GENE TECHNOLOGY IN AUSTRALIA

Agricultural Biotechnology Council of Australia

Introduction

Biotechnology is a broad term used to describe the process of using living things to create products or perform tasks for human beings. Biotechnology has existed in various forms for over 8000 years, ever since yeast was first used for the brewing of beer and the making of bread.

In 1953, the double helix structure of DNA was discovered, and modern biotechnology was born. The first genetically modified (GM) plant was developed in the early 1980s, and since then modern biotechnology has been used as a tool by plant breeders to develop new and improved varieties of plants with desirable characteristics.

Genetic modification is the term used to describe the modification of organisms by the direct incorporation or deletion of one or more genes to alter or introduce new characteristics using modern biotechnology.

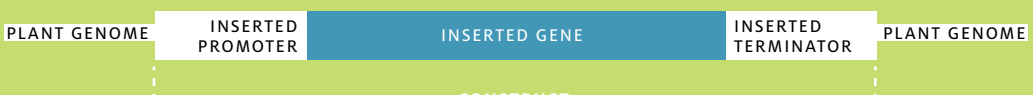
Conventional breeding approaches, facilitated by applications of modern biotechnology, may be the most promising approach for the delivery of some desired traits. However, the scope of conventional breeding is limited, and for some traits, genetic modification may offer the most effective method for developing new crop varieties.

Gene technology

Scientists use gene technology to perform a range of different tasks. This includes the extraction of DNA from cells, making multiple copies of a DNA sequence, identifying genes, making gene products, and engineering novel genes with genetic segments derived from more than one parent. This latter technique is referred to as 'recombinant DNA', and if placed into a target organism, is called a 'DNA construct' (see below).

The use of recombinant DNA and gene technology is much more precise and well understood approach to increasing the genetic variation available to plant breeders than earlier technologies such as gamma irradiation or chemical mutagenesis of seeds. These older techniques induce many random mutations, of which only a tiny fraction might have practical commercial applications in food and agriculture.

A DNA construct inserted into a plant's genome by gene technology (Source: Mewett et al 2008).



When a foreign gene is inserted into a genome, it must contain a promoter and a terminator to perform the regulatory functions that lead to the production of a protein. The DNA sequence between the promoter and terminator determines the type of protein that is produced. The entire DNA segment inserted into a genome is called a construct.

GM crops in Australia

Genetically modified (GM) carnations, cotton and canola are produced commercially in Australia. Carnation varieties displaying violet-purple colouring are available from florists and now the researchers are investigating the development of a 'blue' rose.

The first GM cotton varieties were grown commercially in 1996. They produced a natural insecticide (Bt) to control a devastating cotton pest, providing the cotton plant with in-built pest protection. These early varieties resulted in, on average, a 50 per cent reduction in pesticide applications each year.

These early varieties have now been superceded by the latest insect-resistant varieties which were approved for commercial use in 2002. According to Cotton Australia, these varieties require 80 per cent less insecticide than conventional cotton varieties.

Hand-in-hand with the use of insect-resistant GM cottons, Australian cotton growers can also access herbicide tolerant GM cotton varieties, allowing them greater flexibility in weed control. Almost the entire Australian cotton crop is comprised of GM varieties.

In 2008, herbicide tolerant GM canola was grown commercially in Australia for the first time. Produced in NSW, Victoria and Western Australia, the varieties now represent almost 10 per cent of the national canola crop.

In 2011, the global area of commercial GM crops was 160 million hectares. This represents a 94-fold increase in the area devoted to such crops since their introduction in 1996. The major crops grown were soybean, corn, cotton and canola. Small areas of GM papaya, lucerne and sugarbeet were also grown.

Genetically modified crops were grown in 29 countries by 16.7 million farmers in 2011, with the majority being grown in the USA, Brazil, Argentina, India and Canada. Other countries growing GM crops include Australia, Spain, South Africa, Mexico and Sweden. (Source: James 2011)

Research in the pipeline

In Australia, a number of field trials are underway in relation to GM crop development, particularly cotton, canola, wheat and barley (see below).

Current research underway in Australia

PLANT	RESEARCH/MODIFICATION
Cotton	Enhanced fibre yield, insect resistance, herbicide tolerance, high oleic acid content, disease resistance
Canola	Herbicide tolerance, enhanced yield, delayed leaf senescence, abiotic stress tolerance (drought and salt tolerance)
Indian mustard	Herbicide tolerance
Wheat	Altered grain composition, nutrient utilisation efficiency, drought tolerance, increased dietary fibre, high boron content in soils tolerance
Barley	Altered grain composition, nutrient utilisation efficiency, increased dietary fibre, drought tolerance, high boron content in soils tolerance
Banana	Enhanced nutrition, disease resistance
Perennial ryegrass and tall fescue	Improved forage qualities (animal nutrition)
Sugarcane	Altered composition for bioplastics use, herbicide tolerance, altered plant growth, drought tolerance, enhanced nitrogen use efficiency, altered sucrose accumulation, improved ethanol production
White clover	Virus resistance
Corn	Gene function research
Pineapple	Control flowering, reduce blackheart incidence
Papaya	Delayed fruit ripening, gene expression testing

SOURCE: OGTR, 2012

Regulation of gene technology




In Australia, live and viable genetically modified organisms (GMOs) are regulated by the Gene Technology Regulator (the Regulator) under the *Gene Technology Act 2000*. The regulatory system is focused on a rigorous science-based process of identifying and managing risks to human health and the environment.

The Regulator liaises with other regulatory agencies, including Food Standards Australia New Zealand (FSANZ), Australian Pesticides and Veterinary Medicines Authority (APVMA) and the Therapeutics Goods Administration (TGA) to coordinate the approval of GM products for sale or use in Australia.

FSANZ is responsible for examining the safety of GM foods under Standard 1.5.2 of the Australia New Zealand Food Standards Code. Approval is given if FSANZ concludes the GM food is as safe as its conventional (non-GM) equivalent.

In Australia, approved GM foods or food ingredients must be labelled with the words 'genetically modified' if novel DNA and/or novel protein is present in the final food. Exemptions to the mandatory labelling requirement apply for highly refined foods (such as oils and sugars) where the effect of the refining process is to remove novel DNA and protein; and instances in which the GM food is unintentionally present in the final product in a quantity of no more than 10 grams per kilogram (1 per cent).

in Australia

Benefits of GM crops

Australian cotton farmers have been growing varieties of GM cotton since 1996, and in 2010 almost every farm used the technology (both herbicide tolerant and insect resistant forms).

Since 1996, the total farm income gain derived by Australian cotton farmers from using this technology has been about $395 million (average gain of over $180/ha). The insecticide use saving and associated environmental impact was effectively 75 per cent less than it would have otherwise been if conventional technology had been used.

In addition, since 2008, some canola farmers in some states have had (restricted) access to the technology and in 2010 about 8 per cent of the total crop used GM technology. The total income gain from the use of GM HT canola has been about $13 million (average of about $73/ha).

Crop biotechnology has also contributed to significantly reducing the release of greenhouse gas emissions from agricultural practices. This results from two main sources:

- less fuel use (less spraying and soil preparation)
- additional soil carbon storage from reduced tillage with GM crops.

The carbon savings from reduced fuel use in 2010 were equal to 1.7 billion kilograms less carbon dioxide released into the atmosphere and the savings from additional soil carbon storage via the no/low till systems facilitating role of GM herbicide tolerant crops was equal to a saving of 17.6 billion kilograms of carbon dioxide not released into atmosphere in 2010. In total this is a saving of 19.4 billion kilograms of carbon dioxide, equivalent to removing 8.6 million cars — 69 per cent of cars registered in Australia — from the road for one year.

SOURCE: BROOKES AND BARFOOT 2012

Agricultural Biotechnology Council of Australia

The Agricultural Biotechnology Council of Australia (ABCA) is the national coordinating organisation for the Australian agricultural biotechnology sector. ABCA was established to pursue recognition of the current and potential benefits of agricultural biotechnology. ABCA aims to ensure that the Australian farming sector can appropriately access and adopt this technology for the benefit of national and global food security, the nation's farming sector, and the environment, thus helping to deliver a more sustainable and prosperous future for Australian agriculture.

In pursuit of this vision, ABCA will:

- increase public awareness of, and encourage informed debate about, biotechnology, specifically gene technology, and its applications in agriculture
- provide the public, particularly farmers, with credible, balanced, science-based information on biotechnology, in order to enable them to make informed decisions about the application, uses and future of gene technology in Australia
- provide research and information which places biotechnology and gene technology into context, as another tool, option and technology available to Australian agriculture
- encourage and share research to ensure a better understanding of the benefits that agricultural biotechnology can offer.

ABCA is a joint venture of AusBiotech, CropLife Australia, Grains Research and Development Corporation (GRDC), and the National Farmers' Federation (NFF). We welcome your comments and questions.

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