Pocket K No. 21

Gene Switching and GURTs: What, How and Why?

Genetic Use Restriction Technologies ("GURTs") is an ongoing topic of discussion under the Convention on Biological Diversity. The current focus surrounding this topic concerns whether and how GURTs may impact indigenous peoples, local communities and small-holder farmers. Indeed, in the most recent debate on this topic held in February 2005, the representatives of the indigenous peoples and local communities requested clear and objective information on GURTs so that they could understand the issues and better participate in the discussion.

This Pocket K seeks to respond to that request by explaining what gene switching and GURTs technologies are, how they work, and why public and private sector scientists, as well as governments, are pursuing further research and development in this area.

What is gene switching and how does it work?

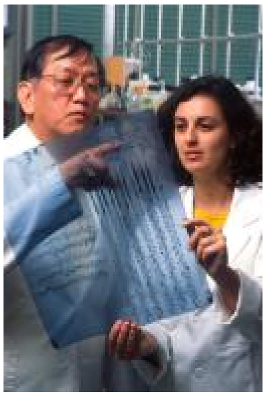
Biotechnology-based gene switching is the use of genetic engineering to control specific genetic material (genes) in plants to achieve certain desired results. The targeted genes are controlled through so-called "switch mechanisms." These mechanisms activate (turn on), deactivate (turn off), or adjust upward or downward specific plant functions.

This can also be described as controlling the "expression" of plant genes. Gene switching mechanisms may be established, among other things, in response to an external trigger (e.g., rainfall, light patterns, chemistry), to activate the expression of genes at critical times, or in particular locations within the plant. One must say "biotechnology-based gene switching" because gene switching occurs naturally and without human intervention in nature all the time (e.g., the presence of water activates plant genes responsible for germination; light patterns turn on reproduction stages; pests activate defense mechanisms).

Much of the current research focuses on gene switching applications to control one or more genes related to specific *traits* of the plant. In these cases, all the other genes in the plant are untouched and continue to function normally. Seed from these plants could be saved by farmers (if applicable national laws permit seed saving) and planted the next year resulting in a normal crop, but in almost all cases, without the special trait expression that was present the first year (e.g., herbicide or insect tolerance).

Some applications of biotechnology-based gene switching are not limited to controlling specific *traits,* but instead control genes responsible for reproduction or seed germination. Plant gene switching can be used to control plant reproduction in a number of different ways, for example, by limiting production of pollen or by producing non-viable seed. In other words, biotechnological controls in the plant allow for normal planting and harvesting of the product, but the plant variety will not be able to reproduce in subsequent years. Commercially available examples of this are seedless grapes and watermelons.

Why are scientists exploring gene switching?



Because of the significant potential beneficial applications of this technology, many public and private sector scientists see gene switching as the future of biotechnology.

For instance, researchers are exploring the use of gene switching to allow a plant to express a gene only when it is needed. That is, a drought tolerant plant will produce the gene for drought tolerance only when drought occurs. In better weather and soil conditions, the plant will not produce the gene, and its resources will be channeled to important activities, such as food and energy production. Farmers who save seed in this context would be able to grow a normal crop the subsequent year, but the special drought resistance feature would no longer function.

Other examples include the following:

- The development of sentinel plants that would notify farmers when there is a nutrient deficiency or a pest infestation in their fields – enabling the application of pesticides and/or fertilizers only when absolutely necessary.
- Targeted release of Bt or other pest protection mechanisms within a plant, helping to further reduce the potential development of pest resistance in conjunction with refugia and integrated pest management (IPM) processes.
- The development of sterile progeny, further contributing to environmental risk management processes in centers of origin and other sensitive environments or areas with stringent biosafety frameworks.

How are gene switching technologies regulated?

While present decision-making concerns only laboratory experimentation, field testing and commercialization of products of gene switching technologies will occur in the coming years. National biosafety frameworks regulate viable products of genetic engineering, including any plants and organisms that may be created through gene switching technologies, on a *case-by-case basis through scientific risk assessment*. Accordingly, any unique attributes of products of gene switching, including those that result in sterile seed, automatically are considered in risk assessment and decision-making.

Because of the detailed case-by-case approach to biosafety reflected in national regimes (and also integrated into the Cartagena Protocol on Biosafety), gene switching products are and can continue to be regulated under the same biosafety system as any other biotechnology application. Nevertheless, the CBD has created guidance for regulators concerning GURTs. Decision V/5 recommends that CBD Parties not approve products created through the use of GURTs for field testing until appropriate scientific data justifies the testing and for commercialization and strictly controlled scientific assessments concerning impacts and adverse effects are carried out and conditions for their safe and beneficial use validated.[1]

What is the purpose of producing sterile seeds?

GURTs can be used to produce genetically engineered plants which will grow and can be harvested, but cannot produce viable seed, thus preventing unintended introduction of the crop to the environment. A number of government bodies have recognized this potential biosafety benefit of GURTs[2], and funds have been allocated to support additional research.[3]

An important motivation for companies to create sterile seeds is to protect their technology and investment by preventing unauthorized saving and planting of seeds in subsequent years. The farmer who purchases this seed will know that he will not be able to save seed from his crop because these products will be labelled by manufacturers with information about the added value trait and any restrictions related to patents and/or plant variety protection. GURTs products may also cost more than conventional seed. Some farmers may choose to buy these higher priced seeds — even though seed saving will not be possible — because of particular benefits (e.g., higher yields, higher quality traits, and more efficient plants) they will offer. Other farmers will continue to be able to choose other seed products without these technological improvements.

Calls for Moratorium Rejected

Calls for a moratorium on the technology have been rejected repeatedly by CBD bodies. The latest rejection of a blanket ban occurred in February 2005 when the CBD's Subsidiary Body for Scientific, Technical and Technological Advice instead recommended that the CBD reaffirm its existing recommendation, which allows for case by case assessment.[4] Neither have the International Agricultural Research Centers rejected the technology as some have asserted. Instead, this particular research system has decided not to use applications designed to prevent seed germination because of its specific purpose of breeding crop varieties for resource poor farmers.[5]

Conclusion

Biotechnology based gene switching in plants describes a wide range of mechanisms to control plant gene expression for purposes beneficial to human beings and our environment. These technologies hold promise to more efficiently and effectively use traits in plants. In the case of the applications that result in plants that do not reproduce, the technology also offers an additional layer of biosafety protection as well as serving to protect research and development investments.

All genetically modified organisms created through biotechnology-based gene switching can and should be reviewed and assessed on a case by case basis, under scientifically sound regulatory frameworks, in line with existing CBD guidance.

References

1 http://www.biodiv.org/decisions/default.aspx?m=COP-05&id=7147&lg=0, at para. 23.

2 *See, e.g.*, Netherlands Commission on Genetic Modification, CGM/041214-01/02, at p. 51 (identifying GURTs as a possible solution for added biosafety for plant made pharmaceuticals); New Zealand Royal Commission on Genetic Modification (2001 Report) ("the use of sterility technology in commercial forestry trees should be investigated as it has the potential to reduce pollen production with its associated allergenicity problems and prevent wild pine escape.").

3 *See, e.g*. Press release concerning Bavarian Research Foundation award for three year research collaboration between Icon Genetics, Research Centre Freising, and the University of Munich http://www.icongenetics.com/html/news_details.php?id=5928&ityp+2 (11 April 2005).

4 http://www.biodiv.org/recommendations/?m=SBSTTA-10&id=10691&lg=0.

5 http://www.worldbank.org/html/cgiar/publications/icw98/icw98sop.pdf, at p. 53.

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