

Seminar on Genetically Modified Coffee  
ICO, London 17<sup>th</sup> May 2005

## Definitions & Key Issues

- relating to GM crops & GM coffee -

PS Baker  
CABI Commodities  
Ascot UK



We don't transfer genes to new organisms,  
but we do transfer organisms to new countries.



## Japanese knotweed

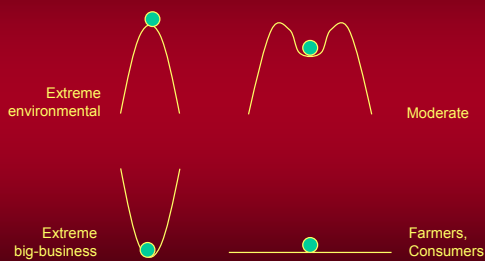


## Japanese knotweed

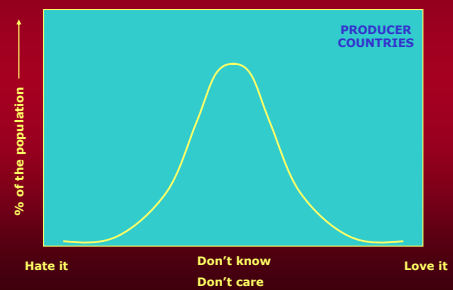


## We meet a wide range of opinions:

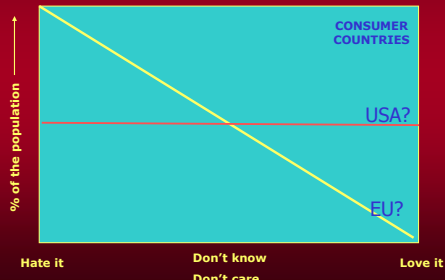
a kinetic model of safety



## How do people see GM? A hypothesis:



## How do people see GM?



## Genetically Modified Foods Eaten Regularly in US

THE ASSOCIATED PRESS March 24, 2005

- Rutgers survey: less than half the people interviewed were aware GM foods are sold in supermarkets. At the same time, many wrongly believed supermarket chicken has been genetically modified.
- "It's just not on the radar screen," said William Hallman, associate director, Food Biotechnology Program, Rutgers Food Policy Institute, which conducted the survey.
- 75% of U.S. processed foods contain some GM ingredients, said Stephanie Childs of the Grocery Manufacturers of America.

## Key messages from UK Govt. sponsored public debate 2004

The report identified 7 key messages:

- 1) People are generally uneasy about GM
- 2) The more people engage in GM issues, the harder their attitudes and more intense their concerns
- 3) There is little support for early commercialisation
- 4) There is widespread mistrust of Government and multi-national companies
- 5) There is a broad desire to know more and for further research to be done
- 6) Developing countries have special interests
- 7) The debate was welcomed and valued

## The issue of perceptions

- Do we need to know more about GM perceptions of coffee stakeholders?
- Do we need to know more about GM knowledge of coffee stakeholders?
- How it changes over time?
- How it varies from country to country?

**Minister to abolish GM scrutiny body**  
The Guardian, December 29, 2004 (UK)  
The environment secretary, Margaret Beckett, is to scrap the Agriculture and Environment Biotechnology Commission after it repeatedly placed obstacles in the way of government plans to introduce GM crops.

**US launches probe into sales of unapproved transgenic corn**  
www.nature.com Published online: 22 March 2005.  
A strain of genetically modified corn that does not have regulatory approval has been distributed by accident over the past four years, Nature has learned.

**Plan to ban genetically modified crops**  
News Limited, March 23, 2004 (Australia)  
Western Australia has become the first state to ban GM crops, declaring it wants to tap consumer sentiment against GM foods.

**Pope hints at thumbs-down for GM food**  
Catholic News, October 18, 2004 (Online)  
In a message for World Food Day, Pope John Paul II stressed the need for biodiversity, suggesting reservations about the production of GM foods. The US Embassy to the Holy See has recently been lobbying the Pontifical Academy of Sciences to secure Vatican endorsement for GM foods.

**Europe split over safety of GM corn**  
Independent, 21 December, 2003 (UK)  
Britain is pressing for a GM sweetcorn to be allowed into shops despite an official French report warning that people eating it could suffer "unforeseen effects".

**The seeds of Indonesia bribery scandal**  
Asia Times Online, January 20, 2005 (Indonesia)  
The Department of Justice and the Securities & Exchange Commission (SEC) charged Monsanto with bribing an Indonesian government official to waive a strict environmental requirement needed to plant the controversial GM cotton seeds in Indonesian soil.

**GM weedkiller use increases**  
Farmers Weekly, October 28, 2004 (UK)  
A new study based on official USDA data on pesticide use reveals that while US pesticide use dropped during the three first years of commercial GM crop cultivation it has increased sharply thereafter.

**UNEP urges caution on transgenics**  
IPS, March 3, 2004 (UN)  
The United Nations Environment Programme warned Wednesday in Mexico that transgenic crops could pose a threat to biodiversity and human health, and

**NAFTA report calls GM grain a threat to Mexico**  
Washington Post, November 10, 2004 (Mexico)

## How do you see it?

- This seminar won't solve any problems
- But it is an opportunity to examine the way you see things
- Your own mental map of the way the coffee world works
- A chance to update it?

## The GM debate

it is very complex

- Health issues
- Ecological issues
- Social/ethical issues
- Economic issues
- Trade issues
- Political issues
- Time issues

## Potential health issues

### General:

- Novel genes might produce toxic new substances
- Novel genes might themselves enter gut cell walls
- Testing techniques ought to be able to pick up any problems??
- Except allergenic effects because take time to appear?

### Coffee:

- It's roasted first (~250°C) – unlikely to be a health problem
- But: could be a problem in processing

## Ecological issues

### General:

- Gene pollution: pollen escapes to wild coffees and even related species
- E.g. wild Mexican maize varieties now contaminated with GM genes

### Coffee:

- Close relatives to *Coffea* in Africa only

## Ecological issues - case by case

### General:

- Herbicide tolerance: now good evidence from UK studies that GM oil seed rape supports less wildlife than conventional rape variety
- Mixed claims about amounts herbicide used – have they gone up or down?
- But: GM maize is slightly better for wildlife
- Hence increasing calls for a 'case-by-case' approach
- GM companies don't want this, takes longer to commercialise

## Ecological issues: herbicide tolerance is a good one to watch

### General: 41 of 52 m ha worldwide are HT crops

- Increasing evidence of weeds becoming resistant
- The high level of adoption of glyphosate-resistant crops has resulted in reduced investment in herbicide discovery, which may be problematic for addressing future weed-management problems \*
- "The types of concern raised by growers vary from year to year depending on the crop and the environment, but include perceptions of increased sensitivity to diseases, increased fruit abortion, reduced pollination efficiency, increased sensitivity to environmental stress, and differences in yield and agronomic characteristics between transgenic and sister conventional varieties."<sup>\*\*\*</sup>

\* Duke, SO. *Pest Management Science*, March 2005, vol. 61: 211-218

\*\* Pline-Smic, W. Syngenta *Pest Management Science*, March 2005, Vol. 61: 225-234

## Social/ethical issues

- E.g. Mexican maize gene contamination – indigenous people affronted by this, the basis of their civilization polluted by foreigners for profit
- NAFTA watchdog panel study for Commission for Environmental Cooperation (2005) said gene transfers could damage Mexico's vast storehouse of native corn, whose wild ancestral genes might one day be needed to help commercial crops overcome diseases or adverse conditions
- Coffee: this could be a problem for Ethiopia – coffee has a unique coffee culture

## Economic issues

- Most criticisms are that GM products have benefited farmers, consumers have not seen advantage
- In US & EU any advantage is buried under a mass of subsidies to farmers
- Early adopters favoured: new technology only temporarily benefits first adopters
- Coffee: will those who adopt this technology be able to exact a major advantage, will they be only large farmers? Will they see it as being worth the risk?
- These are not GM-specific issues

## Global trade issues

- WTO/TRIPS legislation suggests that a country won't be able to keep out GM coffee even if it a majority oppose it
- E.g. if a GM coffee comes onto the market
- A company has the right to sell it in any WTO signatory country
- The onus is on producer country to prove it will be harmful
- E.g. Australian raw salmon import ban overruled by WTO

## Is GM a special issue?

**No:** it's not much different from conventional breeding, we can do lots of pre-release tests, it's been out there for 10 years now, yes there are some problems but there are always problems with any new technology

**Yes:** it is materially different, problems will take time to develop, the advantages to humanity look rather small to date

## A special issue?

e.g. the herbicide tolerant debate

- GM oil seed rape harbours less wildlife (UK expts 2004)
- But: natural herbicide resistance exists in rape
- Fields of naturally resistant rape could be grown
- Gene flow from such a field would carry the resistance gene into relatives
- Pollen containing the resistance gene could be detected on organic farms kilometres away
- Reduction in weeds by glyphosate use would reduce insect populations and songbirds
- Thus it's not the GM-ness of rape that is the problem

## Which issue is it part of?

- Many GM issues are part of a bigger debate – lack of trust in big biz and scientists
- Increasing public disquiet:
  - Mad Cow Disease, Bird Flu
  - Food contaminants
  - Factory farming (pollution, aesthetical, etc.)
  - Declining healthy nutrition of developed countries
- Serious questioning of the direction agriculture and it's control
- Agriculture is part of biz, or part of culture?

## Ironic situations

- GM herbicide tolerance invented to reduce no. of applications, & reduce soil tilling (less soil erosion) – i.e. environmentally friendly
- But now blamed for reducing wildlife, increasing weed resistance & more pollution
- How will this turn out - a test case for agribiz?
- Will GM biz take this on board?
- Or just see it as a public relations hurdle?
- Will the problem go away eventually?
- Or is it part of a still bigger problem?

## Global misgivings

- Increasing public debate about the future
- Especially regarding global warming
- Gives rise to disquiet about science and technology – likely to increase in the future?
- To look at the future of the GM debate you need to consider fundamental issues

## GM meets the sustainability debate

- How does GM relate to sustainability?
- GM will need to be relevant to this debate
- Especially for sustainable coffee projects because they are high profile
- Sustainability looks at things in three ways: economic, social and environmental
- In order to be sustainable, any GM coffee should make things better on at least one sustainable axis, without making things worse on another

## E.g. the environmental balance sheet

Variety	Environmental advantage	Environmental disadvantage
GM decaf	• Less energy consumed	• Removes natural product (caffeine)
GM leafminer resistant ( <i>Bt</i> )	• Less pesticides • Less pollution	• Ignores ecological imbalance
GM reduced alpha-D-galactosidase	• Less area in coffee needed	• ?
GM herbicide tolerant	• Less soil erosion • Less herbicide	• More herbicide • Weed resistance

## US Patent Appl. 20040199943

Coffee plant with reduced alpha-D-galactosidase activity

- "The present invention relates to the modification of galactomannans present in the green coffee bean by reducing the endogenous level of .alpha.-D-galactosidase activity. In particular, the present invention pertains to a plant cell with reduced .alpha.-D-galactosidase activity and to a plant harboring such a plant cell."

Inventors: Marraccini, Pierre; (Londrina, BR); Edmond Deshayes, Alain Francois Paul; (Saint Cyr sur Loire, FR); Rogers, William John; (St-Jean-de-Gonville, FR) October 2004

## Why herbicide tolerant coffee?

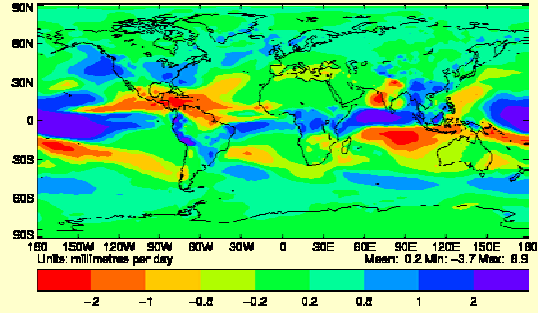


## Time: a major issue

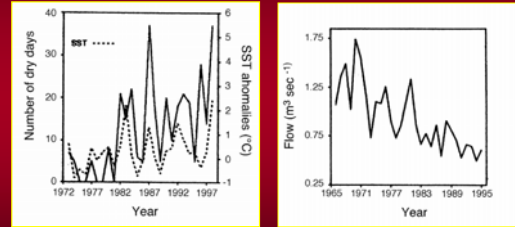
- Plant breeding is long-term
- Especially coffee
- Takes 20+ years to develop a new variety
- GE can shorten this but any perennial takes time
- New coffee variety will have to last 25 years
- A winner will have to meet the needs of the future
- So what will the world be like in 2035?

## The world in 2035

Changes in annual average precipitation from 1980-1990 to 2070-2100 from HadCM2. IS92a

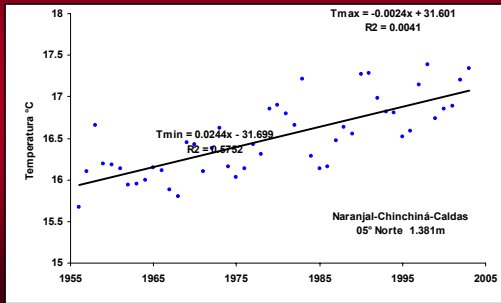


## Already happening: warmer & drier in many places e.g. N Costa Rica



Trends for (a) sea surface temperature anomalies and number of rainless days, and (b) minimum streamflows in northern Costa Rica since the 1970s (adapted from Pounds et al., 1999)

## Warmer & drier in many places e.g. Colombia



Data from: Eduardo Delgado Assad, Hilton Silveira Pinto, Jurandir Zullo Junior e Ana Maria Helminsk Ávila, Empresa Informática Agropecuária, Universidade Estadual de Campinas (Nov 2004)

## Arabica in Estado de Goiás Now you see it ...

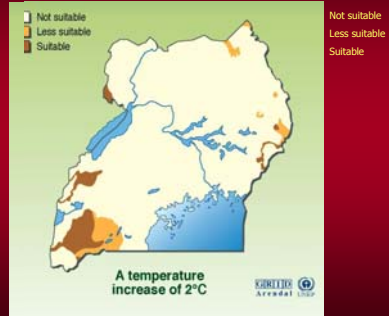


Data from: Eduardo Delgado Assad, Hilton Silveira Pinto, Jurandir Zullo Junior e Ana Maria Helminsk Ávila, Empresa Informática Agropecuária, Universidade Estadual de Campinas (Nov 2004)

## Now you don't



## UNEP projection: Robusta in Uganda





## Long term issues

- The future may be quite unlike the present
- There's a shortage of coffee genes to breed with (outside Ethiopia)
- New threats/challenges will increase temptation to look outside the coffee genome
- The very few coffee varieties in use attests to the difficulties of producing new varieties

## Issue: the potential for GM to divide

- Small country issues:
  - 'we can't afford to develop it ourselves'
  - 'hard to differentiate it, keep it separate from our gourmet coffees'
  - 'we can't afford to risk our image' \*
- Big countries:
  - GM programme is feasible 'we have the capability'
  - 'Can we afford not to do this?'
- Big companies:
  - Will support large countries' GM programmes?
  - Or carry on with 'wait & see'?

\* ['Even if they made a coffee tree that bore 40lb of cherry, needed no fertilizer or water, and had beans that jumped off the tree into the picking basket, it would not be Kona coffee with its 175 year heritage ...'] Christine Sheppard, Pres. Kona Coffee Council.]

## GM coffee development issues

- Very few countries will be able to sustain the effort of a long programme
- Coffee research budget: Brazil +\$US 10 million/yr; Colombia +\$US 5 million/yr
- Few others have a significant budget
- Research institutes already short of funds
- Elite research programmes like GM can cause stinting on traditional research

## What will they produce?

Something for the future:

- GM coffee delayed ripening
  - Towards mechanical harvesting
  - Huge potential quality improvement by unlocking fruit and seed development rates
  - High quality even at low altitudes
  - Specialty quality in bulk
- GM drought-tolerant coffee
  - Climate is changing
  - Can't afford not to try it
  - E.g. US Patent Appl 20050097640 Monsanto
- GM disease resistance
  - Not enough available coffee resistant genes

## How will it happen?

- These will be worked on over the next few years
- They won't be introduced soon
- They will be introduced first in Brasil
- Introduction will follow some specific event e.g. major drought event
- They will say: "we have no choice"

## Side issues

- BST milk: US cows injected with hormone produced by GM bacteria
  - Common in the US, banned in EU
  - US is trying to overturn ban
  - If successful, expect a fuss which affects coffee
- GM experiments on other organisms to control coffee pests\*

\* Góngora B., C. E. (2004) Transformación de Beauveria bassiana cepa Bb9112 con los genes de la proteína verde fluorescente y la proteasa pr1A de Metarhizium anisopliae. Revista Colombiana de Entomología, 30: 15-21.

## The general that loses is the one who is fighting the previous battle

- Challenge for GM coffee is to come up with something that will help fight the battles ahead
- That responds to an urgent need
- That convinces farmers to take the risk
- Drought resistance, disease resistance or delayed ripening are the most likely?
- Will consumers accept it?
- If it's cheap and good quality, they probably will