Transgenics – At crossroads

With the development of recombinant DNA technology, breeders have access to a large number of genes that can be integrated into the plant genome. Direct *in vitro* transfer of DNA between or within species is a new branch of biotechnology, which is referred to as genetic modification or genetic engineering. The term 'transgenics' or genetically modified organisms (GMO) is used to describe new strains of organisms in which the DNA has been modified through *in vitro* insertion of genetic material from a foreign organism.

Transgenic or genetically modified plants are being made both in food and cash crops. Several crop plants have been released for commercial cultivation in USA which are herbicide-tolerant, and insect and disease-resistant. Other transgenic traits fall under the categories of nutritional and post-harvest quality improvement. The transgenic tomatoes (Flavr savr, a Calgene product) with delayed ripening genes were first introduced in USA at a commercial level. In 1998, the global area of transgenic crops increased from 16.8 million hectares to 27.8 million hectares[1]. The major transgenic crops are soybean, maize, cotton, rapeseed and potato, in descending order of area of cultivation. Although the yields of genetically engineered soybean was found to be 5 to 7 per cent less in the university-based soybean varieties trial in 1998, (USDA), other transgenic crops have resulted in higher yield and profit. Economic benefits to the growers from the transgenic crops were estimated conservatively at $128 million for *Bt* cotton in 1996 and $133 million in 1997. Similarly, economic benefits were estimated at $19 million and $119 million for *Bt* corn and $12 million and $109 million for herbicide-tolerant soybean in 1996 and 1997 respectively, in USA. China, after 1996 has approved commercialization of *Bt* cotton, sweet pepper, CMV-resistent and delayed ripening tomatoes[2]. The Chinese have also accepted genetically modified food. In India, work on transgenic plants is hampered by lack of trained manpower, finance and infrastructure facilities.

The multiple benefits of transgenic crops include flexibility in terms of crop management, decreased dependency on conventional insecticides and herbicides, higher yields, cleaner and higher quality grain or end product. The economic returns from these transgenic crops have also increased considerably along with consumer acceptability. The benefits to mankind can be many fold, for example the new 'golden rice' which has β-carotene gene[3] could cure 2 million children from the deadly malaise of blindness. Transgenic bananas containing hepatitis-B vaccine would be of immense help in the immunization programmes for eradicating hepatitis. Nutritionally improved potatoes containing amaranthus albumin gene[4] (*AmA*1) which is nonallergenic and rich in all essential amino acids would be a great boon to developing countries to alleviate the malnutrition problem.

Despite all the promises that the transgenic technologies hold, the antibiotechnology environment groups' thinking that GMO are potential threats to public health and environment is harmful to the development of this new technology. Their main argument is genetic engineering is so new that the effects on the environment cannot be predicted. This argument is highly misleading, in fact for hundreds of years virtually all food has been improved genetically by plant breeders. Genetically altered antibiotics, vaccines and vitamins have improved our health, while enzyme-containing detergents and oil-eating bacteria have helped to protect the environment.

The risks of modern genetic engineering have also been studied by technical experts at the National Academy of Sciences and World Bank. They concluded that the environmental effects can be predicted by reviewing past experiences with those plants and animals produced through selective breeding. None of these products of selective breeding has harmed either the environment or biodiversity. According to the FAO reports, the per-person-grain-harvest declined from 415 kg in 1965 to 360 kg in 1996. There is a need to reverse this trend for which transgenics have created opportunities for efficient crop improvement. Their rapid adaptation into Indian agriculture will ensure increased crop productivity in future. In addition, adopting a wider application of biotechnology, plant tissue culture and micropropagation technologies are capable of producing high quality plant stock at lower economic costs than the conventional methods. It is important that we should enhance farm productivity, per unit land, water and capital without ecological harm. It is therefore urged that the political and scientific leaders, society and the mass media of our country should promote efforts in mobilizing the tools of biotechnology and genetic engineering for improving productivity, profitability, stability and sustainability of our major cropping system.

1. James, C., Global Review of Commercialized Transgenic Crops, Executive Summary, The International Service for the Acquisition of Agri-biotech Application (ISAAA), Briefs No. 8, ISAAA, Ithaca, NY 1998.
2. Ponguvutitham, A., *The Nations*, 1999, Ref no. 2308.
3. Xudong, T., Al-Balili, S., Kloti, A., Zang, J., Lucca, P., Beyer, P. and Potrykus, I., *Science*, 2000, **287**, 303–305.
4. Chakraborty, S., Chakraborty, N. and Datta, A., *Proc. Natl. Acad. Sci. USA*, 2000, **97**, 3724–3729.

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