated $7.4 billion market in 2012 (Textile Exchange, 2011a). According to a very optimistic market analysis, the world market for organic cotton is projected to exceed $19.8 billion by the year 2015, mainly driven by growing

awareness and interest for eco-friendly products among consumers (www.strategyr.com).

However, despite all this breath-taking developments, organic cotton production dropped by 37% in 2011 (Textile Exchange, 2012). This was especially true for India.

One of the main reasons for the sharp decline of organic cotton production may be the rapid expansion of GM cotton in cotton-producing countries. This dominance leads to the decline of diversity and neglect of local/native species of cotton. Organic cotton producers face new challenges as in some areas the availability of appropriate non-GM cotton seed has become increasingly limited. Moreover, the quality of such seeds is often dubious. To overcome this problem, the role of local, native or specially bred cultivars should be recognised. Local varieties, especially locally adapted species, play an important role for conservation of a broad range of biodiversity of the cotton gene pool.

Increasingly, the governments leave the seed sector to private companies and corporations. A considerable amount of resources are spent on R&D of GM seed development, hence, there is little interest and little funding and priority on improving non-GM seed. This leads to a dependency on a small number of patented brands/company monopolies.

GM cotton is found in at least ten cotton-growing countries now – and tested in others. The lobby promoting GM (supported by multinational agrichemical suppliers) is very powerful (Truscott, 2010). Organic production does not permit the use of GMO (www.ifoam.org). Contamination issues are a severe threat to organic production: if organic cotton is contaminated by GM, organic certification is lost. Due to patents on GM crops, traditional seed exchange cannot be practised anymore, even among conventional farmers. Moreover, there is evidence now of secondary pest attack problems and pests exhibiting resistance to Bt cotton (TE Cotton Briefing 2011).

3. West Africa

Most West African countries have ratified the Cartagena Protocol on Biosafety; however, only Burkina Faso, Mali, Ghana and Nigeria have functioning legislation allowing field trials of GM products. Bt cowpea is expected to be introduced shortly in West Africa, which is the most important food crop in dry regions (www.aatf-africa.org). In Mali, authorities are allowed to approve applications for trials. There are no applications for trials to test GM crops yet, but they are likely to adopt Bt cowpea (www.nepadbiosafety.net[1]).

In Mozambique, the biosafety bill is in progress, an application for trials is expected. Senegal has no functioning biosafety framework yet. Benin renewed in 2008 the five-year moratorium set up first in 2002 and will again discuss and decide on the matter in 2013 (www.arkansasonline.com).

Ghana has a functioning biosafety framework that allows trials (www.nepadbiosafety.net[2]).

4. Burkina Faso

In Burkina Faso, cotton is cultivated on a total of 424,810 hectares (ISAAA, 2012). Cotton farmers represented almost 1/6 of all rural households in Burkina Faso in 2006, being the largest employment group in the country. Thirty-five per cent of GDP comes from the cotton sector, and about 18% of the people live from cotton growing (www.cotton-made-in-africa.com).

Cotton is generally produced by smallholder farmers with household labour. The former governmental company was split into three private companies working in assigned zones: SOFITEX, SOCOMA and Faso Coton. Hence, there is a high market concentration. SOFITEX, being the former governmental company, still acts as a gatekeeper and dominates the sector. These companies also define the cotton cultivar(s) that have to be grown in their specific zone.

The average area dedicated to cotton production is 45% of the total land available for a farm. Rural incomes are largely shaped by the seasonal cotton yield and market price.

Conventional cotton growing relies heavily on costly agro-chemical inputs that leave producers indebted to the cotton companies, encourages ecologically questionable farming practices, and promotes a strong bias in favour of male cotton producers through extension services and access to credit (Coulter, 2011).

4.1 Bt cotton in Burkina Faso

In 2000, a joint collaboration between Burkina Faso's national cotton companies and Monsanto started. Burkina Faso signed the Cartagena Protocol on Biosafety and put in place the regulatory process after GM cotton had been (illegally) tested in the country. NGOs have played a major role in ensuring that national legal frameworks for GM crops admission are implemented (Kone and Lanting 2011).

Starting in 2003, official experiments with American GM cotton cultivars (DP50 and Cooker) were conducted under controlled conditions in research centres. In 2006, the Bollgard II event containing the stacked Cry2Ab and Cry1Ac genes was transferred into local varieties. Monsanto assisted the introgression of these Bt genes into the two regional cotton varieties – STAM 59 and STAM 103 – that were widely grown by conventional cotton farmers (Vitale, 2010).

In 2007, field trials were conducted to test these GM cotton varieties with 20 participating farmers on 20 ha under controlled conditions. The 2006 biosafety law was reviewed in 2008 and a contract was signed with Monsanto. In 2008, an area of 8,500 ha was planted with Bt cotton. Finally, in 2009, the first local cotton varieties containing Bollgard II were commercially released. This was the result of

several years of coordinated efforts on behalf of various Burkina Faso cotton stakeholders. A large portion of the resources required for the testing and commercialisation process was provided by Monsanto.

In 2009, 125,000 ha of these local Bt cotton varieties were grown. In the 2009/2010 season, Bt cotton was grown on 128,563 hectares (Vitale 2010). In 2011, Bt cotton area doubled to 247,000 hectares or 58% of the total cotton area (www.isaaa.org[1]), making Burkina Faso the second largest producer of GM cotton in Africa behind South Africa.

In Burkina Faso, Monsanto owns the events that have been introduced into commercial Bt cotton seeds, which entitles it to up to 28% royalties. The current model of seed sales in Burkina Faso gives about 60% profit to the seed farmers, 28% to Monsanto, and 12% to research (Kone and Lanting, 2011) .

4.2 Situation arising from spread of Bt cotton for non-GM cotton farmers

The rapid large-scale introduction of Bt cotton caused several disturbances. Due to price struggles with the companies, farmers decided to boycott cotton production. This matter led the main cotton company to use subtle influence on farmers, which caused even riots and deaths.

With the increase in Bt cotton production in Burkina Faso, isolation zones between GM cotton and non-GM cotton fields were often neglected, which is against recommended practice and leads to genetic contamination of non-GM cotton. However, leaving a 100m distance in a smallholder context is difficult. There are now problems with contamination of non-Bt fibre due to improper handling during sales and transport. There is an emerging competition for availability of land for organic or conventional cotton and Bt cotton (Ngang in DDS, 2012).

Four years after the introduction of GM cotton, there were reports that farmers were switching back to conventional, or non-GM seed. Many farmers in Burkina Faso experienced shorter fibre length which resulted in lower cotton prices than before. The GM cotton was introduced in the area with the promise of 30% higher yields, reduced pesticide use, and higher net income overall. After several years, none of these promises have been realised. Crop yields even dropped in some cases (www.organiccotton.org). The ‘rumours’, that Burkina Faso farmers would abandon GM cotton, were immediately denied and the success of GM cotton underlined by SOFITEX (www.lobservateur.bf).

4.3 Organic cotton in Burkina Faso

In 2011, Burkina Faso produced 252 metric tons of organic cotton, 0.17% of world organic cotton production and was ranked 13th in the world organic cotton producers list. Compared to the previous year, there was a decrease of 15% (Truscott, 2010). The organic programmes in Burkina Faso have been in place since 2004 and operate under the direction of Helvetas, a Swiss non-governmental organisation (NGO). Despite the high level of interest of rural producers in organic cotton

production and the support of an NGO, there is a discrepancy between the ability to start such production and the demand of growers for market entry. Organic cotton programmes operate under the auspices of the cotton company that controls the particular zone, and it is dependent on the goodwill of each cotton company. The three companies derive their profits from conventional and GM cotton. Thus, their support for the lower-yielding organic cotton is limited. Additionally, the recent introduction of GM cotton further endangers the feasibility of organic cotton production. Organic farmers are concerned about contamination of their fields with Bt cotton, whereas cotton companies strive to expand the more profitable conventional and Bt cotton. There is huge pressure on organic farmers, as GM-contaminated cotton fibre obtains no organic premium price. Thus, their investments and efforts are at risk. These developments limit the interest of smallholder producers and thus the expansion of organic cotton production (Coulter, 2011). As the recruiting of new farmers became very difficult, the priority is now to retain farmers who invested in organic. In 2010, the number of farmers dropped to almost one-third of the amount of farmers participating in the programme the year before, which was around 7,000. An explanation for this drop could be the stringent measures that farmers are required to take to minimise contamination.

Organic cotton can be contaminated in many ways. Organic cotton seed can be mixed with GM or conventional seed before planting. Cross-pollination is possible between neighbouring fields of GM or conventional and organic cotton. Contamination can occur through mixing (whether unintentional or intentional) during storage, transport or processing. Even under laboratory conditions, it is difficult to prevent contamination of pure varieties (farmhub.textileexchange.org). Measures taken by organic producers to prevent GM contamination would be to keep a 100m distance between organic and GM cotton fields, which is difficult in a smallholder context and might be not enough to prevent cross pollination (Pierre et al. 2010). The cultivation of GM cotton, which is usually grown by men, and organic cotton, which is grown by women, on the same farm was banned. This led to exclusion of women.

5. India

India is the only country to produce and market all of the four commercial cotton species (Nemes, 2010). In 2010, 80% of global organic cotton production was grown in India, which was 195,412 metric tons (Textile Exchange, 2012).

In 2011/12, total cotton production area in India was 12,178 million ha. Total production of cotton was approximately six million tons of cotton, mostly of *G. hirsutum* (calculation based on figures from cotcorp.gov.in/national-cotton.aspx).

The history of cotton cultivation in India can be traced back thousands of years. At the time of India's independence in 1947, 97% of the cotton grown were the so-called Desi-cotton varieties, *G. arboreum* and *G. herbaceum*, which were

adapted to local conditions after centuries of development and cultivation. Only 3% was *G. hirsutum*, which was introduced by the British at the end of the 18th century to cater for their spinning mills. The American cotton species *G. hirsutum* has longer and stronger fibres than the Desi cotton, but requires more fertiliser and is highly susceptible to drought, water logging, diseases and insect pests. By 1965, after Indian scientists intensified efforts to breed American cotton for Indian conditions, *G. hirsutum* was grown in 40% of the total area under cotton cultivation. The remaining area was under Desi varieties. By 2002, when Bt cotton was introduced, Desi cotton acreage was further reduced to 25%. At the moment, the area under Desi cotton is estimated at 3% in the country (www.financialexpress.com).

India's seed industry was dominated by public-sector seed companies until the end of the 1980s. After India's decision to embrace biotechnology, the seed sector was deregulated and in 1988 a New Seed Policy was implemented. This development, as a means of achieving food security, has attracted several leading biotechnology-focused multinational seed companies to India. Nowadays, 60% of the turnover in the seed sector is made by private companies (Sangar et al., 2010). In 1970 the Gujarat Agricultural University in Surat released the world's first intra-specific (*G. hirsutum x G. hirsutum*) hybrid (H-4) and in subsequent years further intra- as well as inter-specific (*G. hirsutum x G. barbadense*) hybrids were released (CICR 2010).

5.1 Bt cotton in India

In 2002, Mahyco (MAharashtra HYbrid Seed COmpany) in collaboration with Monsanto was the first to receive approval for three Bt cotton hybrids for commercial cultivation in the Central and Southern cotton-growing zones in India. Around 54,000 farmers in India grew these Bt cotton hybrids on 50,000 hectares of land in 2002 (Choudhari and Gaur, 2010, www.isaaa.org[3]).

India ratified the Cartagena Protocol on Biosafety in 2003 (www.siliconindia.com). In 2003/04 Monsanto sublicensed the Bollgard gene to other companies. India's 3rd Amendment to its Patent Act in 2005 has allowed patents for GM seeds, and created a situation where the importance and dominance of the public sector and state seed supplies has diminished. This has paved the way for the private sector to take more control of seed supply (Truscott, 2010). Until 2005, Mahyco-Monsanto Biotech (MMB) dominated the market for cotton hybrids, either directly through selling hybrid seeds or indirectly through sub-licensing the Bollgard events to private seed companies. India's regulatory system gave them a temporary monopoly on the Bt gene. Companies that licensed Bt had to pay a fee, leading to an increase in seed prices (Arora and Bansal, 2012). In 2006, the Indian government adopted a case-by-case method of approval, and shifted later to event-based approvals. Bt cotton hybrids are the principal commercial crops planted, increasing from three Bt cotton hybrids in 2002-03 to 884 Bt cotton hybrids in 2011/12 (www.isaaa.org3). By 2009 the area under GM cotton increased 168 fold to 8.4

million hectares. The Indian seed market suffered proliferation (Ramaswami et al. 2009). In 2010, already 780 Bt cotton hybrids were on the market in India. Six events were approved by government (Choudhari and Gaur, 2010). By 2011, seven million farmers had adopted Bt cotton on 26 million acres, around 90% of the total Indian cotton area (James, 2011, in Kathage and Qaim, 2012).

The march of time and commercially-prioritised technology poses a threat to agricultural traditions of centuries, and ironically in an era of the patent regime, makes seed-saving a criminal act punishable under intellectual property (IP) law. So far in India only Bt cotton has been approved, while the release of Bt eggplant and other food crops has been turned down.

5.2 Organic cotton in India

For the first time in years, the global organic cotton production declined by 37%. India, which produced 80% of world organic cotton in 2010, experienced the greatest reduction, 48% less in 2011 compared to 2010 (Textile Exchange 2012a). Four reasons were found to have the most severe impact. To prevent fraud and control contamination, India mandatorily implemented the comprehensive quality control system Tracenet by APEDA (the Agricultural Produce Export Development Authority). The additional cost caused by this system has to be borne by the organic sector. There is an environment of continued economic uncertainty, which keeps commodity prices down and endangers farmers' stability. There has also been a shift by some companies from established programmes such as organic and fair trade to newer initiatives like Better Cotton Initiative with less strict regulations (allowing the use of GM cotton as well as pesticides) offering a lower barrier to entry.

Due to the ubiquitous presence of GM cotton, it has become increasingly difficult to produce organic cotton. There is a severe shortage in the availability of non-GM cotton seed, and even this seed is often contaminated with GM cotton. The ways of contamination are numerous (see Blake, 2010) and force organic cotton producers to take measures which cause a lot of additional cost and effort (Textile Exchange 2012a). On the other hand, farmers have lost their traditional knowledge on seed production. Hybrid seeds have to be purchased each season and therefore organic cotton farmers depend today on a diminishing supply market of non-GM cotton seed (Stone, 2007).

Recent experience has been that available non-GM seed is of doubtful quality (expired, chemically pre-treated, segregating) and based on only a few hybrids selected for responsiveness to fertiliser and chemical pest control that might not be adapted to rain-fed and low-input conditions (Felkl et al. 2010). While new cultivars are tested routinely under conventional growing conditions (Surulivelu 2011 and Rathore et al., 2011), no systematic cultivar trials were conducted for organic and low-input farming. Moreover, there is a big risk of physical and genetic

contamination of organic cotton with GM cotton and the loss of locally adapted genetic resources. It has become very difficult to produce and maintain non-GM seed. A lot of cultivars are already contaminated (Patil in Forster et al., 2011).

6. The Dharwad Declaration

Stakeholders of the organic movement are highly concerned about this development in the cotton sector in India. Organic farming can only present a viable alternative to conventional production if farmers have access to suitable cultivars. A national workshop on 'Disappearing non-GM cotton – ways forward to maintain diversity, increase availability, and ensure quality of non-GM cotton seed' (Forster et al., 2011) initiated by bioRe India (Ltd.), the Research Institute of Organic Agriculture (FiBL Switzerland) and the University of Agricultural Sciences (UAS) Dharwad presented the first agreement, the 'Dharwad Declaration' (www.fibl.org) towards safeguarding the heritage of Indian Desi cotton, maintaining genetic diversity, avoiding GM contamination as well as supporting the organic farmers with suitable cultivars.

7. Outlook: The Green Cotton project

FiBL, together with bioRe and the University of Dharwad, took immediate action and started with preparations for a participatory breeding project in 2011. Participatory plant breeding is a proven method to develop locally adapted cultivars and to maintain and to increase genetic diversity (Nkongolo et al. 2008; Djaboutou et al., 2007; Lancon et al., 2004).

The short-term aim of the project is to provide organic cotton farmers with high-quality seeds. In the mid term, new cultivars need to be developed that fit the needs of organic cotton farmers and processors. Seed sovereignty and autarky of smallholder cotton farmers should be improved by capacity building and establishing decentralised participatory breeding initiatives. Farmers' experience and breeders' knowledge is combined to develop cotton cultivars adapted to the local conditions of organic cotton farmers. To achieve this goal the following objectives were defined:

(i) Networking with all stakeholders in the organic cotton value chain to achieve coordinated cooperation.
(ii) Collection and conservation of genetic resources.
(iii) Testing of existing cultivars under organic conditions.
(iv) Training farmers in seed multiplication, crossing and selection.
(v) Establishing participatory cotton breeding programmes.
(vi) Re-establishing the non-GM seed chain.

Currently, the following activities are taking place:

Fifty different non-GM cultivars provided by the UAS Dharwad are being tested in 2012 under optimum and water stress conditions with low-input organic management. Different cultivar types (*G. hirsutum* vs. *G. arboreum* (Desi cotton) species, hybrids vs. varietal lines) are being tested assessing yield, resistance traits, and fibre quality according to the market demand. In addition, the optimal planting density for the different cultivar types is being tested. Workshops are conducted with farmers to teach them on cultivar testing, crossing techniques, selection of segregating material and cultivars and seed propagation. In these workshops, the farmers' knowledge is assessed to define the most important traits and ideal cotton genotype under different growing conditions. Farmers manage on-farm cultivar tests in different soil types with and without irrigation. Currently, a socio-economic evaluation of different models for the establishment of a seed supply chain for non-GM cotton in India is being carried out. For the future, it is foreseen to build up further participatory breeding programmes in various cotton-growing regions and countries (Tanzania, Uganda, Benin, Mali, Burkina Faso) by South-South transfer relying on our international networks (Messmer et al., 2011; Roner, 2012; Roner et al., 2012).

Sources

Arora, A and Bansal, S. (2012): Price Controls on Bt Cotton Seeds in India: Impact on Seed Providers, www.jnu.ac.in/Academics/Schools/SchoolOfInternationalStudies/CITD_Oldwebsite/DiscussionPapers/DP02_2012.pdf, 13.12.2012

Blake, F. (Ed.) (2010): Guidance Document for Co-existence between Organic and GMO Cotton in India, http://www.organicandfair.org/oftcc/Publications/Tools-and-Guides/Guidance_Document_final_version_2010_for_circulation_100621.pdf, 15.12.2012

Central Institute for Cotton Research CICR (2010). Vision 2030. Indian Council of Agricultural Research,www.cicr.org. in/pdf/CICR_VISION_2030.pdf, 29.03.2012

Coulter, K.M. (2011):Hemmedin: The Geography of Organic Fairtrade Cotton in Burkina Faso, Masters Thesis, University of Illinois http://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&ved=0CEEQFjAC&url=http%3A%2F%2Fwww.ideals.illinois.edu%2Fbitstream%2Fhandle%2F2142%2F24026%2FCoulter_Kathryn.pdf%3Fsequence%3D1&ei=-GDMUMTiEonxrQfp4YBQ&usg=AFQjCNH51XdoILh-0cIMjsRJaSbaG4U_4Q&bvm=bv.1355325884,d.bmk

Deccan Development Society (DDS) (2012): BT Cotton and Beyond - Status and implication of Genetically Engineered crops and post GE technologies for small farmers in Africa and Asia, An Afro Asian Conclave at National Institute of Rural Development [NIRD], Hyderabad, http://www.ddsindia.com/www/pdf/B&B%20Report.pdf, 12.12.12

Djaboutu, M.C., Lancon J., Sekloka, E., Alabi S.O., Echekwu, C.A., Olarewaju, J.D. (2007): Innovative Farmer Participatory Cotton Improvement Programme in the Savanna Ecology, *Aricultura Tropica et Subtropica*, VOL. 40 (4), 180-186

Felkl G. and Sahai S. (2010): Potentials of agricultural genetic engineering for food security in India – experiences and perspectives, Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Eschborn, Germany

Forster, D. et al., (Ed.), (2011): 'Disappearing non-GM cotton - ways forward to maintain diversity, increase availability and ensure quality of non-GM cotton seed', Source: National Workshop Proceedings, http://orgprints.org/19298/1/ProceedingNationalWorkshop_DisappearingNon-GMCotton.pdf, 14.12.2012

Lancon, J., Lewicki, S., Djaboutou, M., Chaume, J. and Sekloka E. and Farmer-Breeders: Assogba, Takpara, L. and Orou Mousse, B.I. (2004): Decentralized and Participatory Cotton Breeding in Benin: Farmer Breeders' Results are Promising, *Expl Agric.* (2004), volume 40, pp. 419-431

Kathage and Qaim (2012): Economic impacts and impact dynamics of Bt (Bacillus thuringiensis) cotton in India, www.pnas.org/content/109/29/11652.full.pdf+html, 12.12.12

Kone, A. and Lanting, H. (2011): Risks and Opportunities for transgenic cotton growing in Africa: Capitalizing on experience gained by South Africa, Burkina Faso and India, http://www.endadiapol.org/IMG/pdf/Risks_and_opportunities_for_transgenic_cotton_growing_in_Africa_Enda_AProCA._Version_Anglaise_pdf.pdf, 12.12.12

Kotschi, J. (2008): Transgenic Crops and Their Impact on Biodiversity, *GAIA* 17/1: 36-41

Messmer, M., Roner T., Finckh, M., Forster, D., Verma, R., Baruah, R., Patil, S.S. (2011): Participatory cotton breeding for organic and low input farming in India. Organic Plant Breeding: What makes the difference? 10 years' Anniversary Conference, Frankfurt, 3rd and 4th November 2011

Nemes, N., (2010): Seed Security among Organic Cotton Farmers in South India, Master Thesis, Uni Hohenheim

Nkongolo, K.K., Chinthu, L., Malusi, M and Vokhiwa, Z. (2008): Participatory variety selection and characterization of Sorghum (Sorghum bicolor (L.) Moench) elite accessions from Malawian gene pool using farmer and breeder knowledge, *African Journal of Agricultural Research* Vol. 3 (4), pp. 273-283

Pierre J., Hofs J. (2010). Astylus atromaculatus (Coleoptera: Melyridae): Abundance and Role in Pollen Dispersal in Bt and Non-Bt Cotton in South Africa. *Environ*. *Entomol.* 39(5): 1523-1531.

Ramaswami, B., Murugkar, M. and Shelar, M. (2009): Product Proliferation in India's Cotton Seed Market: Are There Too Many Varieties?, *Journal of Agricultural & Food Industrial Organisation*, Vol. 7, Article 2 www.isid.ac.in/~bharat/Research/varietyproliferation.pdf

Rathore P. and Palve S.M. (2011): Proceedings of the AICCIP annual group meeting: 2011-12. Breeding Panel: Technical programme for 2011-12, India

Roner, T. (2012) Participatory cotton breeding for organic and low input farming in Central India, Master Thesis, Georg August University Göttingen and FiBL

Roner, T., Messmer, M.M., Finckh, M.R., Forster, D., Verma, R., Baruah, R., Patil, S.S. (2012) Participatory cotton breeding for organic and low input farming in Central India. Tropentag 'Resilience of agricultural systems against crises', *Göttingen* Sept. 19-21 2012

Sangar, S., Abrol, D. & Raina, R., (2010): Seed sector – R&D and policy support, www.nistads.res.in/indiasnt2010-11/T5_Rural/Seed%20sector%20%E2%80%93%20R&D%20and%20policy%20support.pdf, 22.12.2012

Stone, G.D. (2007): Agricultural Deskilling and the Spread of Genetically Modified Cotton in Warangal, *Current Anthropology*, Vol. 48, No. 1, pp. 67-103, www.jstor.org/stable/10.1086/508689

Surulivelu T. (2011): All India Coordinated Cotton Improvement Project – Annual Report, http://aiccip.cicr.org.in/CD_11_12/1_Preface.pdf, 12.12.12

Textile Exchange (2012): 2011 Organic Cotton Market Report, available on request
Textile Exchange (2012a): Textile Exchange Farm Fiber Report 2010-2011, www.textileexchange.org/2011-farm-fiber-report, 3.9.2012
Truscott, L. (Ed.) (2010): Textile Exchange Cotton Briefings 2011, http://farmhub.textileexchange.org/, upload/library/cotton%20briefings/Cotton%20Briefing%202010%20-%20Small.pdf, 12.12.12
Vitale, J.D. (2010): The Commercial Application of GMO Crops in Africa: Burkina Faso's Decade of Experience with Bt Cotton, *AgBioForum*, 13(4): 320-332
www.aatf-africa.org/userfiles/AgricBiotechAnnual_Dakar2011.pdf, 11.12.12.
www.arkansasonline.com/news/2012/apr/15/geneticlly-modified-cotton-not-option-now/
www.cotton-made-in-africa.com/en/the-initiative/where-we-work/burkina-faso.html, 12.12.12.
www.farmhub.textileexchange.org/upload/learning%20zone/cotton%20dialogues/Organic%20under%20threat%20by%20GM%20in%20Burkina%20Faso.pdf
www.fas.usda.gov/psdonline/psdreport.aspx?hidReportRetrievalName=BVS&hidReportRetrievalID=958&hidReportRetrievalTemplateID=1, 11.12.2012
www.ifoam.org/press/positions/ge-position.html
www.fibl.org: www.fibl.org/fileadmin/documents/en/news/2011/pr_india110706_Dharwad Declaration.pdf
www.financialexpress.com/news/spinning-its-way/743292, 12.12.12
www.isaaa.org[1]:
www.isaaa.org/resources/publications/biotech_country_facts_and_trends/download/Facts%20and%20Trends%20-%20Burkina%20Faso.pdf
www.isaaa.org[2]:
www.isaaa.org/resources/publications/briefs/43/pptslides/default.asp, 10.12.12.
www.isaaa.org[3]: http://www.isaaa.org/resources/publications/biotech_country_facts_and_trends/download/Facts%20and%20Trends%20-%20India.pdf,10.12.12
www.lobservateur.bf/index.php/index.php?option=com_content&view=article&id=13180:coton-ogm—le-burkina-droit-dans-son-sillon&catid=18:societe&Itemid=16, 15.12.2012
www.naturalnews.com/030774_organic_cotton_textiles.html, 9.12.12
www.nepadbiosafety.net 1: www.nepadbiosafety.net/abne/wp-content/uploads/2010/10/Country-report-Mali.pdf
www.nepadbiosafety.net2: www.nepadbiosafety.net/abne/wp-content/uploads/2010/10/Country-report-Ghana.pdf
www.organiccotton.org/oc/Library/library_detail.php?ID=527, GM in Burkina Faso – Summary, 12.12.12
www.siliconindia.com/shownews/India_ratifies_Cartagena_Protocol_on_Biosafety___-nid-18696-cid-2.html
www.strategyr.com/pressMCP-6361.asp, 13.12.12