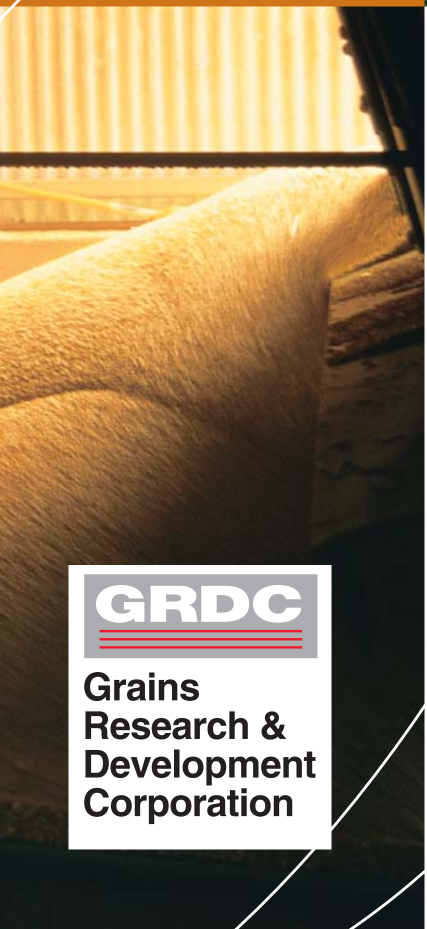
Australian GRAINS INDUSTRY 2003



# GM CANOLA

## What are its economics under Australian conditions?

Max Foster, ABARE

*Significant agronomic benefits are claimed for genetically modified (GM) canola varieties under Australia conditions. However, while there are difficulties in achieving access for GM canola to some markets, there is currently no strong evidence of premiums for non-GM canola in the main world markets. Even the likely additional costs of compliance with GM market access restrictions are insufficient to offset the agronomic benefits to Australian production. This is the case even if substantial costs are incurred in keeping GM and non-GM canola separate in the production and marketing process.*

### First commercial release of GM canola in Australia

The Office of the Gene Technology Regulator is considering the first applications for the commercial release in Australia of varieties of canola that are genetically modified to be resistant to herbicides. This follows extensive trialing of these GM canola varieties in Australia and the successful commercial release of GM cotton varieties in 1995 and 2000. If approval is received from the regulator, the plan of the technology owners is to undertake limited commercial production (3000–5000 hectares) in 2003-04, followed up by a larger commercial area in subsequent years if significant problems do not emerge.

The regulator will decide whether to approve the release of GM canola on the basis of scientific assessment of the environmental impact. There are, however, some important economic considerations that appear to be outside the regulator's ambit. A key economic factor is that the decision of one group of farmers to adopt GM canola has marketing implications — not just for the adopters but also for the other farmers who produce conventional or organic canola. This is because contamination of non-GM canola can occur through cross-pollination in the field or through co-mingling in the grain handling and transport system. Contamination from GM material can mean loss of price premiums for non-GM and organic grain (if premiums exist). The existence of GM crops can mean additional costs to non-GM producers through meeting requirements for avoiding contamination throughout the grain supply chain.

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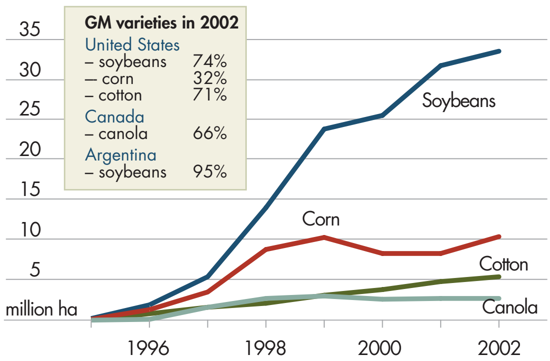
ABARE has analysed aspects of the economics of commercial release of GM canola in Australia and the results are reported here. Newly available data from field trials of GM canola in Australia are used to update the analysis reported in Foster (2001).

## Rapid adoption of GM crops in some countries

**A World area harvested**
GM broadacre crops




There has been rapid and extensive adoption of GM crops in north and south America (figure A). However, various concerns about these crops — even after they have been assessed by government authorities to be safe for humans and the environment — have resulted in consumer resistance to GM products in some countries.

At this stage, Canada and the United States are the only countries growing GM canola. Canada is the dominant exporter in the world canola market (box 1).

The agronomic benefits of GM canola in Canada seem to be substantial. A survey has shown that yields for GM canola in Canada were 10 per cent higher than for non-GM varieties, at the cost of a 3 per cent increase in input costs including a higher seed price (Serecon et al. 2001). Despite this

### Box 1: World canola market

Canola provides around 18 per cent of the world's edible oils and 13 per cent of the protein meals that are usually fed to livestock. It is grown mainly in China (28 per cent of world canola production in the five years to 2002-03), the European Union (26 per cent), Canada (18 per cent) and India (12 per cent). The Australian share of world production was 4.5 per cent in the same period. Around a quarter of world canola production enters world trade.

World canola export trade is dominated by Canada, with a share of 40 per cent in the five years to 2002-03 (rising to over 70 per cent if intra-EU trade is excluded). The European Union accounted for 38 per cent of world trade, the bulk of which was intra-EU trade. Australia had a 13 per cent share, but this share has increased in recent years as canola production has become established in grain production systems in Australia.

The main canola importers are the European Union (34 per cent of total world imports in the five years to 2002-03), Japan (24 per cent), China (21 per cent), Mexico (10 per cent) and Pakistan (4 per cent). EU canola imports and exports involving non-EU countries have each averaged around 0.8 million tonnes a year over the past five years but are highly dependent on seasonal conditions. In 1999-2000, for example, EU canola exports to non-EU countries were slightly over 2 million tonnes, while EU canola imports from non-EU countries were 0.87 million tonnes. The main non-EU sources for imports were eastern European countries and Australia. The main non-EU export markets for EU canola were China, Pakistan and Bangladesh.

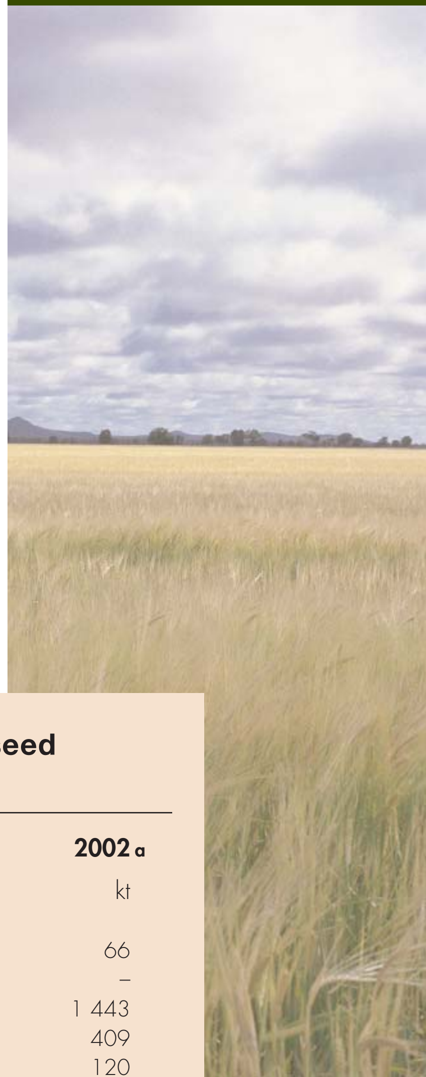
Enlargement of the European Union commencing in 2004 will take in a number of significant canola producing countries in eastern Europe, mainly the Czech Republic, Hungary, Poland and Slovakia. The new entrants to the union accounted for 6 per cent of world canola production in the five years to 2002-03, 8 per cent of world canola exports, and less than 1 per cent of world canola imports.

advantage, GM canola plantings in Canada have declined in recent years from a peak in 1999. However, the proportion of GM canola in total plantings has continued to edge up. A factor strongly contributing to the decline in total Canadian canola plantings has been an extended period of adverse seasonal conditions.

## Market access

Perceptions of consumer resistance to GM products have led governments in a number of countries to introduce a range of market access conditions for these products.

The key market access barrier for canola is that the European Union does not allow imports of GM canola. The European Union does import some varieties of GM soybeans and corn, approved before 1998. Since 1998 a virtual moratorium on the approval of imports of new varieties of GM crops has existed. Importantly, however, the European Union allows for traces of up 0.5 per cent of GM material that has not been approved for import into the European Union but has been approved for consumption in the exporting country.



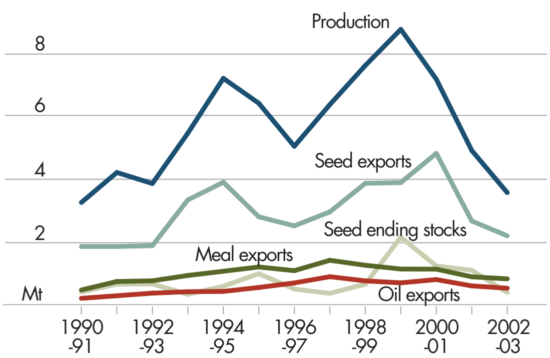
**1 Export destinations for Canadian and Australian canola seed**

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 a |
|---|---|---|---|---|---|---|---|
| | kt | kt | kt | kt | kt | kt | kt |
| **Canada** | | | | | | | |
| China | 20 | – | 1 045 | 1 285 | 1 024 | 1 254 | 66 |
| European Union | 270 | 68 | 2 | 1 | 1 | 2 | – |
| Japan | 1 599 | 1 813 | 1 821 | 1 796 | 1 785 | 1 703 | 1 443 |
| Mexico | 536 | 435 | 667 | 480 | 862 | 754 | 409 |
| United States | 267 | 320 | 355 | 223 | 249 | 164 | 120 |
| Other | 21 | 1 | 50 | 5 | 22 | 8 | – |
| Total, Canada | 2 713 | 2 637 | 3 940 | 3 790 | 3 943 | 3 885 | 2 038 |
| **Australia** | | | | | | | |
| Bangladesh | 108 | 75 | 120 | 89 | 112 | 158 | 115 |
| China | – | 74 | 210 | 588 | 915 | 248 | 386 |
| European Union | – | – | 90 | 315 | – | 362 | 63 |
| Japan | 242 | 245 | 237 | 302 | 426 | 393 | 446 |
| Mexico | – | – | 21 | 155 | 66 | – | – |
| Pakistan | – | – | 28 | 68 | 68 | 182 | 307 |
| Other | 2 | 1 | 14 | 54 | 28 | 76 | 35 |
| Total, Australia | 352 | 395 | 720 | 1 571 | 1 615 | 1 419 | 1 352 |
| | A$m | A$m | A$m | A$m | A$m | A$m | A$m |
| – value, Australia | 142 | 169 | 318 | 614 | 546 | 544 | 592 |

a Year to November for Canada.
*Sources*: Australian Bureau of Statistics (2003); ISTA Mielke (2002); Statistics Canada (2002).

The EU restrictions have provided an opportunity for Australian canola because of its non-GM status and has largely locked out Canada from the EU market (table 1). However, in recent years the European Union has only been an occasional market for non-EU canola imports. The expectation is that the European Union will be largely self sufficient in canola over the medium term following the 2004 enlargement.

**B Canadian canola and canola products**




Despite the ban imposed by the EU market, Canadian exports of canola reached record levels in 2000-01 (figure B), with larger markets being found in Japan, China and Mexico. The substantial decline in Canadian canola exports in 2001-02 and 2002-03 was driven by reductions in export availabilities arising from poor production conditions.

Rules that require labeling of GM products are being put in place in an increasing number of countries. Most of the major grain importing countries — including China, the European Union, Japan and the Republic of Korea — now have mandatory GM labeling regimes.

The nature of these labeling regimes differs significantly between countries. For example, the European Union allows accidental contamination of 0.9 per cent by volume before it must be labeled as containing GM material. (The European Parliament recently voted to lower this tolerance from 1 per cent). Japan and Korea allows 5 per cent and 3 per cent respectively. Japan does not require labeling of processed GM products where modified DNA is not detectable — such as canola or soy oil — whereas the European Union does. The European Parliament also decided to extend mandatory labeling to animal feed containing GM materials but not to products from animals fed GM materials (as was mooted at one stage).

The labeling requirement can add significantly to the cost of delivering non-GM products through requiring elaborate procedures that keep GM and non-GM products separate or tracable throughout the supply chain. It could be expected that the lower the tolerance for accidental contamination, the higher is that cost.

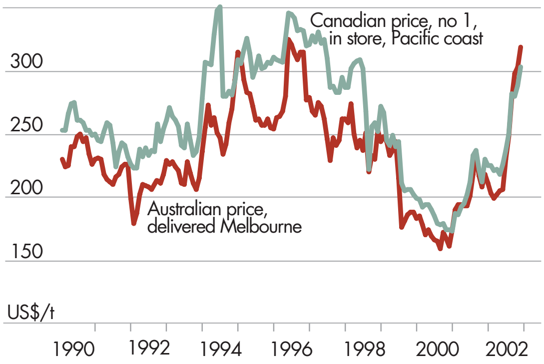
A recent complication for the producers of genetically modified crops, including canola, is that from March 2002 China requires that exporters of GM products to China obtain safety certificates from its Ministry of Agriculture certifying that the products are harmless to humans, animals and the environment. The new rules have created uncertainty, with the result that China's imports of GM soybeans and canola have been severely disrupted. Canola exports from Canada to China have declined from an average of more than 1 million tonnes over the four years to 2001, to only 66 000 tonnes in the first eleven months of 2002 (table 1). This decline is also partly explained by reduced Canadian export availabilities.

Given these market access barriers, it is possible that non-GM canola may command higher prices in world markets than GM canola. This would reflect the higher cost associated with delivering certified non-GM canola and any price rationing effect where the demand for non-GM canola is high in relation to its supply.

## Price advantages for non-GM canola?

There is no clear evidence to suggest that there is currently a premium for non-GM canola. There is some evidence that the gap between Canadian and Australian canola prices, expressed in US dollars, has narrowed in recent years (figure C). However, this narrowing could simply reflect the greater security of supply that has occurred with Australian canola over the same time, the continuing problems that Canada has had in disposing of the record increase in canola production that occurred in 1998 and 1999, and relative movements between the Australian and Canadian currencies over the time period.

**C Canola prices**
Monthly, ended November 2002




At present, Australia is the main export supplier of non-GM canola to the world market. The effect of Australia commercialising GM canola would be a reduction in non-GM supplies, which could lead to increased price premiums for non-GM canola. In the long run, the premiums for non-GM canola will reflect production and marketing costs, including identity preservation costs.

It is also possible that Canada has accumulated stocks rather than taken lower prices to clear those stocks. Canada did accumulate unprecedentedly large stocks of canola until 2000-01 (figure B), at a time when other key canola exporters, including Australia, were able to dispose of most of their supplies. The logistical problems of dealing with such a large crop may have contributed to this steep stock increase. However, Canadian stocks had declined to very low levels by the end of 2001-02, in response to poor seasonal conditions in both Canada and Australia that resulted in low world canola supplies.

## Agronomic performance of GM canola in Australia

The GM canola varieties proposed for Australia have been engineered to include the trait of herbicide tolerance. Weed management systems for canola are outlined in box 2.

Monsanto has recently released summary data on the agronomic performance in field trials of Roundup Ready™ (RR) canola, a variety genetically modified to be resistant to the herbicide Roundup™ (see Grieve 2001; Monsanto Australia 2002). The trials were conducted side by side with trials of alternative non-GM canola varieties and alternative weed management systems. Using the field trial data, Monsanto has calculated comparative gross margins.

Generally the Monsanto data show substantial yield improvements for RR canola compared with conventional and triazine tolerant canola varieties (table 2). Monsanto says there were also significant yield benefits with wheat crops that followed RR canola because of lower herbicide residues in the soil and improved weed management. The wheat yield advantages of a canola–wheat rotation are well known (see, for example, Lovett 2002) but the Monsanto (2002) trial data indicates that these yield advantages are even higher with GM canola varieties than with existing canola varieties. Combined with lower herbicide costs with RR canola, this meant very favorable improvements in terms of gross margins if the

## Box 2: Weed management systems for canola

Production systems for canola in Australia are largely based on minimum tillage, whereby the land to be seeded is sprayed with a chemical herbicide to eliminate weeds before seeding, rather than the land being ploughed. In recent years, herbicide tolerant plants have been developed through both conventional breeding and genetic engineering. These enable farmers to apply herbicides over the top of plants to control emerging weeds within the crop.

The genetic resistance to triazine herbicide in triazine tolerant (TT) canola varieties was developed from naturally mutated plants found in Canada and cannot be transferred by the pollen. However, TT canola varieties are less energy efficient than non triazine tolerant canola, yielding 10–30 per cent less seed and lower oil content (Carmody, Page and Walton 2001). This is compensated for by enabling better weed management that allows growers to sow early (Carmody et al.).

The Clearfield™ production system for canola was introduced in 2000. Developed using conventional breeding methods, this system offers tolerance in canola to the imidazolinone group of herbicides. The seed and chemical is sold as ‘production units’ — that is, sale of the seed and herbicide are linked. During 2001 the cost of accessing this technology was $60–90 a hectare, depending on seed company (Carmody et al. 2001). The Clearfield trait can be transferred by pollen (Carmody et al. 2001).

Roundup Ready™ canola has been genetically modified to enable tolerance to glyphosate, the active ingredient in the herbicide with the brand name Roundup. The novel trait enables the canola plant to produce two enzymes, one of which protects the plant from the herbicide and another that degrades the herbicide (Monsanto Australia 2002).

GM variety was adopted. Monsanto claims that the lower use of more environmentally friendly herbicides represents a significant environmental benefit.

However, Monsanto does not report comparisons with the Clearfield™ system canola varieties — non-GM herbicide tolerant varieties — that were introduced in Australia in 2000 and seem to offer significant agronomic advantages over existing commercialised canola varieties under some conditions. These Clearfield™

## 2 Field trial performance of Monsanto’s Roundup Ready canola, 2001 [a]

| System | Herbicide treatment | Yield | Oil content |
|---|---|---|---|
| | | kg/ha | % |
| Untreated control | No herbicide | 695 | 41.71 |
| Conventional | Trifluralin + Select® + D-C Trate + Lontrel® | 922 | 43.52 |
| IT/Clearfield | Trifluralin + OnDuty® + Hasten® + Lontrel® | 1 144 | 41.09 |
| Triazine Tolerant | Simazine (pre-plant) + Gesaprim® (pre-plant) + Gesaprim (post emergent) | 800 | 42.14 |
| Roundup Ready | | | |
| – A | Two applications of Roundup | 1 055 | 43.00 |
| – B | One application of Roundup | 977 | 43.04 |
| – C | Trifluralin + Two Applications of Roundup | 966 | 43.52 |

**a** All systems received the same fertiliser and insecticide treatments. All varieties of canola sown had similar maturity types and black leg resistance ratings.
*Source*: Monsanto (2001).

varieties made up around 17 per cent of plantings in Canada in 2001, when GM varieties made up about 60 per cent.

Moreover, in calculating gross margins, Monsanto does not appear to include technology fees. In Canada in 1998, for example, the technology fee for RR canola was around US$9 a hectare. The extent to which Monsanto appropriates the benefits of the GM canola variety through charging a technology fee to make a return on its research and development investment will be an important determinant of the profitability to farmers of this variety.

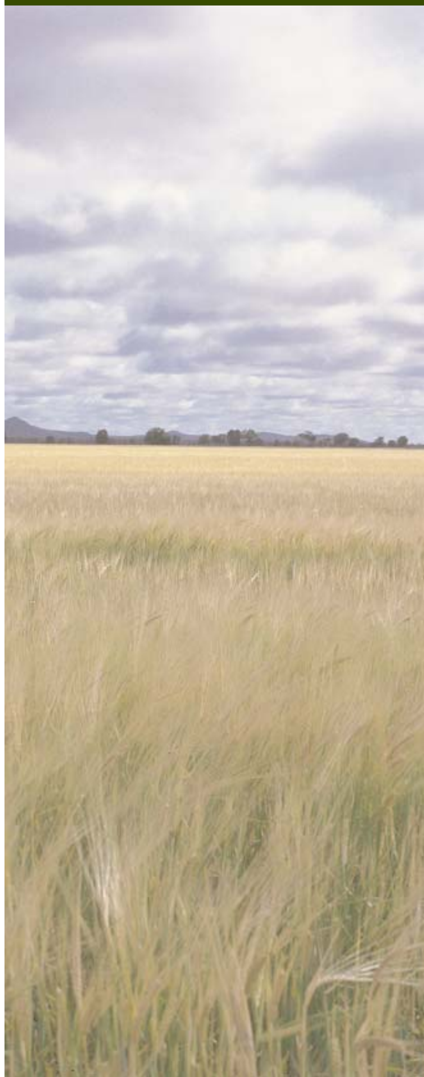
## Estimation of Australiawide benefits

A number of state government departments of agriculture in Australia provide estimates of gross margins for canola for the canola growing regions that they cover. A survey of these suggests that herbicide and application costs are around $60–70 a hectare (see, for example, Carmody et al. 2001; Diggle et al. 2002; GM Canola Technical Working Group 2001; NSW Agriculture 2002).

Based on the Canadian experience and field trial data in Australia, GM varieties are likely to enable savings of the order of 50 per cent of these herbicide costs on an Australiawide basis through requiring fewer applications. However, there is likely to be a substantial technology fee associated with the use of GM technologies. The assumption in this analysis is that the technology fee will be around $15 a hectare, equivalent in Australian dollar terms to the technology fee charged for GM canola in Canada. Once technology fees are taken into account, weed management cost savings for GM canola would be around $15 a hectare.

Calculation of the Australiawide yield advantage offered by GM canola requires assumptions about the composition of non-GM canola varieties in total plantings. It is simply assumed that a very similar mix to Canada occurs — that is, CLEARFIELD canola will make up around 15 per cent of total plantings, triazine tolerant canola, 25 per cent and conventional canola 10 per cent. Based on the data in table 2, the yield advantage that GM canola offers over non-GM varieties is estimated to be 12.7 per cent.

Based on data in table 2, the oil content of GM canola is about 1 percentage point higher than with the assumed mix of non-GM varieties. This translates into a 1.5 per cent price bonus for GM canola. The benefits of a wheat–canola rotation have proved to be difficult to incorporate in the modeling framework employed in this analysis and have been ignored.



## Economic analysis

### *Modeling framework*

In this section the modeling framework for assessing the possible market impacts of adoption in Australia of GM canola is outlined.

The model used to assess the impacts is an ABARE enhanced version of the OECD developed AGLINK model (described in box 3). A key enhancement is a more detailed crop supply response system for Australia, based on Hussain, Liaw and Hafi (1999). Model parameters are altered to reflect the impact of the adoption of GM canola in Australia.

## Box 3: AGLINK model — a brief description

AGLINK is a multicommodity, multicountry/region econometric model of world agriculture. The Secretariat of the Organisation for Economic Cooperation and Development (OECD) developed the model in close cooperation with member countries of the OECD.

The model is based on annual data and represents the dynamics of supply and demand for a range of commodities important to the OECD policy making environment — namely, wheat, rice, coarse grains, oilseeds, oilseed meals and oils, milk and dairy products, meat (beef, pig and poultry) and eggs. Market prices are determined through a global supply and demand equilibrium. AGLINK is a partial equilibrium model in the sense that nonagricultural markets are not modeled. A limitation of AGLINK at this stage is that agricultural markets for cotton, sugar, sheep meat, fish and wool are not yet modeled or are incompletely modeled.

The model consists of complete modules for seven OECD countries/regions: Australia, Canada, European Union (fifteen countries), Japan, Mexico, New Zealand and the United States. There are also model representations for non-OECD countries that are important in world trade in agricultural commodities. These include Argentina and China, for which there are detailed modules. There are less detailed representations for Brazil, the Czech Republic, Hungary, Paraguay, Poland, Slovakia, Chinese Taipei and the countries of the former Soviet Union (as a bloc). The remaining countries are aggregated into a rest of world module.

Many of the supply and demand relationships in AGLINK are partial adjustment processes — that is, it takes a number of years for the full impact of a supply or demand shock to flow through. To allow for this, results are reported for the end of the assessment period — that is, 2010. As well, the results are reported as changes from a baseline set of projections that represent ABARE’s view of the outlook for the range of agricultural commodities represented in AGLINK.

### *Previous work*

Two scenarios were reported in Foster (2001), based on using the AGLINK model of world agricultural trade to assess the market implications of wide scale adoption of GM canola in Australia. These results are summarised in table 3. In the first scenario, the impact of the agronomic benefits alone were assessed; in the second the impact of the agronomic benefits combined with the additional costs of keeping GM and non-GM separate in the handling and storage process were examined.

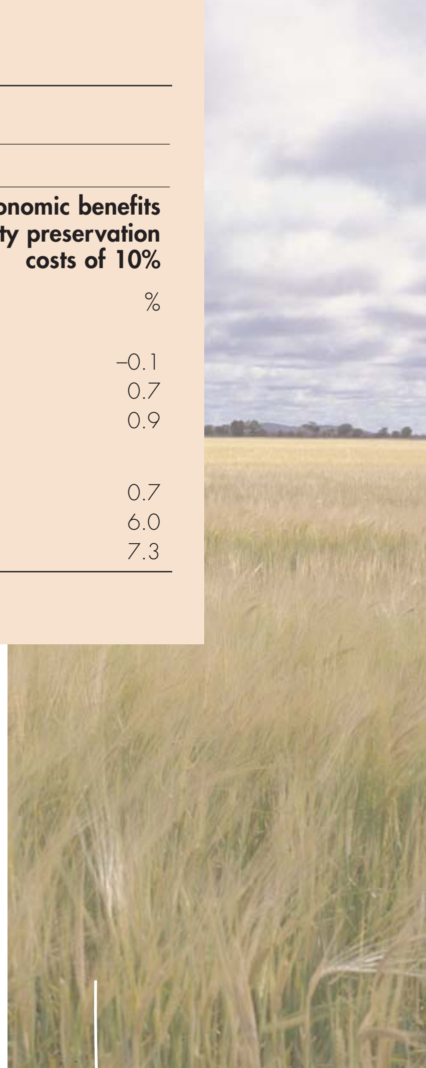
With the first scenario, the assumptions were as follows:

- The agronomic benefits of the GM variety in the Australian context are a yield advantage of 7 per cent over varieties already in use and a decrease in weed control costs (including seed costs) equivalent to a 3 per cent reduction in total production costs. These were based on an extensive review of the literature that was available at the time — for example, Farm Central (2000) and Serecon et al. (2001).
- The adoption rate is 50 per cent, roughly the same as the adoption rate of GM herbicide tolerant canola in Canada in 2001 (it has since increased to around 66 per cent adoption).
- There are no premiums for non-GM canola in world markets — that is, there is one price for all canola.

## 3 Estimated market impacts under various scenarios

| | Scenario | | | |
|---|---|---|---|---|
| | Foster (2001) | | Updated analysis | |
| | 1: Agronomic benefits | 2: Agronomic benefits and identity preservation costs of 10% | 3: Agronomic benefits | 4: Agronomic benefits and identity preservation costs of 10% |
| | % | % | % | % |
| **World** | | | | |
| Canola indicator price | –0.1 | – | –0.3 | –0.1 |
| Canola production | 0.9 | 0.1 | 1.8 | 0.7 |
| Oilseed exports **a** | 1.4 | –0.2 | 2.6 | 0.9 |
| **Australia** | | | | |
| Canola producer price | –0.1 | – | 0.5 | 0.7 |
| Canola production | 8.7 | –1.2 | 16.8 | 6.0 |
| Oilseed exports | 11.8 | –2.3 | 22.7 | 7.3 |

a Argentina, Australia, Canada, European Union and the United States. – Negligible, less than 0.05.



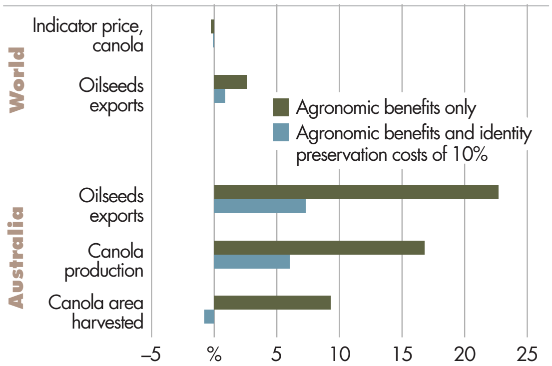
The additional assumptions for the second scenario were as follows.

- Australia segregates its canola crop into GM and non-GM crop at the export level — identity preservation on non-GM grain adds 10 per cent to the cost of delivering all GM canola to the export level. The magnitude of this cost is broadly consistent with assessments available at that time, reported in Buckwell, Brookes and Bradley (1998) and Economic Research Service (2000).
- Canola oil and meal are not subject to identity preservation requirements. (The meal is used as livestock feed and the oil does not contain DNA that would identify it as being genetically modified.) The effect is that more canola could be exported as processed product rather than as seed.

A key conclusion from the Foster (2001) analysis was that Australian production and exports of canola would be increased (up 8.7 per cent) if GM canola was introduced but no identity preservation arrangements were necessary. It was estimated that for Australia to be better off through forgoing the use of GM canola, there would have to be a premium of 10.4 per cent for non-GM canola in world markets. It was noted at that time that a premium of this level did not appear to be available on a wide scale in world markets.

However, Foster (2001) concluded that Australian canola production would decline by 1.2 per cent if elaborate identity preservation arrangements (assumed to add 10 per cent to Australian export canola prices) were required. That is, given the assumptions, the model results suggested that wide scale introduction of herbicide tolerant canola may not be justified if consumer acceptance problems required elaborate identity preservation arrangements. A sustained premium of 10 per cent for non-GM over GM product would be necessary to offset the additional costs.

**D Changes in key oilseeds market variables under two scenarios**




## *Discussion of updated results*

These scenarios were reestimated using a yield improvement of 13.7 per cent, an oil yield price bonus of 1.5 per cent for GM canola, and a weed control cost saving of $15 a hectare for GM canola. Identity preservation costs are kept at 10 per cent; recent analysis by Bullock and Desquilbet (2002) tends to support this level of costs. The updated estimation results are reported in table 3 and illustrated in figure A.

Assuming only agronomic benefits — that is, yield improvements and reductions in the cost of production — the adoption of GM would lead to Australian canola production increasing by 17 per cent by 2010, compared with the baseline, and Australian oilseed exports increasing by 23 per cent. There is a 0.5 per cent increase in the Australian canola producer price that reflects the higher oil yield bonus assumed with GM canola.

At the world level, the impacts are small, with world exports of oilseeds increasing by 2.6 per cent and the additional supplies reducing the world indicator price for canola by 0.3 per cent. Australia would gain world oilseed market share at the expense of the shares of Canada and the United States. Indeed, the impacts on world canola prices are slight in all scenarios. This is because the changes in Australian canola production and exports are small in relation to world availabilities of oilseeds and are largely absorbed by adjustments in the prices and availabilities of other oilseeds, particularly soybeans. Australian produced oilseeds represent only around 1 per cent and 3 per cent of total world oilseeds production and trade respectively.

For Australia to produce the same amount of canola if it remained GM free, it is estimated that the premium for non-GM canola would have to be around 16 per cent. The assessment is essentially the same as in Foster (2001): at this stage, premiums of this magnitude do not appear to be available on a wide scale in world canola markets.

The effect of imposing identity preservation costs — the fourth scenario in table 2 — is to partially offset the agronomic benefits of GM canola. Australian canola production is estimated to still increase by 6.0 per cent compared with the baseline, and Australian oilseeds exports by 7.3 per cent. At the world level, the impact is an estimated 0.1 per cent decline in world oilseeds prices and a 0.9 per cent increase in world oilseeds exports.

Given the Monsanto field trial data and other assumptions, the updated model results alter the conclusion of the Foster (2001) analysis. That is, taking into account the new level of agronomic benefits, wide scale introduction of herbicide tolerant canola may be justified, even if consumer acceptance problems require elaborate identity preservation arrangements.

## Conclusions

It is easier to trade non-GM canola in the current market environment than it is to trade GM canola. However, with Australia considering commercialisation of its own varieties of GM canola, the issue is whether consumer resistance to GM products will manifest itself strongly enough in the form of market access barriers and price disadvantages to offset any agronomic benefits that these crops offer.

Based on the agronomic benefits of GM canola under Australian conditions, as provided by Monsanto, it would appear at this stage that the extent of non-GM canola premiums and market access difficulties for GM canola in world markets are not large enough to offset the agronomic benefits offered by GM canola.

An important issue associated with identity preservation costs is who will bear them. If the effect of the introduction of GM canola in Australia is to impose significantly higher segregation and identity preservation costs on the producers of non-GM canola (as was assumed with this analysis), this may represent a significant market distortion if there are no fully compensating price premiums or market access opportunities for identity preserved non-GM canola.

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