



**AFRICAN STAKEHOLDERS STUDY TOUR**  
**THE PRESENT & FUTURE OF**  
**COTTON FARMING IN INDIA**

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## FOREWORD

Cotton is the most important commercial crops in around 82 countries of the globe where it is cultivated. In 1980's, the cotton production in the world was just 14 million tons (MT). It rose to around 19 MT in the next 4 years but then was stagnant till 2000. Use of genetically modified technology (Insect resistant and herbicide tolerant) coupled with adoption of hybrid technology and expansion in area in some countries including India saw a dynamic growth in production of cotton touching a level of 28 MT by 2014-15. Until 2000, the productivity was in the range of 500-600 kg lint per hectare but subsequently it jumped to 750-800 kg per hectare within next 5 years with the introduction of Bt technology in most of the countries. In fact if we go by the global production trends today only three countries namely India, China and USA contribute around 63 per cent to the global raw cotton production and thus are referred as 'Big Three Giants' of world cotton. India and USA also enjoy the position of largest and second largest exporter of raw cotton, respectively. India with its highest acreage under cotton (37% of the world area and 25% of the total production) and also under the Bt technology (adoption at 11.6 million ha) has emerged as a powerful player in the commerce of cotton trade and textile manufacturing.

The countries of the four sub regions of Africa, which are traditional cotton producers are now considering the rejuvenation of the cultivation of cotton for securing economic development. Thirty seven countries out of fifty four African nations spread across the continent produce cotton on 11 million hectares, nearly equivalent to area under cotton in India. However the average yield stands at 350 kg lint per hectare, which is much less than the world average. Except South Africa, Burkina Faso and Sudan, none of them have adopted the new biotech cottons. Some of them have been conducting the confined field trials including Cameroon, Kenya, Ethiopia, Ghana and Malawi. But many of them have not even commenced the process of creating biosafety laws for adopting the new gene(s) technologies. Therefore, it is logical that these countries are looking to India for gaining the experience of biotech cotton and aspiring to introduce biotech traits in their respective countries.

Agriculture, particularly cotton and textile sectors present a vast opportunity of collaboration in technology, trade and training (3T) between India and Africa. India can provide technologies and expertise in cotton and textile value chain from seeds to fibre to edible oil to most of African countries. In turn, Africa can increase their capacity to grow more, produce more, consume more and trade more with India. Cotton and textile sectors can resurrect the 21st century partnership between two giant continents. In the recent past, the trade between India and Africa has increased manifolds. In 2014-15, it was estimated that India's total trade with Africa and Africa's total trade with India has climbed to US\$72 billion

and US\$39 billion respectively. Interestingly, this was a five-fold increase in the trade, on both ways, in the preceding decade. Notably, in the 3rd India-Africa Forum Summit held from 26-29 October 2015, the Government of India has announced India's offer for concessional credit of US\$10 billion over the next 5 years to African Countries to strengthen India-Africa partnership. Besides, India committed US\$7.4 billion concessional credit program since the 1st India Africa Forum Summit in 2008. It is therefore paramount that India and African countries explore and exploit this opportunity to strengthen agricultural technology, trade and training to ensure food security and sustainable development spurred by inclusive growth in agriculture.

In order to facilitate exchange of ideas, technologies and trade in agriculture sector, a series of study tours, demonstration plot visits, training to the students and staffs have been organized under the Indo-African program since 2010. A study tour of regulatory officials from seven countries was organized in Oct 2013. In this series I am extremely happy that our society, the South Asia Biotechnology Centre (SABC), New Delhi has efficiently organized a study visit of 30 stakeholders from six East-South African countries to Indian biotech cotton hybrid fields in what is known as the "Seeing is Believing" program in September-October 2015, in collaboration with the ISAAA AfriCenter. The participants comprised of policy makers, senior government officials, CEO's of cotton boards, journalists, consumer representatives, private players in cotton trade who witnessed the first-hand experience of biotech cotton hybrid growing in the fields. They got the opportunity to interact with farmers, officials, researchers and private sector seed company Mahyco - the first Indian seed company to introduce Bt cotton in India. The study tour was highly successful as evident from the feedback received from the participants.

In January 2016, our society assisted another African delegation comprising of legal counsellors of biosafety committees of nine African countries led by ABNE, Michigan State University, Michigan and Bejo Sheetal Bioscience Foundation from 19 January to 28 January 2016. SABC interacted with the delegation at TERI, Delhi and also helped them with half a day roundtable meeting at Hyderabad wherein they were briefed about regulatory sciences, development of biotech crops by public sector institutions and role of private sector in India.

I congratulate my colleagues Mr. Bhagirath Choudhary and Ms. Kadambini Gaur of SABC and Ms. Margaret Karembu of the ISAAA AfriCenter, Kenya for organizing and executing the program successfully. I am sure such visits in future will be held to strengthen African capacity and build the confidence amongst the African nations to adopt new technologies and increase agricultural production and trade for the welfare of farmers and for their own socio-economic development.

**Dr. C. D. Mayee**  
President, South Asia Biotechnology Centre (SABC), New Delhi



## PREFACE

Like India, cotton is one of Africa's most important agricultural commodities. Production is widespread across the four sub-regions of the African continent – East, West, North and South. Describing the central importance of cotton to economic development, former Malian President Amadou Toumani Touré and former Burkina Faso President Blaise Compaoré once wrote: **“Cotton is our ticket into the world market”**. Cotton production is therefore crucial to socio-economic development of most African countries. It is important to note that thirty seven out of the fifty four African countries produce the cotton crop estimated to be grown over 11 million hectares, almost equivalent to the total cotton area of India. In Kenya, revival of the cotton sector has been prioritized in the country's poverty reduction strategy owing to its versatility in diverse climatic conditions. Elsewhere, cotton-sector reforms have been strongly advocated by cotton producing countries in West Africa, where millions of smallholder farmers depend on the crop for their livelihood. The fibre is widely used as raw material in the textile industry while by-products are limited to processing into seedcake for animal feed and modestly into edible oils.

Despite the importance of cotton to the economies of the majority African countries, the continent accounts for only about 16 percent of the vast global textiles market, valued at \$1.6 trillion in 2015 – a 32.5% increase from 2010. Asia-Pacific accounts for almost 60% of the global textiles market. The main competitors for African cotton in the Asian market are India, the United States, Australia and Brazil.

Several factors have contributed to the low performance of the continent's cotton sector. Fluctuations in the world market price of the commodity have had dramatic consequence for African farmers. Research shows a direct correlation between declines in cotton prices and an increase in poverty rates by up to 8% in parts of West Africa for example. Deteriorating terms of trade for African cotton exports are also points of contention at international trade such as the World Trade Organization. As well, African governments have consistently pointed to the negative impact of hefty Western cotton subsidies, which have kept cotton prices artificially low.

The other major reason of stumpy African cotton production is low yields. According to the International

Cotton Advisory Committee (ICAC), African cotton yields are among the lowest in the world. The average yield in Africa stood at 355 kg of lint per hectare in 2011-2012, much less than the world average of 750 kg of lint per hectare. In 2011-2012, while Francophone African countries in West and Central Africa had an average yield of cotton lint per hectare of 364 kg, Eastern and Southern African countries produced only 229 kg per hectare. In fact, African cotton yields have been declining over the last 10 years by almost 30%, while world average cotton yield was increasing. The highest cotton yields can be found in Australia with 1,800 kg per hectare and Israel with 1,930 kg per hectare. In India, yields of ~550 kg per hectare up from 300 kg per hectare have been achieved on average with introduction of hybrids and Bt cotton in the recent past.

Several factors explain why yields in Africa have stagnated in recent years. They include the lack of access to inputs, inadequate research and a low rate of technological innovation. New private sector partnerships with the cotton industry are therefore essential to provide much-needed investment for modernization of the industry through technology adoption. The advent of genetically modified (GM) cotton also offers potential advantages to smallholders who are able to use new varieties that protect their yields from the most damaging pest – the Bollworm and efficiently control weeds thus improving productivity. Experiences and lessons from countries with a long adoption history of genetically modified cotton are therefore imperative for African countries striving to improve the sector and bring it back to a competitive trend.

Every year since 2006, ISAAA AfriCenter in partnership with developmental-oriented partner organizations in Africa have been organizing seeing-is-believing agri-biotechnology study tours to countries growing biotech crops in different parts of the world. These visits have provided experiential learning opportunities for a wide range of stakeholders. Participants get an opportunity to interact with farmers who share their practical experiences with biotech crops as well as with policy makers, regulators, the media and consumers at large. The tours have proved a highly valuable and effective tool in awareness creation on all aspects of crop biotechnology and biosafety. Henceforth the initiative has become popular among other African organizations, complementing ISAAA's insights in designing practical communications

that started way back in 1999. It may be recalled the first such biotech tour organized by ISAAA involved six senior policy makers from the South-East Asian countries of Indonesia, Malaysia, Philippines, Thailand and Vietnam. The tour to Europe and North America was an eye-opener and led to the establishment of a global hub - the Global Knowledge Center on Crop Biotechnology (popularly known as KC), hosted by ISAAA SEAsia Center in the Philippines. The KC facilitates dual knowledge sharing among the global community, thus helping fulfil one of ISAAA's missions – knowledge-sharing on all aspects of crop biotechnology.

In furtherance of this mission, a delegation of 30 stakeholders from six East-Southern African countries (Ethiopia, Kenya, Malawi, Sudan, Swaziland and Zambia) participated in a study tour on biotech cotton hybrids in India from 28th September to 2nd October 2015. The visit was organized collaboratively between ISAAA AfriCenter and the South Asia Biotechnology Center (SABC-India) in partnership with COMESA/ACTESA, the Open Forum on Agricultural Biotechnology (OFAB-Kenya) and the Program for Biosafety Systems (PBS). Partial support was also received from the United States Department of Agriculture (USDA) and a private seed company in India – Mahyco Seeds.

Participants who comprised decision and policy makers, regulators, chief executives of cotton boards, researchers, journalists, consumer representatives and private sector players witnessed first-hand exemplary performance of Bt cotton hybrids in farmers' fields. They also interacted with officials from both public and private sector institutions within the cotton sub-sector value chain and visited a seed company producing cotton seeds for farmers and factory processing cotton by-products. They learnt about the benefits and challenges those charged with the responsibility of deploying the technology in India have encountered. The strong collaboration and stewardship measures put in place, managed by the Government of India and the respective States Government, Universities and private sector players were impressive. Among the take home messages were the need for a strong extension service to support Bt cotton farmers, the concerted efforts of different players to sustain adoption and the wide range of varietal choices of Bt cotton hybrids that Indian farmers have at their disposal. It is our hope the Indian model of holistic technology application in the cotton sector that has made India number one cotton producer in the world will inform decision making in Africa for the benefit of millions of farmers who depend on the crop for their livelihood.

## INTRODUCTION

### Six Eastern-Southern African Cotton Growing Countries Make a “Seeing is Believing” Study Tour to Bt Cotton Hybrid Fields in India

A delegation of six Eastern-Southern African cotton growing countries participated in a week long study tour to Bt cotton hybrid fields in India from 28th September to 2nd October 2015. The study tour was conducted by the South Asia Biotechnology Centre (SABC), New Delhi in collaboration with ISAAA AfriCenter, the Alliance for Commodity Trade in Eastern & Southern Africa (ACTESA/COMESA), the Program on Biosafety System (PBS), Open Forum on Agricultural Biotechnology (OFAB) and USDA. Thirty official representatives including decision and policy makers, regulators, senior Government officials, Chair of cotton boards, consumer and media representatives participated in the study tour. The six cotton growing countries in Eastern and Southern Africa include, Kenya (11), Sudan (5), Malawi (7), Ethiopia (1), Swaziland (4) and Zambia (1). The delegates were accompanied by cotton and biotech experts from India representing both public and private sector organizations.

The study tour was designed to showcase the present and future of cotton farming system in India. India being a role model in technology application in cotton, the visit intended to showcase, share and learn from the Indian experiences and insights on technology application, regulation, hybridization, commercialization, high density planting, mechanical picking, biosafety and best agronomic practices of growing Bt cotton in India. This enabled the participants to witness the performance of Bt cotton hybrids in farmers' fields in both irrigated and dry-land conditions and also allowed them to interact with officials of both public and private sector institutions to learn about the benefits and risk of approving and adopting Bt cotton in India.

In the first leg of a week-long “Seeing is believing” study tour, participants visited the irrigated cotton growing belt in Haryana and Punjab States of India on 28-29 September 2015. They had an opportunity to interact with the officials of both CCS HAU, Hisar and ICAR CICR RRS, Sirsa about the safety, efficacy and farm level performance of Bt cotton hybrids in the irrigated belt of Haryana and Punjab. The visit to CCS HAU, Hisar and ICAR CICR RRS, Sirsa allowed the participants to learn about the Indian cotton cultivation

experiences and research undertaken by public sector institutions at the Central government and State governments respectively. Subsequently, the study tour explored the dry land areas of Maharashtra to witness the cotton revolution, introduction of hybridization of cotton and adoption of Bt cotton hybrids and to learn from the best practices of cotton crop in the central part of India from 30 September to 2 October 2015.

India celebrated “Gandhi Jayanti” – birth day of the Father of the Nation, Mahatma Gandhi on 2nd October 2015 which fortunately coincided with the African study tour to Bt cotton fields in India. On this occasion, it was noteworthy to share the importance of cotton and Charkha with the African delegates. The Father of the Nation, Mahatma Gandhi spun the Charkha (cotton spinning wheel) in the beginning of the 20th century that marked the awakening of India. A nation rose and the spinning of cotton thread became the symbol of patriotic feeling during the independence struggle. Cotton has been such an integral part of India. The African delegates were pleased with the reminiscences of Mahatma Gandhi and his affection for cotton and cottage industry. India is now self-reliant and the world largest producer and exporter of cotton fulfilling the goals of self-reliance set by India's Father of the Nation.

In summary, following activities capture the essence of the African Study tour on the present and future of cotton farming in India from 28th September to 2nd October 2015;

- Visit to CCS HAU, Hisar – a premier State Agricultural University and interaction with the Vice Chancellor and his team, and a visit to Bt cotton demonstration cum hybridization field
- Visit to high density Bt cotton demonstration plot on farmers' field, and interaction with Bt cotton farmers at Hisar district of Haryana
- Visit to CICR Regional Research Station, demonstration field, presentation and interaction with key scientists at Sirsa district of Haryana
- Visit to Centre of Excellence (COE) at farmers' field and interaction with Bt cotton farmers at Sirsa district of Haryana
- Visit to Bt cotton farmer field to witness the performance of Bt cotton at Bhatinda district of Punjab
- Visit to Centre of Excellence (COE) at Government field to see new methods and techniques to improve cotton yield at Bhatinda district of Punjab

- Visit to ELS Bt cotton hybrid (HxB) and Bt cotton hybrid (HxH) field and interaction with young farmers in Jalna district of Maharashtra
- Visit to Mahyco R&D centre, meeting with Mahyco Chairman, MD and CTO, and scientists & researchers, and tour to R&D facility at Dawalwadi, Jalna, Maharashtra
- Visit to Abhay Cotext to understand the processing and utilization of Bt cotton by-products at Jalna, Maharashtra
- Field visit to understand hybridization of cotton using both conventional and GMS based technique at Jalna, Maharashtra

The feedback from the delegates indicates that the study tour to the present and future of cotton farming in India allowed them to build the necessary confidence about Bt cotton, cotton hybrid, biosafety and regulatory processes, risk communications and commercialization of genetically improved crops including insect resistant Bt cotton in their respective countries. Knowledge and hands-on experiences gained during the study tour contributed significantly to informed decision making. It is expected that the knowledge gained during the study tour would add to an enabling environment for collaboration between Indian public and private sector institutions and their counterparts in African countries to achieve India-Africa cooperation in agriculture.



## INDIA'S STATE AGRICULTURAL UNIVERSITY (SAU)

### Interaction with CCS Haryana Agricultural University (HAU), Hisar, Haryana

28 September 2015

The National Agricultural Research System (NARS) comprises of the federally run Indian Council of Agricultural Research (ICAR) and State run State Agricultural Universities (SAUs). Though agriculture is a State subject, the research and development (R&D) in agriculture is administered at federal level with strong linkages with State Agricultural Universities. In order to provide a holistic view about R&D in agriculture in India, the South Asia Biotechnology Centre (SABC) organized the visit of the African delegation to Chaudhary Charan Singh Haryana Agricultural University popularly

known as CCS HAU on 28 September 2015 in the first leg of a week-long **"Seeing is Believing"** African study tour in India. The CCS HAU is one of Asia's biggest agricultural universities located at Hisar district in the Northern State of Haryana. Named after India's seventh Prime Minister, Choudhary Charan Singh, the University is a leading agricultural research institute that contributed significantly to Green Revolution in India in the 1960s and 70s. The Vice Chancellor, Dr. K.S. Khokhar and his team, were pleased to receive the African delegation and gave them warm welcome to CCS HAU, Hisar. Dr. S.S. Siwach, Director Research and Dr. Rajvir Singh Sangwan, Senior Cotton Breeder & Head, Cotton, Department of Plant Breeding & Genetics, HAU welcomed all the participants and introduced the African delegation to the Vice Chancellor and team of cotton scientists of HAU.



Mr. Bhagirath Choudhary, Founder Director of South Asia Biotechnology Centre (SABC) thanked the Vice Chancellor and his team at CCS HAU for hosting the African delegation and providing a platform for interaction with the cotton team of the University. Dr. Margaret Karembu of ISAAA AfriCenter introduced all members of the African delegation to the Vice Chancellor and his team. She offered her warm greetings and appreciation with the warm reception extended by the CCS Haryana Agricultural University. She briefed them about the objectives of the African study tour to India. Addressing the VC and the scientists at CCS HAU Dr. Karembu said, **"India is a role model of technology application in cotton. We are here to learn, share and**

**take back experiences of commercialization of cotton hybrids and Bt cotton technology since last 13 years. African delegates are interested in learning more about technology application, regulation, hybridization, commercialization, mechanical picking, biosafety and best agronomic practices of growing Bt cotton in India."** She gave a brief introduction of the African delegation consisting of participants from public sector institutions, cotton value chain, two County agricultural ministers, consumer, media and private sector. **"India's experience with Bt cotton will be very useful in deploying the technology in African countries."** she said. She also said that unlike maize, adoption of hybrids is

not high in cotton in African countries, and therefore it was vital to learn from the experiences of growing cotton hybrids in India.

Dr. K.S. Khokhar, Vice Chancellor of CCS HAU updated the African delegation about the current scenario of cotton cultivation in India. He lauded the transformation of cotton in the Northern India and alluded that the **“Success of Bt cotton is exemplary and has helped in revolutionizing cotton sector in India. The genetic improvement in cotton has helped India achieve the much needed cotton revolution”**. Dr. Khokhar informed the participants that Haryana is at second position in food production with wheat, rice and cotton being three major crops grown in the State besides pearl millet, sorghum, maize, sugarcane and oilseeds contributing to the food basket of India. **“The productivity of cotton which was very low, spiked up after introduction of Bt cotton and since 2005 Haryana witnessed exemplary success of Bt cotton.”** said Dr. Khokhar. The Vice Chancellor and his team had an hour long interaction and discussion with the African delegates on various topics related to cotton sector in Northern India.

Dr. Siwach briefed the participants about the Indian cotton cultivation experiences and cotton research undertaken by CCS Haryana Agricultural University. Prior to the introduction of Bt cotton in India in 2002, severe attack of bollworms on the cotton crop reduced the productivity drastically. **“Bt cotton was a much needed technology intervention that was required to deal with the problem of bollworms”**, noted Dr. Siwach. The African delegation also learnt about other insect-pests and diseases of cotton prevalent in India and crop protection methods popular in combating them.



Dr. Sangwan who is the lead cotton breeder at CCS HAU informed the delegation that more than 300 Bt cotton hybrids have been recommended for Northern zone by the

Central Government. The CCS HAU is testing and conducting field trials for popularly available Bt cotton hybrids to test their performance in demonstration plots at the University. After evaluating the performance, CCS HAU organizes farmer fairs and farmers' field days where farmers can see the demonstration and select for themselves which Bt cotton hybrid to plant in their fields. The cotton scientists at CCS HAU analyze these popular Bt cotton hybrids for fibre quality, yield, insect-resistance and other important parameters. India ranks second in cotton production in the world. However, productivity is still low and HAU cotton scientist are undertaking further research to increase productivity of cotton crop.



Dr. Siwach briefed the delegation about the issue of sucking pests and white-fly which have been causing significant losses in the recent past in Haryana State of Northern India. **“Due to unpredictable and uneven climate this season, white-fly has devastated cotton crop in Hisar district of Haryana state”**, said Dr. Siwach. He emphasized that **“High humidity coupled with erratic rainfall caused white-fly to flourish this year so the virulence has been three times more than normal affecting majority of the standing Bt cotton crop in most of the districts of Haryana”**. He informed the participants that white fly control is difficult and complex as it is a prolific multiplier in congenial conditions. White-fly attack this season has caused losses in cotton crop in Northern zone of India and yield has fallen in the State. Responding to queries about crop losses due to white fly, the Vice Chancellor informed participants that the Government of Haryana is considering a package to provide reasonable compensation to the farmers depending on the level of infestation and crop loss. The Government of Haryana has set specific slabs corresponding to crops' losses including Indian Rupee 20,000 per acre if crop loss is equal to or more than 75% and Rupee 15,000 per acre for crop damage less than 75%.

The African delegation was enthralled by the spectacular success of Bt cotton in India. They were very interested in learning about what measures the Government of India had undertaken so that the adoption quickly reached to more than 95% of total cotton cultivation. "How does Kenya emulate the success story?" a representative from Kenya enquired. Dr. Siwach replied that farmers were quick to adopt Bt cotton as they have seen a manifold increase in cotton yield in the farmers' fields. The performance of Bt cotton with respect to cotton bollworms was satisfactory that attracted farmers to plant Bt cotton season after season.

The extension efforts of CCS HAU on this technology provided another lesson for the delegation. Dr. Sangwan appraised the participants about extension training programs undertaken by CCS HAU for farmers to understand the benefits of Bt cotton technology. The CCS HAU imparts regular training in collaboration with State department, KVKs (Farm Science Centres). The University

undertakes 3-4 trainings before the onset of each crop season. It steers regular monitoring and conducts surveys for spotting chances of outbreak of insect-pest and any disease. The fortnightly survey includes agronomist, entomologist, nematologist and plant pathologist. He said that the linkage between extension and research of CCS HAU is the best in the country. The CCS HAU organizes special farmers' day, kisan divas and on-spot trainings for farmers. It also has a weather-forecasting unit that sends accurate forecast for impending week and texts messages to progressive farmers about weather forecast and other relevant information with regard to plant health. Responding to queries about discontinuation of publicly bred Bt cotton varieties, the Vice Chancellor informed the delegation the project was shelved due to internal issues and has nothing to do with performance of Bt technology. Farmers prefer to grow cotton hybrid seeds over the open pollinated varieties (OPVS) and preferred to grow the advanced BG-II cotton hybrids instead of BG-I cotton hybrids.

*I thank you all collaborators for organizing such a wonderful study tour. Even though the study tour was condensed with a lots of traveling here and there within a very short period of time, I do not feel tired as compared to the knowledge added to my hungry experience of modern world cotton production. Though I gained a lot, we have to do so much back in my home country Ethiopia.*

*Mr. Bante Kassie  
Director of the Cotton Development Directorate - Ethiopia*



Participants were delighted to learn about the package of management practices followed by CCS HAU. They also learnt about the coordination system of CCS HAU, Department of Agriculture, KVKs and ICAR system. The Ministry of Agriculture, Government of India organizes a national conference where all agricultural universities, state departments and National Agricultural Research System (NARS) get together and decide the package of practices for crops grown in summer and winter seasons. At the State level, the departments of horticulture, agriculture, forests and irrigation formulate district plans. They also monitor the supply of seeds and inputs such as, fertilizer, pesticides and irrigation. The district plan is made in consultation with all state departments and agricultural university.

The Vice Chancellor informed the delegation that India has a large amount of arable land with 159 million hectares, placing the country as having highest arable land in the

world. India's arable area as proportion of its land area is 48% (159 million hectares of 329 million hectares) of which it utilizes 142 million hectares. Haryana is contributing 7% to national food kitty with highest productivity of wheat, pearl millet and mustard.

The African delegation was impressed by the extension work carried out by CCS HAU and the success of Bt cotton hybrids in India. They also raised questions about media reports on farmers' suicides in India. Replying to the query, the Vice Chancellor clarified that **"The issue of farmers' suicides was blown out of proportion by the media. If the farmers commit suicide for any other reason apart from crop failure like loan repayment, debt, personal problem and failure of other crops as well, it is being reported in the media as farmers' suicide due to Bt cotton, which is otherwise not true", he affirmed.**

While thanking the Vice Chancellor and his team for an elaborated discussion about the safety, efficacy and performance of Bt cotton, Mr. Moses Mwanje, Chair of the County Governments Executives on Agriculture in Kenya , said that ***“African countries cannot lose and be left behind on technology adoption. African countries want to adopt and need to move forward with the latest technology available for their benefit. After visiting Bt cotton fields in India it is clear that if the technology is not addressing the needs of farmers and other people involved in cultivating cotton, people will not adopt it. All fields we visited, farmers were repeatedly growing Bt cotton which is a testimony that it is addressing people's needs.”***

After interactions with cotton breeders, scientists and the Vice Chancellor, participants visited Bt cotton demonstration-cum-hybridization plots of CCS Haryana Agricultural University (HAU). The scientists answered all the queries from participants while visiting the field and cotton research lab of CCS HAU. They were delighted to see the performance of Bt cotton in the premises of CCS HAU, Hisar,

Haryana. Dr. Sangwan showed each and every plot of Bt and non-Bt cotton hybrids and varieties planted in the demonstration field. He informed them that the CCS HAU screens and evaluates Bt cotton hybrids recommended for Haryana state with respect to insect-pests and disease resistance. The popular hybrids of fourteen Indian seed companies were being evaluated at the CCS HAU in the current season. In addition, the CCS HAU evaluates many hybrids and varieties of cotton developed by both public and private sector institutions under the All India Coordinated Cotton Improvement project of the Indian Council of Agricultural Research (ICAR).

Before concluding the field visit, Dr. P. Balasubramanian addressed the African delegation on the safety aspects of Bt crops and informed them about challenges being faced in deploying new technologies in food crops in India. ***“The public misconception and myth has delayed the introduction of Bt eggplant in India whereas farmers of neighboring country Bangladesh are reaping the benefits of adopting Bt eggplant”***, Dr. Balasubramanian concluded.





## A DELEGATION OF SIX AFRICAN COUNTRIES VISITS CCS HAU, HISAR

Dainik Bhaskar, a leading national daily newspaper of India in hindi language, which has more than 3 million unique readership daily published news article about the African delegation visit on 29 Sept 2015. A delegation of six African countries visits CCS HAU, Hisar

<http://epaper.bhaskar.com/detail/?id=624197&boxid=9293856500&ch=cph&map=map&currentTab=tabs-1&pagedate=09/29/2015&editioncode=81&pageno=6&view=image>

# छह देशों का शिष्टमंडल एचएयू पहुंचा

कपास के बारे में किसानों के अनुभव तथा उत्पादन की उन्नत कृषि तकनीकी की जानकारी भी ली

भास्कर न्यूज़ | हिस्सार

भारत सहित छः देशों का शिष्टमंडल सोमवार को हरियाणा कृषि विश्वविद्यालय पहुंचा। 28 सदस्यीय इस दल में केनिया, जॉरिया, स्वाज़ीलैंड, मालावी, इथोपिया तथा भारत के सरकारी व गैर सरकारी संस्थाओं के कृषि विशेषज्ञों सहित केनिया के दो सांसद भी शामिल थे। विश्वविद्यालय पहुंचने पर शिष्टमंडल ने कुलपति डॉ. केएस खोखर के साथ बैठक की। शिष्टमंडल में शामिल आईएसएएर एफ्री सेंटर, केनिया की निदेशक गथोनी मारग्रेट ने इस दौरे का उद्देश्य स्पष्ट करते हुए कहा कि वे यहां बीटी कपास के बारे में भारतीय किसानों



कुलपति डॉ. खोखर शिष्टमंडल के साथ आयोजित बैठक की अध्यक्षता करते हुए।

का अनुभव तथा कपास उत्पादन की उन्नत कृषि तकनीकी की जानकारी लेने आए हैं। उन्होंने कहा दक्षिणी अफ्रीका में ज्यादातर कपास के संकरों की खेती की जाती है। बीटी कपास के बारे में भारत का अनुभव उनके लिए बहुत उपयोगी साबित हो सकता है। कुलपति डॉ. खोखर ने

शिष्टमंडल को देश तथा हरियाणा की कृषि उत्पादन की वर्तमान परिस्थिति से अवगत कराया। कपास उत्पादन में भारत का चीन के बाद दूसरा स्थान है जबकि हरियाणा सरसों, बासमती चावल, बाजरा तथा ग्वार की उत्पादकता में देश में सबसे आगे है। उन्होंने कहा देश में कपास

की पैदावार बढ़ाने में बीटी कपास की अहम भूमिका रही है। इन किस्मों के प्रयोग से कपास की पैदावार में करीब दो गुणा वृद्धि हुई है।

बैठक में शिष्टमंडल ने किसानों को कृषि तकनालोजी स्थानांतरण करने की प्रक्रिया, बीटी कपास की सिफारिश करने की प्रक्रिया, कपास के प्रमुख कीटों व उनकी रोकथाम की विधियों आदि बारे जानकारी ली। बैठक में मानव संसाधन प्रबंधन निदेशक डॉ. राम सिंह, अनुसंधान निदेशक डॉ. एसएस सिवाच तथा कपास अनुभाग के अध्यक्ष डॉ. आर.एस. सांगवान भी उपस्थित थे। बैठक के उपरांत अनुसंधान निदेशक की अगुवानी में शिष्टमंडल ने हकूवि के अनुसंधान फार्म का दौरा किया।

Source: Dainik Bhaskar, 2015

## VISIT TO MECHANICAL PICKING OF COTTON PLOTS

### Mechanical Picking Experimental Plot and Engagement with Bt Cotton Farmers, Kusumbi Village, Sirsa, Haryana

28 September 2015

After having an informative visit at CCS HAU, Hisar, the African delegation proceeded to farmer's Bt cotton fields at Kusumbi village, Sirsa district of Haryana followed by Central Institute for Cotton Research (CICR), Regional Research Station, Sirsa. The delegation received a very warm welcome from a group of farmers at a farmer's field in Sirsa. They were fascinated by the traditional Indian custom wherein flower garlands made of different fragrant flowers are hung around a person's neck used to show respect to guests.



Dr. Rishi Kumar, an entomologist at the Regional Research Institute of the Central Institute of Cotton Research (CICR RRS) and Mr. Bhagirath Choudhary of SABC led the discussions in the farmers' field experimenting with mechanical picking. It is one of the experimental plots on mechanical picking managed by Delta Pine Company in collaboration with New Holland to demonstrate the potential of mechanical picking in cotton. Usually, farmers and farm laborers pick cotton by hand two or three times in a season. While initiating the discussion, Dr. Rishi informed the delegation that India has the distinction of commercially growing all the cultivated species of cotton. All cotton grown in this area by farmers is Bt cotton. Farmers generally grow wheat after the cotton harvest. In Bt cotton hybrids, early reproductive (fruiting) bodies are

protected from bollworm damage due to inbuilt resistance mechanism provided by Bt gene. This helps in shortening the vegetative phase resulting in early maturity of cotton. In case of non-Bt cotton hybrids, damage of early-fruiting bodies lead to prolonged vegetative phase and thus maturity is delayed. Therefore, Bt cotton hybrids fit well in cotton-wheat rotation in comparison to non-Bt cultivars. Notably, cotton yield productivity of Sirsa district of Haryana is 722 kg per hectare. The States of Haryana and Punjab have the highest yield of cotton in the country. Optimally Bt cotton hybrid yields 80 bolls per plant and medium cotton hybrid 60 bolls per plant. The African delegation was surprised to learn about the high number of bolls per plant in Bt cotton fields.



*The tour was indeed very informative and provided us with great opportunities to witness the economic transformational power of Bt cotton. There is no doubt over the many lessons we can learn from the Indian Bt cotton adoption process that will be useful to our country as we travel that same route.*

*Dr. Dionysious (Dan) Kiambi, Executive Director of the African Biodiversity Conservation and Innovations Centre (ABCIC).*



Dr. Rishi Kumar explained about the features of experimental plots on mechanical picking trial at Sirsa and briefed the delegation about the advancement in cotton sector in North India. He informed them about the mechanical picking of cotton that requires compact sympodial or semi-sympodial plants with synchronized boll opening. Manual picking of cotton is a labor intensive process that requires 3-4 pickings or even more per season. Dr. Rishi said, ***"The mechanical picking of cotton will greatly reduce cost of cultivation and will be a boon to cotton farmers. In the experimental plots, mechanical picking has reduced cost by Rs.8-10 of picking cotton per 1 kg of cotton."***

Further, he explained the process of mechanical picking that requires the application of chemical defoliation before picking of cotton. It helps in the simultaneous opening of most of cotton bolls that is essential for one-time mechanical picking. The high-yielding, long-fibers and open boll varieties are defoliated before the mechanical picking. For the success of mechanical picking, farmers are required to apply growth arrestors to ensure consistent plant height and early maturity. The high density planting bearing 25 bolls per plant in mechanical picking will be sufficient to yield more than multiple hand picking of cotton.



The delegation was delighted to see a very healthy Bt cotton crop in farmer's field at Sirsa. Unlike Hisar, there was insignificant impact of white-fly. The presence of white-fly in this area was below the threshold level. It was the last window of vigorous cotton crop which was standing in good condition in the farmer's field. Here, they had an extended discussions with farmer Devial aged 43 who lives with his two sons in joint family system in Kusumbi village of Sirsa district, Haryana. He has 5 hectares of land area out of which he plants cotton on 4 hectares. He started planting Bt cotton in the year 2005. He also plants pearl millet, sorghum, wheat, barley and vegetables in his farm. Asked about the irrigation system, he explained that it was canal water used for irrigating his field.



Farmer Devilal faced 60% losses before he started to plant Bt cotton in his field. He said, ***“Before the Introduction of Bt cotton, my cotton crop was damaged every year due to bollworm attack to the extent that I decided to give up farming. Bt cotton is a bliss for us as it increased our profit and made our lives a lot more easier”***. While responding to the queries of insecticide reduction, farmer Devilal told them, ***“I only spray for sucking pests now which ranges from 2-3 sprays maximum. Bt cotton is not attacked by bollworms so there is no need to spray for bollworms at all”***. Devilal is a progressive farmer with 10 years of experience of growing Bt cotton. Before the introduction of he used to plant non-Bt cotton hybrids and prior to that he grew desi cotton variety. He said ***“In desi cotton variety and even in non-Bt cotton, I faced severe crop losses due to bollworm attack. Quality of cotton with respect to fibre length, fibre quality and strength was a setback in getting desired income from cotton crop.”*** Farmer Devilal disclosed that in 2004 he had decided to quit cotton farming due to the losses his cotton crop was facing but when he planted Bt cotton in 2005, the remunerative results made him change his mind. Other queries raised included pricing of Bt cotton hybrids compared to non-Bt cotton hybrids and desi cotton varieties, to which farmer Devilal replied, ***“As compared to desi cotton varieties and non-Bt cotton hybrids, the price of Bt cotton hybrids is high but it is worth it as the profit I make after planting Bt cotton hybrids due to high yield and***

***saving on pesticides sprays is advantageous to me and my farmer friends.”***



Responding to another question about the awareness of Bt cotton to the local farmers in his area, Dr. Rishi said, ***“Farmers’ association is very weak in this particular area. Farmer-to-farmer publicity is more common and a few progressive farmers who planted Bt cotton spread the good word about the performance of Bt cotton in their fields. Farmer-to-farmer publicity is very strong and spreads very fast in the village. Relatives and farm families planted Bt cotton in their respective field after witnessing success of progressive farmers.”*** The African delegation thanked Dr Rishi and the farmer for his warm hospitality and time spent with him and his family.





*Thank you so much for doing an excellent job in organizing the traveling worksho, which was a great success. Your organizational skills are exceptional, keep it up. I learned a lot from the tour. To my African brothers and sisters, it was a big plus for me in interacting and learning from your rich diverse cultural background and norms.*

*Mr. Timothy Ogweng  
Ministry of Agriculture, Livestock and Fisheries, Kenya.*



## Farmers' Response to Frequently Asked Questions by Delegation during the Farmers' Field Visit

### 1) *Popularity of Bt cotton*

Open Pollinated Varieties (OPVs) grown earlier by farmers have now been completely replaced by Bt cotton hybrids which are more profitable and remunerative.

### 2) *Small land holdings*

Division of inherited farm land among the siblings as Indian farm families' move from joint family system to nuclear family system has resulted in small farm holdings.

### 3) *Resistance Management*

There is regular monitoring of Bt cotton for bollworm resistance and till now no resistance towards bollworm in Bt cotton has been recorded. Insect resistance is not an issue in North India. BG-II cotton hybrids have replaced BG-I cotton hybrids that provide robust protection against bollworms and no instance has been observed or recorded for resistance development. Bt cotton fields are regularly monitored and farmers also scout fields for the presence of bollworm and other insect-pests.

### 4) *Refugia Practice*

Majority of farmers do not practice growing refugia in this area. Sowing cotton in North India is usually done using tractor or bullock drawn seed drill as compared to hand dibbling so the farmers are not interested in manual sowing of structured refugia. Farmers do not practice growing refuge as they know it would be attacked by bollworm resulting in lowering their yield and income. For sustainability of technology and delaying resistance development, the growing of refugia is important therefore '**refugia in bag**' is being considered for introduction by the regulatory agencies of the Government of India. To sustain Bt technology, it is paramount to address the planting of refugia with good resistance management programs.

### 5) *High price of Bt cotton hybrids*

Although Bt cotton hybrids prices were higher than the non-Bt counterparts, farmers preferred to grow Bt cotton hybrids as net income generated is substantially higher due to reduced cost of cultivation owing to less insecticide sprays and high cotton yield.

### 6) *Who determines the market price of Bt cotton produce*

The price of cotton is fixed by the Government of India as minimum support price (MSP) and cotton is being procured by the Cotton Corporation of India (CCI). Marketplace plays a significant role in price and cotton procurement in the county.

### 7) *Farmers to trade cotton value chain*

Farmers can either sell their cotton crop directly in the local mandi (local market) or some farmers prefer their crop to be picked up at their doorstep by traders. Cotton is considered equivalent to cash by the farmers. It is sold after inspecting the quality while grading is done according to fibre quality, fibre length and fibre strength. Farmers get varied price for final produce depending on the staple length and quality of cotton produce.

### 8) *Government schemes for cotton farmers*

Farmers can get loans easily at minimal interest rate from local and regional banks. Farmer credit card scheme has also been launched to benefit small scale farmers. Government banks and co-operative banks offer loans at minimal rate and also run some schemes benefitting small holder farmers.

### 9) *Farm Equipment*

For small land holding, farmers usually engage in custom hiring of farm equipment where big scale farmers lend to small-scale farmers on a rental basis. Resourceful and affluent farmers lend their farm equipment to small scale farmers on need basis. Co-operative societies operating in the villages also help farmers when required.

### 10) *Socioeconomic benefits of Bt cotton*

The adoption of Bt cotton led to increase in yield, decreased production cost, and reduction of insecticide application resulting in substantial environmental and health benefits to farmers along with significant socioeconomic benefits. It improved the living conditions of small-scale resource poor farmers and they were able to build pakka (concrete) houses, and afford sending their children to school from the income generated from Bt cotton. Extra time saved by planting Bt cotton was utilized in other income generation and better social life activities.

### 11) *Cotton Staple Length*

The market price of cotton is determined by its staple length. India produces varied cotton with different staple length required for different purposes. Different category of staple length include Short staple 20mm & below, medium staple (20.5 to 24.5mm), medium long staple length 25.0 to 27.0mm, long staple length 27.5 to 32.0mm and extra-long staple cotton 32.5mm and above. Majority of Bt cotton produce in India is medium to long staple cotton.

## ICAR-CENTRAL INSTITUTE FOR COTTON RESEARCH (CICR)

### High Density Planting System (HDPS) Experimental Plot at CICR Regional Research Station (CICR RRS), Government of India Haryana

28 September 2015

Before concluding day-one, the delegation proceeded to the Government of India's Central institute for Cotton Research (CICR) Regional Research Station (RRS) at Sirsa. The delegates were greeted in a traditional Indian custom of welcoming the guests by applying tilak or tikka on the forehead and giving them flowers. The tikka or tilak is a red dot of vermilion paste applied on the forehead, between the eyebrows. This spot is considered the centre of latent wisdom and concentration. All participants were refreshed, energized and ready to gather more information, knowledge and visit the experimental plots in the institute premises.

The delegation saw the High Density Planting Systems (HDPS) for achieving high crop yield. Many varieties were planted under the HDPS in the experimental plot. Each plot is aimed at sympodial cotton varieties with more number of bolls near to the main stem and fewer bolls per branch so as to fit in more plants per unit row length and to improve fibre quality. Bolls that were closer to the main stem received better nutrition, were more uniform and were expected to produce lint of superior quality used for surgical cotton. Surgical cotton varieties are mainly used for medical purposes in hospitals for surgical dressings. India hardly produces surgical cotton and therefore, the experiment to identify a suitable variety is a major researchable topic at CICR RRS, Sirsa. Other cotton varieties, mostly not-Bt cotton open pollinated varieties were planted to evaluate various parameters suitable for high density planting. The HDPS is implemented as a large scale research program by CICR to maximize productivity per unit area by increasing plant density. Simultaneously, CICR RRS is keenly recording and analyzing various parameters of agronomy and cropping practices to ensure that HDPS fits well into the conventional cotton production system.





*The Sudan group is grateful for the wealth of information obtained during the tour and for the excellent organization. Special gratitude to the Indian farmers, Mahyco Company and Abhay Cotex Pvt. Ltd.*

*Dr. Asim Abu Sarra,  
Secretary General of the National Biosafety Council of Sudan*



Dr. Rishi Kumar, Senior scientist Entomology, made a comprehensive presentation on India's cotton scenario, research set up and research highlights of CICR regional station Sirsa. He informed the participants about the mandate of which focuses on strategic cotton research to improve yield, fibre quality and by-products as well as effective and efficient disease and pest management strategies. They also develop appropriate cropping systems for different cotton growing zones. CICR headquarter is located at Nagpur, Maharashtra with two regional stations located at Sirsa, Haryana in North India and another at Coimbatore, Tamil Nadu in South India. The research set up for cotton includes: **All India Coordinated Cotton Improvement Project (AICCIP)** with 21 centres (10 major and 11 sub-centres) in North, Central and South zones of India. Besides these, a number of voluntary and private R&D set ups operate throughout the country. Cotton is produced on sandy loam alluvial soils comprising of the States of Haryana, Punjab, Rajasthan and a part of Western Uttar Pradesh under assured irrigation conditions known as Northern cotton growing

zone. Irrigation needs are met through tube wells and canal network in the region and flood irrigation is the only mode followed at present by the farmers. Northern cotton zone once called the **"Cotton Basket of India"** used to fetch 33.4% of the country's cotton production two decades back in 1980s and 1990s. However, the trend changed during the recent past whereas Northern zone contributes around 12.5 to 15.2% of total cotton production from a relatively low area under cotton cultivation. Major constraints for cotton production in Northern India including, inadequate standing crop because of poor emergence due to crust formation by rains just after sowing and also the prevalence of salinity and alkalinity. Other constraints include burning of seedling due to high temperature at emergence, improper agronomy of new generation hybrids and release of large number of Bt cotton hybrids. Northern India also faces problem of pest incidence such as sucking pests usually the white fly, thrips, leaf hopper, para wilt and cotton leaf curl virus disease.



## CENTRE OF EXCELLENCE ON FARMER'S FIELD

### Visit to Centre of Excellence (COE) at Farmers' Field and interaction with Bt cotton farmers at Sirsa district of Haryana

29 September 2015

The African Delegation visited the Centre of Excellence (COE) in a farmer's field on 29 Sept 2015 at Sirsa, Haryana where they saw a very healthy cotton field. The COE is run by Delta Pine company on the farmers' fields. Farmer Krishan Lal aged 40 lives in the village Handi Khera in Sirsa district of Haryana. He has a total 5 hectares of land of which 2 hectares are utilized in planting of cotton experimental plots and trials of high density planting. The remaining 3 hectares is planted with other crops. Farmer Krishan has over ten years of experience in cotton farming and is blessed with three sons. He sends his sons to school (in standard 5 and 6) and wants to provide good higher education for which he has started to save early. Along with other farmers from neighboring area welcomed the delegation to his field. Responding to participants question on why he decided to plant Bt cotton he said, **"My conventional cotton crop before I adopted Bt cotton did not give good yield and I faced crop losses due to damage from bollworm. Now I grow Bt cotton which gives me a very high yield of 25-30 quintals per acre. This has enabled me to fetch a competitive price in the market and has increased my income manifold. Prosperity entered our house after I decided to repeat growing Bt cotton every year."** He also told the participants about the reduction in pesticide sprays, which reduced cost of cultivation as he did not have to buy pesticides and also saved on labour cost that he used to

employ for spraying. **"Earlier I used to apply 15 sprays to control sundi (bollworm), now the number of sprays I apply has reduced to maximum two in a crop season. However, for this season I had to apply four sprays for controlling white-fly."** he said. Asked about the net profit he makes, he replied, **"On average I make Rs. 50,000 per acre and approx. Rs. 15,000-20,000 is spent as cost of cultivation, therefore I earn a substantial sum from Bt cotton hybrids every season."** This translates to an additional benefit of approximately US\$600-650 per acre. Sharing further his experience, he informed the participants that his cotton yield increased from 7-8 quintals (700-800 kg) per acre to 15-20 quintals (1500-2000kg) per acre on average. Another question was on how he managed his cotton crop from sowing to harvest to which he replied, **"First I prepare my land with tractor followed by irrigation, followed by sowing of seeds, which was done earlier by hand dibbling and now with seed drill. I apply basal fertilizers at the time of sowing. After 35 days, weeds are removed through hand weeding. I apply irrigation after first weeding. After 90 days, the crop is sprayed with pesticides to control sucking pests. The first cotton picking starts after 120 days. I do three pickings of my cotton crop which is of five months duration. I receive 30% in first picking, 40% in second picking and rest in third picking. I employ farm-laborers in my field, one for weeding and 5 laborers for picking of cotton. The source of irrigation is submersible pump installed in my field that brings water from 150 feet deep tube well"**. The participants were pleased to learn the practices followed by the farmer. They also had the opportunity to interact with the farmer's sons and other family members at his home and in the cotton field.

*This was a most exciting and most informative tour on Bt cotton. There was so much to learn from our brothers and sisters in India as well as shared between participants. This trip will add an additional brick to our understanding, experience and appreciation of the whole debate of Bt technology. It is our hope and belief that we will be better informed to share such knowledge and skills to the appropriate authorities and colleagues so that we can fast track decisions going forward." Commending the efforts of Mr. Bhagirath Choudhary of SABC he said, "You must know that you made such a wonderful impression on not only me but certainly the majority of the participants. You are such a master on the subject and well gifted in articulating it in very simple language to non-technical persons. Don't be surprised to receive invitations to support our own national efforts to drive the agenda forward. Let me once again thank you most sincerely for the extremely warm hospitality and through you to all donors and indeed all individuals who worked so hard in making this trip a resounding success.*



*Dr. Patrick Khembo  
Chairman, Cotton Council of Malawi on behalf of the Malawian delegation*

### **Salient features of the Centre of Excellence at Farmers' Field at Handi Khera, Sirsa;**

- Planting of different plant population to evaluate the optimum yield potential of cotton hybrids
- Proper implementation of the best agronomic practices to achieve more yield with optimum utilization of resources
- Sowing of suitable cotton hybrids with double gene Bt technology
- Educate farmers about the need to plant refuge to prolong the life of Bt technology
- Proper and timely weed control practices in cotton hybrids
- Adequate and timely application of fertilizers and growth promoters to achieve higher yield
- Timely application of pesticide sprays based on the objective assessment following ETL practices
- Impart education to farmers to identify the true value of cultural operations like weeding and insect control through conducting weed control and application of pesticide sprays and;
- Provide a package of practices for crop management from sowing to harvesting.

The representatives of Delta Pine company Dr. Sushil and Dr. Godara met and briefed the African delegation about the future of cotton at Centre of Excellence (COE). They explained that there are two Centre of Excellence (COE), one is set-up at farmer's field in Sirsa district of Haryana and another is established in collaboration with the State Government of Punjab at Bhatinda district of Punjab. The COE aims at showcasing the cotton technologies that are experimented from sowing of cotton to its harvest. These COE also serves as demonstration plots for farmers to visit and learn about new technologies developed by the private sector in India. The COEs are equipped with various methods and new techniques including planting of Bt and non-Bt cotton plots, high density plots, yield optimization plots, refuge management plots, different agronomy plots and mechanical picking plots. The COEs also showcase new farm equipment and invite farmers in batches to the demonstration plots. The experts and highly skilled professionals handle all the queries of farmers especially relating to cotton crop in Northern India. They informed that on average 60 farmers visit COEs per day in the batches of 20-30 farmers per batch.



The African delegation inquired about the criteria for selection of farmer to establish COE. Responding to the query Dr. Sushil said that selection of farmer is based on critical factors such as the farmer being a progressive farmer, must be co-operative, should possess significant land to conduct trials, have irrigation facilities and then agreement is done with due consent. Dr. Sushil and Dr. Godara informed the African delegation about the Bt cotton hybrids in India that resulted in increased cotton production as compared to conventional non-Bt cotton. Before the introduction of Bt cotton, cotton production in India was very low. The scenario changed when farmers started to cultivate Bt cotton in their fields. The year on year benefits reaped by the farmers changed their lifestyle and raised the socio-economic standard of small-scale farmers. He explained about Bollgard Roundup Ready Flex (BG-II RRF) cotton technology which has dual benefits of superior insect protection as well as herbicide tolerance of Roundup Ready Flex. This will enable farmers to manage weeds conveniently and effectively by spraying a specially formulated Roundup herbicide on their cotton crop flexibly anytime through the season from crop emergence to harvest. The weeds will be effectively removed and healthy cotton crop thrives. BGII RRFlex will help farmers optimize their cost of cultivation and also save on the time spent on managing weeds. They also informed the delegates about the potential of introducing **"Built in Refuge"** system that can solve the issue of refuge planting and help the country in prolonging the life of Bt technology for the benefits of cotton farmers.

## SMALLHOLDER BT COTTON FARMER

### Interaction with Smallholder Bt Cotton Farmer to Witness the Performance of Bt Cotton at Rodki Village, Bhatinda district of Punjab

Rodki, Punjab, 29 Sept 2015

The African delegation was impressed after witnessing the performance of Bt cotton in Hisar and Sirsa district of Haryana State. In the afternoon hours, the delegation visited the Centre of Excellence at Talwandi Sabo in Bhatinda district of Punjab State. During the bus ride from Sirsa to Punjab, the African delegation could see lush green cotton fields and were tempted to visit the vigorous cotton fields. On their request, An impromptu stop at farmer's field. The unplanned and random visit at smallholder farmer's field turned out be very interesting and informative. Smallholder farmer Govind Raj and his family were completely amazed by the surprise visit of African delegation to his field. Govind Raj is a young farmer aged 25 years and has inherited 2 acres from his father. He has one daughter and one son aged one and two years respectively. He started to help his father in farming at an early age of 14 years and when he turned twenty years he independently started to farm on 2 acres of farm land. The African delegation wondered why he choose farming at such a young age to which he replied, **"I have no other source of income. Farming feeds my family and is a source of livelihood for me."** Farmer Govind Raj informed the delegation that he lived in Sardoolgarh, which is half an hour away from his field at Rodki, Punjab. He plants only Bt cotton on his field of 2 acres. **"I plant only Bt cotton in my field as it yields higher and I am able to earn better price in market. My father told me about the benefits of Bt cotton and I have never planted non-Bt cotton in my field. I**

**know about the problems of growing non-Bt cotton as it is susceptible to bollworm attack and requires more pesticide sprays. All my farmer friends plant Bt cotton and it is very popular in my Rodki village."** The delegation also interacted with his family members, Govind Raj's mother and wife who were also helping him in the field. When asked about the issue of farmers' suicide due to Bt cotton, Govind Raj replied that he was not aware of this problem and has not heard of anything like this before. **"Bt cotton brings prosperity, why do you say that farmer killed himself because of growing Bt cotton. This can save life not take life"**, he replied. The delegation asked which hybrid he had planted in his field to which he replied that he does not remember company or brand name but knows it is BGII hybrid which is popular in his village and yields good results.

The participants also interacted with farmer's wife and mother who accompanied him to the field and offered help in growing Bt cotton from planting to harvest. The farmer's wife shared with the participants that with the income earned from Bt cotton field, she wants to educate her two children and not deprive them of basic primary education which her parents could not afford. the Farmer Govind Raj shared with the participants that growing Bt cotton had raised the socio-economic status and they were living off better than at the time when his father grew non-Bt cotton in the field.



## CENTRE OF EXCELLENCE ON GOVERNMENT'S FARM

### Visit to Centre of Excellence (COE) at Government field, Sheikpura, Talwandi Sabo, Bhatinda

29 September 2014



The African delegation visited the Centre of Excellence (COE) of Delta Pine company at Government's field to see new methods and techniques to improve cotton yield at Sheikpura, Talwandi Sabo in Bhatinda district of Punjab State. Delta Pine/Monsanto has established Centre of Excellence in collaboration with Government of Punjab on 19 acres of land in Sheikpura, Talwandi Sabo. The Centre of Excellence aims at making the process of cotton cultivation efficient by maximizing profit of cotton farmers so that they are able to get high yield of the crop, reduce input costs by overcoming the problem of expensive labour, inventing new techniques of cotton cultivation and ensuring better agronomic practices to benefit the cotton farmers. The COE at Sheikpura showcases the right cotton

hybrid along with best-in-class agronomic practices and crop management technologies that help in generating better yields with optimum inputs. The African delegation was delighted to see the COE at Punjab that promotes progressive techniques in cotton cultivation. The COE is farmers' first-hand access to sowing and planting techniques, proper spacing for optimal plant population, right usage of fertilizers and pest management practices. The COE harnesses the collective expertise (Delta Pine/Monsanto and Punjab State) for evaluation, development and implementation of practical solutions to enhance cotton productivity in the State of Punjab. The COE aims at;

- Developing best agronomic practices in Punjab
- Maximizing profit of cotton farmers, reduce input costs, efficient farm practices
- Increasing yield with focus on inventing new techniques of cotton cultivation
- Introducing the mechanization of cotton cultivation by cotton

- picking machines
- Evaluating and recommending suitable hybrids for mechanical picking
- Showcasing new technologies such as high density cotton system
- Evaluation of high yielding cotton hybrids
- Experimenting different weed control trials and recommend best practices for efficient weed management in cotton and
- Demonstrating different approved Bt cotton hybrids (Bollgard Museum)



*I was able to appreciate the profound impact that technology can change the livelihoods of small scale cotton farmers in India. I am engaging with the County Executives of Agriculture from the cotton growing counties on how we can have a sustainable cotton seed framework.*

**Mr. Anthony Muriithi**  
Cotton Development Authority, Kenya



The COE representative at Bhatinda informed the delegation that the application for changing refuge management strategy is pending with the Government of India for prolonging life of technology. The "Built-in-refuge (BIR)" is a proposed new refuge strategy to plant non-Bt refuge along with Bt cotton hybrid. The Bt cotton hybrids with BIR of 5% shall consist of 450 grams of Bt cotton hybrid seeds mixed with an additional non-Bt seeds of corresponding cotton hybrid (isogenic lines for compatibility and same time harvest) as a refuge blended in Bt cotton bag. The refuge management is important for delaying resistance development and technology sustainability. The BIR concept was field evaluated at 5%, 10% and 15% and compared for best results. Notably, the best results were obtained at 5% of non-Bt counterpart, and thus the 5% BIR strategy has been proposed to replace the existing refuge management.

The COE at Sheikpura also showcased Bt cotton with Round up simulation (shield spray) trial. This trial demonstrated the benefits of BGIIRRF cotton which is a third generation biotechnology product in cotton pending commercial approval in India. BollgardII Roundup Ready Flex (BGIIRRF) offers a new method of weed control while efficiently controlling cotton bollworms. The herbicide tolerant (RRF) technology gives the cotton crop internal strength to withstand the application of herbicides. It is estimated that the introduction of BGIIRRF cotton would reduce direct operational cost of Rs. 8000 to 10,000 equivalent of 10-12% spent on controlling weeds per hectare. Farmers attending the meeting with the African delegates at COE advocated for BGIIRRF which they claimed can reduce burden of labor and cost of production. **"Farmers are facing huge shortage of labour, this BGI RRF technology is appropriate and relevant for India"**, said one of the farmers.

Farmer Gurkirpal Singh aged 52 years interacted with the African Delegation at the COE at Talwandi Sabo. Farmer He is a big farmer and owns 50 acres of land out of which 30 acres are used only for growing cotton. He owns this ancestral land along with his brothers and lives in a joint family system. He told the participants about the benefits of Bt cotton which is the reason farmers now do not grow non-Bt cotton at all in this region. **"You will not see any farmer in this area growing non-Bt cotton. If technology is not addressing need of farmers, then farmers will not adopt it. It is as simple as that. Every farmer wants to reap benefits and will want to move ahead with others adopting technology."** Farmer Gurkirpal said. He informed the participants about the cotton productivity in his field which ranges from 15-20 quintals per acre. He also informed that his field required 15 sprays to control bollworms prior to the introduction of Bt cotton, which has now come down to only two sprays. However, he raised issue of counterfeit pesticides, substandard seeds and white fly. Farmer Gurkirpal was an affluent farmer communicating in fluent English with the participants which impressed a great deal. **"We had decided to quit cotton farming but Introduction of Bt cotton injected enthusiasm in us and we resumed to grow Bt cotton in our fields"**, emphasized Farmer Gurkirpal while concluding this remarks.

## Kenyan County Executives of Agriculture Vouch for Bt Cotton

Two Kenyan County Executive Committee members for Agriculture (or County agricultural ministers) have lent their support to the introduction of biotech cotton in the sub-region. This was after an extensive study tour to India's biotech cotton sub-sectors from research, farmers' fields, seed production facilities and cotton seed oil processing. The study tour, 28th September to 2nd October 2015, aimed at exposing African stakeholders to the Indian Bt cotton hybrid farming experiences as well as the country's model biotech crops regulation and commercialization processes. Led by the Chairman of the 47 County Executives for Agriculture, Dr Moses Mwanje from Western region and Mwalimu Menza of Coastal Kilifi county, they committed to sharing the lessons learnt with their respective County and national governments to emulate India's model of technology deployment.

During the tour, the two applauded the strong stewardship program facilitated by both public and private sector partners to ensure optimal benefits. Said Mwanje, **"I salute the Indian Government for actively engaging farmers in education about Bt cotton, thus safeguarding product integrity and adherence to**

**appropriate management practices"**. It is evident that the private sector has played its rightful role in generating a wide range of hybrid seeds and widening choice for farmers, they observed". On his part, Menza acknowledged the potential of biotech cotton in job creation for the youth and full utilization of marginal lands such as those prevalent in the Coastal region. **"The partnerships we have seen here with value-chain actors guarantee farmers reap maximum benefits and through processing of cotton seed into cooking oils and feed, improve livelihoods in the rural areas"** he said. The two ministers were part of a 30-member delegation from 6 African countries (Ethiopia, Kenya, Malawi, Sudan, Swaziland and Zambia) comprising decision makers, regulators, CEOs of cotton boards, researchers, consumer representatives and private sector players in the Indian educational tour. It was co-organized by ISAAA AfriCenter and South Asia Biotechnology Center in partnership with COMESA/ACTESA, OFAB-Kenya, Mahyco-India PBS and the United States Department of Agriculture.



Photo Left to Right - Hon. Moses Mwaje, Chair of County Executive of Agriculture, Kenya and Hon. Menza Mwalimu Katana, County Executive of Agriculture Kilifi County of of coastal Kenya holding a non Bt cotton leaf eaten by Spodoptera and a healthy Bt cotton leaf

## EXTRA LONG STAPLE (ELS) BT COTTON

### Maharashtra's Smallholder Farmers Showcase ELS Bt Cotton Hybrid to African Delegation

1st Oct 2015, Aurangabad



On 1 Oct 2015, the African delegates visited Bt cotton fields of farmer Deepak Arun Ambore of Shel Gaon, Aurangabad. Farmer Deepak aged 41 lives with his two brothers in a joint family in a village 1km from his field. He was accompanied by his father and two brothers in the field to demonstrate the performance and efficacy of Bt cotton hybrids in field conditions. The joint family of farmer Deepak has a land holding of 20 acres. His family grows cotton on 10 acres of land, and remaining land with vegetables, pomegranate, pigeonpea and hybrid maize. Of the 10 acres of Bt cotton, he was very keen to showcase the field of Extra Long Staple (ELS) Bt cotton hybrid which he planted for the second time on 3.5 acre on the land adjacent to road leading to his village. Farmer Deepak was jubilant to take every member of the delegation to ELS Bt cotton field, a lush green tall and erect plant type field. Briefing them about the advantages of ELS Bt cotton hybrid, he claims that ELS Bt cotton fetches around 40% more return compared to medium and long staple cotton. He also highlighted the value of ELS Bt cotton by holding busted bolls which carry a very fine quality thread. He

brought bolls of medium to long staple cotton from another field and gave both bolls to delegates for them to compare the quality of cotton threads. African delegates were very pleased to notice the striking difference between the quality of medium and long staple Bt cotton with the Extra Long Staple Bt cotton.



Farmer Deepak introduced his two brothers to the African delegates. Both his brothers work on the field 24X7 to raise cotton and other crops. Their main occupation is farming however farmer Deepak runs a small stone crushing plant in the outskirts of Aurangabad district of Maharashtra. Farmer Deepak and his brothers surprised the delegates when they shared the parameters of ELS Bt cotton hybrids. They harvest 33-36 mm staple length of ELS Bt cotton which is much higher than the medium to long staple Bt cotton. As a result, the ELS Bt cotton fetches very high price in the market. They harvest around 120 bolls per plant per season, which is twice the numbers of bolls harvested by Punjab and Haryana cotton farmers. The cotton crop in this dryland area is a long duration crop whereas as farmers in Punjab and Haryana grow short duration cotton. In this area, farmers pick cotton bolls 5-6 times compared to 2-3 pickings by farmers in Punjab.

Farmer Deepak informed the delegates that his field of ELS Bt cotton is irrigated by drip irrigation which is subsidized at 50% by Government of Maharashtra. He shared that he harvests much higher yield by growing cotton with drip

*Dr. Margaret Karembu, Director ISAAA AfriCenter expressed her thanks for spontaneous and quick write-ups that had meaningfully captured all the experiences, lessons learnt and take-away messages by the African delegation, she said "Congrats Bhagirath for consolidating the Africa study tour experiences in form of very educative and inspiring stories. I am humbled by the participants' feedback. In this tour, 80% of participants have responded. Let's keep up the network.*

**Dr. Margaret Karembu**  
Director ISAAA AfriCenter





irrigation than with sprinkler and other forms of irrigation methods. He harvested approximately 25 quintals of ELS Bt cotton last year and expects to harvest more this year by deploying drip irrigation. Showing his exuberance of growing ELS Bt cotton hybrid "Bahubali", Farmer Deepak stated **"The Extra Long Staple Bt cotton hybrid is the future of cotton farming in India. If farmers of dryland cotton have to increase their income, they need to adopt ELS Bt cotton. I earned 40% more by growing ELS Bt cotton hybrids as compared to medium to long staple Bt cotton hybrids in the past. I will grow ELS Bt cotton hybrids and will increase area under ELS Bt cotton in my farm next year"**.



In responding to the queries on pesticide sprays, farmer Deepak informed the delegation that he applied more sprays this year than in normal years when he applies 2-3 sprays. This year he had to apply 5-6 sprays to control sucking pests that flourished due to favourable weather conditions in this season. In contrast to situation of white fly in Punjab and Haryana, farmer Deepak informed the delegation he has not seen the infestation of white fly in his farming career in this region.

Farmer Deepak informed the African delegation about intercropping of pigeonpea with Bt cotton but did not plant refuge of non-Bt cotton hybrids. Notably, cotton farmers in this region of Maharashtra reap the full benefits of cotton crop by selling the cotton left-over straws in a nearby Biofuel plant which was established five years ago to generate renewable energy based on bio-gasification. The delegates were very surprised to learn about the optimum use of cotton and bi-products. They were eager to grow ELS Bt cotton in Africa and realize higher returns due to the price advantage vis-a-vis hirsutum cotton i.e medium to long staple" said Mr. Ritesh Mishra, Regulatory Lead, Mahyco.

Farmer Deepak thanked members of African delegation for choosing to visit his field of ELS Bt cotton. On their part, the delegation who were not aware of ELS cotton thanked the organizers for choosing the fields of ELS Bt cotton hybrid, which they had not seen before.



*African delegates were very happy and excited to see ELS cotton. They were eager to grow ELS Bt cotton in Africa and realize higher returns due to the price advantage vis-a-vis hirsutum cotton i.e medium to long staple*

**Mr. Ritesh Mishra**  
Regulatory Lead, Mahyco

## YOUNG BT COTTON FARMERS

### Young Bt Cotton Farmers Greet and Engage African Delegation

1st Oct 2015, Aurangabad

A group of young Bt cotton farmers aged 20-25 met the members of an African Delegation visiting Aurangabad district of Maharashtra on 1st October 2015 on the eve of Gandhi Jyanti. The delegation appreciated the warmth and welcome extended by the young farmers in their Bt cotton fields.

Young farmer Manoj Matre aged 22 grows Bt cotton on his 2.5 acre of ancestral land. He invited the African delegation showcasing the attributes and features of Bt cotton hybrid "Dr. Brent", the most popular hybrid grown in his area. He talked to members of the delegation comprising politicians, regulators, Govt officials, consumers and media from six East and Southern African countries of Sudan, Ethiopia, Kenya, Malawi, Zambia and Swaziland.

harvesting and selling the produces in the market. Young farmer Manoj shared his pride in cultivating Bt cotton hybrid on his small field of 2.5 acre, a complete dryland field depending solely on Monsoon rain. He planted his Bt cotton crop in June and he had not applied any irrigation. His Bt cotton crop flourishes in rich black soil surrounded by other Bt cotton hybrids, hybrid maize, onion and pomegranate. Pigeonpea is another crop that is planted as an inter crop to raise pigeonpea pulses for domestic consumption in a vegetarian dominated society of this area of Maharashtra.

To the excitement of the delegation, young farmer Manoj shared his views and experience of growing Bt cotton that are recaptured as follows;

***"My family has been growing Bt cotton hybrid since last ten years. I started growing them myself since last 2-3 years. I find it convenient to raise Bt cotton crop. It yields 12-15 quintal per acre (1200-1500 kg per acre). I hardly spray pesticides, but this season***



Manoj Matre lives with his two brothers in a joint family in Shel Gaon around 2 kms from his field. Most of the people in his village belong to Matre community and depend on farming as their sole source of income and livelihood. His father guides him and his brothers in planting, raising,

***was an odd season of erratic rainfall resulting in harboring sucking pests. I had to spray four times to control the menace of sucking pests compared to one/two sprays in the past. I dont spray for american bollworm, spotted bollworm and other borer pests. I***

**harvest 50-60 bolls from one plant on average. I pick cotton bolls 5-6 times in a long duration cotton season of 5-6 months. It provides our family a consistent source of income. I support the education of my young brother who is pursuing his education in the field of Homeopathy medicine, a traditional system of Indian medicine", said Manoj.** Young farmer Manoj was very humble and courteous to the African delegation.

While interacting with Manoj Matre, he was joined by a group of young Bt cotton farmers from his village. All of them grow Bt cotton, inter cropping it with pigeonpea. They also grow vegetables, and pomegranate. Another young farmer Jagdish Matre, also aged 22, was the brightest young boy we met in this study tour. He spoke fluently in English and attracted every member of the delegation to him. When asked about his education, he replied enthusiastically **"I am a young Bt cotton farmer**

**simultaneously pursuing my Master of Commerce Degree from a reputed Institute".** The ambitious young boy wanted to become the Probationary Bank Officer (PO). On being asked about his fluency in English language, he said **"I lived in Ahmedabad for my schooling where I learnt English language. I am proud to have lived in the State of Gujarat - our Prime Minister Modi is also from Gujarat".**

Young farmer Manoj and his young friends were carrying smart phones, taking pictures and selfies with the African delegation. Before departing, the African delegation were greatly impressed with young farmer Manoj, Jagdish Matre and his friends. Hon'ble Moses Mwanje, Chair of County Executive of Agriculture and Hon. Menza Mwalimu Katana, County Executive of Agriculture Kilifi County of Kenya were highly impressed and wished the young farmers a very successful career and life.



## MAHYCO RESEARCH CENTRE (MRC)

### Laboratory Visit to Mahyco Research Centre (MRC), Dawalwadi Village, Dadnapur Taluka, Jalna District of Maharashtra, India

1st October 2015

In the afternoon of 1st October 2015, the African delegation visited the research and development facility of Mahyco, an Indian seed and biotechnology company located at Dawalwadi village around 60 kms from Aurangabad. Mahyco Research Centre (MRC) is one of the oldest Centre of Excellence in research and development of improved crop varieties and hybrids of field, commercial and vegetable crops in the country. MRC is India's largest private sector R&D facility that undertakes cutting edge R&D of food, feed and fibre crops. Mahyco has been instrumental in introducing the country's first hybrids of pearl millet, sorghum and cotton, and also hybrids of many vegetable crops. In early eighties, Mahyco started an ambitious project to develop and introduce insect resistant trait in cotton hybrids which were officially released for commercial cultivation by Government of India in 2002. Mahyco Research Centre has been working on many other traits in different crops. The major traits include insect resistance, herbicide tolerance, nitrogen use efficiency, drought and salinity tolerance in cotton, rice, wheat, **"Bt cotton has changed the face of cotton in India. This is the fastest adopted crop technology in India. Farmers have gained so much. Africa has the same potential and I am sure Bt cotton can bring about cotton revolution in Africa"**, Dr. Raju Barwale, Director, Mahycobrinjal, cabbage and okra.

SABC organized the visit of the African delegation to Mahyco Research Centre after visiting public sector institutions, CCS Haryana Agricultural University (HAU), Hisar and Central Cotton for Research Institute (CICR) regional station at Sirsa to familiarize the participants with the R&D work undertaken in both public and private sector institutions in India. Mahyco is India's oldest and largest

private sector seed and biotech company, which recently celebrated 50 years of existence. It was the first company to successfully commercialize F1 cotton hybrids based on GMS/CMS system globally and in the year 2002 commercialized Bt cotton in India that revolutionized the cotton sector.



Dr. B.R. Barwale, the World Food Laureate and the Chairman of Mahyco, aged 85 flew from Mumbai to meet the African delegation at the research and development facility of Mahyco at Dawalwadi village, Jalna, Maharashtra. He was accompanied by his son Dr. Raju Barwale, managing director of Mahyco and his daughter Dr. Usha Barwale, the chief technology officer of Mahyco. Dr. B.R. Barwale welcomed all the participants and reminisced his visit to many African countries including South Africa, Sudan, Kenya and Malawi. The African delegation was delighted and thrilled to learn from the wealth of experience and rich knowledge on agriculture from Dr. B.R. Barwale and his family. Dr. Barwale narrated his journey in seed and biotech sector with the participants. He mesmerized the participants when he shared how accidentally he became a seedsman when he started producing Pusa Sawani Bhendi (okra) seed that he procured from IARI in late 1960s. This variety of okra was resistant to yellow mosaic virus and gave high yield and exhibited excellent quality trait that fetched him good price in the market. The success of okra seeds encouraged him

*Bt cotton has changed the face of cotton in India. This is the fastest adopted crop technology in India. Farmers have gained so much. Africa has the same potential and I am sure Bt cotton can bring about cotton revolution in Africa.*

**Mr. Raju Barwale**  
Managing Director, Mahyco



to learn more about the process of producing quality varietal seeds, hybrids and the science involved in making good quality hybrids. He informed the participants that over the years Mahyco has transformed from an Okra seed supplier to India's premier R&D seed and biotech company that now produces seeds of hybrid cotton, wheat, pearl millet, sorghum, rice and vegetables.



Dr. B.R. Barwale enlightened the African delegation about the success of insect resistant Bt cotton. He informed that participants that due to the cotton hybrids in India, income gain, the farm families who were living under thatched roofs could afford pacca (concrete) roofs and it also positively impacted literacy among the poor farm families who could not afford schooling. After discussing the benefits accrued due to adoption of Bt cotton in India, Dr. Barwale spoke about how Africa could also gain from the introduction of new technologies in agriculture and there is no reason why African farmers be denied of the benefits of Bt cotton. **"Africa has the same potential as that of India. There is no reason what India has achieved from the use of this technology should not happen in Africa"**, said Dr. Barwale.

Dr. Barwale informed the participants about the efforts that Mahyco had put in to make the world's first biotech Bt brinjal which has been successfully adopted by neighboring country Bangladesh. He apprised of the

participants on the research being carried on Bt chickpea—a very nutritious crop that suffers heavy infestation from pod-borer and has the potential to bring the biggest revolution in pulses. **"Bt technology offers the same benefit as cotton in chickpea and India can turn from a chana (pulses) importer to exporter if we improve seeds with Bt technology."** he said.



After a very educational and informative talk by Dr. B.R. Barwale, the chief technology officer of Mahyco, Dr. Usha Zehr Barwale presented the legacy of 50 years of R&D at Mahyco. Dr. Usha updated the participants with the innovative research initiatives of Mahyco in agriculture sector and elaborated on Mahyco's network of 100,000 farmers in 30 production centers in the country. She briefed them on Mahyco's focus crops and efforts undertaken in plant breeding and biotechnology in crop improvement. She informed the participant about the commercial presence and/or network for distribution of products of Mahyco in more than 20 countries covering Asia, Middle East, Africa, USA and Europe. Dr. Usha stated that **"Mahyco's Bt cotton has changed the cotton industry scenario. It is the fastest adopted crop technology that benefitted India. We will continue our efforts to strengthen R&D activities to improve quality parameters and tolerance to diseases and pests."**

*Bt cotton has brought a revolution in India. India was a big consumer of cotton and was importing cotton before the introduction of Bt cotton and faced insurmountable challenge of controlling damage caused by the bollworms. Now, 97% of India's cotton is Bt cotton and we are able to produce exportable cotton surplus. Even in a bad or rough year we are not importing. This technology has satisfied the country's need and benefited small scale Indian farmers. Bt cotton has helped to attain many socioeconomic benefits including more income and education to farmers.*

*Dr. B.R. Barwale  
World Food Laureate and Chairman, Mahyco*



*Indian farmers saw the benefits of using bollworm resistant Bt cotton seed within just a few years after its introduction. Farmer will only buy it if he can see value in it. So value creation is core. I find RRF trait a very valuable tool for Indian farmers in the light of dwindling farm laborers.*

**Dr. Usha Barwale**  
*The Chief Technology Officer of Mahyco*



Dr. Usha talked to the African delegation about the potential of roundup ready trait RRFlex cotton and updated them the BG-II RRF cotton is at the advanced stage of evaluation and ready to be launched in India. Appraising the participants about the infrastructure, she said that the company has 6 research stations, 30 production centers and 6 processing plants with 62,000 tons of annual seed processing capacity. She said that germplasm development via conventional and molecular breeding is one of the critical factors for success of the company. Summing up her presentation, Dr Usha highlighted the presence of Mahyco in key agriculturally important States in India and informed that Mahyco has a strong brand reputation in the market.

#### **Laboratory Visit to Mahyco Research Centre, Dawalwadi, Jalna**

After presentations and interactions with the Dr. Barwales, the delegation toured various research laboratories of the Mahyco Research and Development facility in Dawalwadi village, Jalna district, Maharashtra. The delegation found it to be one of the most advanced seed industry R&D establishment. The African delegation was impressed by the advanced laboratories they toured and interacted with expert scientists of the each laboratory. The expert scientists of MRC were glad to respond to the queries raised by the participants of African delegation. The African delegation visited following laboratories of Mahyco Research Centre:

- Molecular Quality Assurance-Protein Resource Lab
- Crop Transformation Lab
- Entomology Lab
- Molecular Biology Lab
- Pathology Lab
- Cytogenetics Lab
- Molecular Virology Lab
- Seed Health Lab
- Quality Assurance Laboratory







The participants were pleased as their queries were responded well and satisfactorily by the scientists. They were impressed by the world-class infrastructure and activities carried out through well-defined processes in the R&D facility. They were delighted to visit Mahyco's Quality Assurance Laboratory (QAL) which has been accredited by the International Seed Testing Association (ISTA). Mahyco's QAL ensures the production of quality seeds for domestic as well as for export market. The African delegation expressed their appreciation for the opportunity to visit Mahyco Research Centre which has state-of-art R&D Centre with an on-going hybrid breeding program in over 30 crops. Notably, Mahyco is

engaged in research, development, production, processing and marketing of over 115 products including cotton, cereals, oilseeds, fibre crop and vegetables.





## BT COTTONSEED OIL AND CAKE

### Abhay Cotex Private Limited (ACPL), Jalna, Maharashtra

1st October 2015



Bt cottonseed oil and cake contribute a significant portion of edible oil and animal feed requirement in India. India annually consumes approximately 1.5 million tons of cotton oil, which is produced domestically from the genetically modified Bt cottonseeds. Bt cotton occupies approximately 95% of total cotton planted in 2014 and the trend is likely to continue. The production of cotton seed, and its by-products as oil and meal, has increased manifold from 0.46 million tons in 2002-03 to 1.5 million tons in 2014-15 – a three-fold increase in cotton oil production in the last thirteen years. Notably, Bt cotton meal (de-oiled cake) contributes more than one third of the country's total demand for animal feed, whereas cotton oil contributes around 20% of total edible oil production for human consumption in the country. Due to the high nutritional content of cotton oil, Bt cotton oil is marketed after blending it with different edible oils. So far, India consumes a significant amount of Bt cotton oil (20% of total domestic production) and Bt cotton cake contributes one third of the total animal feed from 2002 to 2014, and thus contributed significantly to food (as edible oil), feed (as de-oiled cake) and fibre security. Table 1 shows the trend of Bt cotton oil production in India, from 2002 to 2014.

In the context of India being a major consumer of Bt cotton oil as edible oil and deoiled cake as animal feed, it was vital to expose the African delegates to utilization of cotton by-products for food and feed usages in the country. Therefore, the South Asia Biotechnology Centre (SABC) organized the visit of the African delegation to Abhay Cotex Private Limited (ACPL) based at Jalna, Maharashtra. Abhay Cotex is a relatively large cotton seed processing unit in Jalna area of Maharashtra. Dr. D.A. Prasad, CEO & Director of Abhay Cotex Pvt. Ltd (ACPL) gave a warm welcome to the African delegation and addressed them with brief remarks about the history and growth of Abhay Cotex. Dr. DA Prasad is one of the well known oils & fats technologist in India with over 27 years of experience in the edible oilseeds and oils & its derivative products. Dr. Prasad informed the participants that ACPL has a state-of-the-art infrastructure with strong expertise to carry research & development with highly qualified professionals and built up a significant research expertise through its innovative efforts. Dr Prasad informed the delegation that Abay Cotex has the technical know-how to process cottonseed and is being able to fully utilize various cotton-byproducts including fiber, cottonseed, oil, cake, hull and linters. Cottonseed has an immense potential in the cotton value chain in the country. These value-enhanced products cater to varied sectors including human edible oil, dairy cattle, poultry and aqua. Members of the African delegation were surprised to learn about the multipurpose utility of cotton crop. ***"The byproducts of Bt cotton have been safely consumed in the form of edible oil as food for human consumption and de-oiled cake as an animal feed in India with a safe history record"***, lauded Dr. Prasad.



**Table 1. Contribution of Cotton Oil to the Edible Oil Sector in India, 2002-03 & 2013-14**

Item	2002-03	2013-14
Cotton production (million bales)	13.6	39.1
Cottonseed production @ 310kg/bale (million tons)	4.21	12.1
Retained for sowing & direct consumption (m tons)*	0.50	0.1
Marketable Surplus (million tons)	3.71	12
Production of washed cottonseed oil (12.5%) (m tons)	0.46	1.5

\*very few farmers retain cotton seed for sowing over the last thirteen years as cotton hybrid seed planting increased to 95% of cotton area. Cotton hybrid seeds production is undertaken separately by specialised cottonseed growers and marketed by private seed sector in the country.

(Source: COOIT, 2010; AICOSCA, 2010; CAB, 2014; Compiled by ISAAA, 2014)



Many participants of the African Delegation were not aware of the multipurpose utility of cotton by-products and were keen to learn more about the usages of Bt cotton byproducts. Mr. Ashish Mantri, Director of ACPL and a chemical Engineering graduate from ICT Mumbai gave a detailed presentation about the different usages of cotton byproducts. He claimed that Abay Cotex in the last five years has processed 0.1 million tons of cottonseed oil and sold it in the Indian market as an edible oil. Elaborating on the nutritional content of cotton oil viz-a-viz other edible oil, Mr Mantri referred to cottonseed oil as one of best quality edible oil with an excellent frying attribute and high smoke point used for direct human consumption in India.



Apart from cottonseed oil, cottonseed protein in the form of deoiled cake produced from Bt cotton has been gaining popularity. Bt cotton meal (de-oiled cake) contributes more than one third of the country's total demand for animal feed. It is an excellent source of proteins for a variety of animals and is either used solely or blended with other animal feeds to provide balanced ration. Mr. Mantri reconfirmed that there is no issue of food safety involved as Bt cotton has established its safety for many years. He reiterates that Bt protein is heat liable and therefore is neither present in oil nor in de-oiled cake. On being asked about the safety of cotton byproducts Mr. Mantri

responded, ***"Bt cotton has a history of safe usage. Bt protein is not present in oil or de-oiled cake. Value-addition is must and it has benefitted India very well as it will benefit Africa if they show trust in the technology. India has consumed approx. 1.5 million tons of cottonseed oil every year for direct human consumption and a large quantity of of cottonseed meal for cattle, poultry and aqua"***.



Highlighting the benefits of cottonseed oil for human consumption, Mr. Mantri informed the African delegation that while extracting cotton oil it is unlikely to generate trans-fat while other edible oils do generate trans-fats with health implications. Cottonseed oil is good source of essential fatty acids, stuffed with biologically active micro-nutrients and most desirable oil for frying purpose. Therefore, cottonseed oil is acceptable for modern diets and is the choice of health professionals. As compared to other vegetable oils, cottonseed oil is free from cholesterol. He also emphasized on the quality of deoiled cake which is suitable for all kinds of "feed diets" due to its undetectable gossypol and aflatoxin content and is used in cattle, poultry and aqua. Cottonseed meal is a best alternate to high cost soya meal. While summing up his presentation Mr. Mantri emphasized on use of new technology in agriculture. ***"If we don't adopt technology, we would suffer. So it is Africa's choice to adopt suffering or advance with the benefits of new technologies"***, pointed Mr. Mantri.





The delegates then had a guided tour of the factory and witnessed the industrial processes of manufacturing diverse byproducts from cotton seed.



## HYBRIDIZATION OF COTTON

### “Doing is Knowing” – African Delegates Learn About Cotton Hybridization in Farmers' Field, Jalna, Aurangabad

1st Oct 2015, Aurangabad



The African delegates were curious to know and learn more about hybrid seed production, and inquired as to why hybrids cost more than OPVs. The African delegation repeatedly asked these questions during the study tour on cotton hybrids organised by the South Asia Biotechnology Centre (SABC) from 27th Sept to 2 Oct 2015. The African delegation visited and saw hybrid cotton seed production plots both in the fields of public sector institution CCS HAU, Hisar, Haryana and in the fields of Mahyco at Jalna district of Maharashtra.

In a lay man term, hybrid or cross-breed refers to any offspring (hybrid) resulting from the breeding of two genetically distinct individuals (parents). Hybrids are produced to exploit vigor or heterosis, which is a combining ability of the two distinct parents. Many delegates were curious to know if crossing any pair of inbred parents can produce a desirable hybrid. Notably, the science of cross-breeding is much more intense and rigorous than simply combining any particular pair of inbred parents that may not result in superior offspring or hybrid. Therefore, the breeders have to carefully choose male-female parents that not only synchronize simultaneously but also demonstrate desirable level of uniformity. Importantly, the high level of vigour in female parent and the pollen production ability of the male parent are the common denominator for production of a uniform, superior and high yielding hybrids (F1).



Irrespective of the crops, the hybrid seeds are relatively more expensive than the open pollinated varieties (OPVs). As of now, hybrids can be produced for those crops that are cross-pollinated like maize and in some cases for self-pollinated crops like rice where scientists have created a system of fertilization either by deploying CMS (Cytoplasmic Male Sterility) or GMS (Genetic Male Sterility) systems. However, it is difficult to produce hybrids of many self-pollinated crops such as cereals (wheat), pulses (chickpea) and oilseed crops (soybean).

The next important question African delegation asked was why produce hybrids? Well, it was very easy for the delegation to comprehend the answer of this particular question. Most of them were keen to utilize the combining ability of male-female parents and exploit not only vigour but also transfer key agronomic and quality characteristics such as higher yield, greater uniformity, improved color, resistance to biotic and abiotic stresses in the resulting offspring (hybrid). Many of the African delegates highlighted the challenges being faced by their respective

countries in improving cotton production. The delegates unanimously agreed that yields of cotton can be improved by the introduction of cotton hybrids. The representatives of African countries such as Sudan and Malawi have informed fellow delegates that their respective countries have already approved the cultivation of cotton hybrids, and other countries including Kenya, Ethiopia, Zambia, Swaziland are at the penultimate stage to introduce cotton hybrids in the near future. Picture below show the phenotypical characteristic of cotton hybrid which was introduced couple of decades ago in India.



**“Well, if this is the case then what does it take to breed and produce high yielding cotton hybrid?”**, asked one of the African delegates visiting the hybrid cotton seed production plot at Jalna, Maharashtra. To their convenience and to understand the system of cotton hybridization, it was important a demonstration on the methods of cotton hybrid seed production in the field conditions was deemed necessary. The trained and skilled women farmers with the help of seed production expert demonstrated following two methods;

- First, Conventional Hand Emasculation and Pollination method
- Second, New Generation Male Sterility Based Hybridization method

With the help of experts, the women farmers demonstrated the methods of hybrid cotton seed production. They performed the process of hybridization including emasculation and pollination in their own cotton hybrid production plot. The women farmers first meticulously undertook the process of emasculation of female parent. They informed the participants that the emasculation has to be done after 1PM of the fully developed buds of the female parent. The emasculated buds have to be covered with butter paper to avoid cross-pollination from neighboring cotton field. In the next morning, the emasculated buds are pollinated (crossing of parents) with the pollen of male

parent generally undertaken between 8AM to 11AM. The crossed buds should be then covered again with butter paper at least for 1-2 days for a proper fertilization. The success of pollination depends on various factors including sowing of parents in proper ratio, staggered planting and synchronization, trained and skilled laborer and guidance of a technical expert staffs. Responding to an inquisitive query of African delegation, the woman farmer informed them that she and her colleagues in the field can emasculate and pollinate anywhere between 300 to 1500 flowers per day per person depending on the level of skill and expertise of the individual farmer.



Spontaneously, the members of African delegation raised another interesting query about the potential of hybridization of cotton to generate employment in the rural area. Notably, the number of man-days involved not only in raising cotton crop for hybridization, which equals to commercial cotton crops, however, to African delegation's surprise the emasculation and pollination activity for producing cotton hybrid F1 alone generate around 800 man-days per acre per season of hybrid cotton production plot. An acre of hybrid cotton seed production plot for a season of 180 days generates around 800 man-days or approximately 4 man-days per day of cotton crop season. At the national level, this translates into an enormous opportunity for job creation in rural India, which produces sufficient hybrid cotton seeds that cover 95% of total cotton area of approximately 12.5 million hectares. In addition, the farmers who undertake hybrid seeds production earn as much as twice than growing commercial hybrid cotton crop. The African delegation promised that they would do everything possible to convince their policy makers about this enormous opportunity for employment generation in rural Africa.

Details of hybrid cotton seed production can be obtained by downloading ICAR/CICR Technical Bulletin No. 35 # Hybrid Seed Production in Cotton from [http://www.cicr.org.in/pdf/hybrid\\_seed\\_production.pdf](http://www.cicr.org.in/pdf/hybrid_seed_production.pdf)



Left to Right - Bhagirath Choudhary, Founder Director of South Asia Biotechnology Centre (SABC); Farmer Sunil Harchand Hapse at his hybrid cotton production plot, Jalna, Maharashtra; Hon'ble Moses Mwanje, Chair of County Executive of Agriculture, Kenya and Dr Margaret Kerembo, Director, ISAAA AfriCentre, Kenya.

For the African delegation it was eye-opener to learn about hybrid cotton seed production that not only produces high yielding hybrid cotton seeds but also generates millions of jobs in rural India. The hybrid seed production is not only labour intensive and it is also expensive to produce the hybrids in farmers' fields. It also requires a supply of pure parental materials and training farmers on hybrid seed production techniques. However, more importantly, it creates jobs in areas which do not have other sources of employment. On the question of why hybrids cost more than OPVs, the African delegation went back with self-explanatory answer.

Before leaving the cotton hybrid seed production plot, the political representatives from Kenya offered their heart-felt gratitude and a big thank you note to farmers in the Indian traditional manner by putting a tikka on farmers' forehead and by giving away a shawl, a coconut and a packet of special Kenya tea.



## Hybrid Seed Production Creates Plenty of Jobs By Vivian Fernandes

Bhagirath Choudhary is an agricultural scientist and founder director of the Delhi-based South Asia Biotechnology Centre. In the last week of September, he brought a delegation of East and Southern Africans to India to learn about advances in hybrid cotton cultivation. This report is based on that tour.

Irrespective of crops, hybrid seeds are more expensive than open pollinated varieties (OPVs).

Hybrids can be produced for those crops that are cross-pollinated like maize and in some cases, for self-pollinated crops like rice, by deploying CMS (Cytoplasmic Male Sterility) or GMS (Genetic Male Sterility) fertilization systems. However, it is difficult to produce hybrids of many self-pollinated crops like wheat, chickpea (chana) and soybean.

Hybrid or cross-breed refers to any offspring resulting from the crossing of two genetically distinct individuals (parents), whereas high yielding varieties are selected from a single line. Hybrids are produced to exploit vigor or heterosis, that is, increase in size, yields or other characteristics over those of the parents. Many of the thirty East and Southern African delegates who came to India in the last week of September on a tour of familiarization with India's advances in cotton cultivation were curious to know if crossing any pair of inbred parents could produce a desirable hybrid.

Combining any pair of inbred parents may not result in superior offspring or hybrid. Breeders have to carefully choose male-female parents that not only synchronize simultaneously but also demonstrate desirable level of uniformity. A high level of vigour in the female parent and the pollen producing ability of the male parent are the common denominators for production of uniform, superior and high yielding hybrids (F1). Hybrids are developed not only for vigour but also for desirable traits

like uniformity, improved colour, resistance to pests and diseases and tolerance to climate stress like drought and salinity.

At Jalna in Maharashtra, skilled women farmers showed the African delegation two methods of creating hybrids: (a) conventional hand emasculation and pollination and (b) new generation male sterility based hybridization.

The emasculation of fully developed buds of the female parent has to be done after 1 p.m. The anthers that are likely to open the next day are removed. The emasculated buds have to be covered with butter paper to avoid cross-pollination from neighbouring cotton fields. The next morning, the emasculated buds are pollinated with the pollen of male parents between 8 a.m. and 11 a.m., which is the period of maximum stigma receptivity. The crossed buds are again covered with butter paper for one or two days for proper fertilization. The success of pollination depends on various factors including sowing of parents in the proper ratio, staggered planting and synchronization, skill of the workers and the guidance of expert staff. Depending on the level of skill about three hundred to fifteen hundred flowers are emasculated per day per person.

This is quite a demanding activity. It takes about four persons working for 180 days to produce cotton hybrid F1 on one acre or two to three quintals of cotton seed. Farmers usually use one kg of hybrid cotton seed per acre. About 95 percent of India's cotton acreage of 12.5 million ha is sown with cotton hybrids. That is a lot of employment, which fetches higher wages than conventional cotton growing.

"This story organically appeared on Smart Indian Agriculture website at; <http://www.smartindianagriculture.in/hybrid-seed-production-creates-plenty-of-jobs/>



### Concluding Remarks

The visit of African delegation as a part of African Study tour to India represents a growing aspiration of African countries to increase their cotton production and productivity. The African Study tour "Seeing is Believing" took place at a time when many African, particularly Eastern and Southern African countries are seriously considering either setting up a functional biosafety regulatory system, or field testing and approval of biotech cotton hybrids. Cotton farmers in six African countries that represented the African Study tour are suffering from low yielding cotton genotypes, lack of availability of good quality inputs, relatively high infestation of pests and low cotton yield. Improving the capacity of decision makers including Chair of the Cotton Boards were paramount to bring in a desirable change in the cotton value chain in these African countries. Seeing is Believing study tour became a symbol of change resulting in the approval of first cotton hybrid in Malawi and the submission of biosafety dossier of Bt cotton in Kenya. The visit strengthened the confidence of delegation from Sudan in Bt cotton that they have been growing for last couple of years. Sudan substantially increased the planting of Bt cotton and increased their engagement with private sector to strengthen cotton value chain. Seeing is Believing study tour allowed the African delegation to witness first-hand experience of the exemplary performance of Bt cotton hybrids in farmers' fields in India. The members of the delegation had an intense engagement with officials from both public and private sector institutions within the cotton sub-sector value chain in both irrigated and dry land cotton areas of India. The delegation visited a seed company producing cotton seeds for farmers and a factory processing cotton by-products. They learnt about the benefits and challenges of deploying the technology in India from those who are primarily responsible for introduction of Bt cotton in India. The interaction with farmers from both irrigated and dry land cotton belt reinforced their trust and confidence in Bt cotton technology. The delegations found the strong collaboration and stewardship measures put in place, managed by the Government of India and the respective States Government, Universities and private sector players were impressive. Among the take home messages were the need for a strong extension service to support Bt cotton farmers, the concerted efforts of different players to sustain adoption and the wide range of varietal choices of Bt cotton hybrids that Indian farmers have at their disposal.

The African delegation found a noticeable interest from Indian public and private sector institutions into African agriculture sector. Many seed and biotech companies have shown keen interest to introduce hybrids of cotton and other crops. Mahyco is actively pursuing their interest in many Eastern and Southern African countries whereas

JK AgriGenetics, Advanta, Bioseeds and others are active in the cotton seed market of Eastern Africa including Sudan and Ethiopia. The public private partnership through India Africa Summit beginning 2008 is taking deep root between the two continents. Agriculture, particularly cotton and textile sectors is presenting a vast opportunity of collaboration in technology, trade and training (3T) between India and Africa. India can provide technologies and expertise in cotton and textile value chain from seeds to fibre to edible oil to most of African countries. In turn, Africa can increase their capacity to grow more, produce more, consume more and trade more with India. Cotton and textile sectors can resurrect the 21st century partnership between two giant continents. The vast stretches of land in the East Africa's Rift Valley can be turned into Africa's Biovalley having potential to feed the present and future generation of African continent.

Following the visit of African delegation, the 3rd India Africa Summit held from 26 to 29 October 2015 promised a renewed partnership between India and Africa. The Prime Minister Narendra Modi promised to strengthen India Africa partnership by offering concessional credit of US\$10 billion over the next five years to African countries. In addition, India announced a grant assistance of \$600 million that includes an India-Africa Development Fund of \$100 million and an India-Africa Health Fund of \$10 million. Notably, the summit reinvigorate the capacity building programs by announcing 50,000 scholarships for African students in India over the next five years. Renewed funding support and new initiatives would further intensify the capacity building programs between India and Africa undertaken by the Indian Technical & Economic Cooperation Program (ITEC) and the Special Commonwealth Assistance for Africa Program (SCAAP) of the Government of India. In this context, It is therefore paramount that India and African countries explore and exploit the opportunity to strengthen agricultural technology, trade and training (3T) to ensure food security and sustainable development spurred by inclusive growth in agriculture on two giant continents.





## Times of Swaziland "GMO Bt Cotton: Seeds of Suicide or Saviour of Dying Cotton Industry

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# GMO BT COTTON: SEEDS OF SUICIDE OR SAVIOUR OF DYING COTTON INDUSTRY?

BY THABANELE TO AMINI

**HARYANA - Bt cotton has been all the rage in India since it was officially approved in 2002 and the technology has been adopted by over 90 per cent of Indian cotton farmers.**

Agriculture, according to the Indian Government, is unquestionably the largest livelihood provider in India more so in the vast rural areas.

As in much of the developing world and Swaziland in particular, small-holder Indian farmers meaning those with less than two hectares of land, are most vulnerable to the effects of weather and climate change as well as pests.

According to news articles, before 2002, even though cotton was one of India's main cash crops, the yield was one of the lowest in the world. Pests

... Swazi delegation go on fact finding mission on BT Cotton in India

were a huge problem and farmers spent more money on pesticide for cotton than for any other crop.

Bt cotton came with the promise of not needing pesticides, because it would fight off the bollworm with its own inbuilt toxin. After it was approved by 2010, more than 90 per cent of cotton growers in India used Bt cotton. However, not everybody saw Bt Cotton as the saviour of the industry with Dr Vandana Shiva in particular calling it the 'seeds of suicide'.

A group of Swazi delegates attended a study tour of Bt Cotton in India, aimed at enabling sharing and learning from the Indian Bt cotton hybrid farming experiences as well as the country's model biotech crop regulation and commercialisation



ACAT National Director Enoch Dlamini standing among the Bt Cotton plants.

The Study tour was hosted by the South Asia Biotechnology Center (SABC), New Delhi and the Indian

## WHAT IS BT COTTON?

Bt cotton has been genetically modified by the insertion of one or more genes from a common soil bacterium, *Bacillus thuringiensis*. These genes encode for the pro-

duction of insecticidal proteins and thus, genetically transformed plants produce one or more toxins as they grow. The Bt Cotton is able to produce an insecticide to bollworm

## Farmers reject 5% refuge seeds – increasing possibility of Superpests

One of the major environmental concerns with the Bt Cotton technology is that it will lead to the development of Bt resistant pests, which are no longer affected by the toxin, more commonly known as Superpests.

Bhagirath Choudary the Founder Director of South Asia Biotechnology Centre (SABC), confirmed that the fact that a majority of the Indian farmers were simply ignoring the five per cent refuge recommendation which would help reduce the likelihood of superpest emerging, was posing a threat to the technology as well as to the crops

themselves.

"We noticed that a number of the farmers preferred to grow only the Bt Cotton seeds and discard the non Bt seeds, citing that they produced less yields as the pests would feed on them instead of the Bt cotton," he said during the tour. He added that the seed manufacturers had submitted a proposal to India's government to include the five per cent refuge within the Bt seeds so that the farmer could not discard the necessary refuge seeds. "We are hopeful that this will be approved by government so as to prolong the life of the technology," he said

## What are Genetically Modified Organisms?

GMOs (or 'genetically modified organisms') are living organisms whose genetic material has been artificially manipulated in a laboratory through genetic engineering. Most developed nations do not consider GMOs to be safe. In more than 60 countries around the world, including Australia, Japan and all of the countries in the European Union, there are significant restrictions on outright bans on the production and sale of GMOs.

A large percentage of all GMOs grown worldwide are engineered for herbicide tolerance.

As a result, use of toxic herbicides like Roundup has increased 15 times since GMOs were introduced. GMO crops are also responsible for the emergence of

'super weeds' and 'super bugs,' which can only be killed with ever more toxic chemicals.

The long-term impacts of GMOs are unknown and once released into the environment, these novel organisms cannot be recalled. Because GMOs are novel life forms, biotechnology companies have been able to obtain patents with which to restrict their use. As a result, the companies that make GMOs now have the power to sue farmers whose fields are contaminated with GMOs, even when it is the result of inevitable drift from neighbouring fields. GMOs therefore, pose a serious threat to farmer sovereignty and to the national food security of any country where they are grown.



Bhagirath Choudary the Founder Director of South Asia Biotechnology Centre (SABC), explained that the number of sprays that farmers would usually use is one or two but due to peculiar rainfall patterns, there was an unusual increase in the whitefly population which led to the excessive spraying.



Head of Monsanto Africa Gyanendra Shukla looking closely at cotton plants grown in the dry rain fed areas.



Delegates from the six countries touring a cotton seed processing plant, where the GM Cotton seed is processed into animal feed and cooking oil.



An example of high density cotton cultivation which was said to increase yields, provided enough fertiliser and water was made available.



Cattle feed manufactured from Bt cotton seed.

Society for Cotton Improvement (SCI), Mumbai in collaboration with the ISAAA AfrCenter and the Alliance for Commodity Trade in Eastern & Southern Africa (ACTESA/COMESA).

The tour included on site visits to Bt cotton crop farms, seed processing facilities and relevant cotton sub-sector players in Punjab and Haryana States of Northern India and Amravati district of Maharashtra State of Central India.

Participants had the opportunity to interact with farmers, scientists, researchers, regulators, seed producers, policy makers and other sub-sector players for experiential learning.

According to the organisers, it was expected that the tour will help build the necessary confidence among the African stakeholders on cotton hybrid seed market and regulatory processes, biosafety communications and commercialisation of biotech crops including Bt cotton in their respective countries.

About 30 delegates from Kenya, Malawi, Sudan, Swaziland, Zimbabwe and Zambia comprising of biotech regulators, policy makers, farmer leaders, seed traders and journalists participated.

## Rain fed vs irrigated areas

Though cultivating the Bt cotton variety may be economic in irrigated areas, it would seem the costs of Bt seed and insecticide increase the risk of farmer bankruptcy in low-yield rain-fed settings. Considering that the majority of cotton in Swaziland is grown in the dry 'Shiselweni' Lubombo region, it warrants careful consideration on the part of the farmers and regulators. The questions becomes, will we receive enough rains to guarantee a favourable yield and do the farmers have enough capital to continue spraying other pests which will emerge, other than the bollworm which the plants will eradicate themselves.

## Times of Swaziland "GMO Bt Cotton: Seeds of Suicide or Saviour of Dying Cotton Industry

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# CRISIS AS WHITE FLY ATTACKS INDIA'S BT COTTON

### ...farmers revert to excessive spraying of pesticides

ONE of the observations that was immediately apparent as the delegates arrived in Haryana, was that of a devastating whitefly attack across North India's cotton belt particularly in Punjab and Haryana. Cotton farmers in the belt will be affected due to the pest attack which is estimated to have affected at least 60 per cent of the crop area. When interviewed about the number of spraying sessions that they have had to implement due to the whitefly epidemic, most of the farmers signified that it is well over six or eight sprays over the course of the growing season.



The delegates from six countries who participated in the Bt cotton tour in India.

## OPPORTUNITY FOR FDI THROUGH BT COTTON - COTTON BOARD CEO, DANIEL KHUMALO

THE Swaziland Cotton Board CEO Daniel Khumalo, said the Indian tour was beneficial in that it will enable the delegates to evaluate what this technology can do for their countries.

In relation to Swaziland, he said since India is receiving foreign direct investment through the introduction of GM cotton, it would also open opportunities for FDI in Swaziland too.

"The introduction of GM cotton in India has opened job opportunities for Indian families throughout the cotton value chain. More people were employed at production level due to areas planted.

Ginnery operates throughout the year, similarly seed processing and lint spinning companies operate throughout the year and India is receiving direct foreign investment through the introduction of Bt cotton," he said.

"What the technology has achieved in India is possible here in Swaziland."

"With the Biosafety Act of 2012 in place and a functional National Biosafety Advisory Committee (NBAC), Swaziland is on the right track to follow

ers would typically spray more than 10 times to get rid of the bollworm but now spraying has been reduced to two or three, only to get rid of other sucking pests, he explained.

### Indian Government offers relief packages for failed crops

Following the spate of suicides by indebted farmers feeling helpless after failed Bt cotton, the Indian Government opted to offer relief packages to affected farmers.

The Indian States are suffering the first major pest infestation since the country adopted genetically modified cotton in 2002, raising concerns over the vulnerability of the lab-grown seeds that yield nearly all of the cotton in the world's top producer. Damage from the whitefly attack on the Bt cotton variety in the States of Punjab and Haryana is likely to be extensive and has even been

blamed for farmer suicides, according to local officials and experts.

Bt cotton was tweaked by scientists at Monsanto to produce its own insecticide to kill pests like bollworms, however, the spread of whitefly against which the strain has no resistance is proving to be a challenge. The winged pest damages the leaves of the cotton plant by sucking out fluid and transmitting viral infections.

### Mahyco continues with whitefly research

Bt technology is effective only against specific types of bollworms that are known to cause maximum yield loss and economic damage to the cotton crop. During the tour, the delegates were invited into India's Mahyco research centre where they were informed that there is ongoing research into a gene that will offer plants resistance to the whitefly but thus far they had achieved no success.



Cotton Board CEO Daniel Khumalo listening attentively as researchers explain the process involved in creating hybrids of Bt cotton.

resources.

"The issue of insufficient resources cannot stop us from moving forward, as there will never be a time where we have sufficient resources to handle any technology," he said.

He noted that it was interesting to note that special seasons have special

problems, which are not related to the introduced technology e.g. the whitefly problem in India.

"In Swaziland, we are currently facing a mealy bug problem but that cannot prevent us from moving forward and introduce GM technology which will eliminate boll worms our major problem as a country," he concluded.

Board CEO Daniel Khumalo, they have submitted a report to the National Biosafety Advisory Committee, outlining the progress and results from the field trials. Along with the report, the Board has also submitted an application for a permit/licence to allow them to grow commercial Bt cotton in the country.

## We need better research facilities - ACAT National Director Enock Dlamini

Enock Dlamini, the National Director of ACAT, has said one of the major challenges faced by the country with regards to biotechnology is that we lack the adequate research facilities.



ACAT National Director Enock Dlamini wearing a mask at the cotton seed processing plant, where they said once the oil has been processed, there are no traces of the Bt gene in it.

"Indian farmers are producing a lot of cotton and as such, a lot of support and back stopping support is in place to make it possible. Such included well equipped resources research public and private institutions to support production of cotton," he said.

"I would propose a serious review of the Cotton Industry, with a view to make changes that would see an increase in the number of farmers involved in cotton production. This is pre-requisite to Bt cotton considerations," he added.

"We need to establish those challenges faced by our farmers in the production of cotton in Swaziland, so that we address them once and for all before we explore Bt cotton which, unfortunately, cannot be viewed as our solutions for growing the cotton industry in Swaziland," he said.

"Unlike in India, it remains a challenge for us in Swaziland when it comes to research facilities and equipments.

It is a challenge going forward with the technology," he concluded. Dlamini who is also a member

of the National Biosafety Advisory Committee (NBAC), advised that the country needs to slow down, learn from those ahead of Swaziland to avoid their mistakes.

"Even for India, it took them a lot of time while doing some research on the technology, why should anybody push Swaziland into releasing the technology prematurely," he said.



Biosafety Registrar Bongani Nkabinde addressing the Bt cotton farmers in Punjab.

## Transparent Risk Assessments will protect nation - SEA Bongani Nkabinde

Bongani Nkabinde, the Biosafety Registrar at Swaziland Environment Authority, has said even though the benefits of the technology seem enticing, regulation of the technology is quite important as well as conducting transparent risk assessments.

"As Swaziland, with the Biosafety Act of 2012 in place, I believe that we are placed in a better position to regulate the technology. The SLA could pledge for support from the government and the public to efficiently implementing the Act," he said.

He noted that the technology does have its benefits which may include, yield protection, cost reduction as well as the reduction of the drudgery associated with conventional cotton. There are also concerns that can be associated with the technology and these may be; environmental (genetic pollution, loss of traditional varieties, loss of biodiversity), socio-economic (buying seed year after year, ethical issues) Health issues (potential toxicities and allergenicity).

He added that before embarking on the tour which the organisers dubbed the "Seeing-is-Believing Tour", he was hoping to see the

performance of a commercialised Bt crop, as well as to understand the regulatory regime in countries that have commercialised GM cotton for some time. "I was also hoping to know if they were still conducting 'Post-release' research activities on the commercialised GM cotton," he said.

When asked what he had learned during the tour, Nkabinde listed the following.

Even though they have commercialised Bt cotton for quite some time, the government, universities and private sector are still undertaking scientific research on the released GM hybrids.

Most of the farmers which were used for demonstration purposes were irrigating, yet our farmers rely on dry-land production.

There were a rigorous public education campaigns before introducing the farmers.

Regulation is required at all times.

Farmers, when not monitored, could easily bypass some of the required cultural practices for growing GM crops.

Nkabinde went on to urge all potential users of the technology to apply to the SLA before importing or raising GMOs in the country.

## Why do hybrid seeds cost more than OPVs?

### Agriculture

## Why do hybrid seeds cost more than OPVs?

*Lessons from a study tour to India Biotech Cotton Fields*

By Margaret Korembu and  
Bhagrat Choudhary

Respective of the crops, hybrid seeds are relatively more expensive than the open pollinated varieties (OPVs). As of now, hybrids can be produced for those crops that are cross-pollinated like maize and in some cases for self-pollinated crops like rice where scientists have created a system of fertilization either by deploying CMS (Cytoplasmic Male Sterility) or GMS (Genetic Male Sterility) systems. However, it is difficult to produce hybrids of many self-pollinated crops like cereals (wheat), pulses (chickpea) and oilseed crops (soybean).

One may wonder why there is a need to produce hybrid seeds, who breeds them, who produces them and why do hybrids cost more than OPVs? These are questions that a delegation of 30 stakeholders from six African countries (Ethiopia, Kenya, Malawi, Sudan, Swaziland and Zambia) repeatedly asked during a study tour on biotech cotton hybrids in India. The visit was organized by ISAAA AfriCenter in collaboration with the South Asia Biotechnology Centre (SABC), COMESA/ACTESA, OFAB, PBS, USDA and a local Indian seed company Mahyco from 27th Sept to 2 Oct 2015.



African delegates tour Mahyco Biotech Cotton Hybridization plot in Maharashtra

The African delegation visited and saw hybrid cotton seed production plots both in the fields of public sector institutions such as CCS HAU, Hisar, Haryana and in the fields of Mahyco of Jalna district of Maharashtra.

Hybrid or cross-breed refers to any offspring (hybrid) resulting from the breeding of two genetically distinct individuals (parents).

Hybrids are produced to exploit vigour or heterosis, which is the combining ability of the two distinct parents. Many delegates were curious to know if crossing any pair of inbred parents can produce a desirable hybrid. Notably, the science of cross-breeding is much more intense and rigorous than simply combining any particular pair of inbred parents that may not result in superior offspring or hybrid. Therefore, the breeders have to carefully choose male-female parents that not only synchronize simultaneously but also demonstrate desirable level of uniformity. Importantly, the high level of vigour in female parent and the pollen production ability of the male parent are the common denominator for production of a uniform, superior and high yielding hybrid (F1).

The next important question was, why produce hybrids? Well, it was easy for the delegation to grasp the answer to this particular question from the fields visited and farmers' testimonies. According to 41 year-old cotton farmer Deepok Arun Ambore of Shil Gaon, Aurangabad in Maharashtra, farmers in his village have reaped big from biotech cotton hybrids.



Mr Timothy Ogwang - State Department of Agriculture

## Why do hybrid seeds cost more than OPVs?



The chairman of the County Executives of Agriculture in Kenya, Hon. Moses Mwanje (front row in cap) and Hon Katana Menza – Kilifi Agriculture CEC (In black shirt) with Mr Choudhary (far right) together with some of the delegates in the field during the visit



Dr Anthony Muriithi of Kenya's Fibre Crops Directorate admire Extra Long Staple hybrid cotton during the India visit

From the family farm where they grow Extra Long Staple (ELS) cotton, they harvest 33-36 mm staple length of ELS Bt cotton much higher than the medium to long staple Bt cotton. As a result, the ELS Bt cotton fetches very high price in the market. They harvest around 120 bolls per plant per season, which is twice the number of bolls harvested by Punjab and Haryana cotton farmers. The cotton crop in this dryland area is a long duration crop with farmers picking cotton bolls 5-6 times in the season compared to 2-3 pickings by farmers in Punjab and Haryana regions.

The delegates unanimously agreed that the introduction of cotton hybrids has greatly improved cotton yields in India. Representatives from Sudan and Malawi confirmed that their countries have already approved cultivation of cotton hybrids, while others like Kenya, Ethiopia, Zambia and Swaziland are at the penultimate stage towards introducing cotton hybrids. Most of them were keen to see the cotton sector in their respective countries utilize the combining ability of male-female parents and exploit not only vigour but also transfer key agronomic and quality characteristics such as higher yield, greater uniformity, improved colour, and in some cases, resistance to biotic and abiotic stresses in the resulting offspring (hybrid).

Another striking attribute of hybridization of cotton was the potential to generate employment in the rural area,

going by the number of hours the process demands. The emasculation and pollination activity for producing cotton hybrid F<sub>1</sub> alone generate around 800 days per acre per season of hybrid cotton production plot. Simply put, an acre of hybrid cotton seed production plot for a season of 180 days generates around 800 days or approx 4 days per day of cotton crop season. At the national level, this translates into an enormous opportunity for job creation in rural India, which produces sufficient hybrid cotton seeds that cover 95% of total cotton area of approx 12.5 million hectares. In addition, the farmers who undertake hybrid seeds production earn as much as twice that of growing commercial hybrid cotton crop. Many of the African delegates highlighted the challenges being faced by their respective countries in improving cotton production.

They pledged to share the lessons learned with their respective stakeholders and do everything possible to convince their Governments about this enormous opportunity in cotton for wealth and employment generation in Africa.

**Dr Margaret Karembu is the Director ISAAA AfriCenter and Mr. Bhagrat Choudhary is the Director, South Asia Biotechnology Center**



ANNEXURE

## ANNEXURE-1

### Survey Analysis of African Study Tour to Bt Cotton Fields in India,

28th September-2nd October 2015

This section presents the analysis of the feedback received from the participants of the African Study Tour including those from India. An extensive feedback form was provided to the participants at the beginning of the Study tour. A copy of the feedback form in the format of a questionnaire is annexed in this report. The questionnaire of the comprised of generic information about their affiliations, perception and knowledge of biotechnology, understanding about cotton crop and regulatory system, ability to synthesize and take away messages and capacity to pass on right information to key stakeholders back home. Following paragraphs capture the essence of feedback received from the delegates. The analysis also covers their independent views and opinion expressed by the delegates about the African Study tour "Seeing in Believing" to Bt cotton hybrids in India.

#### Respondent's particulars:

**Gender:** The delegation of African Study tour comprised 88% of male and 12% female participants

#### 1. Have you heard about Bt-cotton before this tour?

Yes	No
25	11.1

#### 1.1 Years of familiarity about Bt cotton

0<	5yrs	<10yrs	10 yrs>
1	8	3	14

#### 1.2 Source of information about Bt cotton

Organization	Rank
Universities	1
Media	2
Industry/ private sector	3
Government agencies	4
Environmental groups	5
NGOs	6
Religious organisations	7

Notably, almost 96% of the participants had heard and knew about Bt cotton before the African Study Tour to Bt cotton in India. Majority (53%) of those participants had heard about Bt cotton for more than 10 years, while 31% had heard for less than 5 years and 12% for slightly below 10 years. Majority saying they had learnt about Bt cotton from university, followed by the media, Industry and private sector, Government agencies, environmental groups, NGOs and religious organisations in that order. This information was important for the organisers to probe them and share with them indepth information about

Bt cotton, regulatory requirements, cultivation practices, growing seasons, resistance management and stewardship issues in the successful cultivation of Bt cotton.

#### 1.3 What do you know/understand about Bt-cotton?

Description	Rank
Cotton with ability to control pest	13
Cotton with a desired gene	6
Cotton that is safe to use	1
Cotton with ability to increase yield	8

A majority (46%) of the African delegates associated Bt cotton with control of pest mainly bollworm, 28% believed Bt cotton has more yield while 21% described Bt cotton as a cotton variety with a desired gene.

#### 2. Have you seen Bt-cotton planted in the field (trial) before this tour?

Yes	No
20	6

#### 2.1 Where did you see planting of Bt cotton?

Description	Rank
Field trial	12
Farmers' field	9

#### 2.2 When did you see Bt cotton in fields?

< 5yrs	< 10yrs
16	4

Interestingly, 76 percent of the participants acknowledged having seen Bt cotton planted before the tour while the rest didn't. Of those who had seen Bt cotton, majority (57%) was at in country field trial, while 43% had prior visited a farmer's field either in Burkina Faso, South Africa or Sudan, three African countries that have released Bt cotton for large scale planting. Notably, majority of them (80%) was from a recent Bt cotton field experience i.e. less than 5 years.

#### 3. Are you aware of the controversies (benefits and risks) of Bt-cotton?

Yes	No
24	2

#### 3.1 How do you rank benefits/risks of Bt Cotton

Controversy	Rank
No quality difference with conventional	1
Effects of Bt on non-target organism	2
Harmful to human & Environment	10
Insecticide resistance in the long run	3
No export market	1
Loss of local variety	2
Gene flow1 May cause cancer	1

At least 92% of the respondents were aware of one or

two controversies of Bt cotton with main ones being a believe it has harmful effect to human and environment (47%), the fear it could lead to emergence of insecticide resistant pests (14%), loss of local cotton variety (9%) and effect of Bt on non-target organism (9%) among others.

**4. Do you believe that your participation in the [Indian] study tour has relevance to your position/work in your country?**

Yes	No
26	0

**4.1 If yes, in what way?**

Description	Rank
Assist in outreach activities	5
Influence adoption in my country	8
Seeing is believing	3
Strengthened knowledge on Bt cotton	5
Learn how Bt cotton farm is managed	2
Demystify myths about Bt cotton	1
Write more articles on Bt cotton	1

Every participant believed that the tour was relevant to him/her, with the majority (32%) stating that the experience would greatly help them influence adoption of Bt cotton in their country. Almost 20% said it would assist them do outreach activities and a similar 20% claimed that they had strengthened their knowledge on Bt cotton.

**5. Can you suggest areas of capacity assistance for people in your profession/work?**

Yes	No
26	0

**5.1 Areas that requires capacity building to accelerate adption of Bt cotton**

Description	Rank
General awareness on benefits and risks of GMOs	21
Biosafety risk assessment	20
Conducting product testing	12
Appropriate and balanced communication	20
Market/Trade issues	2
Partnering in research	1

All participants acknowledged they needed some assistance to boost capacity of their colleagues. With majority 27% requesting for general awareness on benefits and risks of GMOs, 26% biosafety risk assessment, and a similar 26% needed assistance in communicating appropriate and balanced information.

**6. What is the status of Bt cotton research and development**

**in your country?**

Almost all participants aware of the commercial cultivation of Bt cotton in South Africa, Burkina Faso and Sudan. Participants from Kenya were aware of field trials of Bt cotton and were of the opinion that Bt cotton would be approved for commercial cultivation in the near future. Malawi delegation informed that their country has recently approved the cultivation of first hybrid of cotton. Sudan delegation informed that their country has significantly increased area under Bt cotton while Ethiopia was keen to field test Bt cotton.

**7. Who else should be part of such kind of study tours (considering the current status of Bt-cotton development in your own country)? Please rank them!**

Description	Rank
Legislators and Policy makers:	1
Biosafety regulatory authorities:	2
Researchers:	4
Farmers:	3
Private sector actors:	5
Civil Society Organizations:	6
Media:	7
Governors:	8
Researchers:	9

Majority felt that the tour was most suited for legislators and policy makers ranking as number one followed by biosafety regulatory authorities; researchers, farmers, private sector actors, civil society organizations, media, governors and researchers in that order.

**8. How did this study tour help you understand more about Bt-cotton (you may tick more than one)?**

Enlightening	More knowledge	increased confidence	irrelevant
17	21	20	0

A significant majority (36%) believed they had gained more knowledge on Bt cotton from the tour, while 34% had increased their confidence and 29% said they were more enlightened than they were before.

**9. Is there anything new you have learned from this study tour?**

Description	Rank
The role of seed companies in research & technology transfer	1
Indian policy and regulatory frame work	1
Commitment of all development partners	1
By products of cotton seed (oil)	3
Collaboration of different agencies	2
The importance of refuge	6

Lengthy process of making a hybrid seed	1
Importance of investing in R&D	2
% of Bt cotton in India	2
How to pollinate cotton in the conventional way	3

Each participant had something new they learned from the study tour, with the importance of a refuge crop ranking high among the respondents (27%). Around 13% were fascinated by the extraction and consumption of edible oil from cotton seed and 13% learned how to pollinate cotton and produce hybrid cotton in the conventional way among others.

#### 10. Is there any change on your understanding/perceptions with regard to growing Bt-cotton in your own country?

All the participants who responded acknowledged having a perception change regarding GMO and in particular Bt cotton. With some noting as follows;

- They would urge their respective Governments to lift ban on GMO
- People resist GMOs due to limited knowledge
- Bt can be planted by small scale farmers
- Bt is something they need to explore seriously
- Government support is very important to adopt Bt cotton
- They have enhanced their technical knowledge about Bt cotton
- They have learned how the technology can change farmers lives
- They have learned that they can produce Bt cotton in their own country
- They were fascinated by the involvement of young farmers in Bt cotton cultivation

#### 11. How do you intend to use the experience and the learning from this study tour?

A majority of participants were excited to share the experience from the African Study Tour to;

- Reform the research and regulation systems
- Improve the regulatory mechanism
- Raise the public awareness of the stakeholders
- Seek bilateral, regional and international co-operation in agriculture
- Advise regulatory authorities to approve privatization of Bt cotton
- Write more articles on Bt cotton
- Influence policy change for adoption of Bt cotton

#### 12. Your parting shot/memorable quote from this trip

1. "Learning by seeing built confidence" – **Timothy Jomo Ojwang**
2. "We should not let our people suffer now in the

name of protecting the coming generations. Let this technology be adopted immediately" – **Edwin Kichwen Rutto**

3. "We had abandoned cotton farming, we are back in it due to improved earning courtesy of Bt cotton" – **Anthony Muriithi**
4. "Proverb 29:18 – My people perish for lack of knowledge. If we as Kenyans and Africa as a whole don't move faster we shall be screwed up. This is the time to change, otherwise change will change us for worse not for good. I really appreciate ISAAA Africa and SABC for allowing policy makers and implementers from the Counties in Kenya to participate in the study tour. Dr Margaret Karembu and Bhagirath Choudhary, we thank you so much. Keep up!" – **Moses Mwanje Osia**
5. "It was a very good trip" – **Narrik Salaldeen**
6. "It was a good trip and I benefited a lot" – **Mohamed Yousif M**
7. "The well balanced and organized production system for all crops that maximize the contribution of the agricultural system to general economy of the country" – **Asim F Abu Sarra**
8. "GMOs love them or leave them (policy consideration). Innovations to provide food and fibre are ultimate global concerns and are indispensable for growth, development and poverty alleviation. Change challenges to opportunities. Look for the future in the future and NOT in the past. Put young generations on board as early as possible" – **Merghani Ibnoaf**
9. "Seeing is believing" – **Daniel Khumalo**
10. "Bt cotton and GM technology is a technology that is transforming farmers lives through increased financial benefits, better health and improved standards of living. It is necessary and it is needed in Kenya and Africa as a whole. The study tour was very well thought out, well planned, efficiently conducted and with an exceptional level of hospitality. My highest regards and compliments to Dr Bhagirath and his team for an excellent job of organizing the tour in such a short time." – **Dan Kiambi**
11. "Good seed is made" – **Mwalimu Menza**
12. "The trip is one of its kinds in my life. I have travelled a lot but India is the best for me and I will wish our farmers and political leaders be given a chance to visit and see for themselves since seeing is believing" – **John Wanyama**
13. "It was a great trip, eye opening regarding the benefits of the technology. Both the technology



could have been wrongly portrayed to the participants since no concerns were highlighted. There is no technology with zero risk, yet in this tour the potential risks were not clearly outlined amidst the ongoing controversies” – **Bongani Nkhabindze**

14. “Transparency and truth will help us learn from other countries that are ahead of us in using the technology” – **Tsakasile Dlamini**
15. “A worthwhile study tour. Thanks to all organizers.” – **Enock Dlamini**
16. “Do not kill that patent to protect the future” – **Godfrey Chingoma**
17. “Better move with world's developments” – **Lyson Kampira**
18. “Considering the wealth of knowledge and

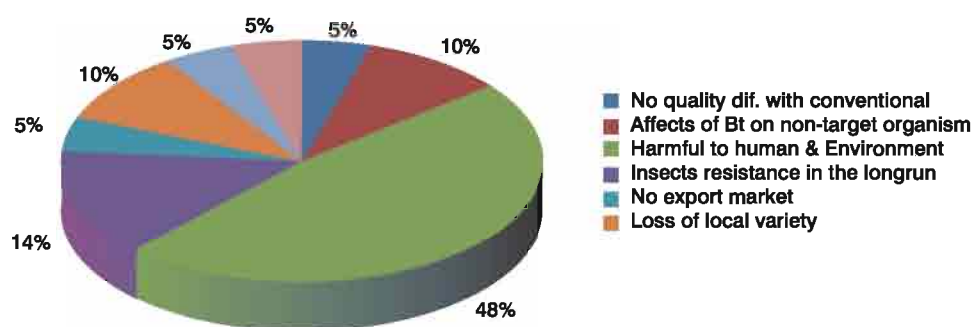
seniority among participants, it would have been extremely beneficial if an opportunity was provided to discuss formally views, status plans of individual countries. This would have provided further confidence and direction for members who might still be uncertain on way forward” – **Patrick Khembo**

19. “At first I will inform my staff members and institute and then I will work hard with all the respective stakeholders for the Bt cotton introduction, trial and production. All Indian hosts are very collaborative to make the study tour group know everything from introduction to production and processing of Bt cotton” – **Bante Kassie**

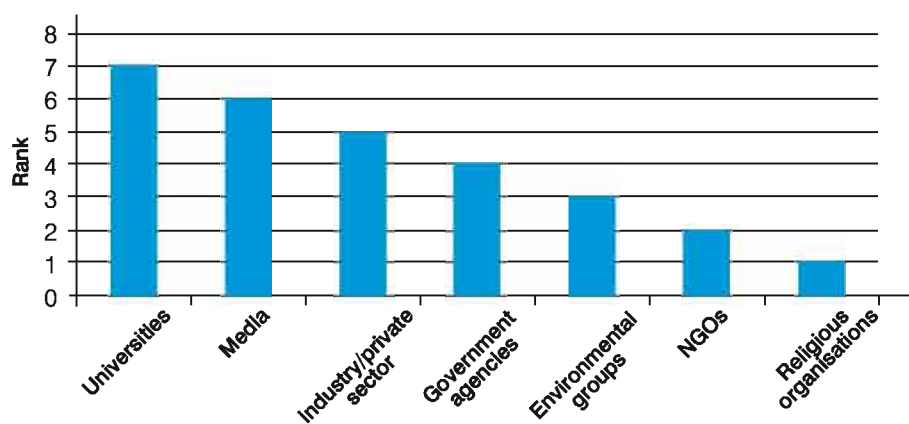


## Graphical Analysis of African Study Tour to Bt Cotton Fields in India

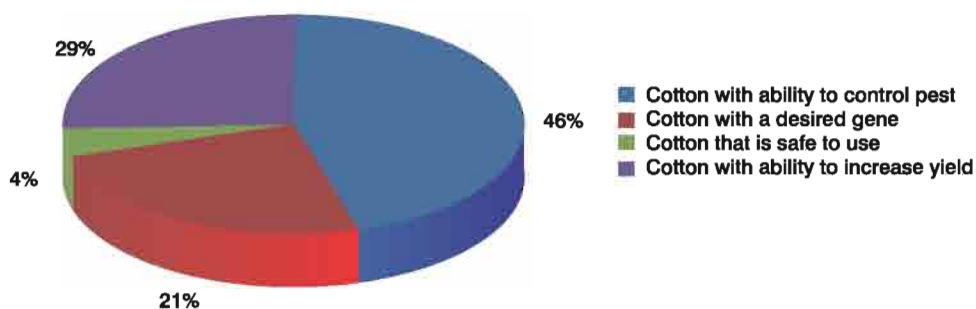
Controversies (benefits and risks) of Bt-cotton



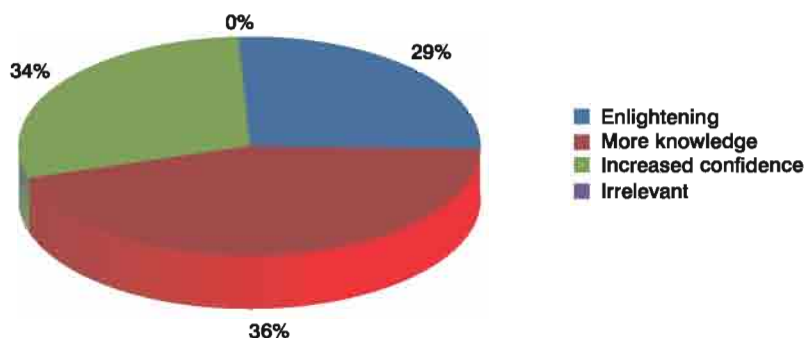
Source of information



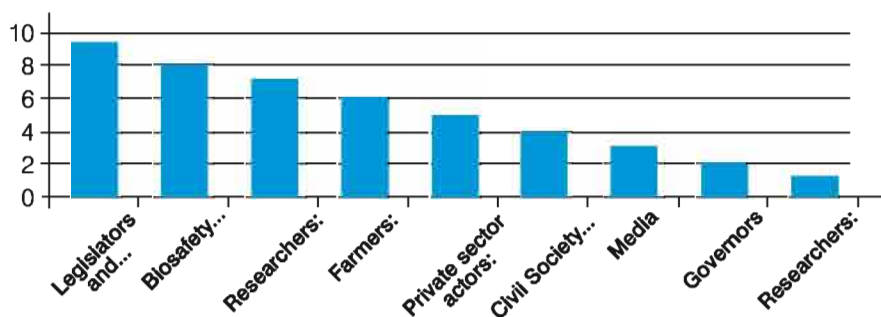
What do you know/understand about Bt-cotton



How did this study tour help you understand more about Bt-cotton



Who should be part of such kind of study tours



## ANNEXURE-2

### Questionnaire to survey opinions from participants on “Seeing-is-Believing” study-tour to Bt cotton fields in India,

28 Sept-2 Oct 2015

#### Respondent's particulars

Name and gender:

Profession/position:

Country:

**1. Have you heard about Bt-cotton before this tour?**

\_\_\_\_\_ Yes

\_\_\_\_\_ No

If Yes,

When \_\_\_\_\_

From where or who? (media, researchers, workshops, others)

Please rank the top four MOST trusted sources of information for you

**Rank Organization**

1. Universities
2. NGOs (ask for applicable examples)
3. Environmental groups
4. Government agencies
5. Religious organisations
6. Media
7. Industry/ private sector
8. None
9. Don't know
10. Other (specify)

**1.2 What do you know/understand about Bt-cotton?**

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**2. Have you seen Bt-cotton planted in the field (trial) before this tour?**

\_\_\_\_\_ Yes

\_\_\_\_\_ No

If YES,

1.1. When? \_\_\_\_\_ Where? \_\_\_\_\_

**3. Are you aware of the controversies (benefits and risks) of Bt-cotton?**

\_\_\_\_\_ Yes

No \_\_\_\_\_

If Yes,

Please briefly describe what you know in your own understanding.

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**4. Do you believe that your participation in the [Indian] study tour has relevance to your position/work in your country?**

\_\_\_\_\_ Yes    No \_\_\_\_\_

If Yes, in what way?

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**5. Can you suggest areas of capacity assistance for people in your profession/work?**

\_\_\_\_\_ Yes    No \_\_\_\_\_

If Yes, Please tick where appropriate:

\_\_\_\_\_ general awareness on benefits and risks of GMOs  
 \_\_\_\_\_ biosafety risk assessment  
 \_\_\_\_\_ conducting product testing  
 \_\_\_\_\_ appropriate and balanced communication  
 \_\_\_\_\_ Other

**6. What is the status of Bt-cotton research and development in your country?**

\_\_\_\_\_ No need (because there is no insect problem).  
 \_\_\_\_\_ under preparation for application  
 \_\_\_\_\_ application submitted to regulatory authorities  
 \_\_\_\_\_ application approved  
 \_\_\_\_\_ Confined Field Trials  
 \_\_\_\_\_ wider multi-location field trials  
 \_\_\_\_\_ commercially released  
 \_\_\_\_\_ I do not know

**7. Who else should be part of such kind of study tours (considering the current status of Bt-cotton development in your own country)? Please rank them!**

Legislators and Policy makers: \_\_\_\_\_  
 Biosafety regulatory authorities: \_\_\_\_\_  
 Researchers: \_\_\_\_\_  
 Farmers: \_\_\_\_\_  
 Private sector actors: \_\_\_\_\_  
 Civil Society Organizations: \_\_\_\_\_  
 Others (specify): \_\_\_\_\_

**8. How did this study tour help you understand more about Bt-cotton (you may tick more than one)?**

\_\_\_\_\_ enlightening                      \_\_\_\_\_ more knowledge  
\_\_\_\_\_ increased confidence          \_\_\_\_\_ irrelevant  
\_\_\_\_\_ other

**9. Is there anything new you have learned from this study tour?**

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**10. Is there any change on your understanding/perceptions with regard to growing Bt-cotton in your own country?**

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**11. How do you intend to use the experience and the learning from this study tour?**

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**12. Your parting shot/Memorable quote from this trip**

**Thank you for your time and kind cooperation!**



## ANNEXURE-3

### African Study Tour Program

<b>Bt Cotton Study Tour by African Delegates to India 27 September to 2 Oct 2015, New Delhi</b>	
<b>Date / Day</b>	<b>Items</b>
<b>Day 1- 27th September 2015</b>	<b>Arrival of African Delegation, New Delhi</b>
<b>Day-2, 28 September 2015</b>	<b>Field Visit To Haryana</b>
	Briefing with Vice Chancellor, Director Research and Cotton Breeder at CCS Haryana Agriculture University (HAU), Hisar Visit to Cotton Breeding Facility and R&D Centre at CCS HAU, Hisar Field visit to Bt Cotton Hybrids Demonstration Plots at CCS HAU, Hisar Briefing with Cotton Scientists, Regional Research Station, CICR, Sirsa Field visit to Bt Cotton Demonstration Plots at CICR Regional Research Station, Sirsa
<b>Day-3, 29 September 2015</b>	<b>Farmers' Field Visits in Sirsa and Bhatinda</b>
	Visit to Farmers Fields of Bt Cotton Hybrids (COE at Farmers Fields), Sirsa Visit to Farmers Field of Bt Cotton (High Density and Mechanical Picking), Sirsa Visit to Small Farmers' Bt Cotton Field, Bhatinda Visit to demonstration plots of approved and New Bt Cotton Hybrids, High Density Bt Cotton hybrids and Mechanical Picking of Bt cotton, Bhatinda Field Visit Farmers' Field and Centre of Excellence of Bt Cotton, Bhatinda Day-4, 30th September 2015 Visit to Govt Officials, New Delhi Meeting with Senior Government officials, New Delhi
<b>Day-4, 1 October 2015</b>	<b>Field Visit, Aurangabad and Jalna</b>
	Visit to ELS Bt Cotton Field, Aurangabad Visit to Young Farmers Bt Cotton Fields, Aurangabad Mahyco's Presentation followed by visit to Mahyco's R&D Facility at Jalna Visit to Bt Cotton Edible Oil and Cake Mill, Jalna Visit to Cotton Hybrid Seed Production at Farmers Fields, Jalna
<b>Day-5, 2 Oct 2015</b>	<b>Departure from Aurangabad</b>

## ANNEXURE-4

### List of Participants

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