

Terminator /Traitor Technology

US Patents and Patent Applications by Zeneca and Syngenta concerning Seed Production

Author: Valentin Küng, Küng – Biotech + Umwelt, Höhweg 17, 3006 Bern

This paper presents three new US patents – one already granted, two filed – which are relating to GM ‘traitor technology’. Traitor technology or “genetic use restriction technology” (GURTs) refers to the use of an external chemical “inducer” to turn on or off a plant’s genetic traits. This mechanism is also used to control seed sterility in ‘Terminator’ plants.

US Patent Application 20010022004 of Syngenta, NC, claims the control of plant fertility by controlling male and/or female sterility.

[0091] „Therefore, the present invention can be used in any plant which can be transformed and regenerated to obtain transgenic plants in which male and/or female sterility can be controlled by the application of the appropriate chemical ligand.“ Although the mentioning of *„The control of plant fertility is particularly useful for the production of hybrid seed.“* This patent covers the control of female fertility and as such this patent claims the protection of a terminator technology.

It is remarkable that the US Patent Application 20010022004 (A1) (September 13, 2001/Syngenta, NC) is almost identical with US Patent 6,147,282 granted to the Novartis Finance Corporation (New York, NY) in November 14, 2000.

- The new and slightly modified application of September 13, 2001 (filed in March 21, 2001) shows that Syngenta has not stopped claiming patent protection on terminator technology.

See also the comments at the end of chapter 1.

US Patent 6,172,279 (Zeneca Limited) and US Patent Application 20010051713, A1 (Syngenta Biotechnology Inc.) are both claiming the control of male sterility in plants, especially for the production of hybrid seeds. These patents are two examples of traitor technology or GURTs with the focus on male-sterility.

1. US Patent Application 20010022004 (A1)

September 13, 2001

Syngenta, NC

Filed: March 21, 2001

Control of gene expression in plants by receptor mediated transactivation in the presence of a chemical ligand

Abstract

*The present invention is drawn to a method of controlling gene expression in plants. Specifically, the method comprises obtaining a transgenic plant comprising at least two receptor expression cassettes and at least one target expression cassette. The first receptor expression cassette comprises a nucleotide sequence for a 5' regulatory region operably linked to a nucleotide sequence which encodes a first receptor polypeptide, and a 3' termination region. The second receptor expression cassette comprises a nucleotide sequence for a 5' regulatory region operably linked to a nucleotide sequence which encodes a second receptor polypeptide, and a 3' termination region. The target expression cassette comprises a nucleotide sequence for a 5' regulatory region operably linked to a nucleotide sequence which encodes a target polypeptide, and a 3' termination region, wherein the 5' regulatory region of said target expression cassette is activated by said first and second receptor polypeptides in the presence of one or more chemical ligands which are complementary to the ligand binding domain of said receptor polypeptides, whereby expression of said target polypeptide is accomplished. The method is useful for controlling various traits of agronomic importance, such as **plant fertility**.*

Claims

1. A method of controlling gene expression in a plant comprising: a) transforming said plant with a first receptor expression cassette which encodes a first receptor polypeptide comprising a first ligand binding domain, a second receptor expression cassette which encodes a second receptor polypeptide comprising a second ligand binding domain, wherein said first and second receptor polypeptides are mutually distinct, and a target expression cassette encoding a target polypeptide; b) expressing said first and second receptor polypeptides in said transformed plant; and c) contacting said transformed plant with one or more chemical ligands which are complementary to the ligand binding domain of said first or second receptor polypeptides whereby said receptor polypeptides in the presence of said chemical ligand activate the expression of said target polypeptide.

(...)

*15. A method of controlling the **fertility** of a plant comprising: a) transforming said plant with a first receptor expression cassette which encodes a first receptor polypeptide comprising a first ligand binding domain, a second receptor expression cassette which encodes a second receptor polypeptide comprising a second ligand binding domain, wherein said first and second receptor polypeptides are mutually distinct, and a target expression cassette encoding a target polypeptide; b) expressing said first and second receptor polypeptides in said transformed plant; and c) contacting said transformed plant with one or more chemical ligands which are complementary to the ligand binding domain of said first or second receptor polypeptides whereby said receptor polypeptides in the presence of said chemical ligand activate the expression of said target polypeptide,*

wherein said target polypeptide renders **fertilization** ineffective or restores effective **fertilization**.

(...)

Description

FIELD OF THE INVENTION

[0001] The present invention relates to the chemical control of gene expression in plants. In particular, it relates to a method whereby receptor polypeptides in the presence of an appropriate chemical ligand regulate the expression of a target polypeptide in a plant cell, as well as to the expression cassettes encoding the receptor and target polypeptides and transgenic plants containing the expression cassettes.

BACKGROUND OF THE INVENTION

[0002] In some cases it is desirable to control the time or extent of expression of a phenotypic trait in plants, plant cells or plant tissue. An ideal situation would be the regulation of expression of such a trait at will, triggered by a chemical that could be easily applied to field crops, ornamental shrubs, etc. One such system of regulating gene expression which could be used to achieve this ideal situation, as yet unknown to be present naturally in plants, is the steroid and thyroid hormone superfamily of nuclear receptors.

[0073] Control of *Plant Fertility*

[0086] It is recognized as within the scope of the invention that either male **fertility** of the transgenic plants, **female fertility** of the transgenic plants, or both, may be controlled.

(...)

[0088] Alternatively, the plant could be engineered wherein expression of the target polypeptide restores **fertility** to a **male-sterile** or **female-sterile** plant.

(...)

[0089] A similar approach could be used to control **female sterility**. By utilizing promoters specific for expression in the **female reproductive tissues** to drive barnase expression instead of the anther-specific promoters, **female-sterile** plants would be obtained. Induction by chemical ligand of the target expression cassette comprising the barstar coding sequence would result in restoration of **female fertility**.

(...)

[0091] Therefore, the present invention can be used in any plant which can be transformed and regenerated to obtain transgenic plants in which **male** and/or **female sterility** can be controlled by the application of the appropriate chemical ligand. The control of **plant fertility** is particularly useful for the production of hybrid seed.

Commentary:

The US Patent Application 20010022004, A1 (September 13, 2001/Syngenta, NC) is almost identical with US Patent 6,147,282 granted to the Novartis Finance Corporation (New York, NY) in November 14, 2000.

The title of US Patent 6,147,282 is „Method of controlling the **fertility** of a plant“. The title of the new patent application is more generalised. It is „Control of gene expression in plants by receptor mediated transactivation in the presence of a chemical ligand“. The focus is still plant **fertility**.

The **abstract** of US Patent 6,147,282 and US Patent Application 20010022004, A1 **is identical**. The claims are slightly modified. The text cited above (parts [0001] [0002] [0073] [0086] [0088] [0089] and [0091]) is identical in US Patent 6,147,282.

- This illustrates that terminator technology is just a special application of GURTs. US Patent Application 20010022004, A1 is an example of a patent which claims protection of GURTs, including the application of terminator technology. It demonstrates how a Terminator patent can be slightly modified and refiled as Traitor patent.

The commentary by RAFI in „2001: A Seed Odyssey: RAFI’s Annual Update on Terminator and Traitor Technology; Suicide Seeds: Not Dead Yet! January/February 2001 Issue # 68“ to US Patent 6,147,282 was almost an year ago:

*US Patent 6,147,282 is the latest in a series of Terminator patents won by Novartis. This patent carries the same abstract and main text as US patent 5,880,333, identified by RAFI last year. The patent describes a complex system for chemical control of a plant’s **fertility**. The application of a chemical inducer can be used to either abolish or restore a plant’s **fertility**. RAFI has written to David Evans of Syngenta to request that the company make a public pledge to abandon its patents on Terminator, and to disavow all further research on the technology.*

- The US Patent Application 20010022004 (A1) of September 13, 2001, filed in March 21, 2001 indicates strongly that Syngenta has not changed its policy.

2. **US Patent Application 20010051713 (A1)**

December 13, 2001

SYNGENTA BIOTECHNOLOGY, INC.

Filed: May 3, 2001

DNA comprising rice anther-specific gene and transgenic plant transformed therewith

Abstract

*This invention describes novel DNA sequences which function as promoters of anther-specific transcription of coding DNA sequences in recombinant or chimeric DNA sequences. The invention also describes recombinant or chimeric DNA sequences, which are expressed specifically in the anther of a plant. The said recombinant or chimeric DNA sequences may be used to create transgenic plants, but especially transgenic **male-sterile** plants.*

Claims

What is claimed is:

1. *DNA comprising a promoter sequence and associated coding sequence wherein the promoter sequence drives expression of the coding sequence specifically in the tapetum, endothecium and connective tissues of anthers but not in microspores or pollen, and*

wherein expression of the coding sequence starts at the tetrad stage and reaches a maximum level at the vacuolated pollen stage.

(...)

26. A process according to claim 25, wherein the plant is **rice, wheat, maize, Sorghum bicolor or orchardgrass**.

Description

[0001] The present invention is in the field of plant genetic engineering.

[0002] It primarily relates to novel DNA sequences which function as promoters of anther-specific transcription of coding DNA sequences in recombinant or chimeric DNA sequences. The present invention also relates to recombinant or chimeric DNA sequences, which are expressed specifically in the anther of a plant. The said recombinant or chimeric DNA sequences may be used to create transgenic plants, but especially transgenic **male-sterile** plants.

(...)

3. US Patent 6,172,279

January 9, 2001

Zeneca Limited (London, GB)

Filed: November 7, 1995

Plant gene construct encoding a protein capable of disrupting the biogenesis of viable pollen

Abstract

Male sterility is imparted to a plant by a cascade of gene sequences which expresses a protein which disrupts the biosynthesis of viable pollen. Expression of the disrupter protein is restricted to male parts of the plant by an upstream promoter sequence which is specific to male flowers, the male specific promoter being under control of an operator sequence. The cascade also includes a gene encoding a repressor protein specific for that operator. Expression of the repressor protein is under control of a chemically inducible promoter which is inducible by the application to the plant by, spraying or like process, of an exogenous chemical. In the absence of the exogenous **chemical inducer**, no repressor protein is expressed, resulting in expression of the disrupter protein and, consequently, **male sterility**. Fertility may be restored to the plant, when required for maintenance of the line, by spraying with the inducer, resulting in expression of the repressor which binds the operator and inhibits expression of the disrupter protein.

Claims

1. An expression system comprising:

(a) a first promoter sequence responsive to the presence or absence of an exogenous chemical inducer;

(b) a first structural gene encoding a repressor protein operably linked to and under the control of said first promoter sequence;

- (c) an operator sequence responsive to the repressor protein expressed by said first structural gene sequence;
- (d) a male flower specific second promoter sequence operably linked to and under the control of said operator sequence; and
- (e) a second structural gene sequence encoding a protein which when expressed disrupts pollen biogenesis operably linked to said second promoter sequence.
- (...)

Description

This invention relates to a method for the production of hybrid plants. More particularly, the invention relates to the molecular control of **fertility** in crop plants.

(...)

In a preferred embodiment of the invention there is provided a recombinant DNA construct for insertion into the genome of a plant to impart restorable **male sterility** thereto, comprising:

- (a) a first gene promoter sequence responsive to the presence or absence of an exogenous chemical inducer,
- (b) a gene encoding a repressor protein under control of the said first promoter sequence;
- (c) an operator sequence responsive to the said repressor protein;
- (d) a second gene promoter sequence expressible only in male parts of a plant; and,
- (e) a gene encoding a protein inhibitor of a plant characteristic essential to the production of viable pollen;

whereby the presence or absence of the exogenous chemical inducer enables selection of **male fertility or sterility**.

- 4. United States Patent 6,147,282 (already discussed by RAFI)**
November 14, 2000
Novartis Finance Corporation (New York, NY)
 Filed: January 20, 1999

Method of controlling the fertility of a plant

Abstract

Identical with US Patent Application 20010022004 (A1)

Claims

1. A method of controlling the fertility of a plant comprising:
- a) transforming said plant with a first receptor expression cassette which encodes a first receptor polypeptide comprising a first ligand binding domain and a first DNA binding domain; a second receptor expression cassette which encodes a second receptor polypeptide comprising a second ligand binding domain and a second DNA binding domain, wherein said first and second receptor polypeptides are members of the Class II steroid and thyroid hormone superfamily of nuclear receptors; and a target expression cassette comprising a 5' regulatory region operably linked to a nucleotide sequence encoding a target polypeptide that renders **fertilization** ineffective or restores effective

fertilization, wherein said 5' regulatory region comprises one or more response elements complementary to said first or second DNA binding domain;
b) expressing said first and second receptor polypeptides in said transformed plant; and
*c) contacting said transformed plant with one or more chemical ligands which are complementary to the ligand binding domain of said first or second receptor polypeptides whereby said receptor polypeptides in the presence of said chemical ligand activate the expression of said target polypeptide, wherein said target polypeptide renders **fertilization** ineffective or restores effective **fertilization**.*

Description

In US Patent 6,147,282 the text parts [0001] [0002] [0073] [0086] [0088] [0089] and [0091] cited above in US Patent Application 20010022004 (A1) are identical.

Citations in *italics*