

The Genetic Engineering Industry: impacts and regulation

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Introduction

What Is genetic engineering?

-the use of recombinant DNA technique to insert
genes from one organism to another
e.g. from bacteria, plant, or animal to a crop

Other terms used:

GM: Genetically modified

GMO: GM organism

LMO: living modified organism

Pleiotropy: the bane of GE - the unintended

- In theory, a gene in one organism when inserted into another does the same function in the new organism
- But in GE work, we always hear of pleiotropy: unintended consequences - what is intended may not be the same as what actually happens with the gene insertion
- E.g. a gene that produces a bright red colour inserted into a plant with pale red flowers loses the redness altogether: scientists learn of 'gene silencing'

...pleiotropy

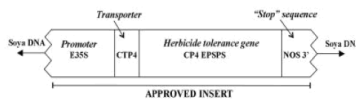
- Some reasons for the unintended consequences:
- Genes are inserted at random into the genome of the target crop:
 - some inserted within the crop's gene
 - some near the crop's gene
- The placement of the inserted gene can affect the working of the crop's genome

...pleiotropy

- GE technique supposed to be precise and predictable: transfer of a gene that does work A in organism X does the same work A in organism Y
- But not so:
- More genetic material than intended was actually transferred. e.g. Monsanto's Roundup Ready Soya. [Windels et al. 2001]

More than intended..

a) Approved DNA insert as described by Monsanto in their original EU application for marketing (from Monsanto, 2000)⁷. The function of each individual component of the insert is stated in italics.



b) Unapproved, multiple DNA inserts and unidentified DNA as now revealed (unapproved DNA is shaded). Two additional, unapproved inserts are present: a 250 base pair (bp) fragment of CP4 EPSPS attached to the main insert and a separate 72 bp insert of CP4 EPSPS (Monsanto, 2000)⁷. Adjacent to the unapproved 250 bp insert is the newly discovered (Windels et al. 2001)⁵ 534 bp of unidentified, unapproved DNA.

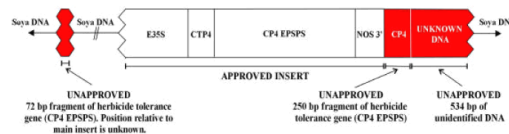


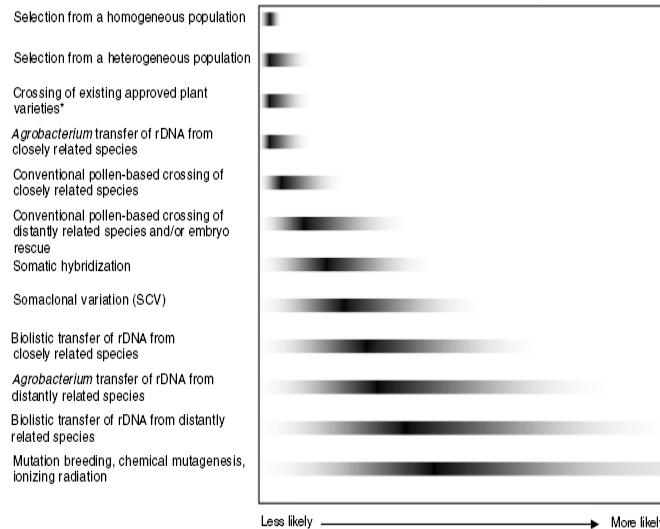
Figure. Schematic of the DNA inserts in Monsanto's Roundup Ready soya. Abbreviations: bp - base pair, used to indicate the length of the DNA fragments⁷; E35S - cauliflower mosaic virus promoter; CTP4 - chloroplast transit peptide sequence from petunia; CP4 EPSPS - herbicide tolerance gene from *Agrobacterium sp.*, strain CP4; NOS 3' - nontranslated region of nopaline synthase gene. For footnotes see main text.

...unintended consequences

- Monsanto didn't know that the extra bits were there
- & didn't know what they may or may not do
- These extra bits inserted may also account for the unintended consequences (apart from the effect of the random gene insertion).

Likelihood of a technique to produce unintended consequences

["Safety of Genetically Engineered Foods". National Research Council, USA. 2004]



Health unintended consequences, some examples

- rats fed Monsanto's HT maize NK603:
- 67 significant differences against those on normal diet.
- E.g. weight differences in heart, liver, brain & body weight. [Seralini et al 2007a]

...Health unintended consequences

- Rats fed on Monsanto's GE maize, MON683: causes hepatorenal toxicity & different weight responses by males and females,
- 3.3% decrease in weight for males,
- 3.7% increase for females
- Seralini et al. 2007b conclude: "with the present data it cannot be concluded that GM corn MON863 is a safe product."
- Yet, this maize already approved by EU in 2005 - based on a Monsanto study.

Professional Bodies are concerned

- Royal Society of Canada's, *Expert Panel on Food Biotechnology (2001)*, recommends that babies in the first six month not be exposed to any food that contains GE products.
- The panel is especially concerned that babies may get allergic reaction from these products.
- British Medical Association, *The impact of genetic modification on agriculture, food and health*, May 1999, called for a moratorium on the planting of GM crops in Britain.

Professional Bodies are concerned

- American Academy of Environmental Medicine (AAEM), 6/5/2009:
- “because GM foods pose a serious health risk in the areas of toxicology, allergy and immune function, reproductive health, and metabolic, physiologic and genetic health and are without benefit”...calls for
- “For a moratorium on GM food, implementation of immediate long term independent safety testing, and labeling of GM foods”

Professional Bodies are concerned

- The Lancet (medical journal) editorial, 2002,
"Health concerns include:
allergenicity; gene transfer, especially of antibiotic-resistant genes, from GM foods to cells or bacteria in the gastrointestinal tract; and 'outcrossing', or the movement of genes from GM plants into conventional crops, posing indirect threats to food safety and security"

U.S. Lacks GE Food Safety Regulation

- Not much GE food safety regulation required by US authorities
- Not much safety tests required
- Much regulation based on the concepts of
 1. "substantial equivalence" between GE-based food and conventional food &
 2. "Generally Regarded As Safe", GRAS
- Both concepts not accepted in Europe, Japan, etc

Why US lacks GE food/crop regulation?

- Too cosy a relationship between GE industry and US Govt (i.e., industry lobby)
- Much industry money go to political parties, both Democrats and Republican
- “Revolving door” between industry and Govt leads to appointment of industry officials to Govt and its regulatory bodies (and back to industry)

..US lacks GE regulation

- President Clinton (1993 – 2001), the formative years of GE crops coming into commercial planting was under his administration.
- was very friendly with the GE industry and heavily promoted GE foods.

GE industry influence at its peak in George W. Bush's administration

- Secretary of Agriculture, [Ann Veneman](#), of Monsanto. USDA (dept of agri) that drew up agriculture policies including those of GE crops was under her. After her term, went back to Monsanto.
- Linda J. Fisher, ex-Monsanto official, nominated by Bush to be second-in-command at the Environmental Protection Agency (EPA).
- [Donald Rumsfeld](#), the defence secretary, was president of Searle Pharmaceuticals when it was bought by Monsanto.
- -[John Ashcroft](#), attorney general, who received \$10,000 from Monsanto for the elections, the most the company gave to any congressional candidate

Industry influence prevents research

- Unlike other crops/foods, researchers can't just obtain a GE product/food and do test
- Must first obtain permission from a GE supplier for seed/product (Monsanto, Syngenta, etc) to do any research either on crop, or its products
- Even if initially agree to research it may be discontinued (especially if negative results appear mid-way)
- Can't just go to a farmer ask for GE seeds and start research or even do research in his field

“ Crop Scientists Say Biotechnology Seed Companies Are Thwarting Research “ NYT 19/2/09

- 26 US scientists wrote to EPA complaining they can't do independent research on GE crops.
- “No truly independent research can be legally conducted on many critical questions”
- Dr. Shields of Cornell: financing for agricultural research shifted from public to the private sector. That makes many scientists at universities dependent on financing or technical cooperation from the big GE seed companies.
- “People are afraid of being blacklisted...If your sole job is to work on corn insects and you need the latest corn varieties and the companies decide not to give it to you, you can't do your job.”
- No independent research for Regulators:
depend totally on industry supplied data for GE approval (of course they give only the good data)

Academics funded by biotech industry

- Because Govt funding for research is limited academics depend on industry funding.
- Funding => research => publish papers => promotion
- Rule: You don't say nasty things about GE products if you depend on their money (and if you want more of the same)
- => Industry-funded biotech researchers say only nice things about GE
- & all their training, PhD etc, is in biotech/GE & all their friends are in biotech. Again, you don't say bad things about GE

Conclusion

- GMOs have shown to have negative impacts on environment and health
- But GMOs safety regulation is much to be desired
- There must be independent research to determine its safety
- With GMO safety in doubt and with little independent assessment of the safety, and with lax regulation, there must be a moratorium on the release of GMOs into the environment.
- And there must be labeling for GMOs especially in food

Thank You