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Challenges for agricultural markets

coexistence, segmentation of grain markets, costs and opportunities

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The differentiation of world grain markets into GM, certified non-GM and organic segments is creating opportunities and challenges for grain market participants.

While world trade in soybeans, corn, canola and cottonseed is dominated by countries producing GM varieties of these grains, there are premium paying niche markets for certified non-GM grains, particularly for soybeans. This is creating opportunities for identity preservation arrangements aimed at capturing these market premiums.

Workable identity preservation and coexistence arrangements have already been demonstrated in many countries with GM soybeans, corn, cotton and canola. Nevertheless challenges remain with some future GM crops, particularly GM wheat.

The paper draws on some recent ABARE research on market acceptance of GM canola; identity preservation costs; and the potential impact of the introduction of GM canola on organic production systems in Australia.

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Introduction

World grain markets have become differentiated into GM, non-GM and organic segments. Tolerances for unintended presence of GM grain in parcels of conventional and organic grain have evolved in different countries that reflect consumer preferences, mandatory labelling requirements and the costs of keeping the different grains separate in grain production and marketing chains. This market differentiation has opened up a range of market opportunities for grain producing countries like Australia, but has also created a number of challenges in realising these opportunities.

The aim of this paper is to outline the opportunities and the challenges in operating mixed production systems of GM, certified non-GM and organic grains. It draws heavily on the experience of Australia, a country that has commercialised GM cotton (producing cotton lint and cottonseed) but has not commercialised GM canola varieties that have met regulatory approval for environmental release because of issues to do with market acceptance and identity preservation. In particular, the paper draws on ABARE research into some of the key elements of a coexistence framework. These elements are: market acceptance of GM grains (particularly canola); the costs of identity preservation of non-GM grains (particularly under Australian conditions); and the impact of GM grains (in this case, canola) on organic production systems in Australia.

Coexistence and identity preservation

In agricultural production systems, there is the possibility that any farmer’s choice of production technology will impact on the crop prices or production costs of other farmers. Where GM grains are introduced, there is the possibility of unintended presence of GM grains in parcels of non-GM grains that can occur through cross pollination in the field or comingling in the grain handling and storage chain from farm to end user. The unintended presence could mean loss of price premiums, or additional costs due to the requirement to keep non-GM crops separate from GM crops throughout the supply chain.

Coexistence is the idea that it is possible to design a set of institutional arrangements — legislated or private — that ensure that there are not undue spillover costs with any of the three production systems — that is, there are arrangements that lead to costs associated with each production system being appropriately internalised. Under these circumstances, it is then possible to leave production decisions to farmers and to enable the market to arrive at the appropriate balance between the three different production systems — GM, certified non-GM or organic.

In theory, a properly functioning tort law system will ensure that costs are internalised because a farmer adversely affected by the activities of another could seek redress of damage through legal actions. In Australia, it was noted in a recent review of the *Gene Technology Act 2000*, (legislation that establishes a nationally consistent regulatory system for gene technology), that case law was developing to deal with many of the issues that might be expected to arise concerning losses due to unintended presence of genetically modified organisms in non-GM crops (Timbs, Adams and Rogers 2006). However, as indicated by the state of negotiations with the liability and redress arrangements under the Cartegena Protocol of Biosafety (see Ad Hoc Working Group 2007), there is still uncertainty in many countries about the adequacy of existing tort law to deal with economic loss issues related to GM crops.

In Australia, as with many other countries, there has been much work on the principles for coexistence between GM and non-GM grain production systems. This is reflected in studies such as Gene Technology Grains Committee (2003), Queensland Department of Primary Industries and Fisheries (2005) and SGA Solutions (2007).

Identity preservation arrangements are an integral part of coexistence arrangements. The process involves keeping grain with desired traits separate from other grains and contaminants, right from planting seed stage through to end use. Identity preservation requirements can impose significant additional costs in grain supply chains. Acccording to United Soybean Board (2001), identity preservation is the process by which a crop is grown, handled, delivered and processed under controlled conditions to assure the customer that the crop has maintained its unique identity from farm gate to end use.

Consumer acceptance issues mean that the identity preservation task related to the first generation of GM crops, involving largely agronomic benefits, is to ensure that non-GM grain cargoes do not exceed thresholds for unintended presence of GM grains. With later generations of GM crops with enhanced quality characteristics, the emphasis will shift to identity preservation of the quality enhance GM crop.

In terms of economic efficiency, segregation and identity preservation aimed at protecting price premiums and market access for non-GM grain is only justified if the additional value it creates in the form of higher value grain is greater than the cost of the identity preservation. The efficiency considerations, therefore, are: market acceptance and price premiums and the costs of identity preservation.

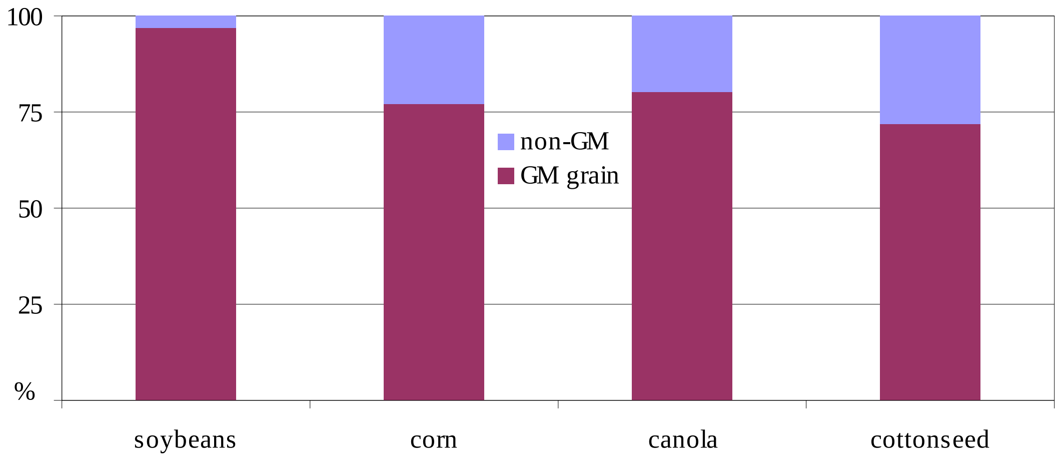
Market acceptance and price premiums

In this section, the evidence for market acceptance existing GM crops is reviewed. The likely acceptance of future GM crops are also examined.

Existing GM crops

World trade in grains and oilseeds that have GM variants are dominated by the GM-producing countries (figure 1). This is despite a range of market access barriers at the country level that have been erected in response to perceptions of consumer concerns and environmental issues. These include mandatory labelling requirements and — now largely lifted — import bans in the European Union.

Figure 1: shares of GM and non-GM producing countries in world grain trade a



a Three years to 2006; excludes intra-EU trade. *Source:* United Nations Statistics Division (2007).

Mandatory labelling of products containing GM inputs applies in most of the main grain importing countries. Recognising that it is prohibitively costly to ensure complete absence of GM material, the mandatory labelling regimes usually have thresholds for unintended presence of GM materials. The thresholds range from a zero threshold in China; 0.9 per cent in the European Union; and 5 per cent in Japan. Importantly, labelling regimes in most countries also do not require labelling if modified DNA is not detectable in the product, the key exceptions being China and the European Union. Only the European Union requires labelling of GM feedstuffs for livestock (with the same threshold as with food). No country requires labelling of products from animals fed GM feedstuffs.

The European Union also has a tolerance of 0.5 per cent for unintended presence of GM material not yet approved for import into the European Union, but which has been assessed as safe for consumption by the European Food Safety Authority.

Markets for non-GM soybeans, corn and cottonseed

There are market segments where there is a willingness to pay price premiums for non-GM grains but these are very much niches. The main non-GM niches are:

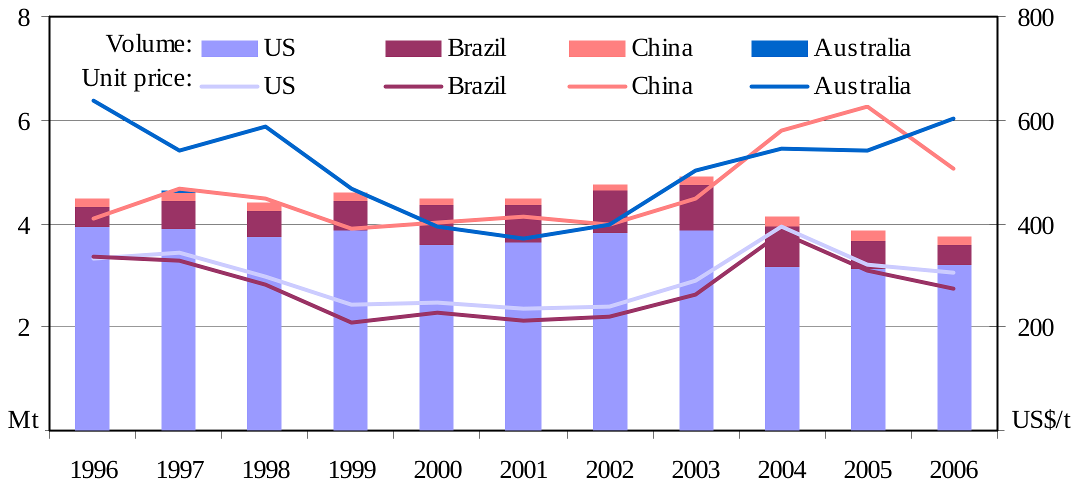
- soybeans and soybean meal in the European Union; where the non-GM share of soybeans in 2004 was 14–17 cent of total soybean use and the premiums were of the order of 2-8 per cent (Brookes, Craddock and Kniel 2005; their definition of non-GM grain appears to be grain that has a GM content of less than 0.9 per cent, the threshold for mandatory labelling in the European Union).
- soybeans in Japan, making up 15–20 per cent of total Japanese soybean use and offering price premiums for non-GM of the order of 6–9 per cent in 2006.

A rough estimate is that around 6-8 per cent of international trade in soybeans is certified non-GM. This is mainly where the use of soybean products as food would require labelling. Evidence from sources such as Koester (2007) suggests there is also a substantial world trade in certified non-GM soybean meal of around 4–5 million tonnes a year, equivalent to around 30 per cent of world trade in soybean meal, mainly from Brazil to the European Union.

The Japanese market for soybeans reveals some interesting price relationships between GM and non-GM grains. There are large price premiums of the order of 70 per cent for soybeans from the non-GM producing countries of Australia and China, compared to soybeans from the GM producing countries of Argentina, Brazil and the United States (figure 2). Australia and China only accounted for around 6 per cent of Japanese soybean imports in the five years to 2006 and it is not clear that factors other than non-GM status contributed to the magnitude of the price premium. Based on data from trade of GM and non-GM grain futures contracts on the Tokyo Grain Exchange (www.tge.or.jp), the extra price for identity preserved non-GM soybeans from the United States averaged only 6–10 per cent over the same period. (Nearly 10 million non-GM soybean contracts — each for ten tonnes — were traded on this exchange in 2006).

A coexistence issue is posed where GM varieties are approved for growing in a country but not approved for import by other countries. This happened, for example, with the corn trade between the United States and the European Union, leading to a requirement in the United States to keep corn varieties approved for import by the European Union separate from those not approved. A national survey of US grain elevators in 2004 found that 24 per cent of grain elevators required segregation of GM corn from non-GM corn (see American Corn Growers Foundation 2004). Thirteen per cent of these elevators were offering price premiums for non-GM corn in the range US$2-10 a tonne. It is not yet clear the extent to which these price premiums have disappeared now that most of the GM corn varieties grown in the United States have been approved for import by the European Union.

Figure 2: Japanese imports and import prices of soybeans from selected countries



Source: United Nations Statistics Division (2007).

Another coexistence issue is posed where a GM variety is unapproved, meaning there is zero tolerance for unintended presence of the unapproved variety. The earliest example of this is Starlink corn which was approved in the United States for feed uses but not food uses because it contained proteins similar to a known allergen. In 2000, however, Starlink corn was found in significant quantities in the US food corn chain. This caused problems with US domestic and export corn markets, leading to a costly (but successful) process to eliminate Starlink corn from the US corn production system. Since the Starlink episode, there have been other examples of unapproved GM varieties entering grain production systems, including Bt-10 corn in 2004, that led to rejection of a number of shiploads of corn by Japan, and GM rice in the United States in 2007. In all these cases, grain testing regimes were implemented by key importing countries.

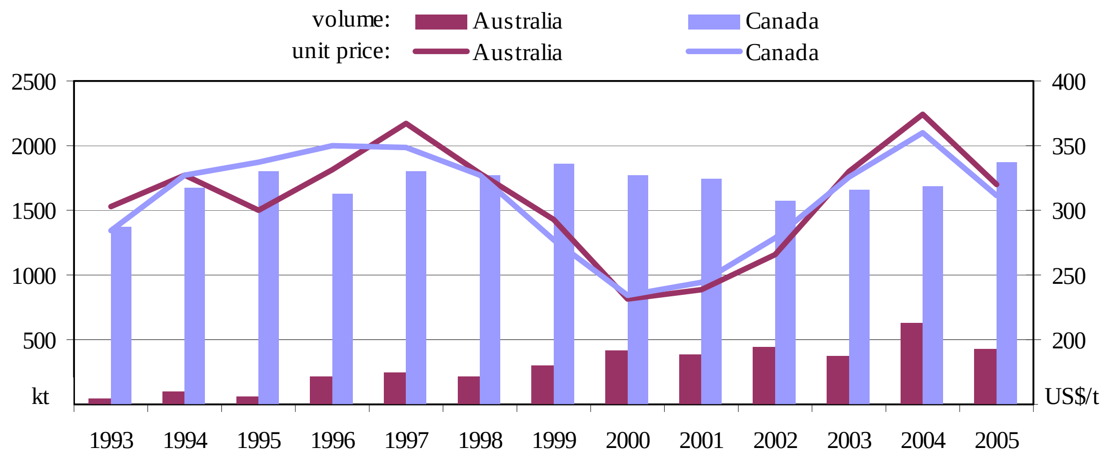
The challenge of workable identity preservation and coexistence arrangements has been largely met in many countries with the existing GM crops. This includes a system of tolerances for unintended presence and industry accepted testing and certification arrangements in regard to GM status of grain parcels that complements each country's regulatory environments aimed at ensuring safety of GM crops to humans and the environment.

Market acceptance of GM canola

In the case of canola, the key conclusion of Foster and French (2007) was that, in the main traditional import markets for canola — Bangladesh, China, Japan, Mexico and Pakistan — GM canola is generally accepted as readily as conventional canola and is priced at very similar levels. This conclusion is illustrated in figure 3 in the case of Japan, the largest world importer of canola and also Australia's main customer for canola. Canada's GM canola is readily accepted in the Japanese market at prices very similar to those received for Australia's non-GM canola.

The contentious market is the European market where until April 2007 Canadian canola (but not canola oil) was effectively denied access because of its GM status. While there is anecdotal evidence of price premiums in the EU market for canola in 2006 due to the introduction of targets and incentives for biodiesel use, this is difficult to confirm, and the very large increases in canola oil imports from Canada put a cap on price rises.

Figure 3: Japanese imports and import prices of GM (Canadian) and non-GM (Australian) canola



Source: United Nations Statistics Division (2007).

The reason there are price premiums for some GM varieties of soybeans and corn, but not for GM canola in most grain importing countries appears to be that there are premiums where the mandatory labelling requirements of the country would be triggered, for example with food uses of soybeans and corn in the European Union and Japan. With canola, there little human food uses other than oil and the oil does not contain modified DNA. The only countries in which labelling would be required for canola oil are China and the European Union.

The European Union had been a major market for Canadian canola prior to the introduction of GM canola in Canada in 1996. At the time of writing, there had been no large scale resumption of Canadian canola trade to the European Union, despite the EU approval of the major canola varieties produced in Canada in April 2007. It could be that very low levels of non-approved GM canola varieties in the canola production system in Canada will continue to hinder market access to the European Union for Canadian canola.

Future GM crops

The future identity preservation task will involve GM varieties with improved quality characteristics of which there are many in the pipeline. With soybeans, canola and cottonseed, this mainly involves the alternation of fatty acid profiles (Holtzapffel, Johnson and Mewett 2007). There is also extensive GM research into producing pharmaceutical or industrial products using GM plants as ‘biofactories’ (see Mewett, Johnson and Holtzapffel 2007).

An example of a quality altered GM crop is high oleic acid soybeans that is expected to be released in the United States in 2009. The altered characteristic eliminates the need for partial hydrogenation in processing. This means lower transfats in processed soybeans products, a particular benefit given mandatory labelling in the United States since January 2006 of the trans fat content of food. An indication of the possible price premium for this variety of soybean is that contracted growers of identity preserved, low linolenic acid GM soybeans (also eliminating partial hydrogenation) are being offered a price premium in 2008 of around US$22 a tonne. (The low linolenic trait is derived through conventional breeding but there is a herbicide tolerance trait that comes from genetic modification). The identity preservation requirements at the farm level with low linolenic soybeans are to not grow it in fields where soybeans had been grown in the previous season and to rigorously clean planting, harvesting, storage and transport equipment.

The introduction of GM wheat would be a test of coexistence arrangements. A number of studies point to consumer acceptance problems with GM wheat (Sayler 2001; Wisener 2006), though this acceptance has never been tested in the market place. A herbicide tolerant GM wheat was submitted for regulatory approval in the United States in 2003 but the developer did not commercialise it because of concerns about consumer acceptance. There are many other different forms of GM wheat at various stages of development throughout the world, including a fungal disease (fusarium) tolerant variety that could be available in north America as early as 2010.

Key wheat marketers and industry organisations in Australian and north America have stated that they only support the introduction of GM wheat if there is widespread market acceptance, workable identity preservation arrangements and acceptable tolerances in world markets for unintended presence of GM wheat in non-GM wheat (Australian Wheat Board 2007; Canadian Wheat Board 2007; US Wheat Associates 2006).

Identity preservation costs

There have been many different studies throughout the world aimed at identifying segregation or identity preservation costs associated with mixed production systems of

GM, non-GM and organic grains. A useful recent review of the different approaches to estimation of identity preservation costs is provided in Henry, Wilson and Dahl (2006).

A framework was reported in Foster (2006) for estimating the additional costs for identity preservation of non-GM grain under Australian conditions, should it be required by the introduction of GM grains. Identity preservation is likely to be implemented mainly in the central grain handling and storage system but it is also possible to have an alternative supply chain, for example, using shipping containers.

Employing the framework with case studies based on typical receival sites in each of four different grain producing regions of Western Australia, it was found that the bulk of the costs (an average of 85 per cent in all four regions) associated with identity preservation of GM canola are incurred on farm, mainly in the form of higher costs for certified seed and additional labour costs for cleaning farm machinery, double handling of grain and waiting in queues at the central receival site.

Additional costs in the central receival system include extra grain testing requirements and higher labour costs due to an extended receival period. The additional costs are small relative to on-farm costs, reflecting the economies of scale with bulk handling of grain.

There is an issue of who should bear the additional costs — GM producers or non-GM producers. If the view is taken that the non-GM canola growers who hope to benefit from the price premiums should bear the additional costs, it is estimated that this will increase their costs by an amount equal to 4-6 per cent of the average farm gate price for canola in a typical year.

In the case of GM canola in Australia, while it is evident that there are additional costs associated with identity preservation of non-GM canola, it does not appear at this stage that there is a price premium in domestic and world markets for non-GM canola that is sufficient to offset the additional costs. This appears to have been a judgment also made by the Canadian canola industry whose crop is made up of around 15 per cent non-GM varieties but which appears never to have segregated its GM and non-GM canola on a significant scale.

Organic production systems

A coexistence issue in Australia is the impact of the introduction of GM canola on the Australian organic industry, a small but growing industry that earns significant price premiums for its produce.

Apted and Mazur (2007) looked at the potential impacts of the commercialisation of GM canola in Australia on domestic organic agriculture. The potential economic costs to organic producers of commercialisation of GM canola are the costs associated with avoiding the presence of GM material in organic products and the costs associated with GM material being present in organic products such as possible loss of sales premiums as a result of having to market products as either conventional or containing GMOs. In particular, Apted and Mazur looked at the impact of GM canola on organic canola, organic beef and organic honey industries in Australia.

Their overall conclusion was that production of GM canola is likely to have only negligible direct impact on Australian organic canola, organic beef and organic honey sectors. One of the reasons for this is that there is virtually no organic canola produced in Australia, because it is a difficult crop to grow organically. Meeting the EU thresholds of 0.9 per cent for the unintended presence of GM material in organic canola for food and feed, and a 0.5 per cent for GM material in organic seeds for sowing, would likely require little or no change to current organic production arrangements in Australia. Current organic standards in Australia already specify that bees may only forage on organic crops or natural flora and that hives must be placed more than five kilometres from both conventionally produced crops, including GM crops.

Apted and Mazur (2007) pointed out that their conclusions do not extend to the potential impacts of commercialisation of other GM crops. The commercialisation of GM varieties of other crops which are more extensively grown in Australia as certified organic, such as wheat, may have a direct impact on Australia’s organic sector.

There is an organic canola industry in Canada, despite GM varieties making up around 85 per cent of the total canola plantings in that country. According to Macey (2006), the organic canola area in Canada was 857 hectares in 2005, down from 1191 hectares in the previous year. The data in Macey (2006) also indicates that organic cereals, oilseeds (other than canola), pulses and livestock industries are generally growing in Canada.

Conclusions

The nature of consumer acceptance of GM crops has led to the differentiation of world grain markets into GM, certified non-GM and organic components. In some relatively limited cases, this is leading to opportunities to capture price premiums for certified non-GM grain through identity preservation arrangements aimed at delivering grain with tolerances for unintended presence of GM grains specified by end users.

To the extent that there are price premiums for non-GM grains and the need to change non-GM production arrangements to meet tolerances for unintended GM presence, there can be coexistence issues in mixed production systems of GM and non-GM crops. The challenge is to develop institutional arrangements — legislated and private — that lead, in effect, to appropriate containment of costs spillovers from one grain production system to another. With appropriate coexistence arrangements, the choice whether to produce GM, certified non-GM or organic grain can be left to individual growers, rather than governments.

With later generations of GM crops with enhanced quality characteristics, the emphasis will likely shift to identity preservation of the quality enhanced GM crops.

However, commercial release of GM wheat is clouded by uncertainty over market acceptance and the evidence available to date suggests there will be large components of the world wheat market that are at least initially strongly averse to GM wheat. The publicly expressed views of the major wheat marketers in the world suggest that the commercial release of GM wheat will only be made possible by low cost identity preservation arrangements. It can be argued that workable identity preservation arrangements have already been demonstrated with the first generation of GM soybeans, corn, cotton and canola.

References

Ad Hoc Working Group 2007, *Report of the Open-Ended Ad Hoc Working Group of Legal and Technical Experts on Liability and Redress in the Context of the Cartagena Protocol on Biosafety on the Work of its Third Meeting*, UNEP/CBD/BS/WG-L&R/3/3, United Nations Environment Programme, Nairobi, February.

American Corn Growers Foundation 2004, *2004 ACGF Farmer Choice-Customer First Grain Elevator Survey Results Regarding GMO Corn Varieties*, Washington DC (www.acgf.org/programs/survey-results/2004/default.asp).

Apted, S.and Mazur, K. 2007, *Potential Economic Impacts from the Introduction of GM Canola on Organic Farming in Australia*, ABARE Research Report 07.11 Prepared for the Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, May.

Australian Wheat Board 2007, *The Application of Biotechnology: AWB Policy*, Melbourne, June (www.awb.com.au/aboutawb/factsandindustryinformation/policy).

Brookes, G., Craddock, N. and Kniel, B. 2005, *Global GM Market: Implications for the European Union Food Chain*, PG Economics Ltd, Frampton, United Kingdom (www.pgeconomics.co.uk/pdf/Global_GM_Market.pdf).

Canadian Wheat Board 2007, *Biotechnology Position Statement*, Winnipeg (www.cwb.ca/public/en/hot/biotechnology/#bio-position).

Foster, M. 2006, *GM Grains in Australia: Identity Preservation*, ABARE Research Report 06.25 Prepared for the Australian Government Department of Agriculture, Fisheries and Forestry and the Grains Research and Development Corporation, Canberra, December.

Foster, M. and French, S. 2007, *Market Acceptance of GM Canola*, ABARE Research Report 07.5 prepared for the Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, March.

Gene Technology Grains Committee 2003, *Canola Industry Stewardship Principles for Coexistence of Production Systems and Supply Chains*, Canberra, August ().

Henry, B., Wilson, W. and Dahl, B. 2006, *Marketing Mechanisms to Facilitate Co-Existence of GM and Non-GM Crops*, Agribusiness and Applied Economics Report no. 593, North Dakota State University, September (agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=23903&ftype=.pdf).

Holtzapffel, R., Johnson, H. and Mewett, O. 2007, *GM Oilseed Crops and the Australian Oilseed Industry*, Australian Government Bureau of Rural Sciences, Canberra (www.affashop.gov.au/product.asp?prodid=13770).

Koester, J 2007, The supply situation in Brazil — a producer’s perspective. Presentation to the Third International Conference on GMO Free Regions, Brussells, 19-20 April (www.gmo-free-regions.org/fileadmin/files/gmo-free-regions/Koester_presentation.pdf).

Macey, A 2006, *Certified Organic Production in Canada, 2005*, Report prepared for Canadian Organic Growers, Ottawa, August (www.cog.ca).

Mewett, O., Johnson, H. and Holtzapffel, R. 2007, *Plant Molecular Farming in Australia and Overseas*, Australian Government Bureau of Rural Sciences, Canberra (www.affashop.gov.au/product.asp?prodid=13725).

Queensland Department of Primary Industries and Fisheries 2005, *Developing Strategies for GM and non-GM Crops in Queensland*, Brisbane, October (www2.dpi.qld.gov.au/extra/pdf/business/coexist_strat.pdf).

Sayler, T. 2001, 'US, Canada face biotech wheat showdown', *ISB News Report*, June (nbiap.biochem.vt.edu).

SGA Solutions Pty Ltd 2007, *A National Market Access Framework for GM Canola and Future GM Crops*, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra (www.daff.gov.au/__data/assets/pdf_file/0013/370021/gmcanola_pathway_to_market.pdf).

Timbs, S., Adams, K and Rogers, W. 2006, *Statutory Review of the Gene Technology Act 2000 and The Gene Technology Agreement*, Australian Government Department of Health and Aging, Canberra (www.health.gov.au/internet/wcms/publishing.nsf/Content/9F34C91EA9E219E2CA2571410009A47E/$File/Stat_Review_GeneTechAct.pdf).

United Nations Statistics Division 2007, *United Nations Commodity Trade Statistics Database (UN Comtrade)*, New York (comtrade.un.org/db/).

United Soybean Board 2001, *The Soy Glossary*, Chesterfield Missouri (www.talksoy.com/pdfs/Soy%20Glossary.pdf)

US Department of Agriculture 2007, *PSD Online*, Washington DC (ww.fas.usda.gov/psd).

US Wheat Associates 2006, *Biotechnology: USW/NAWG/WETEC Position Statement*, May, Washington DC (www.uswheat.org/biotechnology/doc/08B878B6B53F970785256F73005E8F5E?OpenDocument#).

Wisener, R. 2006, *Update on Potential Market Impacts from Commercialising Roundup Ready Wheat*, Iowa State University and Western Organization of Resource Councils, August (www.worc.org/pdfs/Market%20Risks%20Update%20Final%208-06.pdf).