Science and Society Aspects of the GM-Crop Debate

Utrecht, 15th April 2015

Prof. Em. Marc Van Montagu
Chairman, IPBO; President EFB; President PRRI

Institute of Plant Biotechnology Outreach
http://www.ipbo.vib-ugent.be
http://www.psb.ugent.be
http://www.efb-central.org
http://www.prri.net

E-mail: marc.vanmontagu@vib-ugent.be

Projected population growth, 2010-2100

Note: The boundaries on this map do not imply official endorsement or acceptance by the United Nations.

• Can science feed the world? Can science mitigate global pollution?
• If ideology does not kill technology, it must be possible to empower Africa with the necessary innovative technology and alleviate poverty.
• Asia and Latin America do already very well.

www.notimetolose-book.com
How to study science and how to study society?

Private and public life
Science & Technology
Corporate capitalism
Bureaucracy
Morality
Culture
Biotech crop history

1904, *Agrobacterium tumefaciens*

1974, Ti Plasmid, Gent

1990’s genomics

1996 Commercial launch

Plants for Knowledge
Trans-generational epigenetic inheritance, phenotypic plasticity and evolutionary implications

‘It [Lamarckism] is not so obviously false as is sometimes made out’

John Maynard Smith (1998)

Epigenetic insights into the molecular bases of heterosis

Chen ZJ Nature Reviews Genetics 14, 471–482 (2013)

After 26 years of field trials and 13 years of regular consumption

NO!

Not a single health incident that could be attributed to GMO has been reported. There is no research evidence that shows consumption of GMOs to be harmful to our health.

NO!

GM crops are not more harmful for the environment than any other crop. On the contrary, there are clear ecological benefits, at least when placed in the whole picture of the role of agricultural systems in maintaining biodiversity.

Utrecht, 15th April 2015
Unnatural?
Lessons from Molecular Evolution

- The living world is one large gene-pool of functional and pseudogenes
- This gene-pool is permanently evolving, this is the base of evolution
- Nature is one big genetic laboratory
- It is very misleading to talk about human gene, pig gene, rat gene etc.

Horizontal Genome Transfer And Evolution

Natural grafting as an asexual path to the formation of new species

Upon grafting—a mechanism of plant–plant interaction that is widespread in nature—entire nuclear genomes can be transferred between plant cells

Fuentes et al, Nature 511 (2014)
Horizontal gene transfer

- common within microorganisms, lower eukaryotes and plants.
- rare within mammals, surely compared to the frequency of transposition of movable elements during mammalian development.
- so what are the scientific arguments for this complex and extremely expensive regulatory framework?

Genome Redesign

- Small interfering RNA and artificial micro-RNA technology
- Synthetic Nucleases

Agribusiness monopoly invented GMOs that cannot be detected
Bt brinjal is estimated to have the capacity to generate a net additional economic benefit of US$200 million per year for around 150,000 small brinjal farmers in Bangladesh.

Bt brinjal reduced the number of insecticide applications by a massive 70-90%.
Plantibodies: Plant-Generated Monoclonal Antibodies

Rapid high-yield expression of full-size IgG antibodies in plants coinfected with noncompeting viral vectors

Giritch A et al. PNAS 2006;103:14701-14706

Icon Genetics GmbH, Germany and Bayer BioScience N.V., Gent, Belgium

Environment of the rhizosphere, community and ecosystem

Plant Genotype
1. Dependency upon mycorrhizal mycorrhiza adequate soil resources.
2. Potential to control mycorrhizal formation to maximize benefits and minimize costs.

Mycorrhiza

Fungal Genotype
1. Potential to acquire and deliver defensive responses to the plant.
2. Potential to overcome plant control of colonization when the plant is maintaining its costs.

Mycorrhizal Phenotype

Holobiont: Why Microbes Matters
Next-generation plant-microbe biology

Sustainable Intensification
To achieve global food security both intensive and subsistence agriculture are necessary

By 2050, food production must increase by 70% and at the same time halve its environmental footprint

- Innovation and technology diffusion are essential
- GM technology and various uses of molecular biology to enhance plant breeding potential are clearly some of our most important tools for achieving sustainable intensification
In a world of 9.5 billion people, global demand for food, fiber, and biofuels has to be met with minimal possible increases in land, water, fossil fuels, and the minerals used to produce fertilizers

PNAS May 21, 2013
Acceptance and Decisions
Beliefs come first, the explanation for the beliefs follows

The difference between true and false patterns
How to avoid cognitive bias pitfalls?

Science Communication
Should society decide on the correctness of scientific findings?

Science versus Information Cocoons and Confirmation Bias
- UFOs and space visitors
- Horoscope
- Ghosts and communication with the dead
Difficulty to accept rational arguments

“Ethical values” and feelings of disgust

Food aversions  Racism  Homophobia  GMOs

“Du judgment qu’on dois faire des accidents futurs”
La logique de Port-Royal (1692)

Two approaches:
Logical: Emphasis on the probability that the anticipated hazard occurs
Precautionary: Consider only the gravity of the hazard (sinistre maximum possible)

The precautionary principle is to abandon to passions – fear – and the images that it engenders
The good moral attitude: do not surrender to the fear of danger but to master it by calculating the probability that it will strike

Utrecht, 15th April 2015
Research on transgenic crops must be done outside industry if it is to fulfil its early promise.

Nature Editorial, May 2013

But the EU puts the developmental costs of GM crops out of reach of small and medium-sized companies.

Price Tag for Introducing GM Plants

Overregulation and unnecessary testing make that:

- no Small or Medium Enterprise
- no developing country

can afford to introduce a GM crop.

Only multinationals can proceed.
21st Century Plants will be GM-Plants

In a Better Environment