

Technology PROTECTION SYSTEM

Providing the Potential to Enhance Biosafety & Biodiversity in Production Agriculture

The Technology Protection System (TPS), developed through the efforts of the United States Department of Agriculture's Agricultural Research Service (USDA-ARS) and Delta and Pine Land Company (D&PL), has received significant attention since the patent, Control of Plant Gene Expression, was awarded in the spring of 1998.

This paper provides the facts on this technology.

BACKGROUND ON TPS

Biosafety Through TPS

Biotechnology-enhanced crops were produced in 17 countries in 2004 extending to an estimated 81 million hectares (approximately 200 million acres), according to the International Service for the Acquisition of Agri-biotech Applications (ISAAA). As genetic engineering to enhance plants has been widely adopted in so many developed and developing countries, questions about the possibility of transgene movement have been raised.

Transgene movement may occur when a plant that has been genetically modified cross pollinates with a native or wild species. With proper farming techniques, the risk of transgene movement is considered extremely remote, but with the rapid global acceptance of biotechnology-enhanced crops, the concern over transgene movement may become more acute.

TPS provides the biosafety advantage of preventing even the remote possibility of transgene movement. Even in the unlikely event that a TPS plant were to pollinate flowers of a wild, related species, TPS would prevent the resulting seed from spreading the transgenic trait. TPS also provides the additional biosafety advantage of preventing "volunteer" plants, a major problem where crop rotation is practiced.




Increased Genetic Research & Diversity

TPS will stimulate breeding and marketing efforts in countries that have not yet benefited from the clear advances that have been made in crop sciences. These advanced crops are not available in many countries where there is no protection of intellectual property. TPS will allow farmers in those countries to have access to the products of advanced conventional breeding and biotechnology.

While critics of TPS have said that the technology will limit the choices that these farmers have, it will actually have the opposite effect – more options for growers. Farmers everywhere will be able to grow high-yielding, disease-resistant plants with enhanced transgenic traits.

We expect this new opportunity to present farmers in developing countries with the option of moving into production agriculture rather than, in many cases, their current subsistence farming. Importantly, new technology will not prevent farmers from maintaining local land races and heirloom varieties by saving seed, as these varieties will not contain TPS.



The Texas High Plains is an area that long practiced cotton seed saving as a way to reduce farmers' production costs. Data from the USDA-AMS on this region presents a clear story for the benefits that farmers receive when they purchase seed. As biotechnology-enhanced seed was approaching introduction in 1996, approximately 10 percent of the 1.4 million hectares in this region was planted with purchased seed. There was one major breeding program in that area and a single variety accounted for more than half of the planted area. Just a few years later, growers in that region chose to purchase approximately 90 percent of the seed planted on 1.5 million hectares. The number of major breeding programs jumped to four and the previous predominant variety was planted on just 21 percent of the area. Obviously, farmers have been the beneficiaries of new technology in many ways, including the resulting incentive to seed breeders to enter the market.

TPS will be broadly available to both large and small seed firms. This approach will encourage competition in breeding research in many crop species and geographic areas in which breeding in the past has not been adequate to optimally serve farmers. Consequently, there should be sizable improvements in technology and variety features. Delta and Pine Land Company and the USDA-ARS believe that this is a distinct advantage to farmers because they will have better varieties and biotechnology traits can be launched in additional markets.

Genetic diversity in many important crops is a real concern of both private and public breeders today. There is no correlation between TPS and lack of genetic diversity. In fact, with the increased incentive for many private seed companies as well as universities to breed crops that have not received sufficient attention in the past, it is entirely possible that diversity will increase as breeders focus on providing unique and improved versions of germplasm to farmers.

Equity for Farmers In The Global Economy

This technology will insure farmers a more level playing field when competing in commodity production with other growers worldwide. Farmers in countries such as China, South Africa, Australia and the United States have been paying for advanced seed technologies for the past several years based upon the value of proven enhancements. Some of these advanced technologies have moved into other countries that are major competitors on the world market. In many cases, farmers in these other countries are receiving the advantages of these traits without paying for their use, a situation that undermines the competitive viability of many farmers as well as seed and trait producers.

UNDERSTANDING THE SYSTEM

TPS is a transgenic system comprised of genes and gene promoters that, in their normal state, are inactive. This means the plant is normal and produces normal seeds that germinate when planted. Seeds carrying TPS produced for sale to the farmer will simply have an environmentally-safe treatment applied prior to the sale of the seed which, at time of germination, will trigger an irreversible series of events rendering the seed produced on farmers' plants non-viable for replanting. It's important to note that TPS will have no effect on the seed product whether for feed, oil, fiber or other uses, much the same as with hybrid varieties that are familiar throughout the world.

Other Germplasm Protection

While TPS is the most prominent of the Genetic Use Restriction Technologies (GURTs), there are other older and widely used means of protecting genetic breakthroughs. The most common type of protection system is hybrid seed production. Although primarily a system for increased yield via hybrid vigor, it is also a protection system. Hybrids are seen in many cross-pollinated crops such as corn, sorghum, sunflower and in some canola varieties. Hybrid seed is seldom saved for replanting, due to differences from the parent seed in the produced generation and resulting reduction in performance. Farmers, recognizing the value added from increased yields, are willing to buy new hybrid seed each year instead of saving and replanting seed from their previous crop. Their continuing repurchase of seed insures quality while funding continued research that leads to new and improved products.

On the other hand, few germplasm protection systems have been successfully implemented for self-pollinated species, such as soybeans, wheat, rice and cotton. The difficulty in producing hybrids, combined with costly implementation, has kept companies from investing heavily in hybrid production for some of these crops.

Misconceptions Concerning This Technology

There have been many misunderstandings communicated and erroneous information disseminated concerning TPS. Some have been concerned with the possibility that sterility would spread in populations and wipe out an entire species. However, sterility is one trait that cannot spread in a population. By its very nature, it is only present for one generation and because sterile seeds do not produce plants, these nonexistent plants cannot produce pollen with which to propagate more sterile plants.

Some have expressed concern that a farmer growing a non-TPS crop next to a field of a TPS crop of the same species would not be able to save the non-TPS seed because pollen flow from the TPS crop would cause the seed to be sterile. The TPS target crops – soybeans, wheat and rice – are highly self-pollinated. Therefore plants of these crops will have produced seed fertilized by their own pollen prior to accepting pollen from the adjacent TPS crop. The frequency of outcrossing is extremely low and therefore, the amount of sterile seed produced on the non-TPS crop would be negligible and indiscernible.

“While the realities of agriculture and health in Africa make the case for urgent use of biotechnology, the region is still seriously lagging behind on the biotech map. In fact, the main beneficiaries of current biotechnology revolution are developed countries who of course have nothing like the food security and health problems that face Africa.”

Dr. Peter Doherty,
Nobel prize winner in medicine in 1996

http://www.uneca.org/eca_resources/Speeches/am_oako/2003/041003lecture_ilri.htm



Timetable for Development

Several years ago, a D&PL cotton breeder and researchers from the USDA-ARS generated the idea for a technology protection system during an informal meeting. Research began in 1993, and has progressed over the ensuing years to move the concept toward reality. In the spring of 1998, D&PL and the USDA were jointly awarded a patent by the US government. The system is being developed further and we expect that it will be a few years before TPS transgenic varieties are commercialized. Though research has progressed well, at this time there are no TPS plants of any species growing in a field anywhere in the world.

FARMERS TO RECEIVE CHOICE AND BENEFITS

Farmers will continue to select those varieties offering them the highest returns and most benefits. As is currently the case with transgenic varieties, farmers will be able to choose from TPS and non-TPS varieties. It is the expectation of both D&PL and the USDA-ARS that the benefits realized by planting TPS varieties, carrying advanced technology traits, will be significant. Many farmers will be likely to choose TPS varieties when given the opportunity, but it will clearly be their choice.

Measuring Success

In the end, it is the farmers who will decide if the TPS and other new agricultural technologies have tangible benefits. Seed companies and technology providers are dependent on the success of farmers. If a technology does not bring benefits and increased prosperity to our customers, the farmers, they will not purchase the technology. It is in everyone's interest that more choices be available to all of the world's farmers, and the TPS is a means of achieving this goal.

"The system will negate fears of transgenes escaping into the environment. Our whole mission is to improve agriculture and keep it at the forefront of the world market."

Mel Oliver, Ph.D.,
USDA-ARS,
co-inventor of TPS



FOR ADDITIONAL INFORMATION

Dr. Harry B. Collins, vice president of technology transfer, leads the TPS effort for Delta and Pine Land Company and welcomes the opportunity to discuss the TPS with media, government and regulatory representatives, seed and technology companies, as well as individuals. He can be reached at D&PL's headquarters in Scott, Mississippi by calling 662-742-4533 (8 a.m. to 5 p.m. CST), faxing 662-742-3795 or e-mailing at harry.b.collins@deltaandpine.com. His postal address is P.O. Box 157, Scott, MS 38772.

D&PL