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Golden Rice: Triumph for Science

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SYNOPSIS

After almost two decades, Golden Rice was approved last week by the Philippines authorities for use as food. This together with the approval of the bioengineered Bt eggplant represents a landmark victory of science over misinformation; it will provide consumers with improved nutrition (Golden Rice) and safer food (Bt eggplant).

COMMENTARY

BIOTECHNOLOGY CROPS have been controversial in spite of overwhelming support for their safety by the scientific community. This is specially so for the class of biotechnology crops commonly called 'GMO' or genetically modified organism. The controversy has led to public concerns about their food safety, in spite of the fact that GMOs are only approved after years of intensive testing by independent government agencies, evaluation and approval upon satisfying stringent criteria for safety.

This approval of Golden Rice and the lesser-known Bt eggplant are therefore milestones in the use of biotechnology to meet food security needs through more (nutritious) food with less pesticides. In the 29 countries which currently grow GMO-biotechnology crops in 2019, over 17 million farmers growing about 91 million hectares have been shown to benefit financially and health-wise. So has the environment from the reduced insecticide use. At the same time, worldwide, beyond the 29 growing countries, another 43 countries import GMO-biotechnology crops for food, feed and processing; this includes Singapore.

Golden Rice: Addressing Vitamin A Deficiency

The Philippines has a high incidence of Vitamin A Deficiency (VAD) which can lead to blindness and death, particularly among children. Rice is the staple in the Philippines, with many households consuming it two to three times a day.

Almost 20 years ago, an international group tested the development of a rice variety which could provide enhanced levels of Vitamin A and therefore relief for the many malnourished children in developing countries.

This enhanced Beta-carotene rice subsequently came to be called “Golden Rice” because of the yellow hue in the grains. The development and testing of this rice has gone through intensive scrutiny by scientific and regulatory bodies in several countries. Indeed this rice has been tested for safety and environmental concerns more than any other modern rice variety.

The World Health Organisation (WHO) estimates that over half a million children worldwide are affected by VAD, with disastrous impact. The International Rice Institute (IRRI) estimated that 17% of children under five in the Philippines suffer from VAD, so the Golden Rice has the potential to change the fight against this disease.

Bt Eggplant: Engineered To Reduce Insecticide Use

Eggplant (a.k.a. Aubergine) is one of the most widely consumed fruit vegetables in South and Southeast Asia. However, eggplant is highly susceptible to the fruit borer which severely damages the fruit that is sold through its feeding on the fleshy part of the fruit that is used by humans.

To produce a crop that is cosmetically acceptable to consumers and profitable for farmers, almost all eggplant farmers have resorted to using insecticides. In Bangladesh, eggplant farmers have been known to spray as many as 70 times in a single season to ensure that their crop is saleable! Oftentimes the pest has also become immune to the cocktail of insecticides used.

The alternative technology that was proposed in the early 2000’s was to use biotechnology to give resistance to the fruit borer so that insecticide use could be reduced, farmers could produce a crop and consumers could buy a safer vegetable. Scientists engineered eggplant with a gene from a common soil bacterium called *Bacillus thuringiensis* (Bt) and were able to show greatly increased resistance to the pest. This same bacterium in its raw form is used by organic farmers for pest control.

The same Bt technology has also been successfully used in crops like maize, soybean and cotton. Indeed Bangladesh became the first country to grow this Bt eggplant in 2014 and since then some 34,000 small farmers have grown over 2,000 hectares in 2019; farmers have been less exposed to dangerous insecticides, and consumers have accepted this safer product.

Other countries have been slow to adopt this technology because of the fear of controversy surrounding GMO-biotechnology crops and opposition by “green groups”. And it is to the credit of Filipino scientists and regulators that they have finally accepted the scientific evidence and shown courage to approve this new eggplant variety, and give consumers a safer vegetable.

Future Biotechnologies

The importance of the approval by the Philippines of Golden Rice and Bt Eggplant cannot be understated. The Philippines was the first Asian country in 2000 to approve a biotech crop, the Bt maize for planting by farmers. And since then the economic benefits to farmers, especially smallholder farmers have exceeded expectations, as studied by credible economists. It has drastically reduced the foreign exchange bill of importing maize to fuel the growing demand for animal feed. The Philippines was even able to export maize in one year.

The doomsayers who predicted environmental disaster from introducing a biotech crop like Bt maize into the environment have been proven wrong as the fears of upsetting biodiversity have not been evidenced.

Neither has any of the concerns about animal and human safety been seen. Indeed the 20 years of biotech maize use around the world has only seen a yearly increase in the uptake by farmers, to the benefit of consumers through a reliable supply of an important animal feed (and human food in some countries).

Moving Forward

The latest report on food insecurity by the Food and Agriculture Organisation (FAO) in 2021 (http://www.fao.org/3/cb4474en/online/cb4474en.html) shows that the Asian continent is still rife with hunger and malnutrition. Many tools are needed to address the food needs in Asia, and the approvals by the Philippines last week augur well for the application of various biotechnologies to meet the challenges of producing more of both traditional food as well as novel food.

Moving forward, the new generation of biotechnology applications to meet the demands of humanity for food, feed and fibre are exemplified by Plant Breeding Innovations such as gene editing. Their impact is just being felt in terms of crops with improved yield, tolerance to pests, diseases and climate change, and improved nutrition and extended shelf life.

Likewise, biotechnology processes have been used in the fast-growing alternative protein industry to produce food like plant-based protein and cellular meat. However, whether these benefits will be realised will depend much on consumer acceptance and government approvals.

At a time when food security worldwide is being threatened by disruptive forces like climate change and pandemics, technology has an important role to play in innovating solutions. Countries like Singapore are capitalising on some of these new technologies, not just to produce more food but also to address the environmental impact of food production. But ultimately, much will depend on a science-literate populace accepting food produced with new technologies.

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