Florence Nightingale School of Nursing & Midwifery

Can we really trust genetically modified foods?

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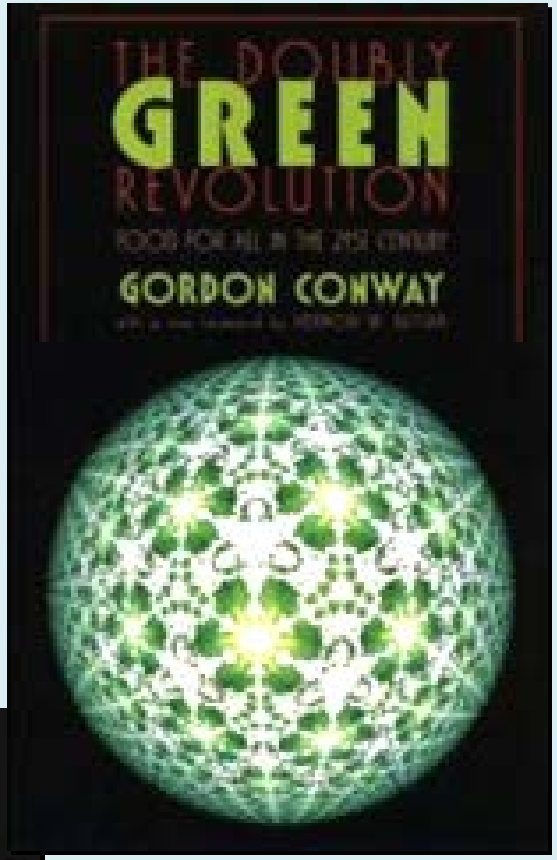
Miracle foods for a hungry world....



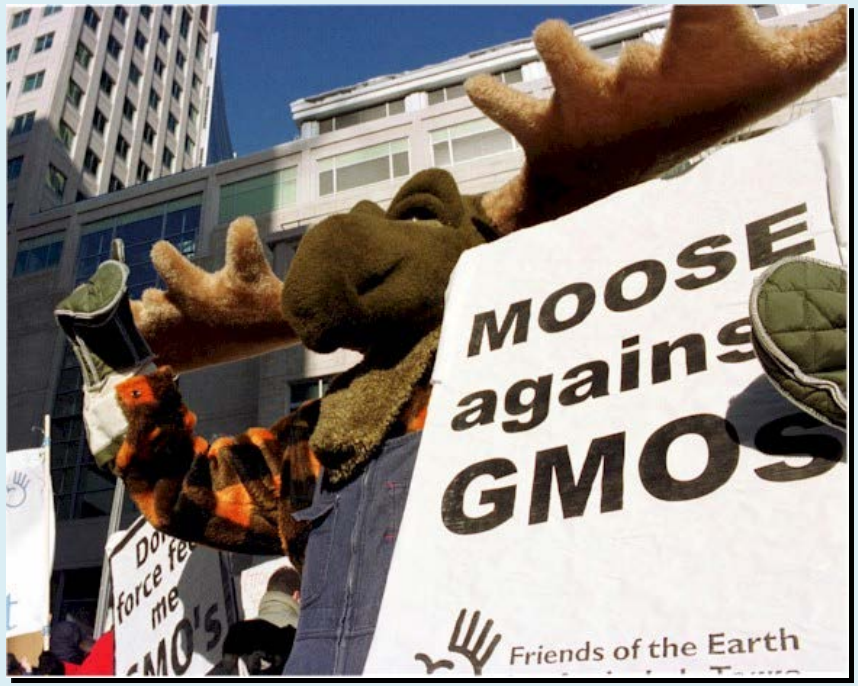
http://scope.educ.washington.edu/gmfood/

.....or a public menace?

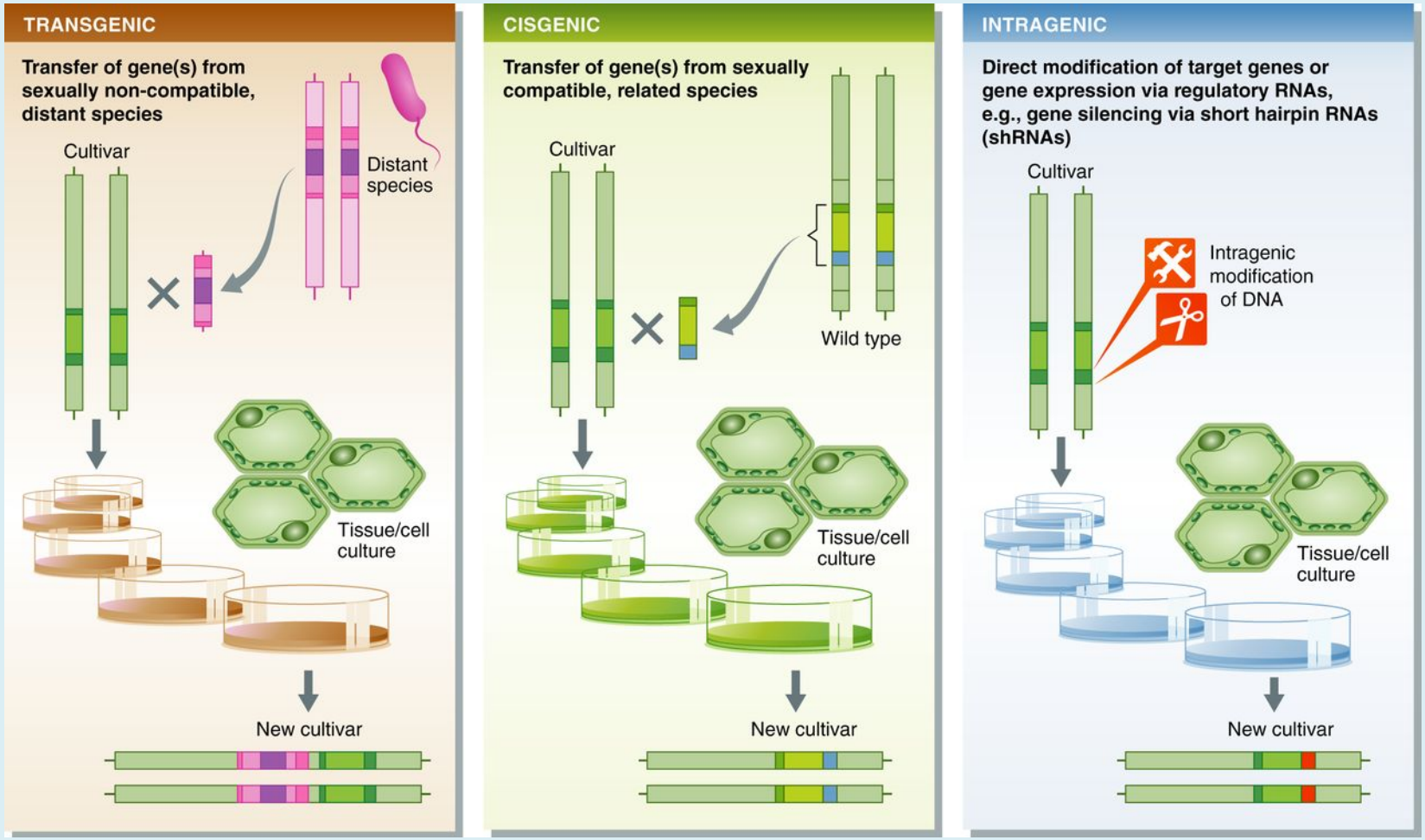
i.cnn.net/.../10/biotech.us.europe/story.gm.jpg

http://www.newint.org/issue320/Images/tradepic.jpg

http://www.foeeurope.org/press/eric01.jpg

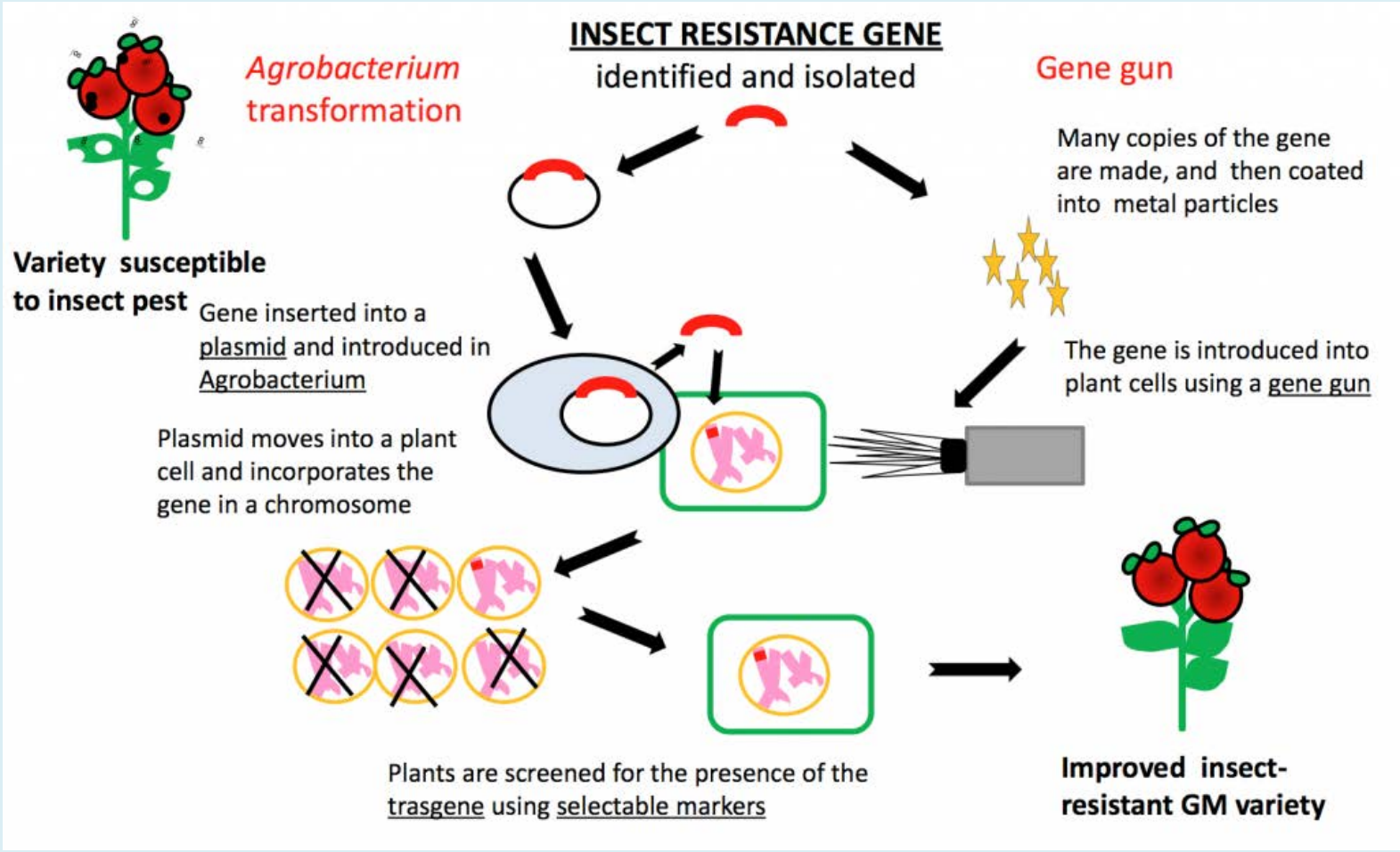


Transgenic, cisgenic and intragenic genetic modification of crop plants.



Hunter P EMBO Rep. 2014;15:138-141

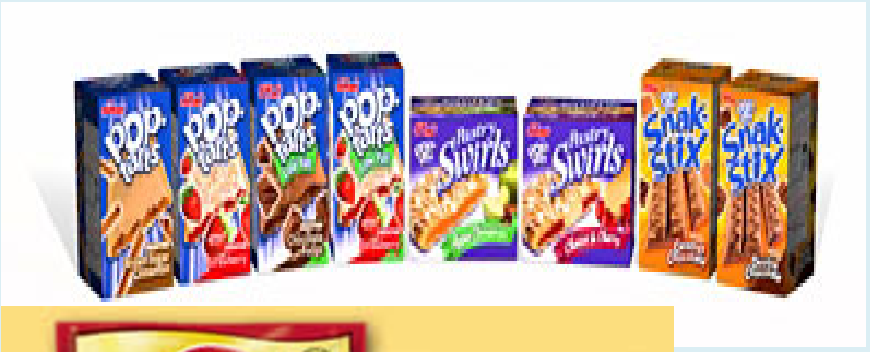
In practical terms..



Flavr Savr Tomatoes

This was the first “genetically modified” food approved by the FDA in 1994. It was eventually pulled off the market in 1997 because of the controversy surrounding it. Questions arose about it’s effects on human health, the environment, potential gene transfer, and the creation of “Frankenfood”.

Examples of GM foods



How do we know what we are eating?

ELSEWHERE IN THE WORLD

EU If a food contains GMOs or ingredients produced from GMOs, this must be labelled. It covers all GM food and animal feed, regardless of the presence of any GM material in final product. Threshold for accidental presence of GM material in non-GM food is 0.9%

AUSTRALIA GM foods, ingredients and additives containing novel DNA or protein must be labelled as 'genetically modified' next to the name of the food. Labelling is also required when genetic modification results in an altered characteristic in a food

JAPAN Thirty foods including soy and corn-based products like tofu and soymilk are subjected to mandatory GM labelling. If the GM content of these foods exceeds 5%, they must carry tag 'GM Ingredients Used' or 'GM Ingredient Not Segregated'

U.S. FDA doesn't require labelling of GM food, but advocates of labelling have been fighting for it

GM foods “gained ground” in the food industry Adejumo & Nwaige (2013) & Kramkowska et al 2013

Food	“Health” benefit
Potatoes	Modified with cholera antibody vaccine
Corn	Sweetcorn modified with insect killing gene..
“Golden Rice”	Enriched beta carotene to fight vitamin A deficiency/alleviate blindness in developing countries Higher bioavailability of iron
Soybean	Resistance to herbicides
Milk (cow, sheep and goat)	Modified Casein Lower lactulose content (allergy..)
Tangelo (Pending..) Polish group developing a “GM salad” containing vaccine against Hepatitis B.. (Cichocki et al (2006..)	Boosts fibre intake and increases vitamin C Not enough evidence for general use.

The “ethics” of GM foods are a major public concern..

Negative Aspects of GM foods (Kramkowska et al 2013)

GM Food	Negative Results of transgenesis
Soybeans (enriched with methionine from a brazil nut)	Increased risk of food allergy
Star Link Maize	Increased risk of food allergy
Milk from GM cows	Increase in Insulin Growth Factor1 Ve+ correlation with Ca breast, lung and colon
Potato (with lectin)	Immunity handicap, incorrect mitosis of cells and tissues..
Maize MON810	“harmful” influence for cells in; pancreas, kidney and liver BUT.. In rodents.

GM foods main issues of concern (WHO 2014)

- Tendencies to provoke allergic reaction (allergenicity),
- Gene transfer
- Outcrossing

Soya Bean Brazil Nut fiasco..

- 1996 Pioneer Hi-Bred, which introduced genes from Brazil nuts into soybeans to increase the level of sulphur-rich amino acids.
- The soya was intended for animal feed, not human food.
- Brazil nut gene spliced into soybean gene could produce fatal allergy ranging from mild wheezing/allergy to anaphylaxis (Leighton-Jones 1999)
- The point that is usually not emphasised in coverage of this case is that the problem was identified because safety checks were, and continue to be, in place to identify the unintended introduction of an allergen into a genetically modified crop

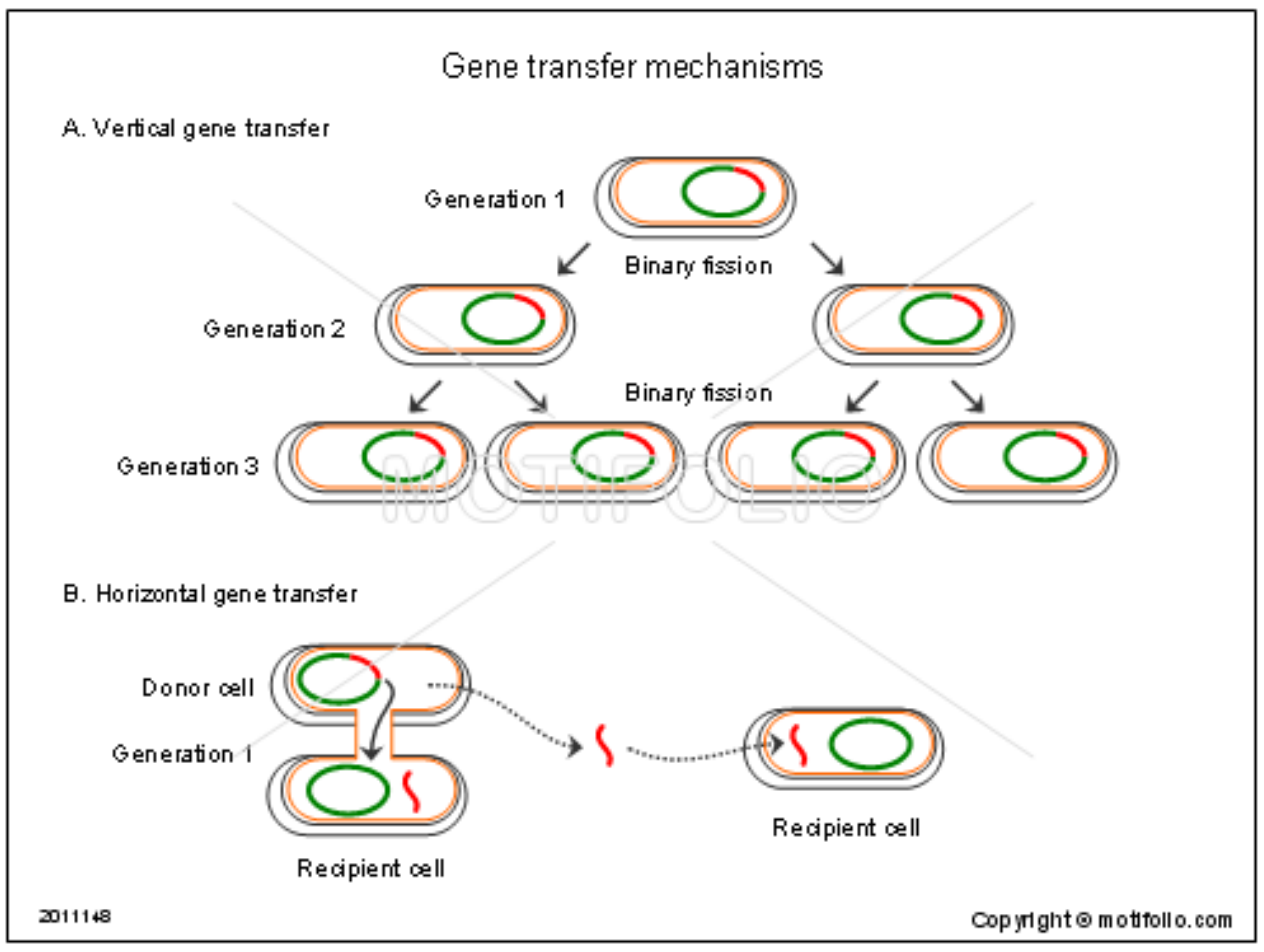
Starlink or “taco gate”

- Increased interest in allergy unfavourable effects found in GMO maize identified in tacos
- Additional gene from *bacillus thuringiensis* -> production of Cry9c protein causing strong allergenicity issues
- Mass media “sensationalization” -> increased reports of “allergy” symptoms including headache, nausea and vomiting and diarrhoea ?? Due to consumption of GM maize.. (Dona et al 2009)

Current Advice on allergenicity

- As a matter of principle, the transfer of genes from commonly allergenic foods is discouraged unless it can be demonstrated that the protein product of the transferred gene is not allergenic (WHO 2014)
- To date: No allergic effects have been found relative to GM foods currently on the market.
- The risks from increased allergen expression are minimal as the risk management strategy for food allergy is for allergic individuals to avoid consuming any food containing their allergenic source, regardless of the crop variety (Goodman et al (2013)

Gene Transfer



Potential Health Hazards GM Crops

Effects on biogeochemistry	Ve- influence of soil decomposition -> changes in nitrogen and carbon recycling..
Increased persistence on the environment and invasiveness	Potential -> ecological fit advantage to the GM crop -> persistence and invasiveness of “super weeds”?
Transfer of genetic material	Risk of cross pollination to other crops or weeds which may or may not be a hazard depending on genetic trait transferred
Instability of genetic modification	Potential to down regulate naturally occurring hazardous trait
Unintended effects	Potential influence of other genes in the organisms -> unexpected hazards
Antibiotic resistance	Increased risk of human and animal diseases

Common concerns with HGT from GMO sources myth??

- However HGT cited as potential risk to human health BUT.. HGT NOT an adverse “effect” but an event that MAY or MAY NOT lead to “harm” (Keese 2008).
- WHO (2014) argues that HGT from GM foods to bacteria in the GI tract would cause concern if for example antibiotic resistance genes were to be transferred
- Latest evidence suggests that most HGT events are not expected to alter the likelihood of host survival to such an extreme extent, and will confer only minor changes in host fitness (Nielsen et al 2014)
- Recent FAO/WHO expert panel encourages gene transfer without ARG
- Important to note. What is risk? Very subjective term depends on value judgements as to what constitutes “harm” and severity of harm..(Keese 2008).

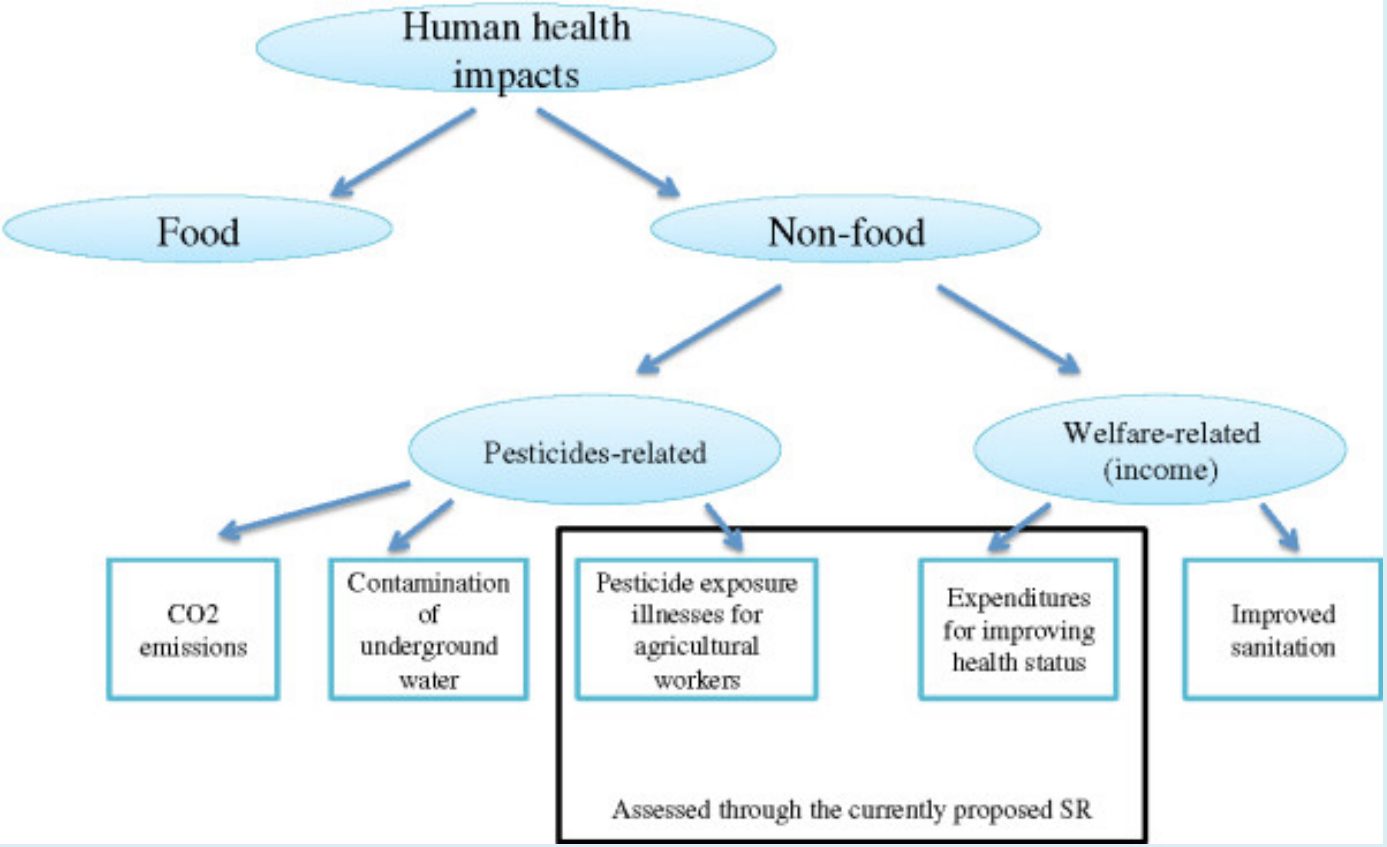
Genetically modified (GM) maize causes serious disease in rats?? Seralini et al (2012)

The study found that rats fed for two years with Monsanto's glyphosate-resistant NK603 maize (corn) developed many more tumours and died earlier than controls. It also found that the rats developed tumours when glyphosate (Roundup), the herbicide used with GM maize, was added to their *drin*king water

Paper withdrawn..

- Authors showed “no evidence of fraud or intentional misrepresentation of the data..
- However.. the small number and type of animals used in the study mean that “no definitive conclusions can be reached”.
- The known high incidence of tumours in the Sprague–Dawley strain of rat ”cannot be excluded as the cause of the higher mortality and incidence observed in the treated groups

The future..Racovita et al (2014)



Questions..

- Does the cultivation of GM crops result in a lower number of pesticide poisoning?
- Does cultivation of GM crops allow for higher financial resources to be used by farmers to improve their lives and their family's health status? (work in progress..)

Current US Views on GM safety (FDA 2014)

- While FDA regulates foods and ingredients, including foods made from GE plants, the agency neither supports GE plants based on their perceived benefits nor opposes them based on their perceived risks.
- However, FDA recognizes that there are diverse views among food manufacturers, the agricultural industry and the public.
- The foods evaluated through the consultation process have not been more likely to cause an allergic or toxic reaction than foods from traditionally bred plants

Conclusion

- Are GM crops safe/dangerous to human health?
- Sensible question, one of public concern and is up for discussion
- However Martinelli et al (2013) argue this question is “too wide” and unanswerable
- Concentrate on “case by case” evaluation of individual plants

Thank you..

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Thank you for your attention!
Questions and comments are welcome!

References

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