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Gene silencing

CSIRO Plant Industry

Gene silencing is a technique used to turn down or switch off the activity of genes. It is a powerful technology for gene discovery and determining gene function in humans, animals, plants and insects. It is also used to develop new crop varieties and holds tremendous promise as a therapeutic agent to control disease in humans and animals.

CSIRO remains at the forefront of gene silencing technology and its application in introducing novel traits to plants after a CSIRO Plant Industry team led by Dr Peter Waterhouse first discovered double stranded RNA-mediated gene silencing in plants in 1997.

Members of the CSIRO team who first discovered hairpin RNAi gene silencing in plants in 1997.

How does gene silencing work?

Genes are found in living organisms and are passed on from one generation to the next. They are the coded instructions an organism uses to make proteins, and it is these proteins that make up the structures and perform the functions of living things.

RNA is the courier that delivers the gene's instructions to make a protein. Gene silencing directs a natural mechanism to degrade the RNA instructions of a specified gene, preventing the gene from making its protein. Because of its effect on RNA, gene silencing is also referred to as RNA interference (RNAi).

The plant on the left has had the gene that suppresses flowering silenced – so it flowers. As opposed to the plant on the right, that doesn't flower.

Gene silencing switches off the activity of only a targeted gene, so it is possible to determine the precise function of that gene. This specificity is important when using gene silencing to develop new traits where the activity of a targeted gene is switched off.

Gene silencing is an effective tool that:

- Allows the function of hundreds and thousands of genes to be tested;
- Can silence genes throughout an organism or in specific tissues;
- Offers the versatility to partially silence or completely turn off genes;
- Works in both cultured cells and whole organisms; and
- Can selectively silence genes at particular stages of the organism's life cycle.

Applications of gene silencing

Gene silencing can be used to identify gene targets for the development of new drugs, eliminate gene function to protect against viral diseases in humans or to potentially turn off the genes responsible for cancer. CSIRO Plant Industry is using gene silencing to develop novel traits in plants including virus resistance, healthier cooking oil, improved pharmaceutical products and grains with improved nutritional qualities.

Healthier cooking oils

Using gene silencing CSIRO Plant Industry is improving the nutritional value of food oils obtained from a range of oilseeds.

By 'switching off' genes involved in the production of particular undesirable fatty acids in the oil (such as saturates and trans fatty acids) CSIRO is developing improved oils that will help lower cholesterol and reduce the risk of cardiovascular disease. These improved oils will ultimately provide for healthier cooking oils and margarines.

Virus resistant plants

Gene silencing can be used to introduce virus resistance into a plant. Viruses are a significant problem in many of Australia's crop plants and developing virus resistant plants could provide many benefits to farmers and the environment.

Introducing virus resistance to plants via gene silencing is done by inserting a piece of a DNA that has been modified to include one small fragment of a virus into a plant. This then effectively vaccinates the plant. When the plant is actually exposed to the virus it has a ready defence mechanism primed to destroy the now recognisable virus.

Gene silencing intellectual property and licence agreements

CSIRO holds more than 30 granted patents and patent applications in Australia and overseas for its gene silencing technology.

Gene silencing is applied by CSIRO in plants and animals. CSIRO is also making gene silencing widely available through licences, such as the major licence granted to Bayer CropScience for use in specified crops. CSIRO has also made its gene silencing tools for plants widely available to academic researchers worldwide.

Both of these plants have been exposed to a virus, the one on the left has been gene silenced to be resistant to the virus, the one on the right has not.

More information

For scientific information about the gene silencing technology please visit www.csiro.au/RNAi.

For licensing enquiries please contact Bill Taylor on 02 6246 5223 or bill.taylor@csiro.au.

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