Editorial

Dear readers,

For the very first issue of the year 2010, the quarterly newsletter on agriculture and biotechnologies «DABA» does not depart from its editorial line, which is to raise discussion on Bt cotton issues and the stakes thereof. For this edition, the Agripol section mainly drew on the outcome of the capitalization of the Indian experience in the adoption of the Bt Technology in the cotton sector.

India has been chosen because of its rapid adoption and popularization of biotechnologies in its agriculture. Within the space of ten years, partly on account of biotechnologies, India has become one of the major stakeholders of the international trade through the export of agricultural products. With the green revolution, launched in the 70s, India succeeded in putting in place strategies for agricultural development. This helped the country to meet its population’s food needs. The population is now more than a billion inhabitants.

Through its various headings, the fifth issue of DABA deals with the Indian experience in Bt cotton adoption, popularization and marketing. Thus, the “Behind the Scene” heading will help to focus on the genesis of the introduction of Bt cotton in India. In this article, you will find the different stages and ways to the adoption of Bt cotton in India. Moreover, research carried out prior to the introduction of this kind of cotton in Gandhi’s land will be dealt with. The “Breaking News” section provides major information from the summit of the world’s regions on food security held on 18 and 19 January 2010 in Dakar. This summit sufficiently proves that today, taking agriculture into account in the development of nations is a critical stake for poverty reduction in the world. In the same line, the editorial committee put the well known types of cotton in parallel: Bt cotton and conventional cotton. The objective is to find the specificities of each type of cotton. This will be dealt with in the “Cross-Perspective” heading. In order to help farmers grasp the different farming systems, the “Alternatives” heading proposes to identify readers on integrated agriculture, farming halfway between the conventional and biological cotton.

Finally, in the last sub-headings entitled «Testimony», the Director of one of the biggest research centre in India, that is the Central Institute for Cotton Research (Cicr), gives his impressions on the position of his country as far as Bt technology is concerned. Prior to that, he sheds spotlight on the reasons why India engaged in the large scale marketing of the Bt cotton.

To close this first issue, emphasis has been put on Bt gene through the «Focus on» heading. In discovering its origin and its specificity, the readers can then get more familiar with this terminology.

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BT COTTON GROWING IN INDIA

Outcome of a long process

Cradle of cotton, India has been cultivating this plant since 3000 BC. Over the last years, the invasion of pests has forced the country to spend SUS 660 million a year on insecticides with 54% dedicated to the cotton sector. With regard to resistance by some pests, the government has allowed the experiment, then the commercial farming of the genetically modified cotton so as to cope with the situation. Flashback on the introduction process of the Bt cotton in India.

The introduction process of the Bt cotton in India started in 1995 when the Maharashstra Hybrid Seed Company (Mahyco) asked for a permit, from the Department of biotechnologies (Dbt), to import a sample of the Bollgard cotton seed developed by the American company Monsanto. The following year, Mahyco received from Monsanto, a stock of 100 grammes of cotton seed of the American Cooker 312 strain, containing the Bt genes (Cry1 Ac). The hereditary traits of Cooker 312 were introduced into the genome of some 40 parental lines. This mixing produced hybrid varieties containing the Cry1 Ac gene.

Between 1996 and 1998, risks assessment studies were initiated in laboratories and in a few experiment fields, under the supervision of the two biotechnology supreme bodies in India: the Genetic Engineering Approval Committee (GEAC) and the Review Committee on Genetic Modification (RCGM). These assessments dealt with the possibilities of pollen flow, the toxicity and the biochemical analysis of genetically modified plants. Meanwhile, repetitive trials were being carried out, on 40 sites within the nine States of India, between 1998 and 1999, to assess the agronomic and security advantages of the Bt cotton. The results were submitted to the RCGM for validation.

During the years 1999 and 2000, trials were carried out again; but this time, on the field (Editor’s note: 10 trials in total in six States of India), and the results were submitted to the RCGM. In July 2000, based on recommendations, the GEAC allowed large scale trials on 85 ha, and then, the production of seeds on an acreage of 150 ha. In 2001, field trials of about 100 ha were carried out by the Indian Council of Agricultural Research, through a project for the enhancement of cotton in India.

India adopted Bt cotton production

Following the outcomes of the project, in March 2002, the GEAC approved the commercial farming of the hybrid status developed by Mahyco (Mech 12 Bt, Mech 162 Bt, Mech 184 Bt). Thus, Bt cotton became the first ever transgenic crop to be allowed in India for commercial purpose. So, it took Mahyco between six and seven years to complete all the regulatory procedures relating to biosafety and its agronomic impact in order to obtain the official approval for the marketing of this hybrid species. Following the successful attempt by the latter, many seed companies in India expressed the desire to get the right to integrate the Cry1 Ac gene into their hybrid varieties. In 2008, 280 hybrids incorporating the Cry1 Ac gene, from various companies, were approved for commercial farming. These companies include Razi, Ankur, Nazivedu etc.

After the Bollgard I cotton with the Cry1 Ac gene in 2002, Monsanto improved its technology in creating the Bollgard II with different genes (Cry1 Ac+Cry2 Ab). During the same year, the Chinese Academy of Science developed another type of genetically modified cotton with Cry1 Ab: .Cry1 Ac. In 2009, the Bangalore Methahelix group created the Cry1C. The Indian Institute of Technology (Iit) based in Kharagpur also developed its own genetically modified cotton (Event 1) with the Cry1C crystals. Ibib for the Central Institute for Cotton Research (Cicr) of Nagpur which also developed its own Bt cotton. All those varieties of cotton were approved for commercial farming. Today, the number of varieties and hybrids into which the Bt gene has been integrated amounts to 283 in India.

As for the Bt cotton acreage, it shifted from 29,307 ha to 6.8 million ha between 2002 when it was introduced and 2008. To date, the Bt cotton occupies 82% of the total cotton acreage; that is 7.6 million ha out of the 9.3 million ha dedicated to cotton farming in general. The number of Indian farmers to have adopted cotton Bt growing shifted from some thousands in 2002 up to about 5 million producers today. Each year, 11.05 % of conventional cotton growers in India adopt the Bt cotton. This rate is the highest as regards biotechnology adoption in the Indian agriculture. According to Dr Manjunath, former Director of the CICR, « the output shifted from an average of 308 Kg/ha in 2001-2002 to 591 Kg/ha in 2007-2008 ».

Thanks to its successful Bt cotton experiment, India has become, within ten years, the second world leading cotton grower, and has joined the group of world leading exporters where it is ranked third. This is a testimony of the growing interest for the technology in the development of the Indian agriculture, namely in the cotton sector.
The volatility of global market foodstuff prices, the impacts climate change, the staggering growth of population and the ineffectiveness of policies and strategies implemented at the global level for the development of agriculture are the factors that plunges the whole world into food insecurity. According to estimates by the United Nations Food and Agriculture Organization (FAO), more than one billion people are underfed and two billion people are victim of malnutrition. In other words, half of the world population does live in food insecurity. To reverse the trend, territorial communities from the five continents gathered in Dakar on 18 and 19 January 2010 for a Summit.

The theme of the summit was “Agriculture, Access to Food, Nutrition: Regions in Action against the Food Crisis”. The objective of that world meeting was to develop common strategies for a better involvement of « world’s regions » in the attainment of food security. World’s regions stands for territorial communities as a public authority level (region, department, and rural community). The concentration of power by definition, the development, implementation and monitoring of public policies by the central government (State) at the macro level proved to be ineffective as a strategy to reduce poverty and to achieve the MDGs by 2015. Thus, according to many agriculture specialists, “it is urgent to act at the grass-root level in the conduct of policies, particularly in the field of agriculture ». That is why « the “region” level is thought to be a good lever, because it is a link between the government and citizens (grass-root populations). As for intermediate entities (regions), that is to say, the elected representatives, they are more aware of the grass-root stakeholders’ concerns, needs and expectations. They are therefore in a more proactive position to work for a better involvement of these stakeholders in the development of their region”.

At the different plenary sessions where the issue of involving the regions in the attainment of food security was discussed, decentralization was suggested as capable to lay the foundations of the agricultural and rural sector growth for the attainment of food security. This policy is likely to efficient, because it will consist in transferring more authority to the citizens or to their local elected representatives. In the agricultural sector, this transfer of power could strengthen the portfolio of these communities and widen their intervention area to upgrade the level of agricultural activities. Such a kind of success may generate additional incomes for the rural populations. Participants also stressed the need for developing partnership between the world’s regions and institutions working on agricultural development issues (FAO, PNUD, national Co-operations, etc.). The establishment such a multi-partnership framework should help avoid duplicating similar actions in identical intervention areas and, by the same token, see to a mutualization of resources for a consistent implementation of policies. Finally, the accountability of the grass-root stakeholders was often advocated during the discussions. Giving these stakeholders responsibilities would help them to appropriate all the dimensions related to their environment and to facilitate their involvement in the development of policies.

It should be noted that all the recommendations of the Summit have a common denominator without which no development action is possible: political will. The various experiences talked about at the Summit showed that most of the successful actions towards food security attainment resulted from joint efforts and contributions by the different stakeholders involved supported by a true political will. The attainment of food security is at that price.
COTTON GROWING

Is transgenic cotton a solution to the inefficiency of the conventional cotton?

Conventional cotton and genetically modified cotton are two different types of cotton according to their properties and farming method. Whereas conventional cotton growing requires that the farmer gets the seeds and insecticides in order to face pest attacks, the genetically modified cotton or Bt cotton already has its own proteins to fight against pests.

Protection of the environment, efficient fight against pests, increase of the output, and reduction of work time are, inter alia, reasons why some farmers adopted genetically modified cotton instead of the conventional cotton.

The Bt genes, which are toxic for some pests, namely the Lepidoptera, have been isolated and carefully introduced into the genome of the cotton plant. Farmers no longer have to treat their fields against the attacks of some pests. The transgenic cotton plant is therefore immune to pests, and then, the work time and exploitation costs are reduced.

This is not the case with the conventional cotton. Actually, the spraying methods resorted to for the protection of conventional cotton plants...
are externally applied. Therefore, it is difficult to obtain a uniform coverage of the cotton plant. This leads to an overuse of pesticides. For Bt cotton, on the other hand, the protein produced by the transgenic cotton plant covers the whole plant all along its growth, that is to say, from the root to the leaves through the stem. The protein continuously provides an effective control of bollworms, and ensures a better yield for farmers. The other characteristic is that the surface treatment of the conventional cotton is not necessarily efficient. In fact, the action of the insecticide sprayed on the plant is lessened, because it is exposed to sun and rain water. On the contrary, for genetically modified cotton, the protein present within the plant is not directly submitted to external contingencies.

Apart from these important differences, it should be noted that the treatment of conventional cotton fields results in the degradation of the environment, particularly plant and animal life, and the pollution of the water table. This concern is taken into account by the Bt technology, because it is only harmful to pests of the Lepidoptera family. In principle, it is therefore said, according to researchers, to harmless to other plants and living organisms. Thus, it helps to significantly reduce the number of synthetic chemical treatments, for a better protection of the environment, plants and animals.

Despite these advantages, genetically modified cotton remains sensitive to attacks by other pests not belonging to the Lepidoptera family. Farmers who grow it must carry out specific treatments against the other insects. Moreover, the protein in the Bt cotton declines between 90 and 100 days after sowing. This may require additional control measures.

It should be mentioned that transgenic seeds are more expensive than the conventional ones. As a matter of fact, the intellectual property right on the technology is included in the Bt seed price.

Moreover, the notion of « refuge zone », which goes together with genetically modified cotton growing, is often not well understood by farmers. Some researchers warned that without this « refuge zone », the pests might be developing resistance to genetically modified cotton after 10 or 12 years of farming practices.
Balancing respect for the environment and economic profitability, seems to be the motto of supporters of the reasoned agriculture. They define it as an agricultural production system, the primary objective of which is to optimize the economic performance by controlling the quantities of inputs, including chemicals that are used such as pesticides, herbicides and fertilizers, in order to limit their impact on the environment.

Aware of the difficulties arising from the non-use of pesticides, advocates of reasoned agriculture, unlike their counterpart of organic agriculture, do not refrain from the use of synthetic chemicals. Therefore, “reasoned agriculture” is a compromise halfway between organic and the so-called intensive farming. However, this alternative is suggested only when absolutely necessary. In other words, farmers must use pesticides when the quality and quantity of the harvest is at stake. Hence, the use of modern pesticides, often more efficient and with low persistence on the plant and soil, is allowed. Integrated farming is beneficial to producers in that it promotes the association livestock and agriculture. By using livestock by-products to fertilize and maintain the fields through organic manure, it diversifies the source of income for farmers. The interest of integrated farming is twofold. In addition to enabling the producer to significantly reduce its expenditures in plant treatment, it yields products with fewer chemicals for the consumer.

As a form of sustainable agriculture in tune with the principles of sustainable development and intended for all producers, integrated farming contributes to a better preservation of the environment. But the difficulty with his practice is that it entails extra work, because it requires many observations, analyses, manpower, and invaluable technical support. Such conditions make its application difficult for producers in Southern countries, because they require extra financial means.

With regard to difficulties inherent in its implementation, reasoned agriculture could be adapted to different farming situations of the moment. Its practice will allow farmers to make smooth changes in their modes of production. By gradually adopting more environmentally friendly methods, farmers could, on the long run, shift to organic production. Therefore, sustainable agriculture may well be a step that could lead to organic farming.

The solution of sustainable agriculture has been advocated for the sake of the ongoing effort to protect the environment while providing intensive agricultural production. This concept of reasoned agriculture is nothing but the French translation of the English phrase “Integrated Farming”.

“Reasoned agriculture” is a gateway to organic farming.
The introduction of Bt cotton in Africa must be done step by step

Dr. Kranthi is the Director of the Central Institute for Cotton Research, Nagpur, India. In the interview he kindly gave to DABA, Dr. Kranthi, Cotton Researcher of the Year Award 2009, shed a spotlight on the history of the introduction of Bt cotton in India. The cooperation between his country and Africa for better adoption of this technology has also been discussed.

Daba: What is the impact of the introduction of Bt cotton in India

Bt cotton was introduced into India in 2002 from Monsanto through an Indian company called Mahyco. Ever since the introduction of Bt cotton, we found that it was very useful; primarily because it reduced a lot of drudgery that was associated with cotton farming. Farmers are no longer scared of the American Bollworm but I must also let you know that before the introduction of Bt cotton, farmers were completely disgusted with the American Bollworm, which we call Helicoverpa Armigera. The American Bollworm had developed a great deal of resistance to almost all the commonly used insecticides. Prior to the introduction of Bt cotton in India, the conventional hybrid was about 40%, today after 7 years, Bt cotton represents about 85% of total cotton acreage in India.

How can the breakthrough of Bt cotton in so short a span of time be accounted for?

Bt is not a yield enhancing technology, it is a crop protection technology. Farmers were able to save a lot of investment by reducing 50 to 60% insecticide usage. In most cases, 90% of the insecticide quantity used on the Bollworm was eliminated because of Bt cotton, so what earlier farmers used to apply something like 20 applications, was reduced to an extent of 1 to 2 applications. This situation had had a positive impact to the environment.

What are the major difficulties encountered during the adoption of this crop?

In the initial few years, there was a problem with the price because the seeds were about 4 to 5 times more expensive as compared to the conventional hybrid, but later the Supreme Court in India ensured that the seeds cost now is almost less than half of what it was before. Currently, farmers get Bt seeds at about 650 Indian rupees (about FCFA 6500) for 450 grams of the hybrid Bt seed, but this package also comes along with 330 Bt seeds and 120 grams of the non Bt seeds.

How can you explain the increasing number of applications reported in India for some time now?

It is very clear that ecologically things are moving well, but at the same time because the insecticides usage was reduced some miscellaneous minor insect bugs also became more important, bugs like mealybug, which never occurred on cotton, mirid bugs which were not known to cause any damage earlier and thrips which started giving about more problems of late. So, it is true now that though we have a substantial advantage in the reduction of insecticides, today there is a slight increase and we want to stop that. What used to be an average of about 3 to 4 applications of insecticides before 3 years, now has become about 5 to 6. We don’t want this to increase at all, so all of us here are trying very hard to ensure that there is no resistance development, in sucking pests, such as the jassids and mealybugs, and also we want to establish a good resistance management strategy for the bollworms, so that resistance development against Bt cotton will be delayed. We are putting together all our efforts on this, so that India will have its own specific strategies.

We can enjoy the benefits of B.T. cotton for some more time and because the yield what was before was 16.5 million bales, 1 bale is 170 kg, the 16.5 million bales increased within six years to 31.5 million bales, which is spectacular. We want our farmers to get the benefit of Bt cotton for the longest possible time, and today because Bt is affordable farmers are happy and we want to ensure that things go well for the longest possible time.

Why did so many farmers commit suicide in the State of Andhra Pradesh since the introduction of Bt cotton?

Farmers’ suicides are unfortunate. However the issue has got nothing to do with cotton and of course not at all with Bt cotton. There is not even a single case, anywhere in the country where we can establish a cause and effect relationship between cotton farming and suicides. Our institute conducted studies in a state of Andhra Pradesh to know more about it. You are in Central India, in Maharashtra. This is where every one was starting to say that initially it was cotton and suicide. The economy was very difficult earlier. There are farmers who would have got low yields due to wrong choice of genotypes, wrong agronomical practices and wrong management. These issues still remain. We want proper hybrids for the proper region and a good agronomic for that and the yields will increase.
Now, here is a case where the cotton is looking up, in India, including Maharashtra, where cotton yields doubled after the introduction of Bt cotton. So why would anyone commit suicide? It is wrong to say that is short link between Bt cotton and farmers’ suicides.

What is your opinion about cotton growing in Africa?
Countries in Africa have enormous potential as far as cotton growing is concerned. With the conditions that prevail there, the yields are not at all bad. However, this can be improved. The yields can certainly be doubled.

We are primarily interested in the fact that the input usage in Africa, whether it is fertilizer, water, or primarily insecticides, should come down. We want good ecology. Once the ecology gets stabilized, the natural occurring biological control of pests becomes stable and cotton farming will have a very good future.

From India our Ministry has been very clear on positive cooperation. Anything that we can do together, with the countries of Africa, we have always been very positive about it. Your scientists have been coming here and our scientists have been going to Africa. This relationship has been very friendly and cordial, but we must exploit it for mutual benefit. The choice of varieties and good agronomy will be the keys to enhance yields. That is where we can certainly assist because India has probably the largest pool of cotton scientists. We must work together to increase productivity and produce good quality of cotton.

Your last word about african cotton growers?
African countries should take Bt cotton wherever Helicoverpa Armigera is a major problem. You must take Bt cotton. But do it in a very carefully guarded manner, not in a rush. Do it carefully to introduce the Bt technology in good varieties. As conclusion the introduction of Bt cotton in Africa must be done step by step. It is most important to know how you take it forward to the field; especially the choice of the variety plays a crucial role.

FOCUS ON...

THE BACILLUS THURINGIENSI S (Bt) GENE

A powerful natural insecticide

Discovered in 1901 by a Japanese microbiologist, Ishiwata, Bacillus thuringiensis (Bt) is a powerful natural insecticide. Frequently present in soil, water, but also in plants and dead insects, the properties of this bacterium have been revealed in 1911 through the work of the German researcher Berliner. He was the one who described the bacterium and gave it its current name.

More commonly known as Bt, Bacillus thuringiensis is characterized by the presence of protein crystals (Cry acronym) in the cytoplasm of its cell. Some properties of this bacterium are still unknown. To date, some 250 protein crystals from about 80 Bt subspecies have been identified. Each of these proteins affects a range of insects belonging to a particular group. In other words, a specific Bt protein affects but larvae of a specific group insects. As such, it has no effect on other organisms.

For Bt to act as an insecticide, certain conditions have to be met. First, the concerned protein must be ingested by the insect, since Bt has no contact effect. In the case of cotton, this occurs when the larvae feed on plant tissues. Then, to be active, the protein needs an alkaline gut (small intestine and colon) with a pH (potential Hydrogen) higher than 9.5. Finally, the presence of protein receptors in the plant gene. It is then introduced into the genome of the plant in the best position, using genetic engineering. Thus, the newly introduced gene stabilizes in the genome of the plant and becomes a hereditary trait.

Plants containing Bacillus thuringiensis genes are known as Bt or transgenic plants. This is the case of Bt rice, Bt eggplant, Bt potato, Bt tomato, Bt corn and Bt cotton, among others. In each of these plants are integrated one or more proteins according to the insect whose harmful effects one would like to control.

The initial Bt plant was developed in the 80s by the Chinese Academy of Agricultural Sciences (CAAS), and then, by Monsanto in 1990. However, the regulation for commercial cultivation of Bt crops, including cotton, corn and potatoes developed by Monsanto, took place in 1996, marking thus the beginning of genetically modified plant marketing.

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