

An overview of technical GMO detection challenges: historical overview and future challenges

Marc De Loose

International Workshop of GMO-analysis networking
JRC Ispra (VA) Italy, 8 – 9 April 2013

Institute for Agricultural and Fisheries Research

Technology and Food Science Unit

www.ilvo.vlaanderen.be

Agriculture and Fisheries Policy Area

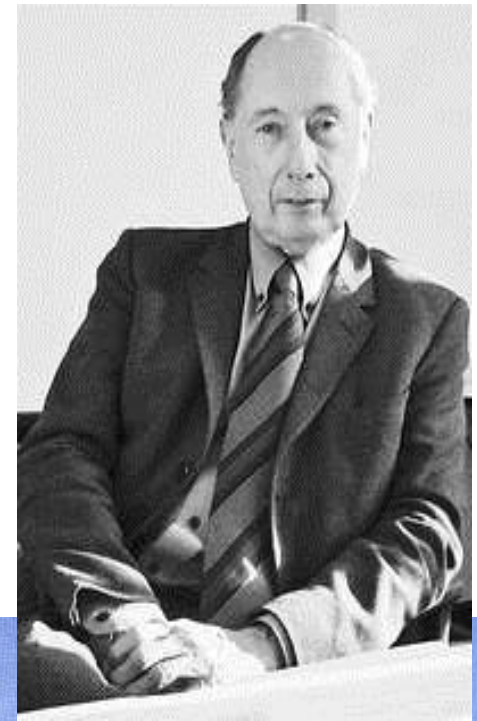
An overview of technical GMO detection challenges

- 30th Anniversary of the first transgenic plant
- GMO detection and the role of research
- Future challenges
- Co-existence: an evaluation in real life



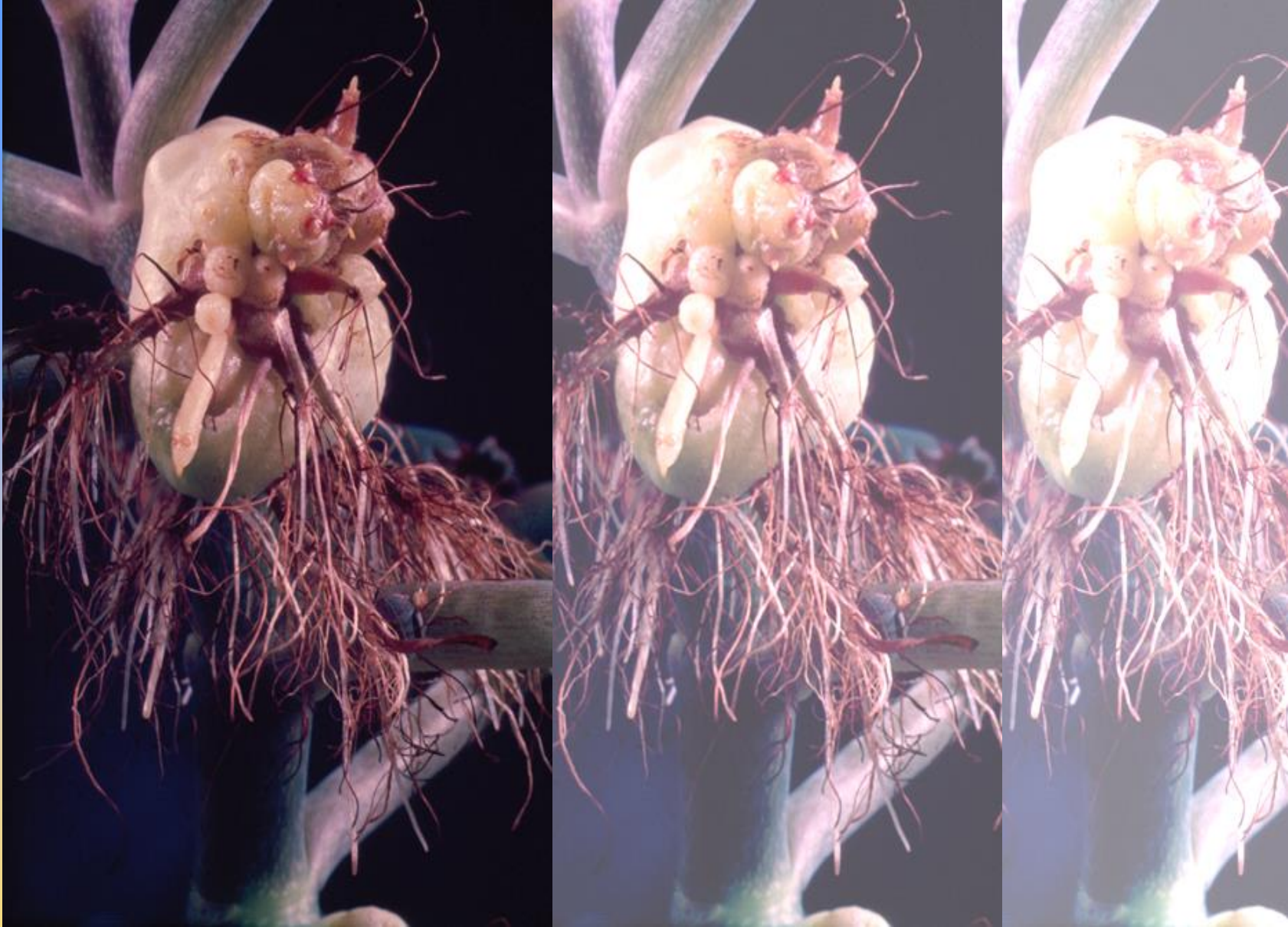
Pioneering Plant Biotechnology in Europe

Monday 22 April 2013
a tribute to Jeff Schell
1935 - 2003



Ledeganck
5th floor





Research question: why is *Agrobacterium tumefaciens* inducing tumors on plants

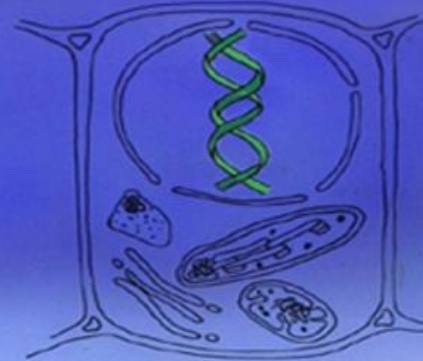
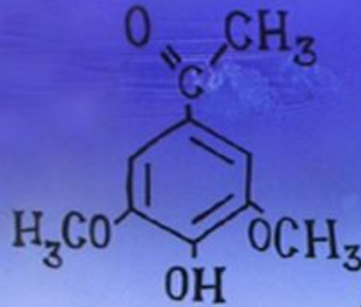
The research groups of Jeff Schell and Marc Van Montagu

↓ : 1978

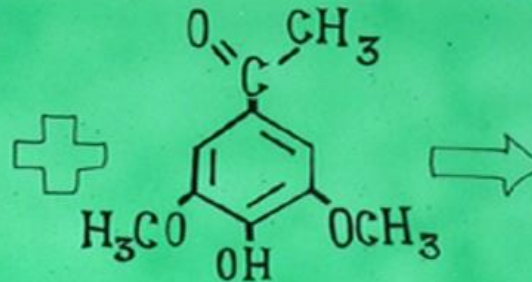


Wounded plant

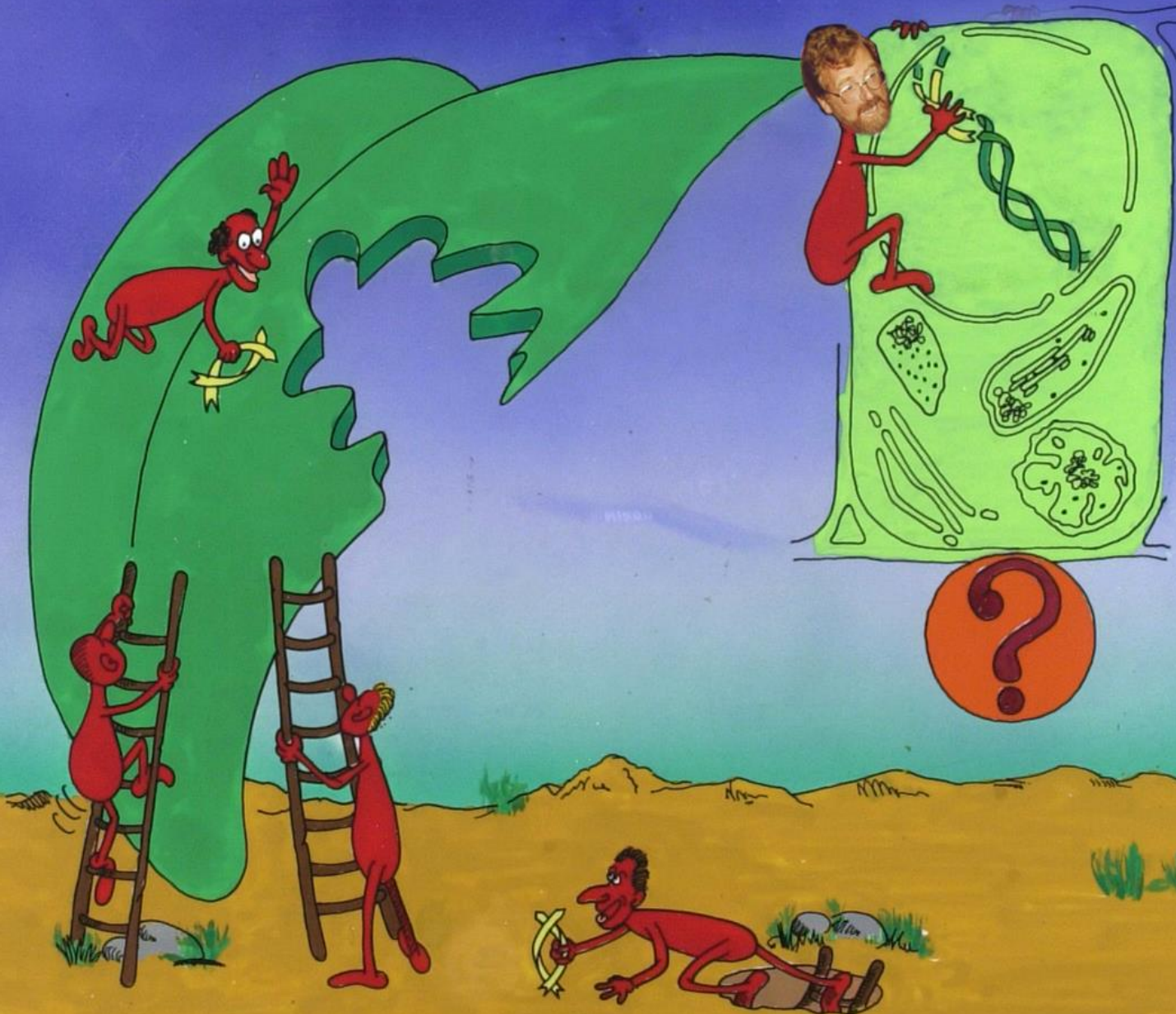
Plantcell



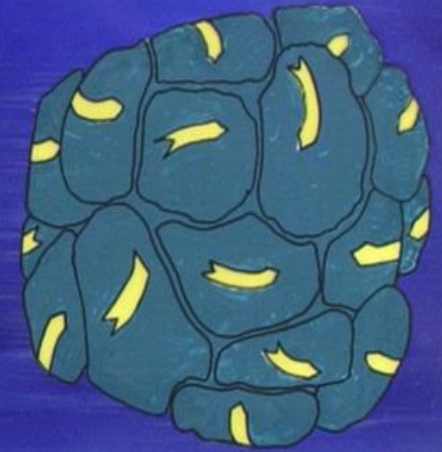
Agrobacterium tumefaciens



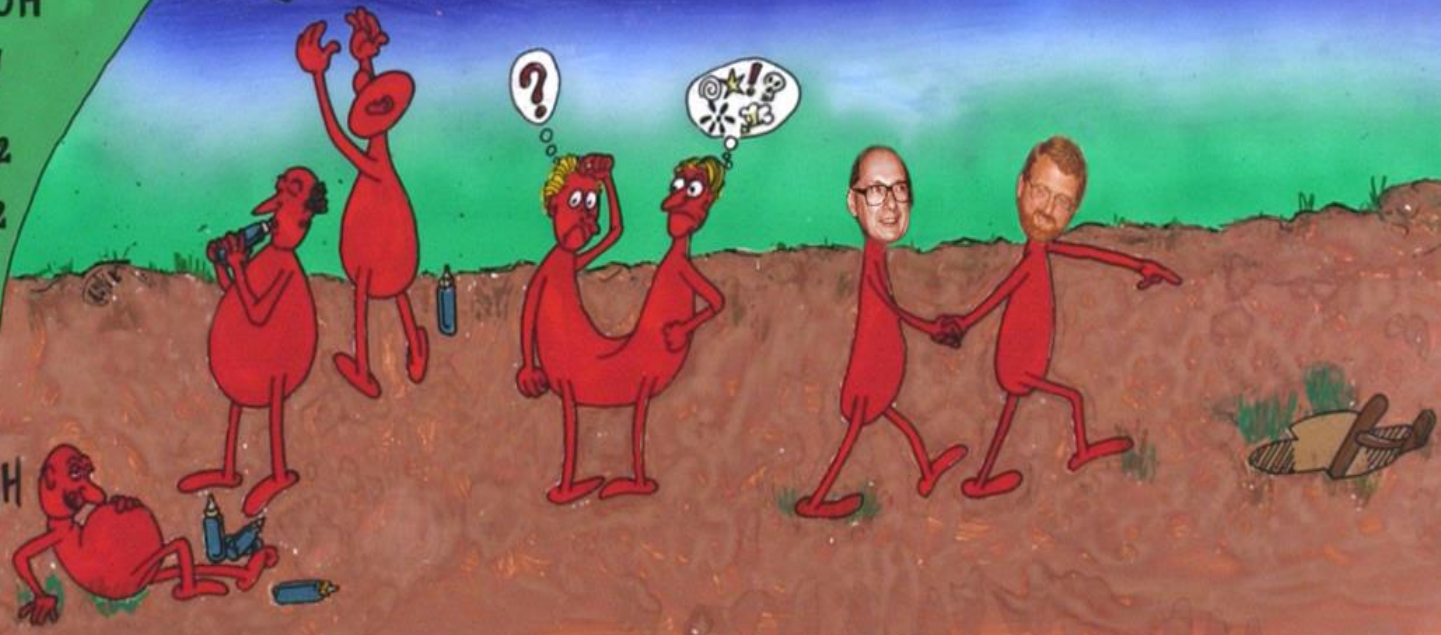
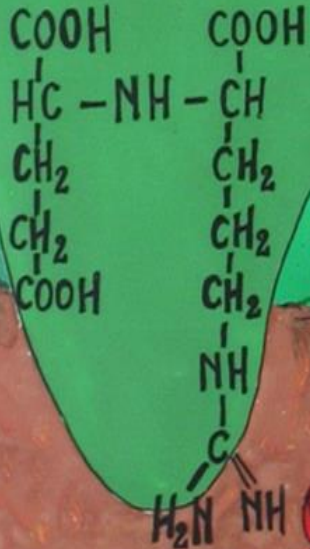
Transfer of DNA into the plant cell



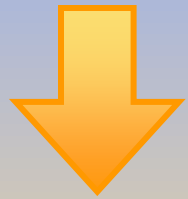
Tumor



NOPALINE

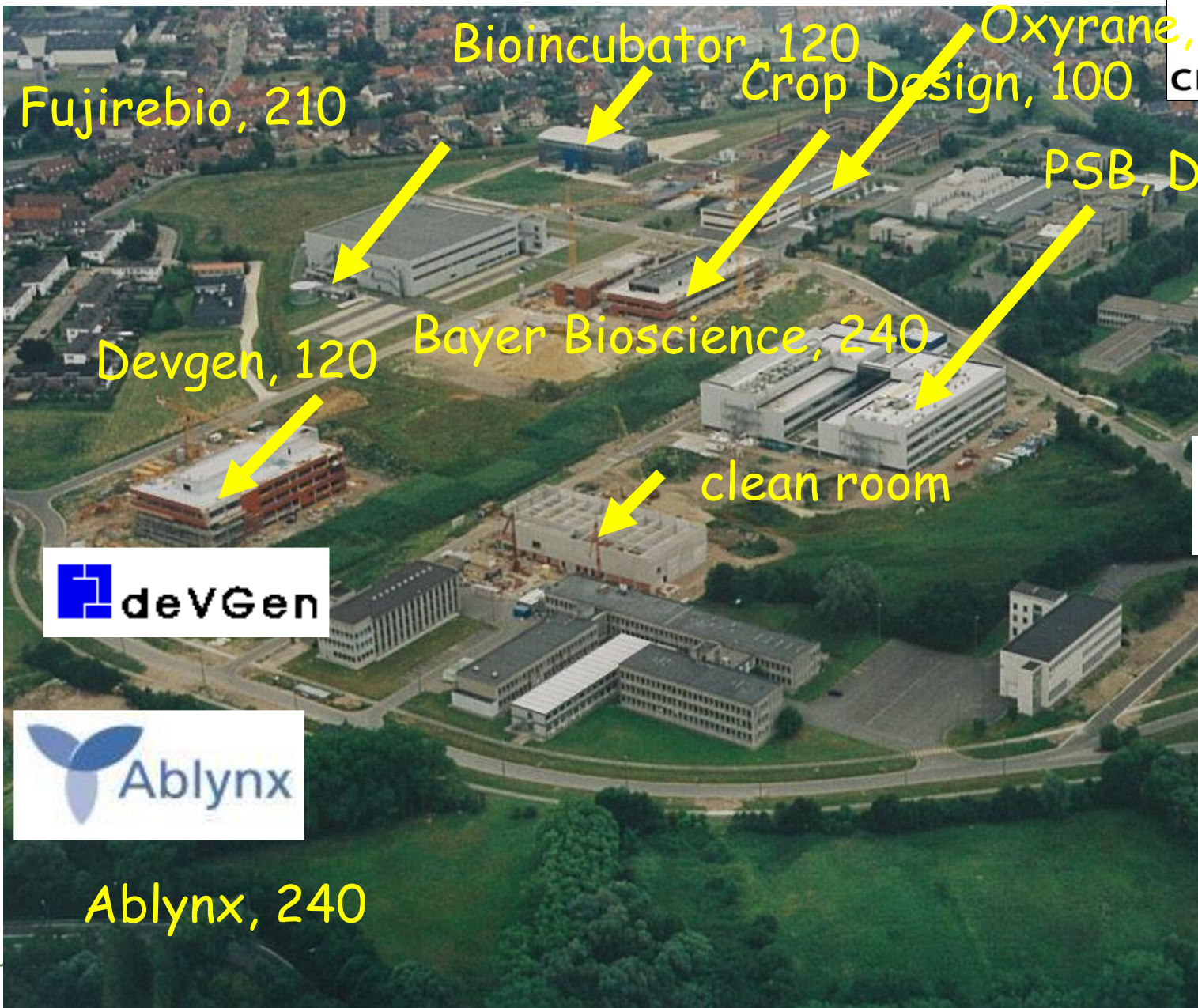


: 1983

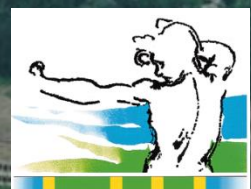


The first genetically modified plants





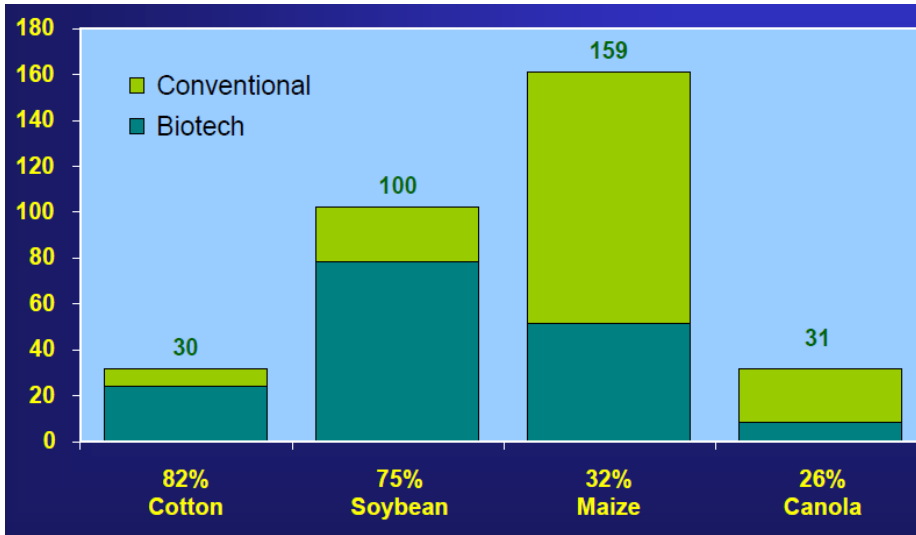
cropdesign



V I B
FLANDERS INTERUNIVERSITY INSTITUTE
FOR BIOTECHNOLOGY



Worldwide cultivation of the main agricultural crops



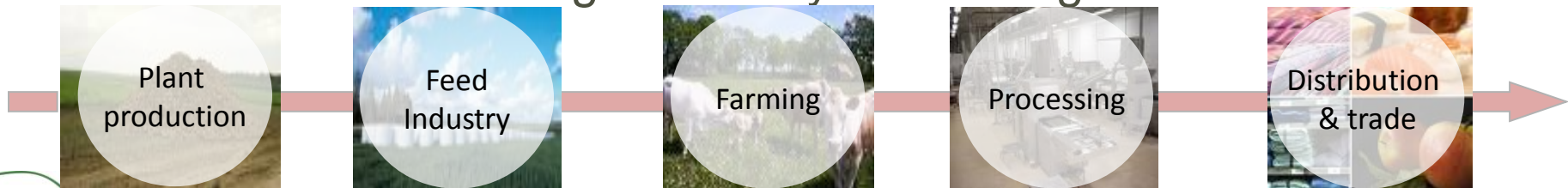
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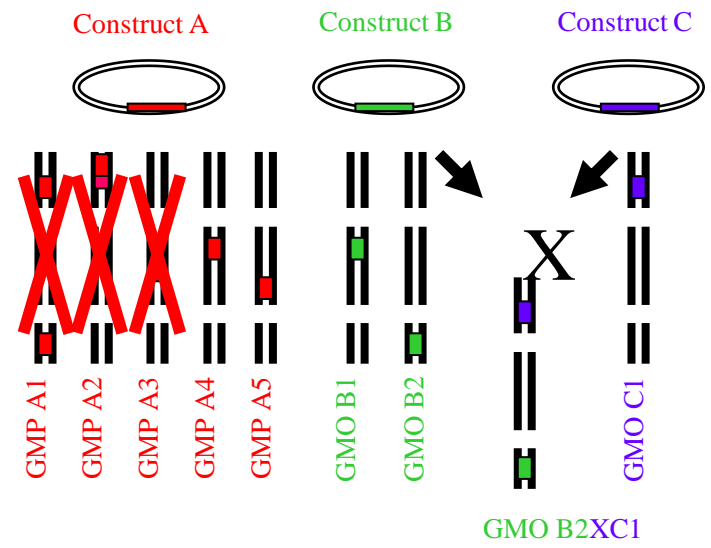
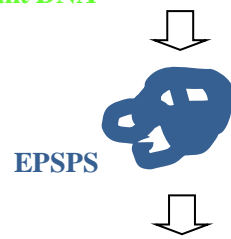
The GMO issue

GMO: the EU legislation

- Europe and its politicians decided that a **positive risk evaluation report** is needed before GMOs can be authorized for human and animal consumption and/or deliberate release in the environment and cultivation
- Resulting legislations **2001/18, 1829/2003, 1830/2003,**
- In order to guarantee the **choice** of the consumer ...
Labeling of GMO containing products ...
- Impact on production processes and leading economical value differences
- Need for monitoring and analytical testing



What is the difference between GMO and non-GMO

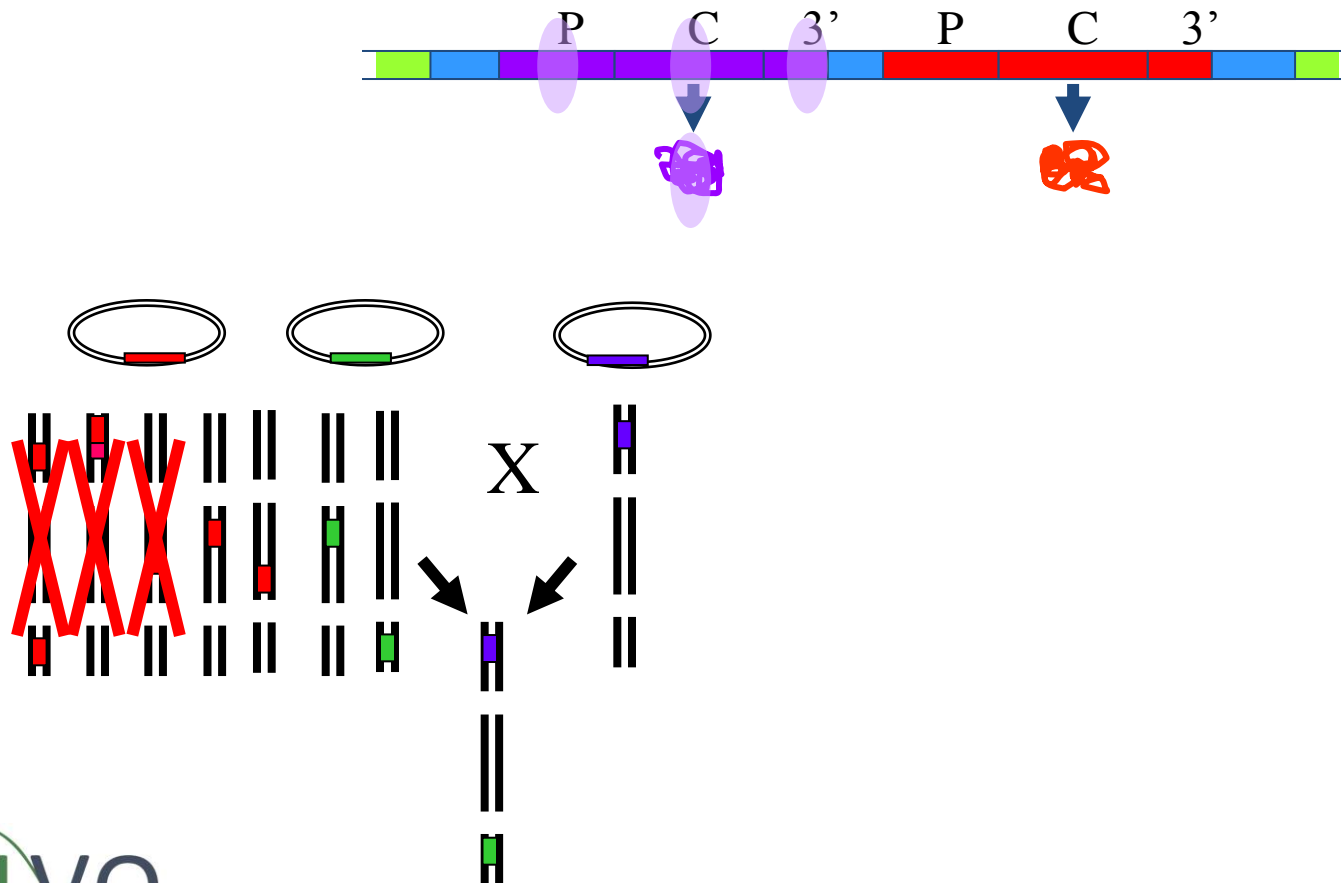


EU has chosen for authorising events
Need for event specific detection

Detection of GMOs

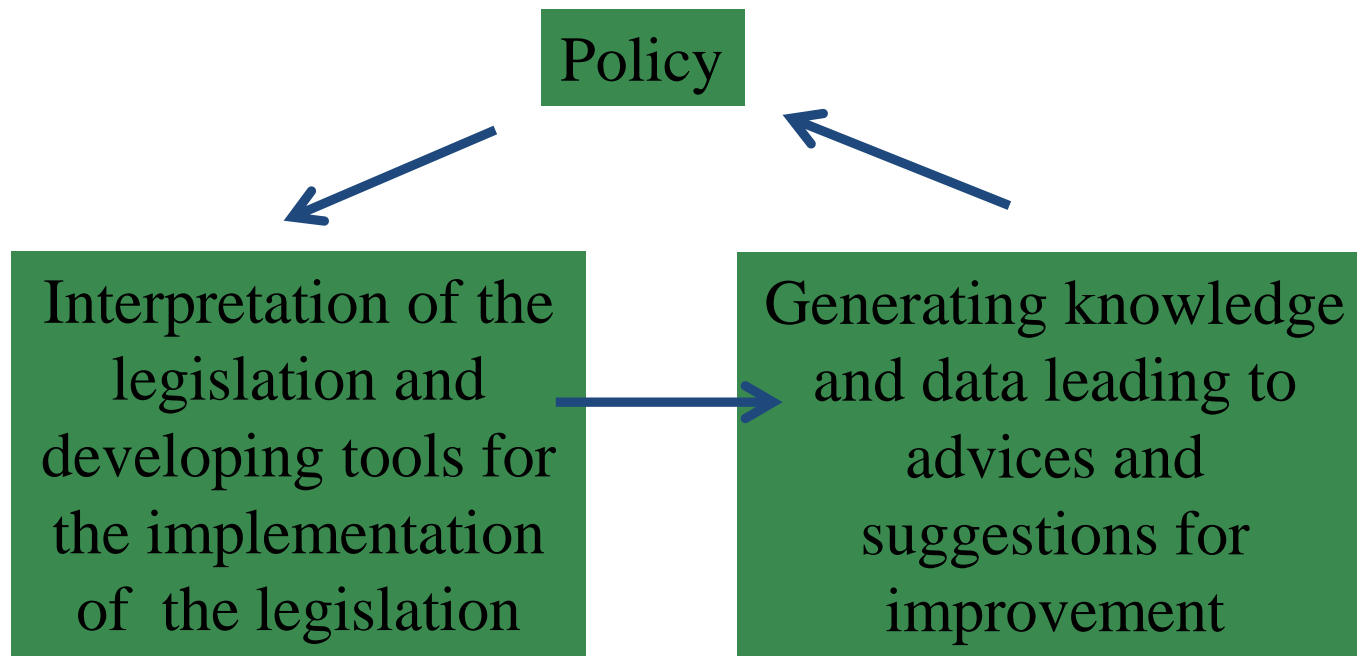
TILL 2003 LIMITED NUMBER OF GMOs COMMERCIALISED

Till 2003 no sequence data on the **transgene locus**, neither an **event specific detection method** was present in the dossier



The role of research (institutes)

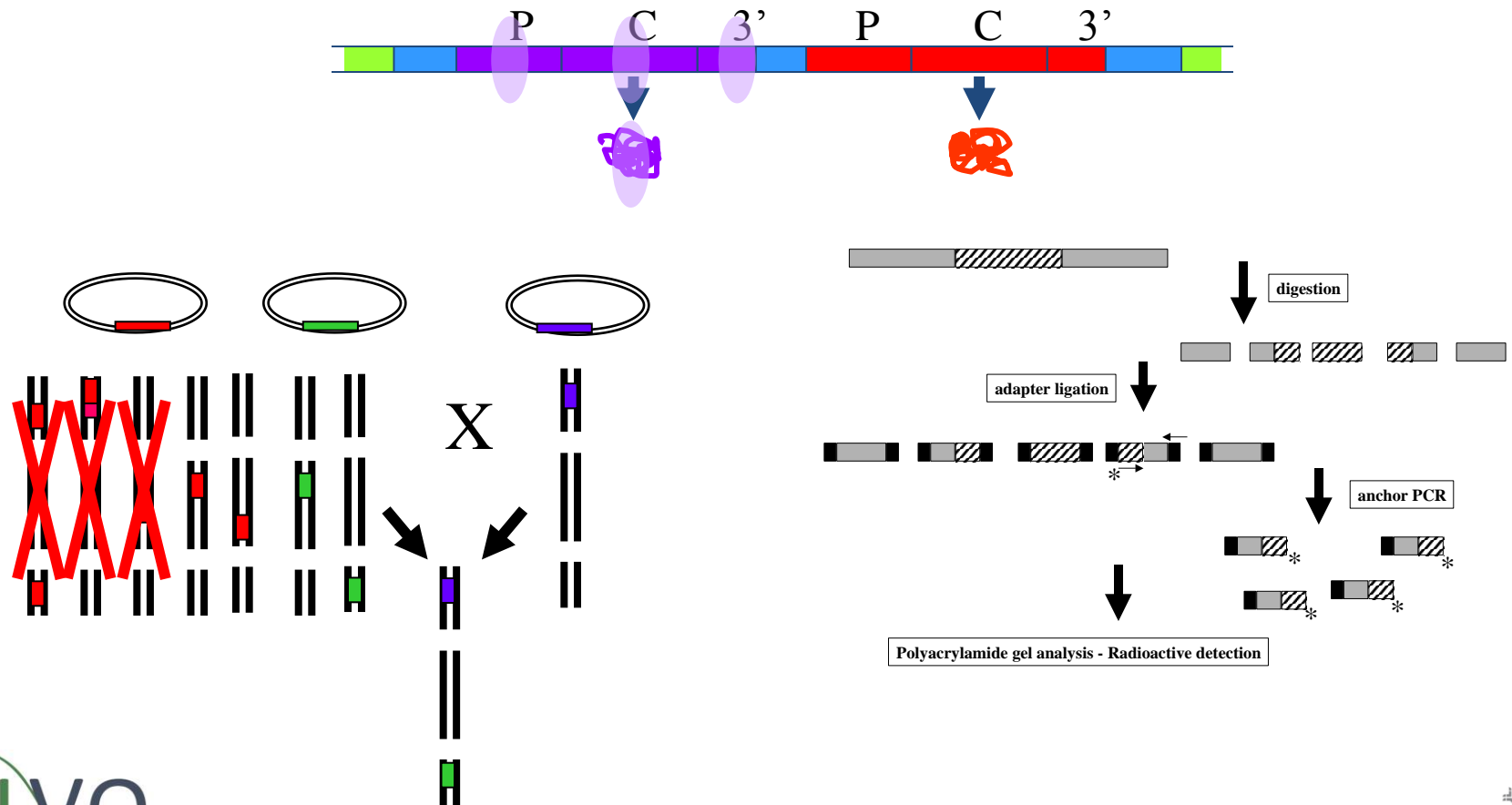
ILVO's mission is to perform and coordinate policy-supportive scientific research and to provide related services with an eye toward economically, ecologically and socially sustainable agriculture and fisheries.



Detection of GMOs

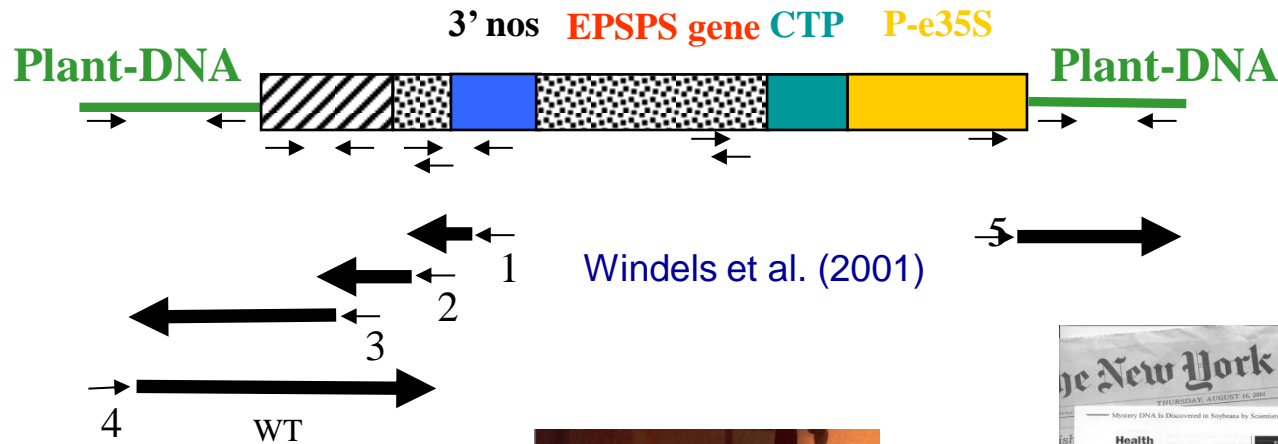
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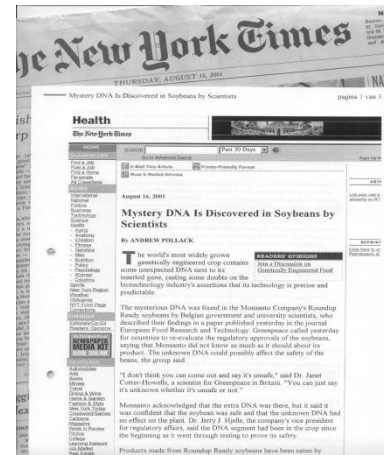
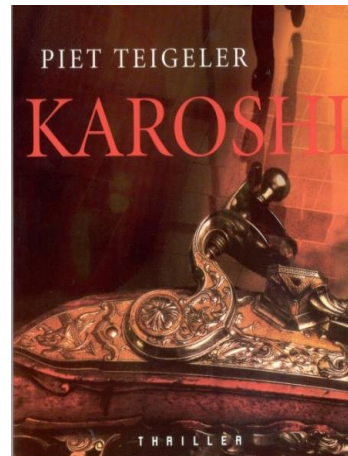


Policy supporting GMO Research

MOLECULAR CHARACTERISATION OF GMO

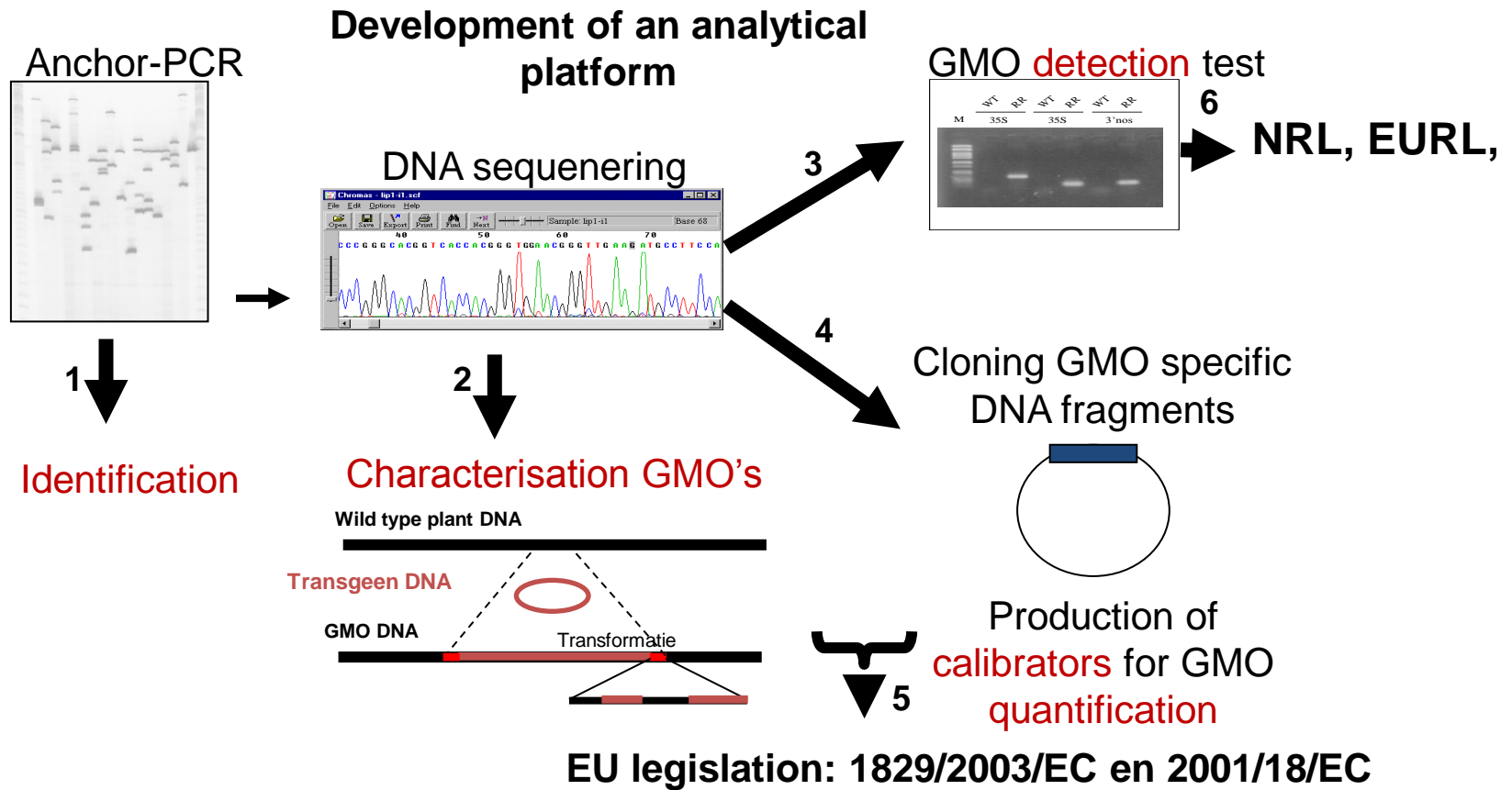


Windels et al. (2001)



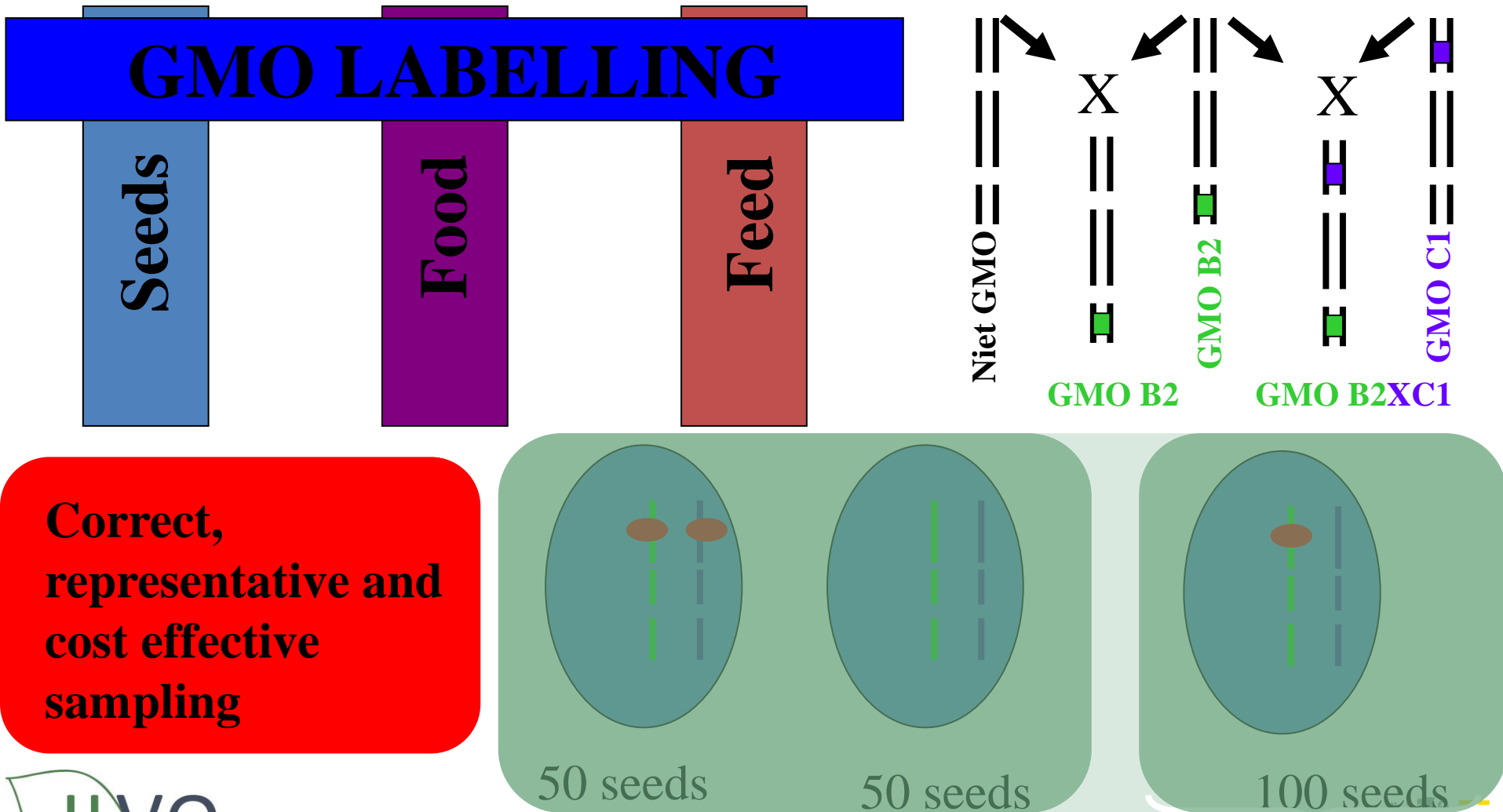
Policy supporting research

independency from the stakeholders



All problems solved? Theory – Real live

The biological reality – The political compromise



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Future challenges

- Currently the focus is on the detection of **transgenic plants** and its derived products
- Future challenges
 - **Growing number** of authorized events
 - **Stacked** events
 - Plants obtained by using **new breeding techniques**
 - GMO or not?
 - Distinguishable from wild type?
 - **GM animals** (screening elements? Unique identifiers? derived purified products?)
 - **GMM** (screening elements? Unique identifiers?)
 - **Unknown** GMOs
- Improved /alternative/ complementary approaches are needed for detection/monitoring
- **Rationalization** in function of **cost efficiency** and proportional to **risks**

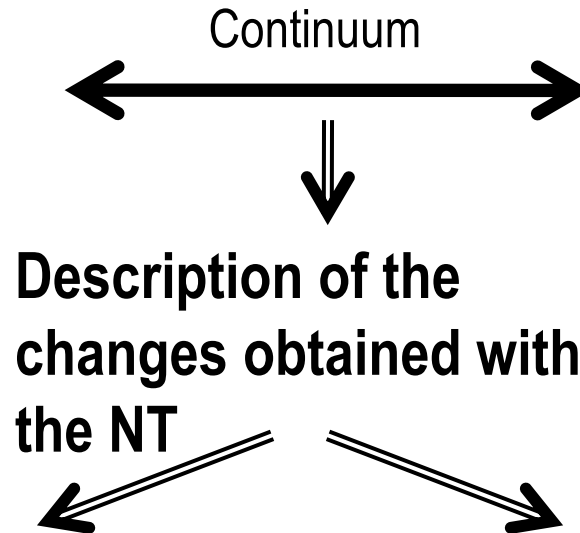
New breeding techniques

Genetic variation: the start of each breeding program

Conventional breeding

- Searching for variants with interesting phenotypes
- Combining different variants
- Recombination's in the genome

New Breeding Technologies



Transgene technology

- Insertion of new combination of DNA sequences in the plant genomes
- Rearrangements in the accepting genome
- Searching for the best performing genotypes

Might be relevant for safety evaluation

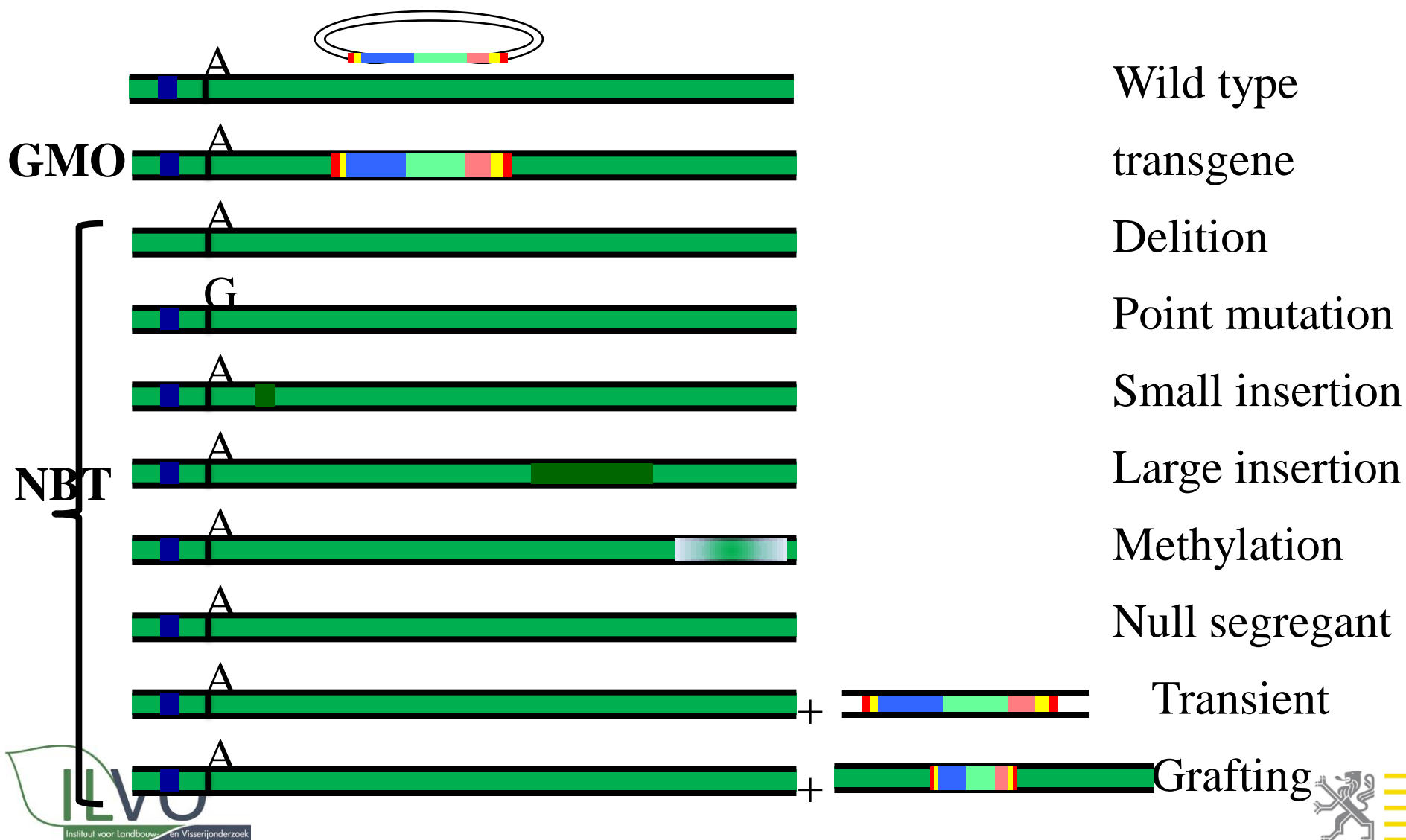
EFSA

Necessary in context of detection and identification

EURL GMO

New breeding techniques and changes in the genome

Screening elements? Unique elements?



Monitoring for the potential presence of non-authorized GMOs

- Unknown GMOs, do they exist?
- Why is monitoring necessary?
 - Risk evaluation is not carried out
- How to find unknown GMOs?
 - Making use of all available information in combination with “detective” strategies
 - Developing an experimental approach to characterise the suspected products and confirm the hypothesis

focus on unauthorized GMO discovery

current routine screening designed to detect, identify, quantify known, authorized GMOs

testing blind samples: no prior knowledge on sample composition is used
discovery of some UGM products is possible but:

very low chance, not in admixtures, indirect evidence, only UGMs with screening elements

challenge:

improve the use of documented evidence

to discover rare, unexpected UGMs

optimization of product selection,

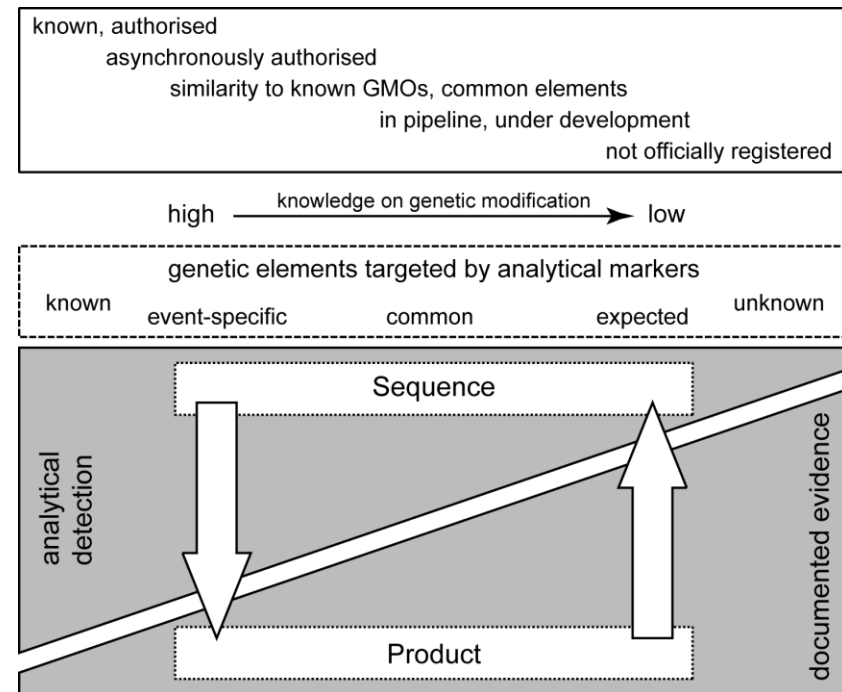
optimization of choice of analytical tests

develop a novel method for event characterisation/identification

by anchor-PCR fingerprinting and NGS:

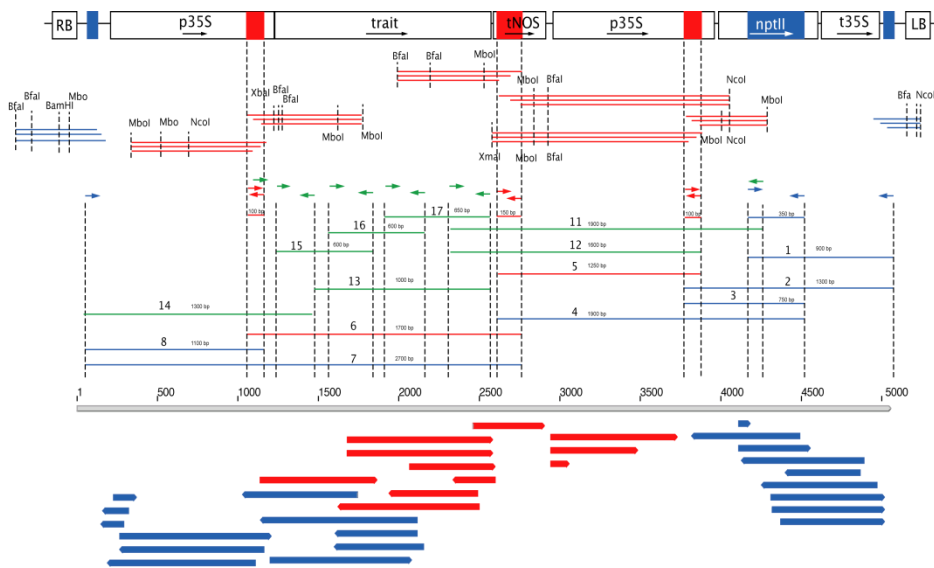
provide direct evidence for UGM

discover masked UGM events



Molecular characterisation of the suspected sample

Targeted selection of suspect samples in stead of random sampling
knowledge of GMO content per product (documentation)
check on authorization status of each product
targeted selection leads to enrichment with `suspect` UGMs
optimization of monitoring program
confirmation of presence of UGM



The screenshot shows the website for EFEKT public relations. The header includes the logo and a navigation menu with links to Home, News, About us, Our offer, Clients, and Our realisations. Below the menu, there is a section titled "WITAMINA B12 W PRZYSWAJALNEJ FORMIE" (Vitamin B12 in assimilable form). The text describes the benefits of Vitamin B12, particularly for the nervous system, and mentions the product Coban. The website also features a contact section with the address: EFEKT PR, ul. Czerska 18 / 390, 00-732 Warsaw, Poland, and phone number: (22) 408 87 01 to 03.

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Co-existence

Non-GMO



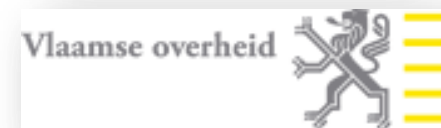
GMO



- The EU decided that nevertheless a positive risk evaluation report the consumer must have the choice to consume GMO or not
- The consequences of this is that in agricultural separated production needs to be organized: **Co-existent**
- **The member States (or regions)** need to work out a legal framework to achieve this goal. In Belgium **the regions** are responsible to work out such a legislation (Decreet and BVR)

GOAL OF THE EXPERIMENT

1. Are the measures developed in the legislation sufficient to avoid admixing in amounts that might cause economical damage.
2. The development of cost efficient, realistic and representative sampling
3. The development of educative material, usefull to inform farmers and contractors.



Instituut voor Landbouw en Visserij Onderzoek

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The GMO issue

Conclusion: growing complexity



Analysis

Event specific quantification
 Total quantification
 Identification
 Detection

Seed
 Grain
 Raw, pure product
 Raw, mixed product
 End product



Product

EU authorised Part C

Authorised in non-EU

EU authorised Part B

Unknown/
 unauthorized

Legal status



Cost ↔ Risk

Results have to be scientifically correct

Questions?

Marc.Deloose@ilvo.vlaanderen.be

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