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India's cry1C gene: Pioneering agriculture

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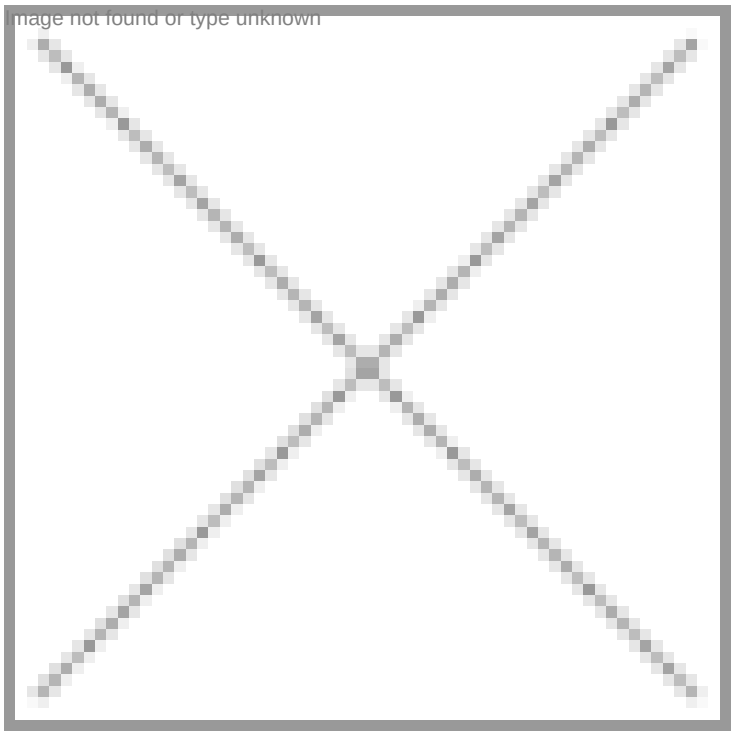

cry1c gene from Metahelix Life Sciences recieved the approval from GEAC for its use in two Bt cotton hybrids, MH5125 Bt and MH5174 Bt, in June 2009. This first commercial gene developed solely by a private Indian company offers the cotton plant double protection against two pests - bollworms and spodoptera

What is cry1C gene?

â€œWhen we ventured into this area, we wanted to bring out something different, with additional properties. One of the common strains of Bt that are used is Bt aizawai. A major crystalline (cry) protein involved in this strain is the cry1Câ€?, says Dr KK Narayanan, co founder and managing director, Metahelix Life Sciences.

The cry1C was used first in cabbage and cauliflower; which are highly affected by the diamond-back moth. In addition to this, it has high activity against bollworms; and is also very active against the army worm, Spodoptera. When Bt cotton was commercialized initially, the incidence of Spodoptera increased drastically. Metahelix took this as an advantage, and began looking at using cry1C gene, which had activity against these leaf-eating worms.

In Bt technology the first gene used, developed by Monsanto India (Monsanto) - a subsidiary of Monsanto Company, USA - was cry1Ac gene. The gene, first commercialized in 2002; mainly addresses the issue of bollworms which are of three kinds: American Bollworm (Helicoverpa armigera), spotted Bollworm (Earias vitella), pink bollworm (Pectinophora gossypiella). cry1Acaddresses American and spotted bollworms; but the pink bollworm is known to have field-resistance to this gene.

There are two more players in this area: one is Nath Seeds (Nath), Ahmedabad (Gujarat), which has the technology from

China. Nath has a variation of cry1Ac gene, which is based on a fusion technology. The other company is JK Agri Genetics (JK), Hyderabad (Andhra Pradesh), that had a truncated version of cry1Ac gene, called Xgene, commercialized around 2004-2005. The active part of the protein in JK's gene was similar to the active part of Monsanto's cry1Ac gene. And all of these address the three species of bollworms.

The journey from development to approval

The development of the cry1C gene was a long process, that began in 2001. The first step in developing the cry1C gene in the cotton plant, was choosing the best pattern of gene sequence for the protein, in order to have optimum activity. The nucleotide sequence has to be modified, to express the same protein; but with better activity and compatibility to the plant. The second is to decide whether to express the entire protein or the active portion of the protein. Metahelix decided to express only the active toxin. This was done for two reasons - one, the plant does not have to spend extra metabolic energy in expressing the whole protein; and also activity of the toxin is based on its concentration in the tissue that is, lower levels of the protein are expressed for higher activity.

â€œOne of the breakthroughs that we made, was cracking this procedure using a technique called agrobacterium-mediated transformation, using Agrobacterium tumefaciens as a vector. Once the transgenic plant was developed, a number of such transgenic yields were developed because the process of integration of this gene into the genome is in some ways randomâ€? explains Dr Narayanan. Depending on where the gene gets integrated, the activity varies accordingly - it could be very high to moderate, to low. It could also affect the agronomic performance of the gene leading to sterility, and so on. Hence, several transgenic yields were required to select the optimum event.

First Person

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ne has been found to be effective against hough it is not yet commercialized, it has been the GEAC. This approval in a way, proves its effectiveness because to get a GEAC approval, go through rigorous evaluation stages.â€?
e Kagliwal, Chairman, Nath Seeds

In 2004, the hybrids were ready for field trials. Several demonstrations were set up all over the country in Maharashtra, Gujarat, and Andhra Pradesh. First station trials are done in one of the five research breeding stations - Bangalore, Attur, Aurangabad, Ghaziabad, Ahmedabad. After station trials, multi-locational trials are conducted in more than 20 stations, all over India. These locations are all managed and run by Metahelix. Then a system called Hybrid Advancement Trials (HATs) is done for both conventional and Bt hyrbids. HATs are done in collaboration with farmers. For these trials, the farmer receives only the input; and the company monitors the fields constantly.

These trials took nearly three years. The hybrids needed a combination of the right amount of rainfall, temperature, andpests to get the required results. During these trials, a Supreme Court case came up, against transgenic crop. The Court put on hold all transgenic crop trials and this caused a delay of nearly two years in the product's development. The company went through several hurdles; and finally the government allowed the completion of the large scale trial in 2008, with very good results. They submitted their dossier the same year. Again, there were many issues with the biosafety trial. Finally, in 2009, GEAC gave its approval.

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â€œ nology Stewardship' key to market survivalâ€?

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Dr KK Narayanan, co-founder & managing director, Metahelix Life Sciences

Q What is next on the table for the cry1C gene?

As we are testing stacks with the cry1C gene, we aim to make a breeding stack. For a breeding stack, we have events which have already been approved. The stacked cry1C gene would widen the spectrum, increase the number of modes of action, so that the insect-resistance management strategy can be addressed; and it is a unique stack combination. We are already in the final stages of testing these combinations, so that, we bring out our product as a stack, rather than a standalone gene.

Q How do you plan to place the product in the market?

There is a new term in the West called, 'technology stewardship', which is as important as developing the product itself. Without this, the product cannot survive in the market; and several major companies spend as much or even more on this, than product development itself. The market today for Bt cotton is close to 350 lakh packets; and the total cotton cultivated area is about 10.5 million hectares. Metahelix will focus on the States of Maharashtra, Gujarat, Andhra Pradesh, areas of Madhya Pradesh, Haryana, northern Rajasthan, southern Punjab and some areas of Dharwad (Karnataka). We want to start

small with maybe 50,000 packets.

Q What plans do you have for the Indian market?

In India, our future aspirations would be to reach sales of about 100 lakh packets. By 2014-2015, we should be among the leaders in India, in cotton.

Q Any global plans for the cry1C technology?

The cry1C gene has not been commercialized anywhere else. It opens up the possibility to publicly license out thetechnology to the rest of the world. We will have a realistic approach, keeping in mind the regulatory procedures of various countries. The regulation is not just restricted to the cultivation; it also has to be deregulated in the countries which import the product. We would need a large resource pool to be able to do this; and we could possibly initiate some tie-ups, if the need arises.

Some countries we might look at for expanding into are: South Africa, Australia and USA. We are also looking at Bangladesh for opportunities. We have received approvals for rice and maize hybrids in Indonesia and Vietnam.

Martina Andrea D'Couto in Bangalore