Technology Protection System

Commercial production of Bt and herbicide tolerant varieties has been conditional on a fee to be paid to the owner of the genes. In the case of transgenic varieties resistant to lepidopteran insects, U.S. farmers have to pay a technology fee of US$80/ha. It was assumed that the Bt gene would save more than US$80/ha in insecticide costs. The ability of the cotton plant to tolerate herbicide applications over the top of the plant and the ability to produce a specific toxin injurious to a variety of bollworms are heritable characteristics. Once these resistant genes are inducted into the cotton plant, they are automatically transmitted to the next generation, and farmers can use the transgenic seeds year after year. However, farmers sign agreements with biotech companies to prevent them from storing and planting the same transgenic seed the next year. Also, farmers are not allowed to transfer seed to other growers.

Biotech companies maintain a list of their transgenic cotton growers. Although the technology fee varies between Australia and the USA, similar practices are followed in both countries. This is also true in Argentina, Mexico and South Africa, which have already gone into commercial production of Bt cotton. China (Mainland) also planted about 52,000 hectares of Bt cotton in 1998/99, but the arrangements were slightly different from other countries. Agreements with biotech companies may or may not have been abused, and the illegal transfer of seed may or may not have taken place. Nevertheless, theft is a potential threat that could affect the recuperation of research and development costs by biotech companies. Chances are that the technology could be leaked free to other farmers and countries by growers receiving the advantages of Bt traits.

In 1993, research was started in the USA on a system to limit the use of planting seed to only one year. After almost five years of collaborative research, the USDA and Delta and Pine Land Company were awarded a patent in 1998 on technology called Technology Protection System (TPS). TPS is a clever three-gene system that forces plants to produce a toxin that is fatal to their own seeds, compelling farmers to buy new seeds every year. TPS is a transgenic system comprised of a complex array of gene promoters which, in a normal state, are inactive. This means that a transgenic variety with TPS will produce viable seed like a normal variety. But, if the same seed carrying TPS is given a treatment prior to sale, the treated seed will germinate as normal, but will not produce a viable seed. The treatment will trigger an irreversible series of events rendering the seed non-viable for replanting. The toxin is harmless to people and is produced late enough in the season so that the commercial value of the seed is not affected. The seed matures like a normal seed and is perfectly fit for feeding or oil extraction.

TPS varieties are not yet available, but farmers will soon have a choice of TPS or non-TPS varieties. However, there may be an additional fee for TPS. Economically speaking, the technology should have a discount to encourage farmers to grow TPS varieties, which would allow biotech companies to reap the benefits of the technology fee for a longer period of time. According to TPS-technology owners, the long-term benefits of specific technologies will bring more money to research and ultimately benefit cotton growers.

One of the additional advantages of TPS is biosafety of the transgenic species. The currently available non-cotton genes, transferred to the cotton genome, have been tested for many years and do not have any deleterious effects. But, as more and more genes are being explored, there are chances that transgenic genotypes could spoil the germplasm particularly in areas having high out-crossing. TPS can help to preserve wild species and other varieties, as the cross-pollinated seed will not germinate.

Commercial production is the second stage. First, seed companies need a viable seed for multiplication for at least three generations: nucleus, basic and certified. The stages of multiplication may vary in different countries but normally seed production involves at least three stages before the seed reaches farmers for commercial production. Thus, multiple seed generations should be able to produce mature fertile seed to sell to growers. To do so, researchers have manipulated the plant's DNA to control yet another genetic mechanism, which suppresses the effect of the suicide genes indefinitely. In the suppressed stage, transgenic plants having TPS always produce fertile seeds.

The TPS system can be activated according to the desire of the companies to produce infertile seeds at any stage. The fertile seeds will be sprayed with a chemical (in one version, it is said to be tetracycline antibiotic in nature) called "inducer," which awakens the dormant self-infertile genes to overcome the suppression effect. An inducer application revives the ability of the plant to produce seed toxins such as Ribosomal Inhibitory Protein that induces seed infertility. Such a seed, if planted, gives normal germination and produces a normal crop but lacks the ability to form mature seeds.

The commercial availability of the TPS system is still some years away. The technology's simplicity and the companies' confidence in its performance on cotton implies that the technology will be available for commercial use in less that five years, or even two to three years.

The currently available Bt genes or herbicide tolerant varieties have limited applicability because of the farming systems used in many countries. There are only two ways by which countries can get the transgenic technology:

1. To develop their own transgenic genotype systems. Some statistics show that on average over US$200 million are spent to identify, induct and commercialize a single gene. Some

countries do not have the resources for expensive research facilities and for making heavy investments in fundamental research.

2. To buy the technology through joint ventures with multinationals. This option is easy, but has a cost, and multinationals have limitations to enter into such agreements. Some of these limitations could be that the seed production systems are not well developed yet or fear that farmers could keep seeds for the next season. Smallholdings present another hurdle as agreements would have to be made with millions of growers in one country.

Farmers' associations or governments in some countries using the second option have a choice to buy the technology by paying a one-time fee and give it free to farmers or devise a system to collect the fee at the gin level. But, such a procedure would require a sound seed production system and also expertise for monitoring and management of problems like resistance in Bt cotton, quantity of toxin produced, and effectiveness of the toxin.

Commercial utilization of the TPS technology will encourage the expansion of transgenic technology to many more countries. Farmers will have to come back to seed companies every year, and seed companies will be guaranteed to recoup their costs for as many years as they want. Owners of transgenic technologies could go into agreements with governments to use TPS for a limited number of years and then have the seed available free.

Technically, cotton is a cross-pollinated crop, but in most countries it behaves like a self-pollinated crop. It is safe to use TPS technology under self-pollinated conditions, but, if there are conditions where natural cross-pollination in cotton is enough, TPS technology could create a disaster in the germplasm through cross-pollination. Pollen from terminator plants grown on one farm could fertilize nearby native or commercial crops and make them sterile. Such an outcrossing could trigger an epidemic of crop sterility.

While TPS technology could be a solution to expand biotechnological developments to developing countries more safely and quickly, TPS could be considered an additional financial burden on billions of poor farmers around the world. Subsistence farmers in many countries are in the habit of keeping seed for next year. Not only will they be forced to buy seed every year, but they will have to pay for the TPS technology, in addition to the technology fee for the novel gene.

*****