A Bt crop is unique, but it is not new. It may be not be ordinary but it is no longer unfamiliar in the global as well as local agriculture. For more than a decade now, its distinctive trait makes it special for farmers; it has proven to benefit them and would continue to benefit the whole world.

Enhanced through modern biotechnology using genetic engineering, these crops have been known to help farmers gain more and produce more because of the effective mechanism of the Bt insect resistance technology.

At present, the available crops enhanced with the Bt technology are corn, cotton, rice, and potato.

The famous Bt corn has already been adopted in many nations, including Argentina, Canada, France, Germany, Honduras, Philippines, Portugal, Spain, South Africa, the United States (US), and Uruguay. This variety is highly resistant to the corn’s most important insect pest, the corn borer. Other Bt corn varieties have also been developed for resistance to the corn rootworm, which can likewise cause significant damage to the crop.

In the US, Bt corn was first approved in 1996, and has been adopted and consumed ever since. Last 2009, Bt corn adoption increased to 23 percent of the total biotech corn in the US (James, 2009). The dominant varieties are the stacked trait corn (77 percent), which, apart from the Bt technology, has herbicide tolerance.

In South Africa, the staple food, white corn, also has its Bt variety, and has been consumed by the people since it was made available in 1998; it was only approved for planting in 2001. Currently, 81 percent (983,366 hectares) of biotech white corn in South Africa is Bt (James, 2009). Apart from white corn, South Africa also has Bt yellow corn. Overall, area planted to white and yellow biotech corn in the country, Bt included, has increased from 166,000 hectares in 2001 to 1.878 million hectares in 2009.

In the Philippines, the adoption of Bt corn (which was approved in 2002 and propagated in 2003) has greatly reduced the pest damage caused by the corn borer, which subjects the plant to fungi. Fungi could consequently cause plant diseases or carry cancer-inducing aflatoxins.

Since its adoption in the Philippines, the number of farmers planting Bt corn has been projected to increase every year, from 100,000 in 2006 to 250,000 in 2009 (James, 2009), based on an average of two hectares per farmer.

One likely reason for the growing number of farmers switching to Bt corn was the economic benefits they gained. A study by Gonzales (2009) concluded up to 75 percent income advantage per hectare of Bt corn. Three other economic studies since 2005 (Gonzales, 2005; Yorobe and Quicoy, 2006; Gonzales, 2007) showed similar findings that Bt corn is indeed more advantageous over conventional or hybrid corn.

In the US, a recent study has found that between 1996 and 2009, Bt corn has provided farmers with almost $7 billion cumulative economic benefits (Suszkiw, 2010).

Meanwhile, a Bt variety of Asia’s staple food, rice, has been given biosafety clearance in November 2009 and will soon be cultivated in China. This is a big leap for China, which has been estimated to have 75 percent of its rice affected by the rice borer. Like the other Bt crops, or genetically modified food for that matter, Bt rice underwent several stages of assessments before it was issued a Biosafety Certificate.
from China’s Ministry of Agriculture. The tests included laboratory approval, intermediate testing, environmental release, production test and applications for safety certificate, all covering several years.

*Bt* cotton in Argentina, Australia, China, Colombia, India, Indonesia, Mexico, South Africa, and the US has helped farmers evade the damaging attacks of cotton bollworms. In India alone, more than 5.6 million small and marginal resource-poor farmers planted and benefited from 8.4 million hectares in 2009 which is equivalent to 87 percent of the total cotton planted in India. Socio-economic surveys confirm that *Bt* cotton continues to deliver significant and multiple agronomic, economic, environmental and welfare benefits to farmers and society (James, 2009).

In the US, *Bt* potato, which had been available since the last half of the 90’s, has targeted destructive Colorado potato beetles, the major pests of the said crop.

### RISK ASSESSMENTS: BEEN THERE, DONE THAT

Despite being a safer alternative to chemical pesticides, *Bt* crops are still rigorously tested by scientists and experts using international and local standards, in all adopting countries.

To ensure the safety of the products of modern biotechnology to the environment, particularly to biodiversity, an international agreement was established in 2000 among 135 countries. The Cartagena Protocol on Biosafety is a legal global protocol that ensures that the transfer and handling of living modified organisms (LMOs) would be safe to the environment.

In terms of food safety, the Codex Alimentarius Commission of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) of the United Nations has been around since 1963. The Codex gives the general guidelines for food safety assessment of biotech products.

Also, the Organization for Economic Cooperation and Development or OECD (an intergovernmental organization composed of 30 industrialized countries in North America, Europe, Asia, the Pacific region, and the European Commission, that work together to address international problems) has a Consensus Document which shows that based on the known information and assessments, *Bt* is generally safe. The OECD Consensus Document on the biosafety of *Bt* in genetically modified plants is basically a summary of all known information about *Bt*.

That is why biotech crops had been subjected to various tests in adopting countries.

In the United States, *Bt* was actually tried on humans. According to the Extension Toxicology Network (Extoxnet), a project of several universities in the US on pesticide information, those who ate a gram of *Bt* a day for five alternate days did not have any complaints; while those “who ate one gram per day for three consecutive days were not poisoned or infected.” And like the *Bt* protein in the soil, the *Bt* protein in the genetically modified crops was also reported to be easily degraded by acidic conditions, particularly by the human gastric fluid.

The *Bt* protein also did not have any harmful effects on mammals (dogs, guinea pigs, rats) amphibians (frogs and

### NATURALLY SAFE

What could be more natural than something that came from the earth itself?

*Bt*, which is a shortened name of *Bacillus thuringiensis*, is very, very natural, according to entomologist and retired University of the Philippines professor Dr. Emiliana Bernardo.

*B. thuringiensis* is a bacterium that has been present in the soil for so many years. In 1901, it was discovered to have an insecticidal property, which came from the protein it produces.

Since the 1950s it is already a well-known biological insecticide.

Specificity is what makes the *Bt* exceptional from other kinds of pest controls. One brand of the *Bt* microbial pesticide is called Dipel. It is so named because it is an anagram of the Order of insects that it targets—the Lepidopterans. Lepidopterans are insects with scaly wings during their adult stage. Moths and butterflies are examples of Lepidopterans.

Because of its natural source, the *Bt* insecticide is actually one of the few pesticides permitted by organic standards.

However, according to Dr. Bernardo, farmers are not too keen on the *Bt*’s specific mode of action; they want all insects to be eliminated. That is why the use of *Bt* bio-pesticides declined, and more chemical pesticides were used by farmers.

Dr. Bernardo explained that in *Bt* crops, the *Bt* gene has been incorporated in the plant system that enables the plant to produce *Bt* protein that makes it resistant to the target insect pest. The alkaline condition and the presence of the needed enzymes in the digestive system of the target insect pest activates the pesticidal segment and separates it from the *Bt* protein. The pesticidal segment gets absorbed through the endotoxin receptors in the digestive system resulting in death of the insect.

It should be noted that the non-target insect pests do not have the needed receptors. Other animals, including man, also do not have the needed receptors. They also have an acidic digestive system which degrades the pesticidal segment of the *Bt* protein.

*Bt* corn, in fact, had been shown in several Philippine studies as harmless or even beneficial to insects. Javier et al. (2004, as cited by James, 2009) found from farms in the Northern Philippines, that more beneficial insects thrive in *Bt* corn farms than in conventional ones. And a study on the long term effect of *Bt* corn on insect diversity, conducted 2006-2009, (Alcantara, 2010) showed that non-target insect population did not diminish nor was affected by *Bt* corn.

Dr. Emiliana Bernardo, chair of the Insect Resistance Management Advisory Team, Dept. of Agriculture, attests to the safety of *Bt* technology.
Bt crops in India has undergone food safety, allergenicity tests. The Bt brinjal (eggplant) has been fed to various animals—fish, rabbits, chickens, cows—and tested for various irregularities; it has also been compared with conventional eggplants in terms of nutritional composition all results showed that the Bt brinjal is the same as the non-Bt one.

Extensive research studies on the environmental safety of Bt brinjal concluded that the Bt brinjal did not show signs of aggressiveness or weediness. There were also “no differences” in populations of bacteria, fungi, earthworms, and other soil invertebrates for Bt and non-Bt brinjal based on an analysis of its effect on microbial population in soil.

Meanwhile, as the pioneering country to approve genetically modified Bt corn in Asia, the Philippines has also been very careful in the regulation of biotechnology products. In fact, its National Biosafety Framework is looked up to by other countries.

Developing genetically modified plants in the Philippines, before being fully introduced to the environment, goes through a series of tests. From contained laboratory to multi-location field trials, the biotech crops are tested for their effects on the environment and health, by experts from different government agencies such as the Department of Science and Technology and the Department of Agriculture. These tests are also reviewed by an independent body of assessors, the Scientific and Technical Review Panel.

These crops are not left alone after being approved. For the Bt corn in the Philippines, corn borer is being monitored by the Insect Resistant Management Advisory Team (IRMAT) of the Department of Agriculture, headed by Dr. Bernardo. This group of scientists looks out for signs of corn borer resistance to the Bt corn.

From all the tests it has undergone for biosafety and food safety, these Bt crops had been approved for food, feed, and processing.

TRIED, AND TIME-TESTED

The numbers and the farmers also convey positive feedback about Bt crops.

Since 1996, the total hectares planted to biotech crops, Bt crops included, have increased. In 2009, biotech crops have already been planted on 134 million hectares globally (James, 2009).

Bt crops, particularly Bt corn had been around since 1996 in the United States, and 2002 in the Philippines.

Since it was planted in the Philippines, no safety issue had been recorded from the said crop. More than that, the area of land planted to Bt corn and its number of farmers continue to increase. Even with the introduction of other traits (herbicide tolerance and stacked), the adoption of Bt technology in farms remained rising.

The approval of the Bt corn has indeed been a turning point for Filipino corn farmers, who have long been struggling against the damage of the corn borer.

In the top corn producing province in the Philippines, Isabela, almost all of the corn farmers use genetically modified corn. According to Mr. Isidro Acosta, Regional Agriculture and Fishery Council chairman of Region II, farmers in Isabela would always answer “Bt” or “Bt/RR” when asked what corn variety they plant. He also attested, based on experience, that one need not watch a Bt corn farm for pests, because it already stays protected.

In the neighboring province of Cagayan, farmer Joseph Benemerito won a national award for his quality Bt corn. He said that a vast land of 22 hectares can be easily managed with Bt corn.

Other countries also reported significant decrease in the use of pesticides on the Bt crops – same with the testimonies of many Bt farmers in the Philippines. In 1998, a US Department of Agriculture study found that 8.3 million pounds of active chemical ingredients in pesticides were cut from the farmers who plant Bt crops. In China and Argentina, planting of Bt cotton has reduced pesticide use by 60-70 percent.

For 2008 and 2009, the global area of crops with Bt technology is nearing half of total area in the world planted to biotech crops (James, 2009). Meanwhile, the graph below shows that Bt technology is steadily adopted globally, along with other traits from biotechnology.

Global Area of Biotech Crops, 1996-2009: By Trait (Million Hectares, Million Acres) (James, 2009)
READY FOR MORE Bt

With the years of Bt’s safety, more of these crops are expected to emerge. And as efforts steer towards development, these crops are developed as products of the public sector, for the benefit of the people.

Among those near the top of the list of public biotech products is the Bt eggplant in the Philippines, which is highly resistant to the fruit and shoot borer. It has the same mechanism with the Bt corn; once a Lepidopteran eats any part of the Bt eggplant, it would die. Other insects would not be affected.

The Bt variety of the eggplant, which is the most important vegetable produced and planted in the country, was projected by studies to significantly increase farmers’ income by Php50,000 per hectare and reduce pesticide impact to the environment.

The Philippine Bt eggplant is purely a public product, developed by the University of the Philippines Los Baños.

Like the other GM crops in the Philippines that were applied for propagation, Bt eggplant underwent various trials to ensure its safety. It was subjected to contained and confined field trials, and is now in multi-location field trials in different parts of the country. These trials have been, and are being strictly monitored by the country’s Department of Science and Technology (for the contained and confined trials) and Department of Agriculture (multilocation trials).

India is also gearing up for other Bt-enhanced crops such as okra, cabbage, cauliflower, tomato, wheat, and rice. Like the Philippine Bt eggplant, these are also being developed by public research institutes.

Indeed, Bt crops has a well-established place in agriculture. They are not only natural; they have also been tested in time; by different experts, in many different places all over the world. Equally important, it has contributed to the welfare of farmers, consumers, environment, and food security, on the whole.

References:


Bt corn: What you need to know. 2003. (Primer). SEARCA Biotechnology Information Center and the Department of Agriculture - GMA Corn Program.

General biotechnology and its applications. (Brochure). SEARCA Biotechnology Information Center.


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