**Bt BRINJAL**

**What is Bt brinjal?**

Bt brinjal is eggplant — also known as talong in the Philippines and aubergine in Europe —that has been genetically modified (GM) to provide effective protection against the devastating eggplant fruit and shoot borer (EFSB) *without the application of pesticides*.

**Who developed Bt brinjal?**

Bt brinjal was developed through a collaborative partnership funded by USAID and managed by Cornell University and its India-based Sathguru Management Consultants. India-based Maharashtra Hybrid Seed Co. (Mahyco) did the first work to establish that Bt genes could effectively deter the eggplant fruit and shoot borer (ESFB). The Bangladesh Agricultural Research Institute (BARI) teamed up with Mahyco to insert the protective Bt genes into brinjal cultivars popular in Bangladesh. BARI conducted research trials in different locations around Bangladesh and shepherded the four GM varieties through the government approval process. BARI ultimately shared the improved seeds at no charge with smallholder farmers. Meanwhile, the University of the Philippines-Los Baños has been conducting similar research on its local cultivars.

**Why was Bt brinjal developed?**

Brinjal is a very popular vegetable in South Asia. However, it is subject to frequent and intense attacks by the EFSB. In an attempt to control the destructive pest, smallholder farmers typically buy and apply large quantities of insecticide sprays that they often use right up to the time of harvest. Farmers may apply as many as 84-100 insecticidal sprays per season in an attempt to control the EFSB and other insect pests. This practice exposes farmers, consumers and the environment to high levels of hazardous pesticides. It also represents a substantial expense that smallholder farmers cannot easily afford. Worse, farmers often experience significant losses even after applying pesticides. This unsustainable situation prompted Mahyco to initiate development of an EFSB-resistant variety as an alternative to insecticide use. BARI and the University of the Philippines joined the collaborative research effort to increase eggplant production in those two countries. USAID, Cornell University and Sathguru came on board because the project is compatible with their shared mission of supporting sustainable food production in developing nations.

**Where is Bt brinjal available?**

Bt brinjal is currently under cultivation in Bangladesh. It will soon begin moving through the regulatory process that leads to commercialization in the Philippines. In India, the Genetic Engineering Appraisal Committee (GEAC) approved commercialization in 2009 following field trials and safety evaluations. However, the seeds have not yet been released to farmers. In response, farmers have resorted to civil disobedience in a bid to secure legal access to the improved Bt brinjal seeds.

**How has Bt brinjal affected farmers in Bangladesh?**

Since entering the market in 2014, Bt brinjal has helped smallholder farmers in Bangladesh achieve higher yields, a 60 percent reduction in pesticide costs, and a six-fold increase in net returns. These documented results offer hope for increasing production of the popular vegetable while curtailing the human and environmental health impacts associated with the high pesticide use required to grow non-Bt varieties.

The first Bt brinjal seedlings were distributed to just 20 Bangladeshi farmers in four districts in early 2014. Within four years, some 27,000 farmers — about 17% of the nation’s brinjal growers — had tested the crop, though that number is likely higher since farmers share seeds. Bt brinjal also has been well-received in the market, often fetching higher prices due to its excellent fruit quality and reduced pesticide inputs. A 2016-17 study by BARI scientists found that farmers who grew Bt brinjal experienced a six-fold increase in their net returns over those growing non-Bt varieties. This is due to both increased yield and effective protection against the EFSB. Those growing Bt brinjal were able to reduce their insecticide costs by 60% while experiencing no losses from EFSB, thus significantly reducing their production expenses and pesticide exposure.

Net returns were $2,151/ha for Bt brinjal as compared to $357/ha for non-Bt varieties. This additional income is significant for smallholder farmers, allowing them to pay school fees for their children and otherwise improve their standard of living. A study done a decade ago estimated that widespread cultivation of Bt brinjal would result in a benefit of $200 million annually for Bangladeshi farmers, a figure that would be far higher today.

**How does Bt brinjal work?**

Researchers inserted insecticidal crystal (*Cry1Ac*) proteins from *Bacillus thuringiensis* (Bt) bacterium into the genetic code of brinjal cultivars. This gives the plant and each fruit it produces inherent resistance to attacks by the EFSB, the crop’s primary insect pest. Bt has been used as a foliar insecticide for decades, particularly in organic farming, and has a stellar safety record for humans and the environment. Its effectiveness is greatly increased when the insecticidal genes are incorporated into Bt crops, as opposed to the use of foliar sprays. The Bt approach to insect control has been safely and effectively used globally in other GM crops, such as maize, for over two decades. Given the experience in Bangladesh, the benefits of Bt brinjal are clear: higher yields, increased economic return to farmers, decreased pesticide use and more sustainable production. Some spraying is still required to control other insects, such as whiteflies, thrips, and mites, that attack brinjal but are not affected by *Cry1Ac*. BARI scientists are now developing treatment guidelines for this complex of “sucking insects” that can reduce plant vigor and subsequent fruit weight.

**What is unique about Bt brinjal?**

Bt brinjal is the first GM food crop created specifically for smallholder farmers in a developing nation, and the first GM food crop adopted for cultivation in Bangladesh. It is also a sustainable, environmentally friendly crop that significantly reduces pesticide use and improves the livelihoods and lives of the smallholder farmers who grow it.

**Can farmers save Bt brinjal seeds?**

In Bangladesh, the approved varieties of Bt brinjal are open pollinated, which means farmers can and do share seeds. However, BARI discourages the practice to ensure the continued integrity of the four lines. To meet farmer demand, BARI is expanding its capacity to produce high quality seed at prices affordable to smallholder farmers. Bangladeshi farmers cannot export seed or share it with farmers in other countries because the varieties they grow are approved for use only in Bangladesh.

**Who owns the technology behind Bt brinjal? Is it the property of a multinational company?**

Mahyco initially developed an eggplant that expresses Cry1Ac (EE-1) to control EFSB. This EE-1 event was provided to BARI, a government agency, through a public-private partnership between Mahyco, USAID, Sathguru Management Consultants, Cornell University and BARI. Under the partnership, BARI subsequently introgressed the EE-1 event into its own local eggplant lines, which it manages and controls. The ultimate goal of the partnership is to ensure that the process and knowledge of the EE-1 event are properly incorporated into the core practices of Bangladeshi public sector agencies, as well as private sector companies that develop and sell high quality Bt brinjal seeds for increasing productivity.

**What is being done to prevent insects from developing resistance to Bt?**

Farmers and extension agents in Bangladesh are thoroughly trained in internationally recognized stewardship practices for cultivating Bt brinjal. This includes growing some non-Bt plants in borders, where insects can feed. This strategy helps to prevent insects from developing resistance to Bt.

**Is Bt brinjal safe?**

Extensive international research has documented that *Cry1Ac* proteins are safe for human food and livestock feed. Appropriate and qualified agencies in Bangladesh have evaluated Bt brinjal and determined that it is as safe to eat as conventional brinjal. Rigorous food and feed safety studies, including toxicity and allergenicity evaluation and nutritional studies, confirmed that Bt brinjal is as safe as its non-Bt counterparts. Other studies have found Bt brinjal has no adverse environmental effects. These include studies conducted on pollen flow, effects on soil microflora, agronomy, germination and weediness. These extensive studies indicate Bt brinjal has no unintended effects. It also has no negative impact on beneficial insects, which instead benefit from the reduced use of pesticides.

**How was Bt brinjal tested for safety before it was approved?**

In Bangladesh, BARI tested the Bt brinjal lines under contained, confined and open field conditions for seven consecutive seasons, after which BARI applied to the National Technical Committee on Crop Biotechnology (NTCCB) for their release. Scientists in the Philippines conducted contained use experiments on Bt talong from 2007 to 2009 and then received a biosafety permit to pursue confined field testing at four approved trial sites, all of which were completed in August 2012. India conducted extensive field tests of Bt eggplant between 2004-2008, using more than 50 trial locations and documenting a 77 percent reduction in pesticide use. Following safety evaluations conducted by the Indian biosafety body, the Genetic Engineering Appraisal Committee (GEAC) approved commercialization of Bt brinjal in 2009.

**What is BARI doing to improve Bt brinjal in Bangladesh?**

Farmer adoption continues steadily in Bangladesh, but the four initial varieties should be augmented by additional newer lines that offer increased disease resistance and are better suited to specific locations. BARI has applied for commercial cultivation of three new varieties that are based on cultivars that are very popular among farmers. These new varieties are better performing and less susceptible to wilt disease. BARI is also following internationally approved practices to expand its production of quality Bt brinjal seed to ensure farmers have an adequate supply.

**What is the outlook for Bt brinjal in South Asia?**

Given that EFSB pressure is intense in both India and the Philippines, where it can cause 80 percent crop loss, it is anticipated that the adoption of Bt brinjal in those countries would result in economic and health benefits similar to those documented in Bangladesh. This is particularly true for the Philippines, where eggplant accounts for one-third of all vegetable production. Eggplant is also an important source of cash for resource-poor farmers in the Philippines, where the gross national income per capita was just $3,830 in 2018.

In the Philippines, anti-GMO activists have engaged in a relentless attack on Bt talong, starting with the destruction of two field trials in 2011. When this failed to halt research, they pursued a legal challenge to stop the project. Though they were ultimately unsuccessful, court proceedings that ran from 2012-2016 delayed the development and commercialization process. The USAID-funded Feed the Future South Asia Eggplant Improvement Partnership, which includes the University of the Philippines-Los Baños, is now preparing to submit a regulatory dossier for the Philippines. This is the first step toward commercialization in that country. The dossier meets international standards and will support the introduction of Bt brinjal elsewhere in South Asia. The Philippines also has continued to conduct research on new varieties.

In India, some farmers have begun growing Bt brinjal that was apparently developed by the Indian Science Institute but is not approved for cultivation. The discovery and destruction of these illicit crops led to national protests, with farmers demanding greater access to GM seeds. Mahyco’s Bt brinjal was fully approved by the relevant scientific committee in India. However, responding to challenges from activist groups, the Indian Minister of Environment and Forests imposed a moratorium on release in 2010 that remains in effect today. It remains to be seen whether the farmer protest will lead to a change in the political climate for GM crops generally. Bt cotton is the only GM crop currently allowed in India and has been widely adopted by farmers.

**Where can I get more information?**

Feed the Future South Asia Eggplant Improvement Partnership — bteggplant.cornell.edu

“Bt Brinjal in Bangladesh: The First Genetically Engineered Food Crop in a Developing Country”

<http://cshperspectives.cshlp.org>

“Bt eggplant (*Solanum melongena* L.) in Bangladesh: Fruit production and control of eggplant fruit and shoot borer (*Leucinodes orbonalis* Guenee), effects on non-target arthropods and economic returns”

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0205713>

Shelton, A. et al, 2018: ‘Bt Eggplant Project in Bangladesh: History, Present Status, and Future Direction’, *Frontiers in Bioengineering and Biotechnology*, 6, 106 <https://www.frontiersin.org/articles/10.3389/fbioe.2018.00106/full?&utm_>

Rashid, M., et al, 2018: ‘Socio-economic performance of Bt eggplant cultivation in Bangladesh’. *Bangladesh Journal of Agricultural Research*, *43*(2), 187-203. <https://www.banglajol.info/index.php/BJAR/article/view/37313>

“A review of the food and feed safety of the Cry1Ac protein.”

<https://ilsirf.org/wp-content/uploads/sites/5/2017/02/cry1ac_en_ffs.pdf>

Genetically engineered crops help support conservation biological control

<https://www.sciencedirect.com/science/article/pii/S1049964418305103?via%3Dihub>