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Introduction

Biotechnology in agricultural development

1.1 From the start of human history, new technologies have played a key role in the development of agriculture. The introduction of mechanical tools, such as tractors and harvesting machinery, marked the first of the more recent revolutions in agricultural practice. The industrialisation of agricultural production intensified when chemical fertilisers, pesticides and herbicides became available. The application of these substances resulted in dramatic rises in farm productivity. The third revolution, which promises further gains in productivity, as well as greater environmental sustainability, is based on biotechnology.[1]

1.2 Several factors have contributed to the pursuit of biotechnology as a source of solutions to agricultural problems. The cost of oil rose in the 1970s and is rising again now. As many agrochemicals are oil based, higher oil prices have increased the costs of farm inputs. Since the 1970s it has also been clear that incremental improvements from the application of chemical fertilisers to American crops has decreased, and the effectiveness of pesticides and herbicides has declined. In addition, widespread concern has arisen about the impact of agricultural chemicals on the environment. Biotechnology is seen by some as offering a means of addressing these issues.[2]

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1 R Pistorius & J van Wijk, *The Exploitation of Plant Genetic Information: Political Strategies in Crop Development*, CABI Publishing, Wallingford, UK, 1999, pp. 106-7.

2 R Pistorius & J van Wijk, *The Exploitation of Plant Genetic Information: Political Strategies in Crop Development*, CABI Publishing, Wallingford, UK, 1999, p. 107.

1.3 At the same time as the above events unfolded, understanding of the structure and operation of genes grew to the point where genes could be manipulated, as Box 1.1 describes. At this point, breeding new varieties of crops and livestock more quickly than by conventional means became a reality. The range of characteristics that can be bred into living organisms has been extended too; gene technology allows greater possibilities for the transfer of genetic material between closely related species, as well as between those more distantly related. As a result, varieties can be 'custom designed' to suit particular primary producer, consumer or environmental requirements, and contribute to increased agricultural productivity and sustainability.

1.4 The usefulness of genetic manipulation in agriculture is demonstrated by the rapid uptake in several countries of genetically modified (GM) crops. Between 1996 and 1998, the area planted worldwide for commercial GM crop production increased more than 15 times to 27.8 million hectares.[3]

1.5 Consumer and environmental concerns in several countries are slowing the rate of uptake of GM crops and may even stop it in some cases. The Tesco supermarket chain in the UK, for example, has announced that it will not buy fruit and vegetables from suppliers who have previously grown GM crops on the same sites.[4] A survey of US farmers carried out in February 2000 indicated that they will plant 16 per cent less GM corn this year than last year.[5] Notwithstanding the recent lack of consumer confidence in GM food and consequent reduction in plantings, it has been expected that GM crops will eventually be very widely grown.

1.6 To mid 1999, only three genetically modified organisms (GMOs) had received approval for commercial use in Australia. Of these, only one, Bt cotton, is a significant commercial crop; the other two are varieties of carnations. By comparison with their major competitors, Australian primary producers have access to far fewer GM crop varieties, giving rise to fears that Australia's competitiveness in world markets will suffer. Various causes have been identified for Australia's slow uptake of GM crops, and suggestions made about how they might be addressed. There is, in addition, a strong desire that Australian expertise in genetic

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3 C James, *Global Review of Commercialized Transgenic Crops: 1998*, The International Service for the Acquisition of Agri-biotech Applications Briefs no. 8, Ithaca, New York, 1998, p. iii. This statistic excludes China as only tentative estimates of the area planted to GM crops there are available.

4 J Meikle, 'GM ban is extended by Tesco', *News Unlimited Special Reports*, 7 January 2000, http://www.guardianunlimited.co.uk/gmdebate/Story/0,2763,119632,00.html, accessed 15 May 2000.

5 M Kriz, 'Global food fight', *National Journal*, vol. 32, March 2000, p. 689.

manipulation be harnessed to benefit Australian farmers and generate a financial return to Australians.

Box 1.1 What is gene technology and how is it used?

All living things are made up of cells. All cells contain genes, which determine the physical characteristics of an organism. The building blocks of genes are composed of DNA. While DNA is the same across all species, the variety of ways it can be put together creates the difference between species and individual organisms. On average, plants contain around 22,000 genes, and animals can have up to 50,000.

Gene technology includes a range of techniques that can control, modify or delete particular characteristics of an organism, and transfer desired traits from one species to another. These processes give rise to plants, animals and other organisms that are referred to as genetically modified, genetically engineered or genetically manipulated. The term 'transgenic' describes plants or animals which have a new gene inserted into them.

Not every gene in an organism is active, and only the genes which are expressed are responsible for the characteristics of an organism. Much of the research undertaken in gene technology concentrates on activating or suppressing the expression of genes known to cause particular traits.

Desired traits can be transferred to different species through a number of methods. For example, a desired gene can be introduced into a plant cell using bacteria or a virus to which it is susceptible. Genes can also be transferred into cells using a gene gun, which shoots the DNA through the cell wall.

The main uses of gene technology lead to the same output as conventional breeding programs, but with greater speed and precision; for example:

- genetic markers easily and rapidly identify the presence of a particular gene, and helps with the selection of lines with desired characteristics; and
- gene transfers from near relative species can be done faster and more easily through this technology than by conventional means.

Other uses of gene technology produce results that cannot be achieved through conventional breeding, including accessing desired traits through gene transfers from unrelated species.

Source: Australian Academy of Science, http://science.org.au/nova/009/009box01.htm, accessed 11 May 2000; Biotechnology Australia, http://www.isr.gov.au/ba/Biotechnology/definition.html, accessed 11 April 2000; CSIRO, Submission no. 56, p. 5 and http://genetech.csiro.au/what.htm, accessed 3 April 2000 ; Nugrain, Submission no. 25, p. 8.

The committee's inquiry

1.7 It was in the context of the global and domestic situation sketched in the last section that the committee's inquiry into primary producer access to gene technology originated. The then Minister for Agriculture, Fisheries and Forestry, the Hon Mark Vaile, MP, referred the inquiry to the committee on 30 March 1999. The inquiry's terms of reference provide that the committee will inquire into and report on the following areas, with particular emphasis on the capacity of small and medium sized enterprises to access the benefits of gene technology:

- the future value and importance of genetically modified varieties;
- the ability for producers to compete using traditionally available varieties;
- the commercialisation and marketing of agricultural and livestock production varieties;
- the cost to producers of new varieties;
- other impediments to the utilisation of new varieties by small producers;
- assistance to small producers to develop new varieties and the protection of the rights of independent breeders, in relation to genetically modified organisms;
- the appropriateness of current variety protection rights, administrative arrangements and legislation, in relation to genetically modified organisms; and
- opportunities to educate the community of the benefits of gene technology.

1.8 The committee advertised the inquiry in capital city newspapers, the Financial Review, the Weekend Australian, rural publications in each state, the New Scientist and Australian Grain. In addition, information about the inquiry and requests for submissions were sent to state premiers, territory chief ministers, and Commonwealth ministers and departmental secretaries with an interest in the inquiry topic. Also approached to make submissions were organisations representing scientists, business and primary producers; research and development

(R&D) organisations; the food industry; life science and seed companies; academics; and environmental groups. Eighty-seven submissions and seven exhibits were received; they are listed in Appendix A.

1.9 Public hearings were held in Canberra, Perth, and Melbourne with the groups listed in Appendix B. The committee also held private discussions in Western Australia with a group including officers of Agriculture Western Australia, and individual gene technology researchers, farmers, seed suppliers and handlers, and organisations representing them. Briefings were provided to the committee in Canberra on intellectual property (IP), Biotechnology Australia's (BA) public awareness program, the regulation of gene technology, and the view of the field as seen by gene technology businesses. The committee was provided with a hands on insight into genetic manipulation during a visit to the Center for the Application of Molecular Biology to International Agriculture (CAMBIA).

1.10 The committee's inquiry is not the first parliamentary inquiry into this topic. In 1992, the House of Representatives Standing Committee on Industry, Science and Technology reported on the results of its investigation into the development, use and release into the environment of GMOs.[6] That inquiry covered many of the same issues that this current inquiry has grappled with.

The structure of the report

1.11 Each of the report chapters that follow deals with a major factor that influences primary producers' access to gene technology. Chapter 2 describes the benefits that result, or may in the future result, from the use of genetic modification. It also catalogues the risks that have been identified, or may arise, from growing GMOs.

1.12 Chapter 3 deals with consumer attitudes to genetic manipulation which influence the market for GMOs and affect producer readiness to replace conventional varieties with their GM counterparts. This chapter also examines the ways in which public understanding of the issues surrounding the use of GMOs can be enhanced. In Chapter 4, the committee looks at the scope for the continued use of traditional varieties by Australian producers in the context of uncertainty about the relative costs and benefits of using GMOs.

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6 House of Representatives Standing Committee on Industry, Science and Technology, *Genetic Manipulation: The Threat or the Glory?*, AGPS, Canberra, 1992.

1.13 Chapter 5 examines the research effort on which Australia's access to gene technology is based. Growers' access to the technology may depend on the commercialisation of Australian research, or it may involve arrangements for bringing overseas technology to Australia. Chapters 6 and 7 consider two important underpinning elements of the commercialisation process and ongoing use of GMOs: the protection of IP (Chapter 6) and regulation of their use (Chapter 7).

1.14 Readers will notice that the report is written largely in relation to crops rather than livestock. This reflects the relative progress that has been made in these two fields, even though the first application of gene technology to animals occurred only a year or two after its first application to plants. It has, however, proved harder to develop GM livestock than GM crops. This is partly due to the difficulty of inserting genes into eggs.[7] The committee is aware that cloning may be a more effective way of making transgenic livestock but that topic is beyond the scope of this inquiry. Nevertheless, many of the issues raised in this report in relation to crops apply equally to livestock.

7 O. Mayo, 'Animals', *Gene Technology and Food*, National Science & Industry Forum Report, Australian Academy of Science, April 1999, p. 5.