GM Crops

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Feeding more people from less crop land

Population

Crop land

Billion people

Area (billion ha)
When you think of “GM crops”, what do you think of?

What crops & Which genes?
GM crops have a gene(s) inserted from another species
Global GM crops 1996 to 2006 (million ha)

Clive James 2006
Glyphosate-resistant crops (Roundup Ready)

Nearly all worldwide GM crops have a bacterial gene endowing glyphosate resistance. Glyphosate controls weeds. Enables early seeding & no-tillage cropping.
GM Bt crops

- A bacterial gene from *Bacillus thuringiensis* (Bt).
  The crop produces a toxin lethal to caterpillar stage of insect pests

- Bt plants produce their own insecticide, reducing the need for insecticide sprays
1996 to now:

**Glyphosate resistant and Bt**

account for

nearly ALL GM crops grown worldwide

e.g. 60% of global soybean production is glyphosate resistant
Global GM crops: by trait (million ha)

- Glyphosate resistant
- Bt
- GR + Bt

Clive James 2006
Global GM crops: by crop (million ha)

Soybean
Maize
Cotton
Canola

Clive James 2006
Countries producing GM crops dominate world markets in these grains

In 2006

- 80% globally traded soybeans GM
- 60% globally traded canola GM

“GM crops: The first ten years – global socio-economic and environmental impacts”
Graham Brookes and Peter Barfoot
PG Economics Ltd., UK
USA 2007 crop area

Maize 36 m ha (55% glyphosate resistant)
Soybean 27 m ha (~95% glyphosate resistant)
Cotton 5 m ha (~95% glyphosate resistant)
## US GM crops

<table>
<thead>
<tr>
<th></th>
<th>Ha (million)</th>
<th>Yield (million tonnes)</th>
<th>Net income (Billion $US)</th>
<th>Pesticide use (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>50</td>
<td>3.8</td>
<td>2.0</td>
<td>-31,682</td>
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</tbody>
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*National Center for Food and Agricultural Policy Nov 2006*
Brazil & Argentina
Argentina – all of the 17 million ha soybean area is GM glyphosate resistant

1996 – 2006:

- GM soybean gave large productivity gains
- US$20 Billion in direct value to Argentina
- GM soybeans greatly helped economic resurgence in Argentina

“Ten years of GM crops in Argentine agriculture” EJ Trigo & EJ Cap
Environmental benefit: Argentina
GM soybean enabled rapid adoption of
environmentally sustainable, no-till farming

➤ No-till farming increased from 0.1 million ha in 1991 to 20 million ha in 2006

➤ GM soybeans a principal factor in the growth of no-till farming in Argentina.

➤ No-till farming minimising soil erosion in the Pampas

“Ten years of GM crops in Argentine agriculture” EJ Trigo & EJ Cap
Argentine GM soybeans v No-till farming

GM Soybeans (m ha)

No-till farming (m ha)


GM Soybeans

No-till farming
GM Agriculture areas in Canada

Canola

Corn/Soy
Canada - GM canola adoption

Year


Canola area (%)
Canada:
Trade Markets & GM Canola

- There is no segregation of non-GM & GM canola in Canada
- Canada: biggest global exporter of canola
Europe- GM Bt maize

- **2006 Bt maize, 65,000 hectares**
- **7 countries out of 25:** Spain, France, Germany, Portugal, Poland, Czech Republic, Slovakia
  
  PG Economics, UK

- **2007**
  France will plant 50,000 ha GM Bt maize
  (5,200 ha in 2006) USDA
Europe: € € & environmental benefits from GM insect-resistant (Bt) maize

- **Higher yields:** Av. Yields ≥ 10%

- **Higher income:** users of Bt earned additional income of €65 - €141 per ha. Improved profitability of 12 to 21%

- **Environmental gains:**
  - less insecticide use and reduced fuel use

Graham Brookes 2007
Asia

- Widespread adoption of GM Bt cotton by millions of Indian and Chinese farmers

- India & China – Bt cotton hybrids ⇒ 34% yield increase over non-GM hybrids

CropBiotech Update July06/March07
GM crops in Australia

current situation:

- **Cotton** - 90% of Australian cotton is GM
- **Carnation** (blue)
- **Canola** – OGTR (Federal approval) but under State Govt moratoria
OGTR
Gene Technology Act, 2000
Dr Sue Meek – Gene Technology Regulator

To protect
the health and safety of people
and the environment:

➢ By identifying risks posed by, or as a result of, gene technology
➢ By managing those risks through regulating certain dealings with GMOs
What is Regulated

- Live & viable genetically modified organisms
- ‘Dealings’ – research, manufacture, production, breeding, import, storage

What is NOT Regulated

- Comparisons with alternative technologies
- Cost/benefit considerations
- Marketing & trade impacts
INTEGRATED REGULATION

- Prescribed agencies
- State & territory governments
- Local councils
- Technical Advisory Committee (GTTAC)
Australian cotton 2006-07

- Conventional
- GM
Australian cotton - Trait adoption

- Conv
- Bt
- RR
Environment benefits of GM glyphosate resistant & Bt cotton in Australia

➢ Bt cotton has reduced insecticide use in cotton by 60% (ABARE)

➢ Reduction in herbicide use
GM Canola - OGTR approved
But State Govt. moratoria
Canola in Australia

- Canola is an important rotational crop
- TT canola most commonly grown (WA 95%)
- TT canola is ONLY grown in Australia because there is a weed penalty
- GM canola has higher yield than TT canola
GM -v- TT Canola for WA

- Potential one million hectares
- TT canola av WA yield = 1.5 t/ha
  ⇒ 1.5 m. tonnes
- GM canola WA yield = 2.0 t/ha
  ⇒ 2.0 m. tonnes

∴ adoption of GM canola
  ⇒ extra production of 0.5 m. t / an

0.5 m t @ $400/t = $200 million/an
Future for GM crops

- **Major agric producers** (USA, Brazil, Argentina, Canada) and China/India etc, will steam ahead with GM crops

- **Europe** gradually introducing GM crops
Future for GM crops

- First GM crops have been input traits (GR, Bt). The second wave of GM crops will have consumer health and other benefits.
- Small and large biotech companies pursuing many gene traits. Universities & other research agencies.
- Delivery of GM traits and consumer acceptance in some markets remains an issue.
New Opportunities

- Molecular “pharming” – plant-made pharmaceuticals
  e.g. smallpox vaccine in plants
  insulin produced by plants

- High carotenoid tomatoes

- High omega-3 oil in canola & soybean
  (polyunsaturated fatty acid)

- High oleic acid/low linoleic acid soybean & canola

- More & better soybean protein

- Nitrogen Use Efficient (NUE) canola

- Drought resistant crops

- Low caffeine coffee
GM future in Australia

- GM Cotton will continue to dominate
- GM Canola – already approved by OGTR and held up by state govt moratoria
- GM wheat – various OGTR field trials underway (CSIRO, Universities, CRCs, Biotech companies, multi-nationals) (Salt stress, water stress, better starch making properties, high amylose)
Soybean Harvest - Mato Grosso, Brazil

Soybean harvest followed by planting of double crop corn (31 combines & 12 planters)

"Expansion in Brazil is the most important shift in global agriculture since the Midwest was settled in the 1800s."

- USDA Economist
The Future: Feeding the world while conserving natural ecosystems is a HUGE challenge – Needs brains & a range of technologies, including GM!