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MOLECULAR CONVICTION BEHIND THE PRODUCTION OF "SUICIDE SEEDS"

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Abstract

Advancement of biotechnology and genetic engineering upon green revolution has now been emphasised by the top seed companies using sophisticated terminator gene technology to secure a much stronger monopolistic pathway in the seed market around the globe. They objectify sterile seed production in successive generations by manipulating novel genes, so that farmers cannot reuse their once harvested seeds and are forced to buy new seeds from the market every year. Antibiotic tetracycline is mostly used as an external stimuli that switches on the suicide mechanism inside the seed just after embryogenesis. United States have patented this biotechnological innovation for the first time and made a worldwide threat on food security especially in developing countries where most of the population are involved in agriculture. Therefore, Government should critically investigate and evaluate the intension of this terminator gene technology before giving it permission to be commercialised.

Introduction

The global agricultural research is continuously flourishing their potential with gradual improvisation and innovations to find out the most appropriate solution to world hunger. In this regard, biotechnologists are keen enthusiastic in discovery of terminator technology or genetic use restriction techniques (GURTs) as a nifty revelation to protect originality of inventor's findings. Although this technology has not yet been popularized in world market, the apex body of giant companies as well as top seed industries have already started promoting their brainchild as a "biosafety" tool among the farming communities. Monsanto denominated this technology as a "gene protection technology" (Mukherjee and Kumar 2014). On March 1998, United States Department of Agriculture (USDA) coupled with Delta and Pine Land (D&PL) Company of Mississippi got patent of GURTs entitled "Control of plant gene expression" (Yousuf et al. 2017). But the Indian Parliament has banned the use of suicide seeds in accordance with the "Protection of plant varieties and farmers' rights act" in 2001.

GURT: Types and Mechanism

The genetic use restriction technologies (GURTs) are new biotechnological interventions, mainly involved in protecting the IPRs of the original mastermind. It deals with specific genetic switch mechanisms that restrict the ineligible use of genetic material by altering either reproduction (V-GURT) or a specific trait expression (T-GURT) in GM crops (Eaton et al. 2002).

V-GURT is actually based on controlling a chemical inducer mediated seed development process, promoting the embryo to produce a cell-toxin that will prevent its germination if replanted (Lombardo 2014). Thus causing seeds to be sterile, V-GURT acts as a cobweb for the poor farmers. T-GURTs on the other hand, are not truly involved in affecting the viability of seeds. But, a number

of genes conferring a single trait may be switched on or off by the action of chemical inducers (Yousuf et al. 2017).

Pre-requisites

i. a repressor gene that perceives an external stimulus
ii. a recombinase gene, whose expression is blocked by the action of repressor
iii. a target gene that produces cell toxin

In V-GURTs, the repressor gene produces repressor protein which is directly involved in the activation of recombinase gene. A lethal gene RIP (Ribosomal Inactivating Protein), under the control of LEA promoter (Late Embryogenesis Abundant promoter) is separated from the promoter by a spacer sequence, which blocks RIP expression in the first generation. During late embryogenesis, RIP gets permission from its promoter to express to affect only the embryo development in the very next generation. On either side of the spacer, a recombinase gene (*CRE/LOX* system from a bacteriophage) sequence is placed to snip out the spacer sequence in between promoter and RIP sequence, so that the late promoter is able to activate the lethal gene late in the season. Repressor protein when perfectly binds to the site near a recombinase gene, transcription of the recombinase gene is inhibited and therefore no recombinase protein is produced to remove the spacer sequence (see figure 1). Hence, rest of the entire terminator mechanism gets switched off (Yousuf et al. 2017).

Upon exposure to chemical inducer like tetracycline, hybrid seeds start exhibiting inability to regrow. Tetracycline when applied to the seed lot before selling to the consumers, restricts the activity of repressor protein and promotes transcription of recombinase gene leading to successful toxin production by the lethal gene (Gupta 1998).

In contrast to V-GURT, a gene cassette is programmed to express in the seed for the production of disrupter protein in T-GURT and a particular trait of interest is altered accordingly, keeping the embryo intact. The chemical inducer upon application over the seed lot before being sold to farmers allows the trait expression in the first generation but, hinders in the successive generation (Pilger 2002).

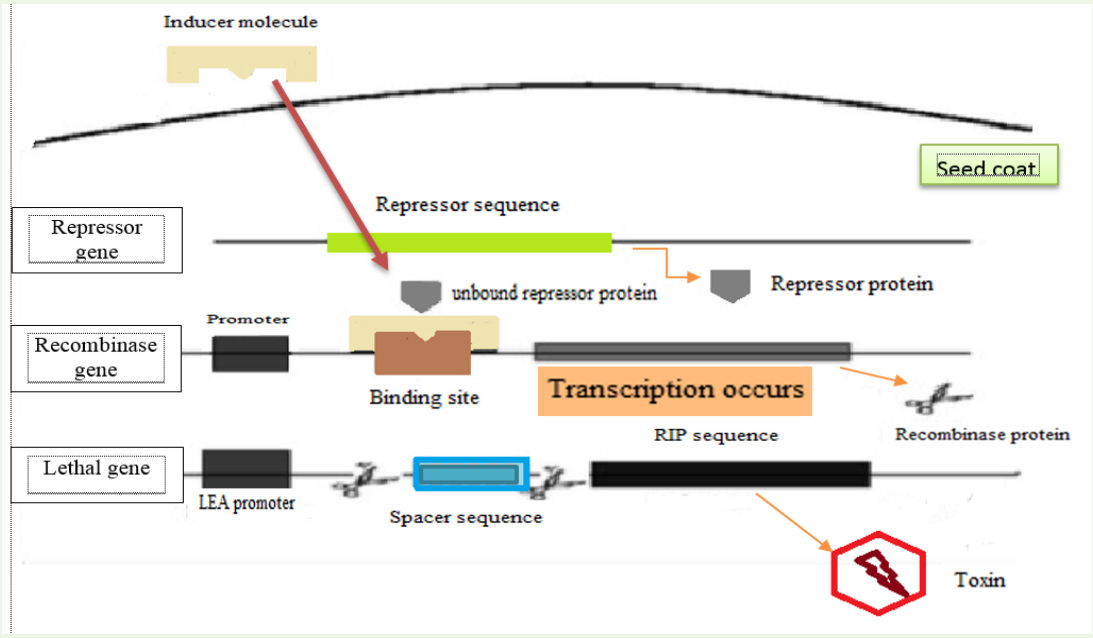

Figure 1. Suicide mechanism after treating with inducer

Relevancy of Terminator Technology

Advantages

1. Use of new seeds every year leads to maximum yield.
2. The giant private companies must compete each other to invest in agriculture which ultimately benefits the farmers.
3. Seed lethality prevents unwanted gene flow from transgenic to non-transgenic varieties (including wild relatives) via seeds, as only pollen carries the lethal genes.
4. Terminator technology promotes genetic diversity.

Disadvantages

1. Harvested seeds have to be used only for consumption purposes.
2. Pollen carrying RIP genes may transfer lethality/ seed sterility from transgenic lines to nearby wild type crops.
3. Specific genotype of a particular crop may become vulnerable to pest and diseases.

Conclusion

Terminator technology as a biotechnological novelty offers a number of amenities like checking of transgene contamination, protection of IPRs and increasing of genetic diversity. But, the scientific community working on precision agriculture has not yet been satisfied by the advancement of GURTs. Various potential hazards of using suicide seeds including inability of farmers to procure harvested seeds and extensive monitoring over terminator technology badly impact on overall biodiversity and economic symmetry. In case of developing countries like India, where maximum fraction of population is engaged in agricultural sectors GURTs need to be improvised with every efforts from the service point of view rather business motives.

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