



DISCUSSION DOCUMENT

“The Voice of Manitoba Farmers”

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Genetic Use Restriction Technology (GURTs)

Commonly referred to as “Terminator Technology”

Presented to General Council, July 2006

Following a resolution on terminator technology at the January 2006 annual meeting, KAP’s Research & Biotechnology Committee was tasked with collecting and reviewing information on this issue. In June 2006, the committee met with two representatives from the University of Manitoba to fulfill this mandate and, as a result, wishes to provide the following summary about the technology, how it works, the potential uses, and the pros and cons of such use. The committee hopes this document will be a source of information for KAP members, to be used to help begin constructive discussions within the organization about GURTs, and assist in developing any KAP policy that members may believe is needed.

What Is Genetic Use Restriction Technology?

There are two types of GURTs that are being discussed by researchers. The first is trait-related (T-GURT), where the seed never becomes sterile. These would involve having a specific trait (T) like drought, insect or frost tolerance inserted into the seed that activates under these conditions. T-GURTs are totally theoretical at this time, and no developer is known to be working on a seed of this kind.

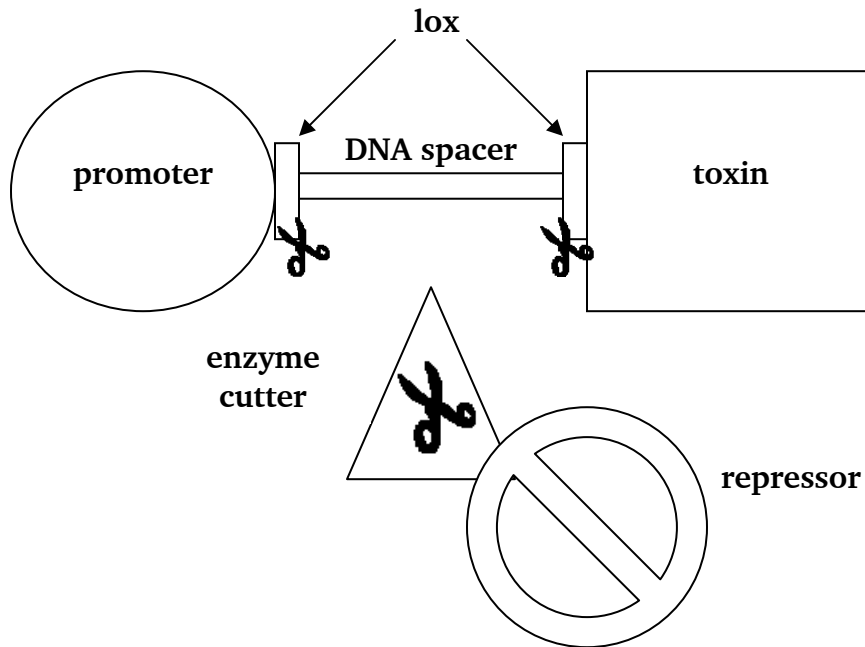
The other type, the subject of the remainder of this document, is called a V-GURT (variety-related) and is commonly referred to as “terminator technology.” This type targets the seed’s reproductive process to cause seed sterility. However, the design must also allow the breeder to multiply seed before making it sterile when sold to farmers. This is usually done by treating the seed prior to the sale. The seeds will then mature to harvest but will not be able to germinate.

The Seed Sterility Process

The technology needed to create a sterile seed is not easy. It requires the engineering of a series of genes in close proximity that also must be permanently transferred to the plant. The process has to include a gene with a toxin that kills the seed late in development, but not any other part of the plant. It must also include a method to allow the plant breeder to grow several generations of the plant (which already has the toxin inside it) without any of the seeds dying. Finally, it must also have a mechanism that activates the toxin once the seed is planted, creating seed sterility.

How Do They Do That?

The process that is currently being discussed includes the following parts: the seed-specific toxin, a “promoter” that activates the toxin to kill the seed, a DNA “spacer” kept in place by lox, an enzyme to cut the lox surrounding the “spacer,” and a “repressor” that is continually active. The entire process is a chain reaction, modified to allow for seed breeding.



The toxin can only kill the seed if it comes in contact with the promoter. To allow for seed breeding, the spacer is inserted to keep them apart. To create seed sterility later, the enzyme cutter is also included, and its job is to interact with the spacer and cut it out at both lox, causing the toxin and promoter to come into contact. However, this enzyme is continually active, so a repressor is needed to stop it from cutting the lox before seed breeding is completed by the developer. In the configuration shown above, the seed would have all of the necessary genetic changes needed to become sterile, but isn't actually sterile.

To make the seed sterile when it's sold to the farmer, the repressor has to be turned off. This causes the enzyme cutter to get rid of the spacer, causing the toxin and promoter to come into contact. To do this, the seeds are soaked in tetracycline (an antibiotic) prior to planting.

Challenges of the Process

The process is extremely complicated. While there may be research coming forward on other ways to create seed sterility, this is currently the only model. It would be extremely expensive to introduce, and would only be used on an extremely valuable crop. It's very likely that no “commodity” crop as is grown today is valuable enough to warrant the use of this technology. The series of chemical interactions required also use enzymes (proteins), so all known and possible proteins and other by-products that would be created as a part of this process would have to be researched and studied for their potential impacts on humans or animals. Finally,

researchers have noted that the use of an antibiotic to start a process on a product that could be used for human consumption is a “non-starter” from a regulatory / health perspective.

Advantages & Disadvantages

Seed sterility could help to alleviate poverty / hunger in the developing world if a more economical process is found. By eliminating pre-harvest sprouting, billions of dollars in crops would not be lost. GURTs could also eliminate volunteers in crop rotations and limit outcrossing. It could also serve as a potential solution to some of the issues within the Cartagena Biosafety Protocol, as this relates to trans-boundary movements of living modified organisms. There is also the possibility of “pharming” high-value crops to grow antibodies, biopharmaceuticals, nutraceuticals, functional foods, and edible vaccines. The two crops identified as most suitable to act as the basis of this kind of industry are tobacco and alfalfa.

The negatives include the likely impacts on farmers in the developed and developing world regarding the loss of farmer-saved seed privileges with GURT crops. The potential of outcrossing is still unclear. There is also a high level of technical complexity that may make the technology less reliable than is required, which may create a GURT crop that is not fully sterile. There is also some question about what impact gene mutations may have on GURTs.