SCION
Next generation biomaterials

Assessing the Risks and Benefits of GMOs for the Forest Industry

Christian Walter

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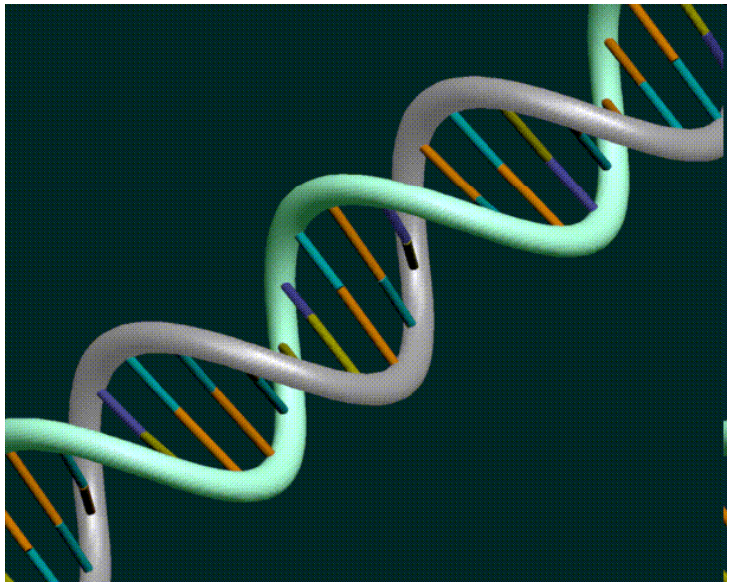
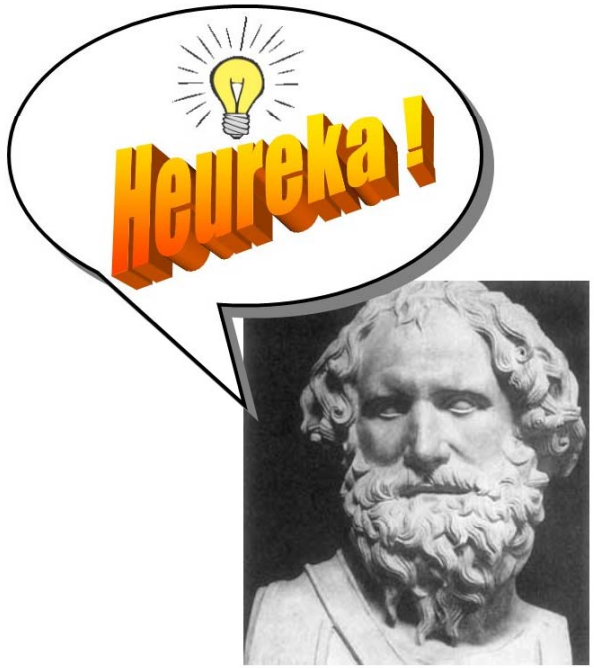
Clarification: What does GE do?

- GE uses known and characterised sets of information (genes)
- GE transfers one or a few defined genes into a new organism, or
- GE modifies the expression of an endogenous gene



Clarification: What does GE do?

GE introduces change, however this is much smaller and more precise then any other "conventional" breeding technology

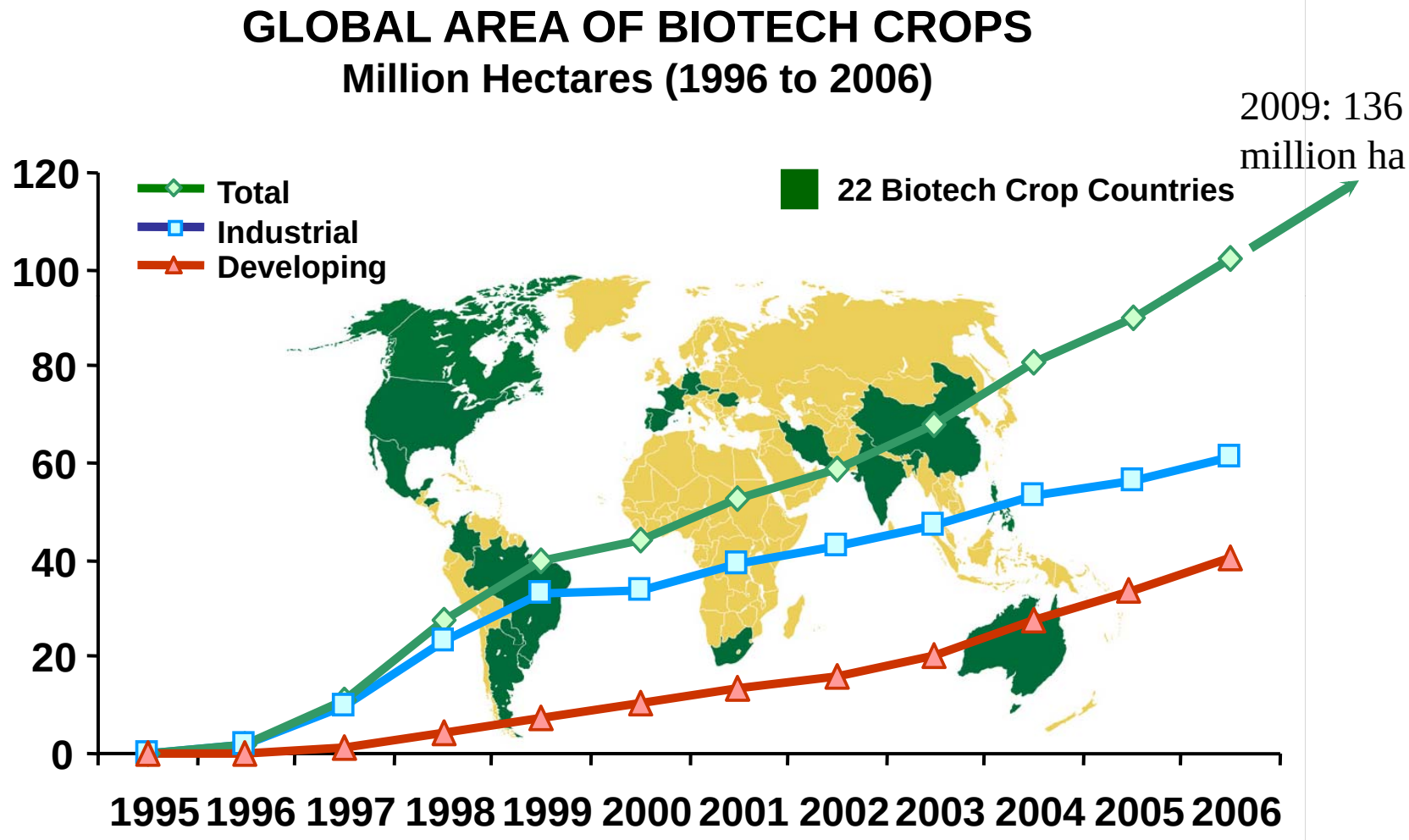


What is the opportunity?

- Lift the productivity and value of forests
- Enhance the competitiveness of the forest industries
- Contribute to the goals of improved forest health, sustainability and increased carbon sequestration.

Lets consider the success of Genetic Engineering in crop production

GE use: The numbers

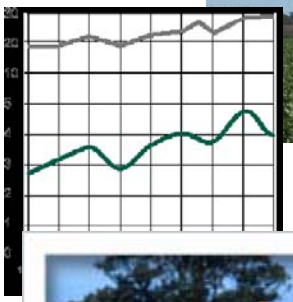


Increase of 13%, 12 million hectares or 30 million acres, between 2005 and 2006.

Source: Clive James, 2006.

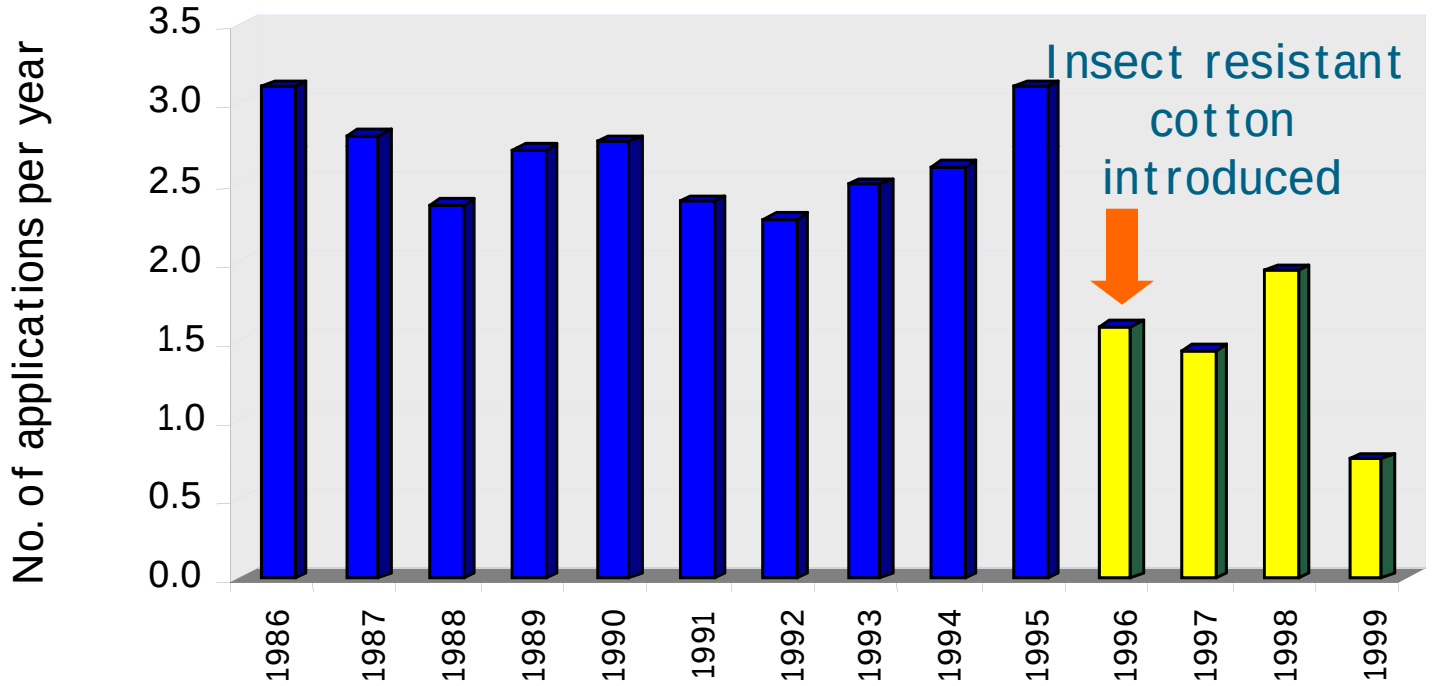
GE: The benefits

- **Farmers:** fewer pesticides, better yield, less work, more $$$$
- **Environment:** decreased environmental footprint, protecting natural environments
- **Health:** healthier nutritious foods, neutraceuticals, reduced allergenicity



GE cotton in the US: resistance against insects

Average number of insecticide treatments for tobacco budworm, cotton bollworm and pink bollworm across 16 States in the US



Source: Carpenter & Gianessi (2001). Agricultural biotechnology: updated benefits estimate. Report from the National Center for Food and Agricultural Policy, Washington DC (USA)

The Opportunity in forestry

40 million ha plantation forests world wide
This provides 25% of world wood fiber supply

Potential impacts of GE:

- Increased Growth
- Tolerance to stress and disease
- Improved Quality
- Better pulping
- New Biomaterials
- Biofuels from Trees
- Carbon sequestration

Some numbers (GE forestry)

- Herbicide resistance world wide: Expected benefit is in the $ 4 billion range
- Scion studies (2005): Increased revenues to growers and processors from

  - metabolic engineering: 455 mill pa
  - improved wood pulping: 281 mill pa
  - Improved density: 221 mill pa
  - Increased stability: 86 mill pa

- New analysis in progress

Examples of GMO trees

- More than 700 field tests with GMO trees worldwide: environmental safety + economic benefits
- Poplar modified in lignin biochemistry (England and France): better pulping and environmentally safe

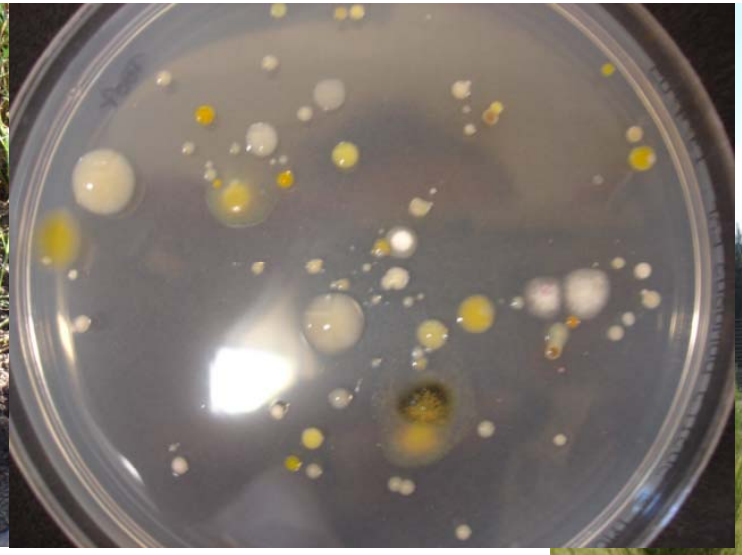
- Bt poplar in China (2002): 1.4 million trees planted – Successful establishment in high insect pressure area
- Virus resistant Papaya, Hawai 2003

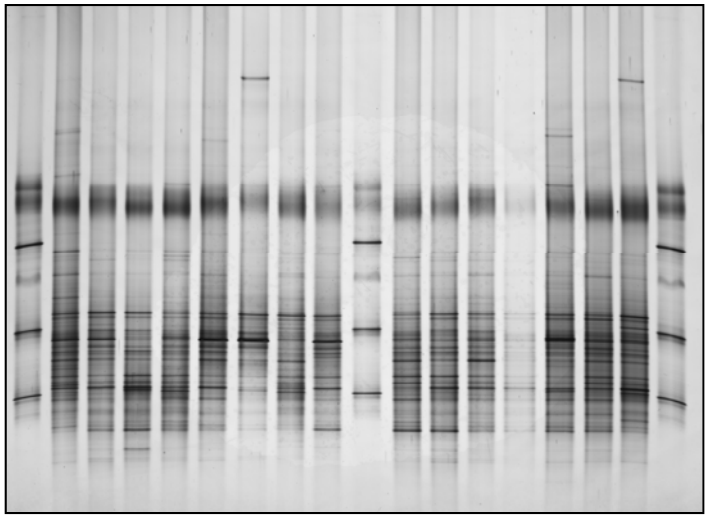
- Bt radiata pine in Chile: in development
- USA: GE pine, poplar, eucalypts, at stage of commercialisation
- Brasil: Cold tolerant eucalypts expected within next years

Scion's history with GE pine

- **1992:** Genetic modification technology developed for pine
- **1996:** small trial with GE pine in Rotorua, approval granted by IAG
- **2000:** Approval for a 1 ha, 20 years trial with GE pine and spruce: ongoing
  - Expression stability
  - Environmental safety
- **2010:** Application for a new trial with GE pine

Impact of GE pines on soil microbes



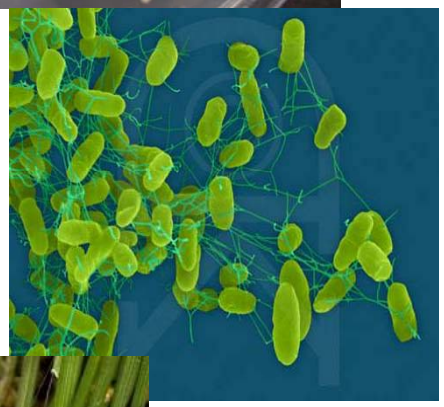


Jana Lottmann, AgResearch

Understanding diversity in GE pine field trial

GE pines in field trial: Results

- Introduced genes are stably expressed over 8 years
- GE pine have no negative effect on rhizosphere microbe populations
- The insect biodiversity in our GE pine field trial is unaffected



New field test application (ERMA)

- Traits proposed:
  - increased wood stability
  - improved utilisation of woody biomass
  - improved tree growth
  - controlled reproduction

- Containment:
  - Physical
  - Controls
  - No development of pollen or seed

- Process;
  - Public submissions closed
  - Public Hearing in Rotorua
  - Authority decision

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Questions / Discussion