Anti-GMO forces can slow train of technological progress but cannot derail it

Even though genetically modified food has been endorsed by the most prestigious scientific institutions, academies, agencies and societies in the world, including the U.S. National Academy of Sciences, the UK Royal Society of Medicine, Health Canada, the World Health Organization, the Food and Agriculture Organization and the International Council for Science, it has become a very controversial subject.

This however should not be the case as genetically modified food has proved to be safe for human consumption and not hazardous to the environment. The reality is that after almost twenty years on the market not one death, ilnness or allergic reaction has been attributed to genetically modified food. Yet there are many people who want to ban it because they believe it is dangerous. This is a clear misperception of risk. Motor vehicle accidents killed 32,719 people in 2013 but no one is seriously arguing cars should be outlawed.

GMO opponents have become experts at fear-mongering and misleading the public. For example on the GMO Awareness website, there is a picture of a tomato with a syringe in it in order to depict the Frankenstein world of genetic modified food and to suggest that dangerous chemicals are being inserted into the food system. It's a familiar visual meme on activist sites. It's also flat out misleading. Firstly, there are no GMO tomatoes on the market. Genetic engineering of food is also not done with a syringe. Rather, it is a precise method of inserting genes into seeds and is much more precise than the process of mutagenesis which is allowed in organic farming. Mutagenesis is a procedure in plant breeding in which random mutations are induced in plant DNA using chemicals or *radiation.*

No doubt the organic food industry would strongly object to GMO labeling if it included imposing labels on organic products — hundreds of them produced through mutagenesis as many organic seeds are derived from such a process. Organic and non-organic varieties of wheat, barley, rice, pears, peas, cotton, peppermint, sunflowers, peanuts, grapefruits (ruby red grapefruit), sesame, bananas, cassava and sorghum have been developed through the process of mutagenesis. The National Academy of Sciences has warned that regulating genetically modified crops while giving a pass to mutant products "isn't scientifically justified."

To a large extent the rhetoric of the GMO opponents reflects the reality that they are losing the battle over the science of genetic engineering. With each passing year biotechnology is becoming more and more an integral part of our society. The clock cannot be turned back to some supposed golden non-GMO age and the genie cannot be put back into the bottle without doing profound damage to the way we live. GM seeds for instance dominate many crops grown in the U.S. such as cotton, soybeans, canola, sugar beet and corn, and those that contain the gene for Bacillus thuringiensis (Bt), a bacterium, has led to a marked reduction in the use of pesticides or the use of pesticides with a lower toxicity compared to conventionally grown crops. It should be noted that Bt is a natural botanical that is used extensively in organic farming where it is sprayed on crops. Paradoxically it cannot be used by organic farmers when the gene is inserted into a cotton or a corn seed.

More and more countries are approving the use of GMOs for food production. The Executive Summary of

the 2014 Commercialized Biotech/ GM Crops Report that was released by the International Services for the Acquisition of Agri-biotech Application on March 25, 2015, noted,

> In 2014, biotech crop hectarage continued to grow for the 19th consecutive year of commercialization;18 million farmers in 28 countries planted more than 181 million hectares in 2014, up from 175 million in 27 countries in 2013. Notably, Bangladesh…approved Bt Brinial/eggplant for the first time on October 30, 2013…the Innate potato…was approved in the US in November 2014. It has lower levels of acrylamide, a potential carcinogen in humans, and suffers less wastage from bruising…Also in November 2014, a new biotech alfalfa…which leads to higher digestibility and productivity was approved for planting in the US…a new 2014 comprehensive global meta-analysis, on 147 published biotech crop studies over the last 20 years worldwide confirmed the significant and multiple benefits that biotech crops have generated over the past 20 years, 1995 to 2014; on average GM technology adoption has reduced chemical pesticide use by 37%, increased crop yields by 22% and increased farmer's profits by 68%.

In *March 2015, the FDA approved for sale the Arctic Apple, which is genetically engineered to resist browning associated with cuts and bruises. On April 21, 2015, former Nigerian President Goodluck Jonathan signed the National Biosafety Agency Bill which will enable the country to regulate and commercialize biotech crops. On August 12, 2015, Kenyan Deputy President William Ruto announced* the government will lift its ban *on genetically modified organisms this fall. He said:*

> Various government ministries, departments and agencies concerned with biotechnology have already consulted and agreed on the necessary regulations and safety measures to be adhered to so that we can maximize agricultural production…conserve the environment and basically improve the living standard of our people…Kenya will not be left behind as the world adopts biotechnology.

The Brazilian state owned agricultural giant, Empresa Brasileira de Pesquisa Agropecuária (EMBRARA), is conducting research on new varieties of GM soybeans as well as GM sugarcane and a folate-fortified lettuce that are expected to be commercialized in 2016. Meanwhile, the Federal University of Rio de Janeiro is conducting research to develop insect-resistant GM rice, the Federal University of Viçosa is developing drought-resistant GM soybeans, and Fundecitrus is developing a GM orange that is resistant to citrus cranker and citrus black spot.

Trials are being conducted for Vitamin A rice, which if successful will make a big difference in the health of many people in developing countries who do not consume enough foods rich in Vitamin A. This modified rice can be of great help in curbing the damage caused by Vitamin A deficiency. According to the Golden Rice website*;*

> Dietary micronutrient deficiencies, such as the lack of vitamin A, iodine, iron or zinc, are a major source of morbidity (increased susceptibility to disease) and mortality worldwide. These

> deficiencies affect particularly children, impairing their immune system and normal development, causing disease and ultimately death…In rice-based societies, the absence of Beta-carotene in rice grains manifests itself in a marked incidence of blindness and susceptibility to disease, leading to an increased incidence of premature death of small children, the weakest link in the chain.

If Vitamin A rice is successful it will open the door to fortifying the vitamin content of other foods such as cassava, which is a staple crop in many African countries. According to the Swiss Federal Institute of Technology:

> Cassava roots contain starch up to 85% of their dry weight, but are virtually devoid of storage protein (on average 1 percent total protein mass). The nutritional value of this very low protein amount is further reduced by the particularly low levels of the essential amino acids…the US Department of Agriculture estimates a 60 kg person has to consume at least 1.3 kg cassava storage roots per day to meet the recommended daily requirement of all essential amino acids…Cassava roots have also limited amounts of vitamins.

Genetic engineering is key in many every day products and could help rescue many threatened crops.. About 80-90 percent of the cheese produced in America is made with fermentation produced chymosin, a milk-clotting enzyme that is a product of genetic engineering. Many beers are made from yeast that has been genetically modified. The Hawaiian papaya was saved through genetic modification. The crop was being decimated by the ringspot virus which caused a sharp reduction in production. In 1998, after an extensive review and approval for food and environmental safety by the U.S. government, the Rainbow papaya was put into production, genetically engineered to withstand the virus. As a result, 77 percent of the papaya crop in Hawaii is now genetically modified. Without such genetic modification, the entire papaya industry in Hawaii would have been eradicated. Genetic engineering may also prove to be the solution to saving the orange crop in Florida, the banana and cassava crops in parts of Africa and coffee in Central America from being decimated by serious diseases.

Genetic engineering is essential for the manufacturing of medicines that many people rely upon. The process for creating these medicines in many cases is not that much different than the process for creating genetically modified food. Most of the insulin that is produced in the U.S. for instance is genetically engineered. Genetic engineering is also involved in the production of human growth hormones and human serum albumin, which is the most abundant protein in human blood plasma, and for treatments for hemophilia, viral infections, anemia and dissolving blood clots. The Hepatitis B vaccine is genetically engineered and trials are being conducted for a genetically engineered vaccine against Ebola. In early 2013, the FDA approved the first genetically engineered flu shot.

Increasingly, genetic engineering is being used for the treatment of cancer patients. An October 15, 2014 article in the New York Times titled, “T. Cell Therapy puts Leukemia Patients in Extended Remissions”, noted:

> An experimental therapy has brought prolonged remissions to a high proportion of patients facing death from advanced leukemia after standard treatment had failed…The therapy involves genetically reprogramming cells from the patient's own immune system to fight the disease. The research included 30 patients: five adults ages 26 to 60, and 25 children and young adults ages 5 to 22. All were severely ill, with acute lymphoblastic leukemia, and had relapsed several times or had never responded to typical therapies. In more than half, the disease had come back even after a stem-cell transplant, which usually gives patients the best hope of surviving. Their life expectancy was a few months, or in some cases just weeks. Six months after being treated, 23 of the 30 patients were still alive and 19 of them have remained in complete remission.

Genetic engineering can be used to control dangerous insects that spread diseases. A one year trial in northeast Brazil that involved genetically modifying the mosquito that carries dengue fever, which causes severe pain in the joints and abdomen, vomiting and circulatory system failure, resulted in a 90 percent reduction in the mosquito population. The trial involved genetically engineering the male mosquitos so it will pass on a mutation when mating with a female mosquito. The mutation kills the offspring before they are able to reproduce or transmit dengue fever.

Genetic engineering is a possible means of reviving the American chestnut tree, which has been decimated by chestnut blight. It is caused by a fungus from Asia that enters the tree through a wound in the bark and releases oxalic acid that kills tree tissue. William Powell and Charles Maynard of the College of Environmental Science and Forestry in Syracuse, New York, have pioneered a method of genetically modifying the tree by inserting a wheat gene that fights the fungus by breaking down oxalic acid. The genetically modified trees have been grown in labs and test sites. Powell indicated the next logical step would be to request approval from the FDA, the USDA and the EPA to plant the trees which don't differ significantly from other chestnut trees. The application process, which involves follow-up studies and addressing any possible public concerns, could take up to five years.

Scientists are working on putting vaccines in crops via genetic engineering. This would save the cost of transporting and refrigerating vaccines in developing countries. There is research being conducted to genetically modifying animals. Alison Van Eenennaam, a specialist in animal genomics and biotechnology at the University of California, Davis, has written:

> There are many examples of potentially beneficial applications of GE animals including applications that improve the healthfulness of animal products, and the health and welfare of the animals themselves. These include GE animals with altered milk (e.g. decreased lactose) and meat (e.g. increase omega-3 fatty acids) composition for food purposes. Researchers at UC Davis are working on goats that produce milk which is protective against juvenile diarrhea, a major killer of infants in developing countries.

There has never been a scientific breakthrough of this magnitude that has been stymied. Imagine if that

would have been the case for vaccinations. Science ultimately conquers ignorance and so it will be with GMOs. All that the anti-GMO forces can do is slow the train of progress down but they cannot derail it.

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