Topic – Terminator Gene Technology

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Terminator Gene Technology

The terminator gene technology or genetic use restriction technology (GURT) is the genetic modification of plants to make them produce sterile seeds in second generation. It is also famous as a suicide seeds.

Terminator alters the expression of certain genes in plants, thus they (plants) terminate their reproductive switch, about the embryo and make themselves sterile. Such plants then produce seeds but they will not germinate.

This technology was patented by U.S. Department of Agriculture and the Seed company Delta and Pine Land, company.

During 2002, Monsanto acquired Delta and Pine land.

The technology has been named Terminator by the Canadian Government Organization, Rural Advancement Foundation International (RAFI).

It was described as gene protection technology by Monsanto.

Types- The technology is of 2 types

1. V-GURT (Varietal GURT)
2. T-GURT (Trait GURT)

1. V-GURT (Varietal GURT)

   It is restricted at the plant variety level. It is designed to control plant fertility or seed development through a genetic process triggered by a chemical inducer. It will allow the plant to grow and to form seeds. But due to formation of cell toxin by embryo, the germination is prevented if replanted. Thus second generation seeds remain sterile.

   This type of GURT produces sterile seeds meaning that a farmer that had purchased seeds containing V-GURT technology could not save the seeds of this crop for future planting.

2. T-GURT (Trait GURT) –

   It is also known as traitor technology.

   It is restricted at the trait level, hence the tem T-GURT.

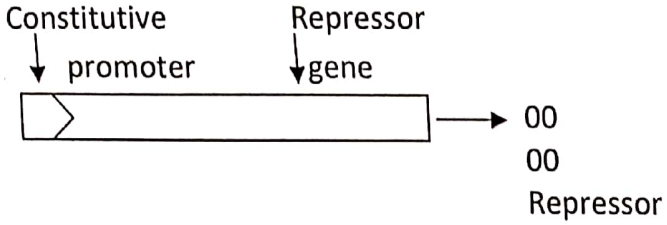
   T-GURT is designed to switch on or off a trait using the inducible promoters regulating the expression of transgene through induced gene silencing (e.g. by antisense suppression) or by excision of the transgene using a recombinase.

   In this case, the genetic modification is activated by a chemical treatment or by environmental factors (e.g. heat) enabling farmers to maintain the value added traits of the seeds.

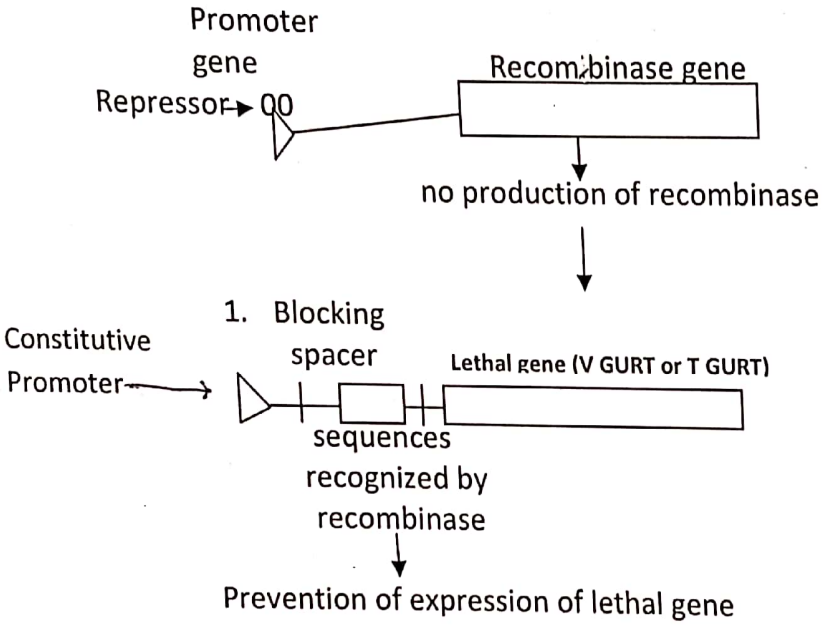
Seeds can be saved by farmers for use each year. However, they do not get to use the enhanced trait in the crop unless they purchase the activator compound.

Molecular Mechanism-

1. Production of repressor molecule -

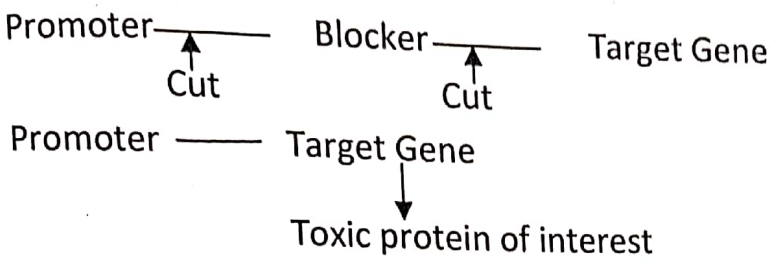


2. Binding of repressor at operator site contained in the promoter-
   It prevents transcription of recombinase. Finally expression of lethal genes (V-GURT or T GURT) is prevented.



3. If external inducer is added:-

External inducer
↓
Inducer binds to repressor
↓
Changed repressor will not bind to operator
↓
Expression of recombinase gene
↓
Blocker spacer is cut
↓
Expression of target gene
↓
Toxic protein of interest



Advantages of Terminator Technology

1. It prevents escape of transgene into wild relatives.
2. Farmers get maximum production due to use of new seeds every year.
3. This technology will induce private sector to make more investment in research and development of pure line varieties and open pollinated ones. In these varieties, the farmers do not change the seeds each year.
4. It can be used to limit the spread of genes from GMOs to other plants in natural environment.

Disadvantages of terminator technology-

1. Harvested seeds are used only for consumption.
2. It may cause health hazards because it has been treated with some chemicals before sowing.
3. Location specific and season bound varieties can't be grown
4. Tetracycline is used to activate the toxic gene. It may alter the soil flora and fauna.
5. These plants can transfer pollen grains to our wild type crops and cause sterility in their seeds too.
6. Genetic diversity may be lost due to covering by just one genotype in maximum crop field.