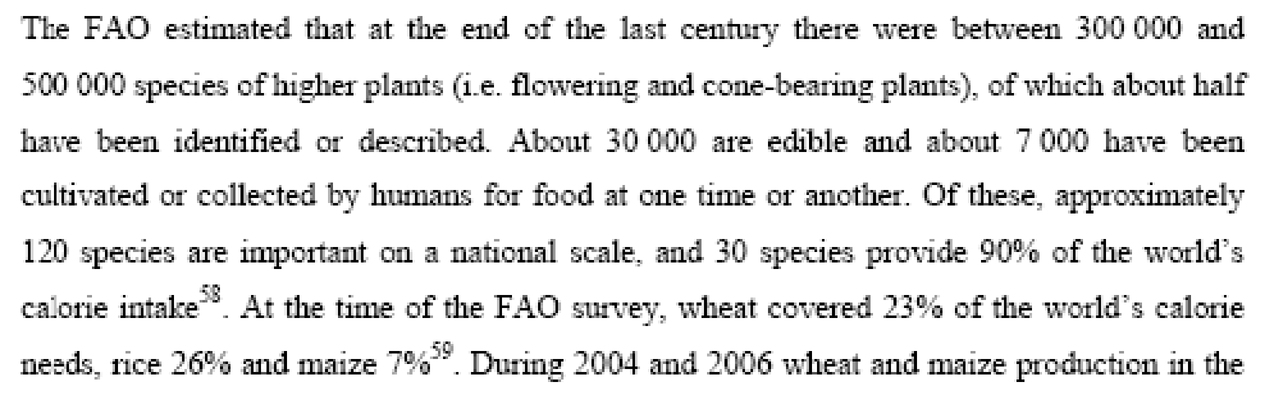
La modificación genética de plantas ¿Dónde estamos a finales del 2011?

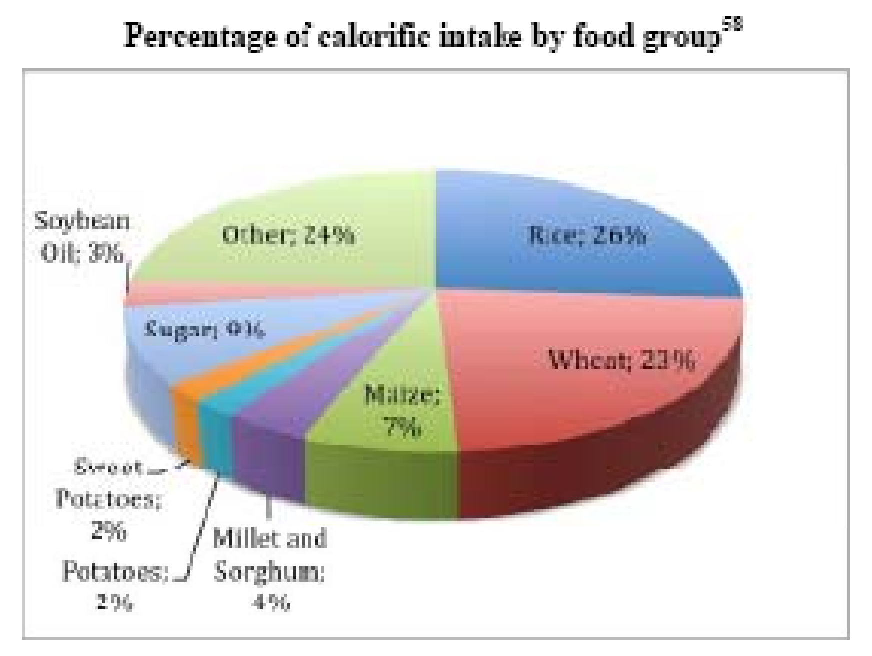
Pere Puigdomènech
Centre de Recerca en Agrigenòmica. CSIC-IRTA-UAB-UB

Granada. Diciembre 2011

¿Qué comemos?

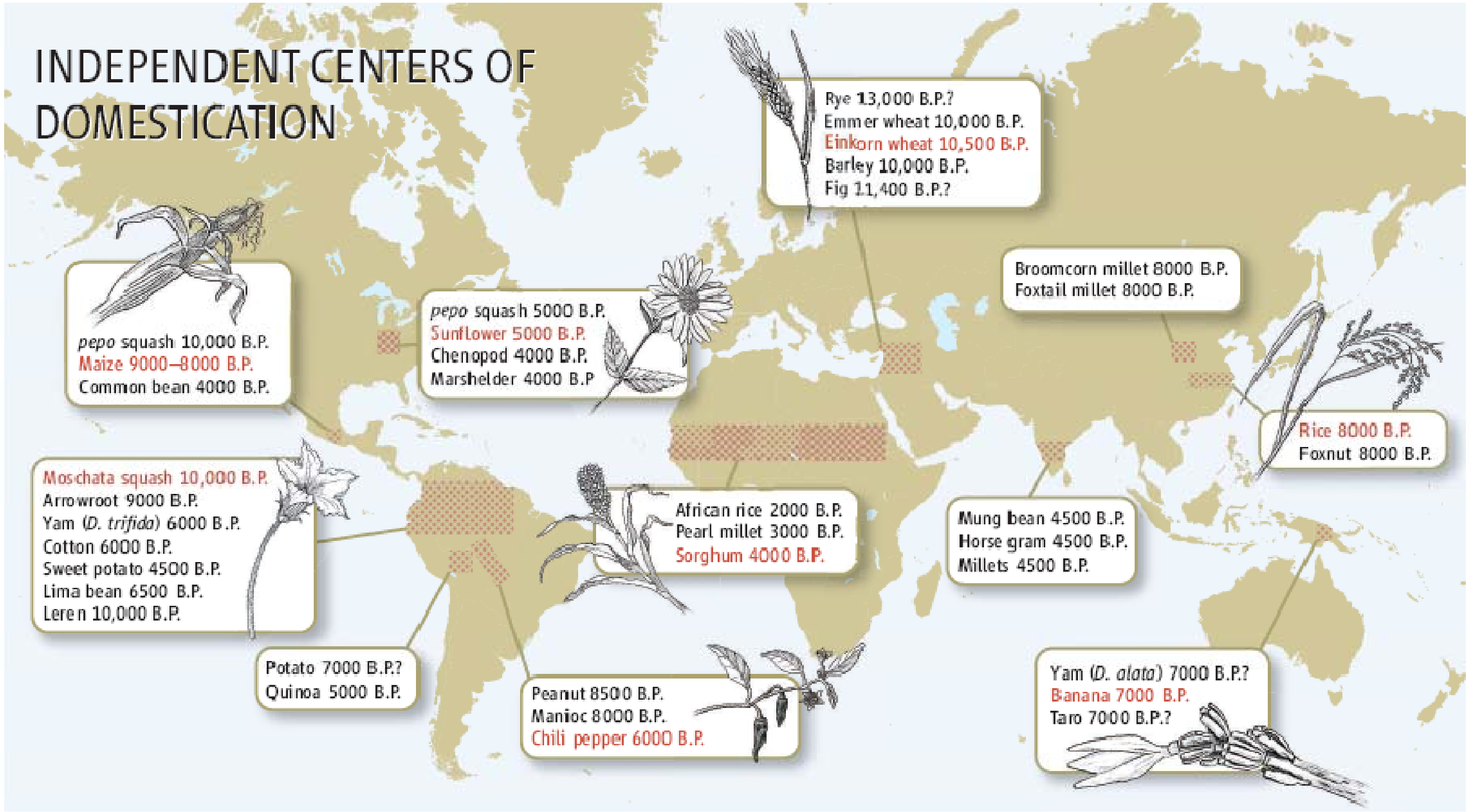


The FAO estimated that at the end of the last century there were between 300 000 and 500 000 species of higher plants (i.e. flowering and cone-bearing plants), of which about half have been identified or described. About 30 000 are edible and about 7 000 have been cultivated or collected by humans for food at one time or another. Of these, approximately 120 species are important on a national scale, and 30 species provide 90% of the world's calorie intake[58]. At the time of the FAO survey, wheat covered 23% of the world's calorie needs, rice 26% and maize 7%[59]. During 2004 and 2006 wheat and maize production in the



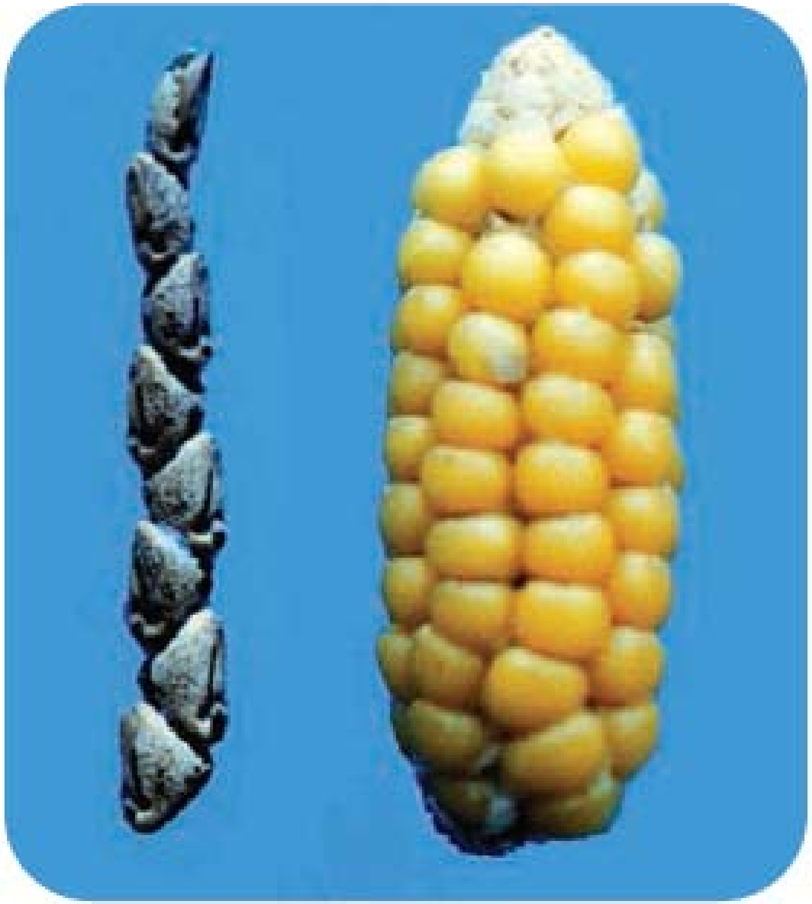
Percentage of calorific intake by food group[58]

Centros de domesticación de plantas



Multiple birth. People in many different parts of the world independently began to cultivate and eventually domesticate plants.

El maiz, regalo de los dioses

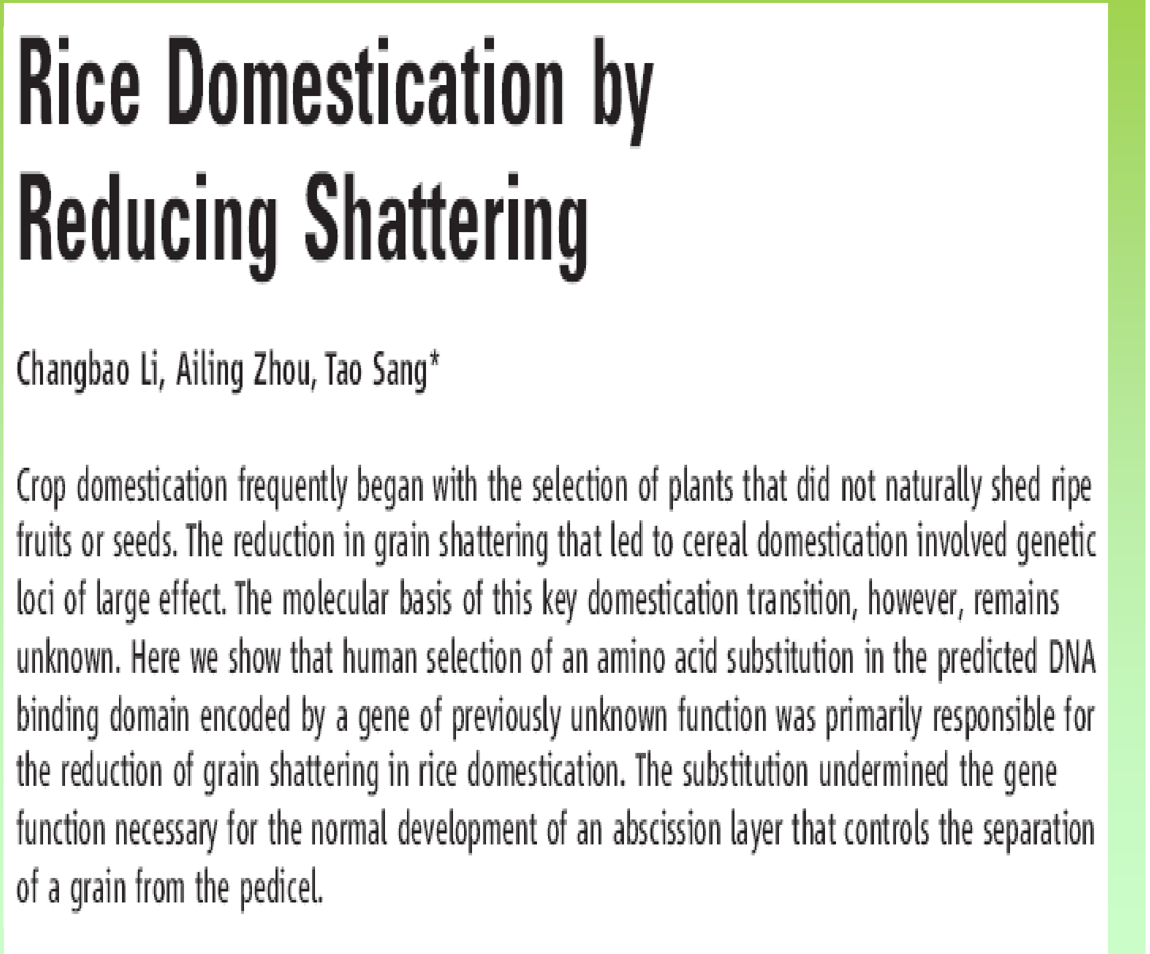


All in the family. Maize and its wild ancestor teosinte (*left*) are closely related despite their differences.

Maíz

Teosinte

Domesticación del arroz

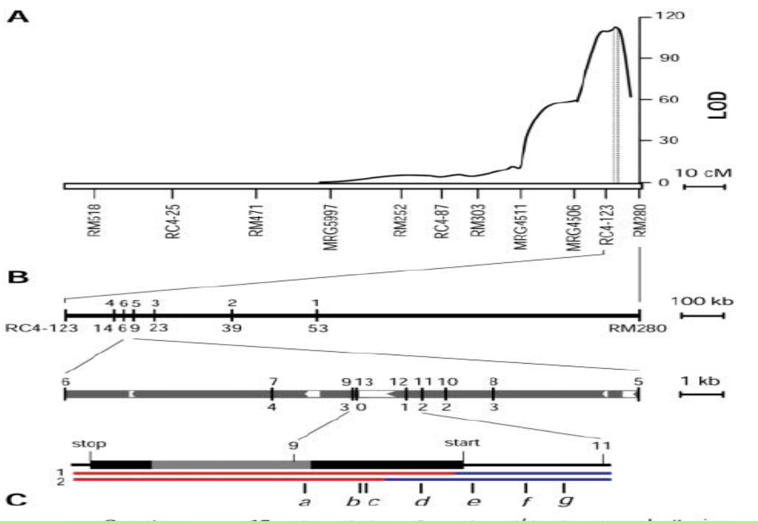


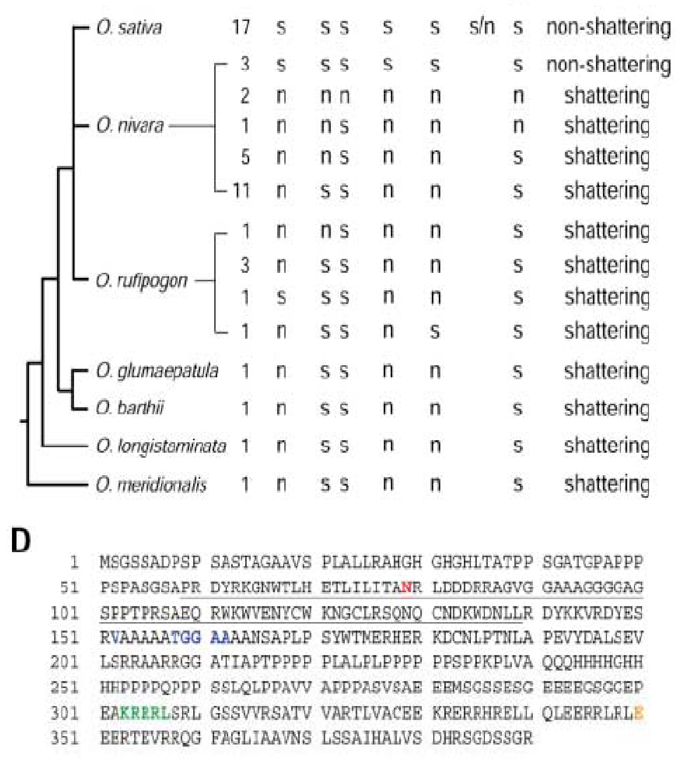
Rice Domestication by Reducing Shattering

Changbao Li, Ailing Zhou, Tao Sang*

Crop domestication frequently began with the selection of plants that did not naturally shed ripe fruits or seeds. The reduction in grain shattering that led to cereal domestication involved genetic loci of large effect. The molecular basis of this key domestication transition, however, remains unknown. Here we show that human selection of an amino acid substitution in the predicted DNA binding domain encoded by a gene of previously unknown function was primarily responsible for the reduction of grain shattering in rice domestication. The substitution undermined the gene function necessary for the normal development of an abscission layer that controls the separation of a grain from the pedicel.

Domesticación del arroz





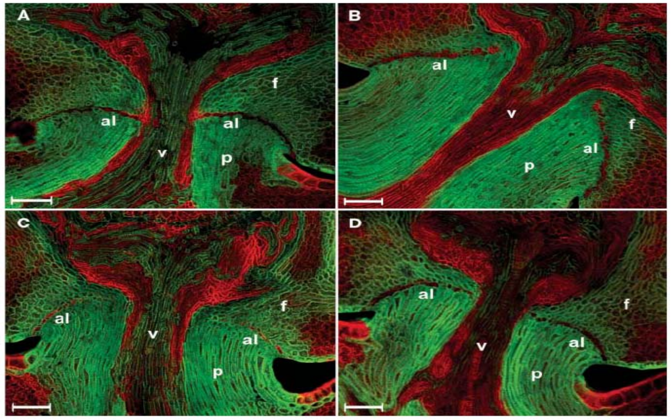


Fig. 4. Fluorescence images of longitudinal section of flower and pedicel junction. (**A**) *O. nivara* mapping parent, with complete abscission layer (al). (**B**) *O. sativa* ssp. *indica* mapping parent, with incomplete abscission layer. (**C**) *O. sativa* ssp. *japonica* Taipei 309, with incomplete abscission layer. (**D**) Transformant of Taipei 309 expressing construct 1, with improved abscission layer. f, flower side; p, pedicel side; v, vascular bundle. Bar, 50 μm.

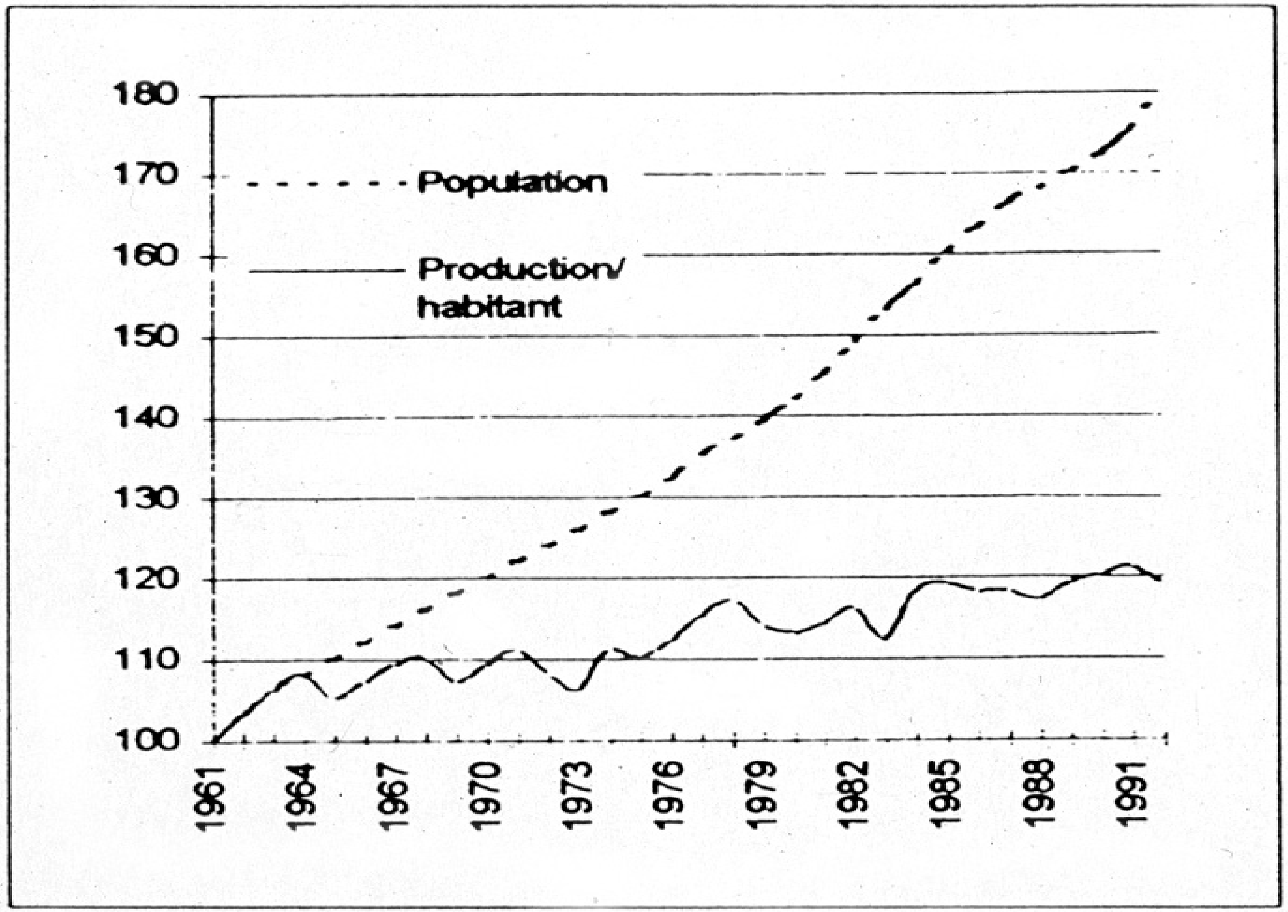
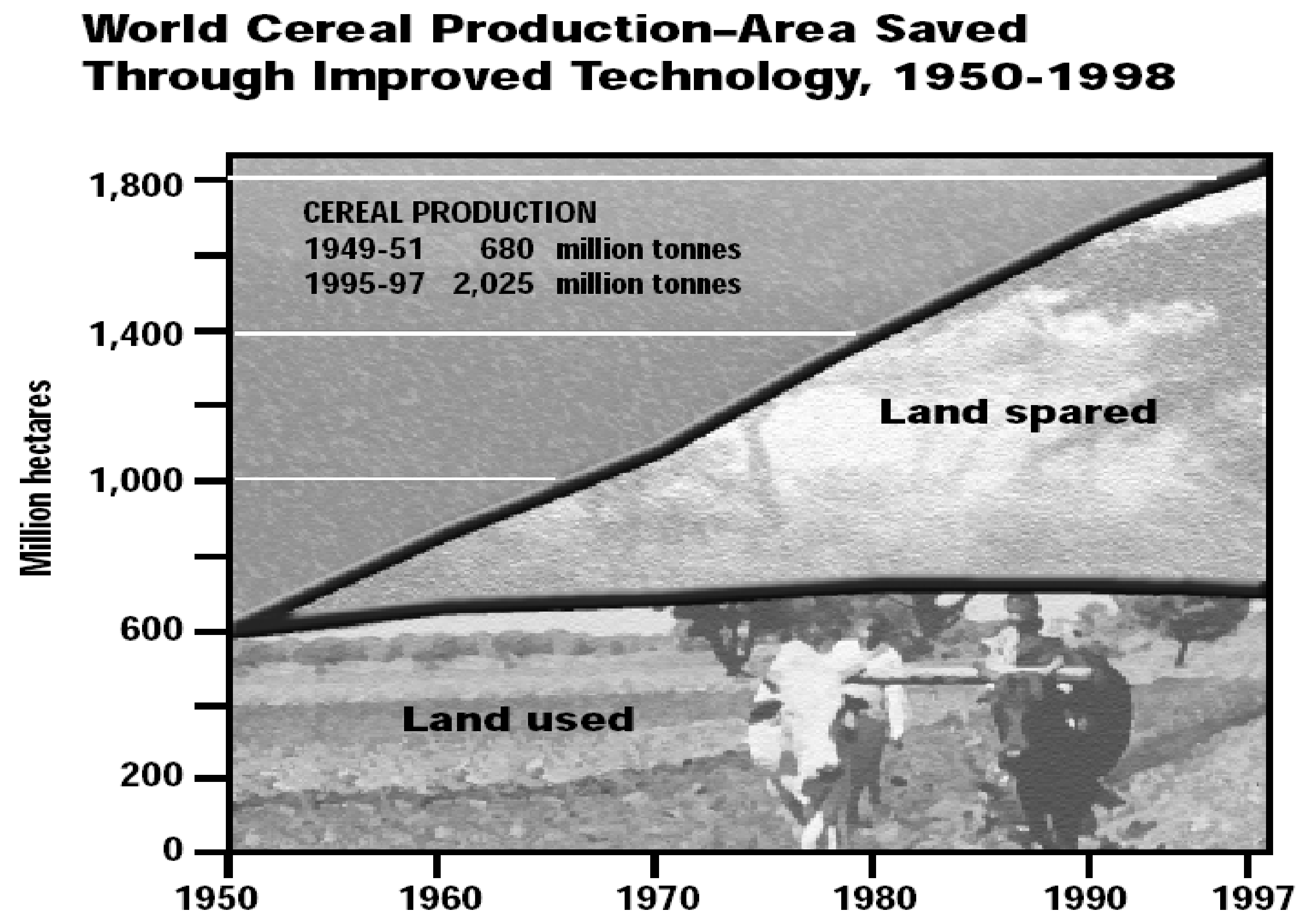


Figure 4. Évolution globale de la production agricole et de la population de 1961 à 1992 (indice 100 en 1961) [11].

La revolución verde. Norman Bourlaug



Desarrollo de la mejora genética vegetal

		Especies salvajes	
-10000 años	Domesticación		Nacimiento de La agricultura
		Plantas cultivadas	
1859	Darwin: Teoría de La evolución de las especies		1. Introducción consciente de diversidad génica 2. Selección
1865	Mendel: Leyes de la herencia		
		Plantas mejoradas	
1950	Watson y Crick: Estructura del ADN		
1960-1970	Mejora de las técnicas de cultivp "in vitro"		Introducción dirigida de caracteres
1983	Primera transferencia de genes en plantas		Plantas transgénicas
2001	Primer genoma de plantas	Plantas de diseño	

¿Por qué queremos diseñar plantas?

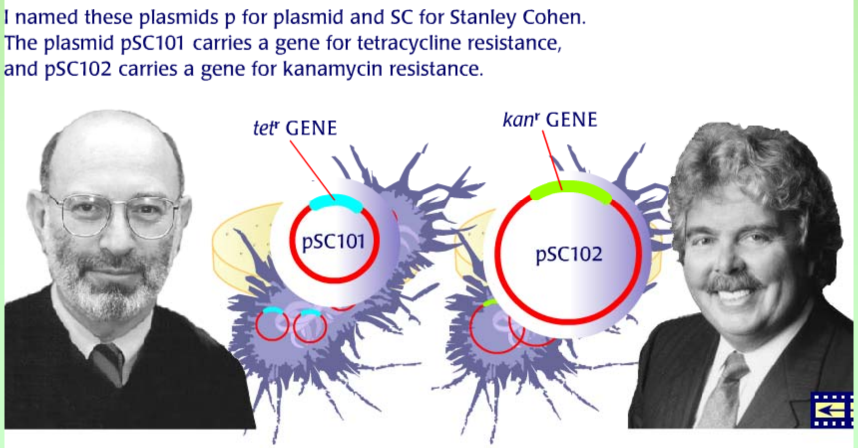
- Para tener una agricultura más eficiente
- Para tener una agricultura más adaptada de cara al futuro
- Para tener una alimentación más acorde con nuestras necesidades
- Porque siempre lo hemos hecho

Variabilidad genética

- Conservación
- Análisis y aprovechamiento de la variabilidad existente
- Creación de nueva variabilidad por mutagénesis
- Creación de nueva variabilidad por modificación genética

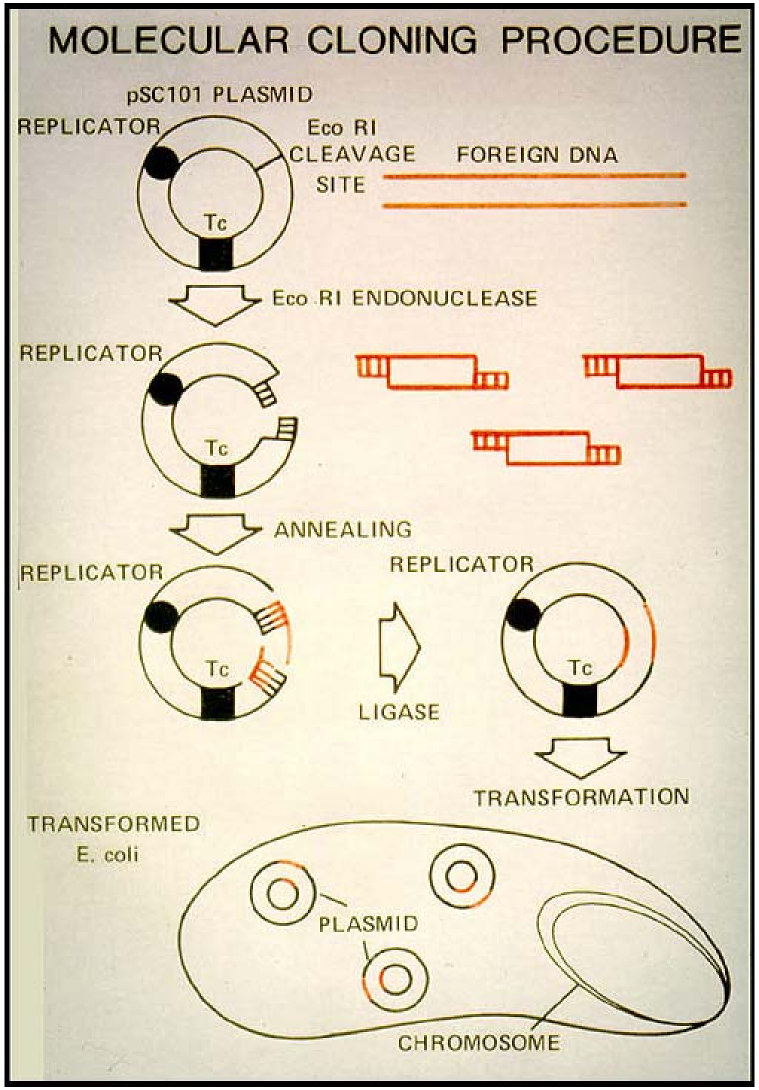
DNA recombinante. 1972-73

Paul Berg

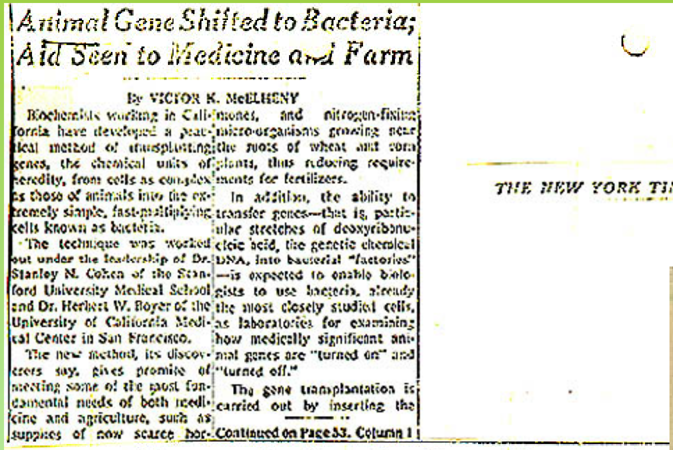


I named these plasmids p for plasmid and SC for Stanley Cohen.
The plasmid pSC101 carries a gene for tetracycline resistance,
and pSC102 carries a gene for kanamycin resistance.

Stanley Cohen i Herbert Boyer



DNA recombinante. Entra la empresa



Animal Gene Shifted to Bacteria; Aid Seen to Medicine and Farm

By VICTOR K. McELHENY

Biochemists working in California have developed a practical method of transplanting genes, the chemical units of heredity, from cells as complex as those of animals into the extremely simple, fast-multiplying cells known as bacteria.

The technique was worked out under the leadership of Dr. Stanley N. Cohen of the Stanford University Medical School and Dr. Herbert W. Boyer of the University of California Medical Center in San Francisco.

The new method, its discoverers say, gives promise of meeting some of the most fundamental needs of both medicine and agriculture, such as supplies of now scarce hormones, and nitrogen-fixing micro-organisms growing near the roots of wheat and corn plants, thus reducing requirements for fertilizers.

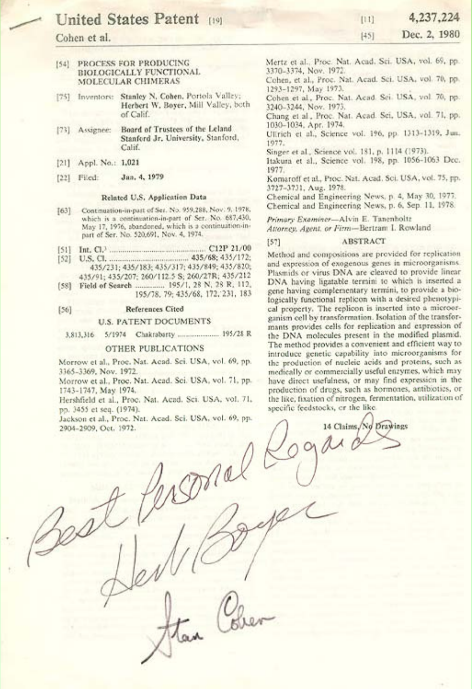
In addition, the ability to transfer genes—that is, particular stretches of deoxyribonucleic acid, the genetic chemical DNA, into bacterial "factories"—is expected to enable biologists to use bacteria, already the most closely studied cells, as laboratories for examining how medically significant animal genes are "turned on" and "turned off."

The gene transplantation is carried out by inserting the

Continued on Page 53, Column 1

THE NEW YORK TIMES, MONDAY, MAY 20, 1974

p. 1



United States Patent [19] | [11] 4,237,224
Cohen et al. | [45] Dec. 2, 1980

[54] PROCESS FOR PRODUCING BIOLOGICALLY FUNCTIONAL MOLECULAR CHIMERAS

[75] Inventors: **Stanley N. Cohen**, Portola Valley; **Herbert W. Boyer**, Mill Valley, both of Calif.

[73] Assignee: **Board of Trustees of the Leland Stanford Jr. University**, Stanford, Calif.

[21] Appl. No.: **1,021**

[22] Filed: **Jan. 4, 1979**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 959,288, Nov. 9, 1978, which is a continuation-in-part of Ser. No. 687,430, May 17, 1976, abandoned, which is a continuation-in-part of Ser. No. 520,691, Nov. 4, 1974.

[51] **Int. Cl.**^{2} C12P 21/00
[52] **U.S. Cl.** .... 435/68; 435/172; 435/231; 435/183; 435/317; 435/849; 435/820; 435/91; 435/207; 260/112.5 S; 260/27R; 435/212
[58] **Field of Search** .... 195/1, 28 N, 28 R, 112, 195/78, 79; 435/68, 172, 231, 183

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,813,316 5/1974 Chakrabarty .... 195/28 R

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Singer et al., Science vol. 181, p. 1114 (1973).
Itakura et al., Science vol. 198, pp. 1056–1063 Dec. 1977.
Komaroff et al., Proc. Nat. Acad. Sci. USA, vol. 75, pp. 3727–3731, Aug. 1978.
Chemical and Engineering News, p. 4, May 30, 1977.
Chemical and Engineering News, p. 6, Sep. 11, 1978.

Primary Examiner—Alvin E. Tanenholtz
Attorney, Agent, or Firm—Bertram I. Rowland

[57] ABSTRACT

Method and compositions are provided for replication and expression of exogenous genes in microorganisms. Plasmids or virus DNA are cleaved to provide linear DNA having ligatable termini to which is inserted a gene having complementary termini, to provide a biologically functional replicon with a desired phenotypical property. The replicon is inserted into a microorganism cell by transformation. Isolation of the transformants provides cells for replication and expression of the DNA molecules present in the modified plasmid. The method provides a convenient and efficient way to introduce genetic capability into microorganisms for the production of nucleic acids and proteins, such as medically or commercially useful enzymes, which may have direct usefulness, or may find expression in the production of drugs, such as hormones, antibiotics, or the like, fixation of nitrogen, fermentation, utilization of specific feedstocks, or the like.

14 Claims, No Drawings

Best Personal Regards
Herb Boyer
Stan Cohen

BIOTECH IS A GOLD MINE FOR TWO LEADING UNIVERSITIES

University of California

In fiscal 1992, the University of California received $28.8 million in royalties and fees from inventions made at its nine campuses. Here are the top five royalty-producing discoveries:

Invention (campus, year)	Licensee	1992 royalties (millions)
Genetic engineering (S.F., 1974)	Non-exclusive	**$5.3**
Nicotine patch (L.A., 1984)	Ciba-Geigy Corp.	**$4.7**
Hepatitis B vaccine (S.F., 1981)	Merck & Co.	**$4.6**
Human growth hormone (S.F., 1977)	Genentech Inc.	**$2.7**
Lung surfactant (S.F., 1980)	Burroughs-Welcome Inc.	**$2.6**

Stanford University

In fiscal 1992, Stanford University received $25.5 million in royalties and fees from its inventions. Here are the top five:

Invention (year)	Licensee	1992 royalties (millions)
Genetic engineering (1974)	Non-exclusive	**$6.2**
FM Sounds music chip (1971)	Yamaha	**$2.7**
X-Ray scanner (1974)	General Electric Co.	**$1.1**
Molecular tags (1981)	Non-exclusive	**$0.9**
Enzyme used in biotech manufacturing (1982)	Non-exclusive	**$0.3**

Sources: University of California, Stanford University

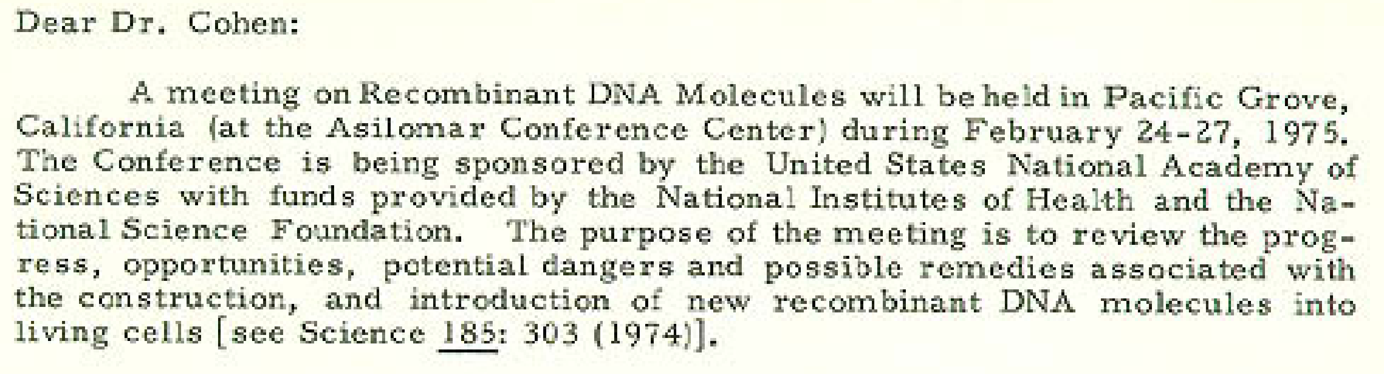
CHRONICLE GRAPHIC

UC Wants More Research Profits

System might set up a firm to increase its revenue from new products

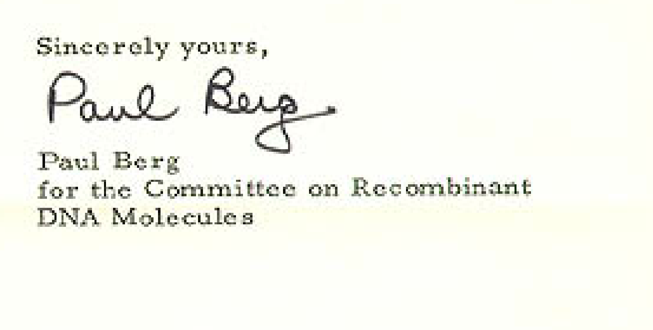
DNA recombinante. El debate

The controversy



Dear Dr. Cohen:

A meeting on Recombinant DNA Molecules will be held in Pacific Grove, California (at the Asilomar Conference Center) during February 24-27, 1975. The Conference is being sponsored by the United States National Academy of Sciences with funds provided by the National Institutes of Health and the National Science Foundation. The purpose of the meeting is to review the progress, opportunities, potential dangers and possible remedies associated with the construction, and introduction of new recombinant DNA molecules into living cells [see Science 185: 303 (1974)].

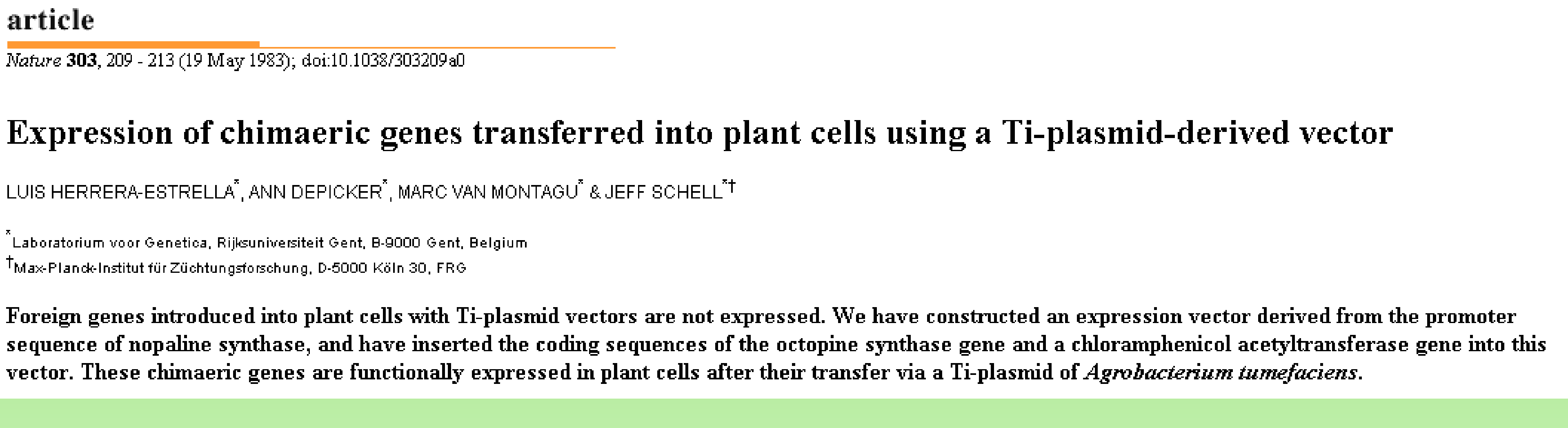


Sincerely yours,

Paul Berg

Paul Berg
for the Committee on Recombinant
DNA Molecules

La modificación genética



article

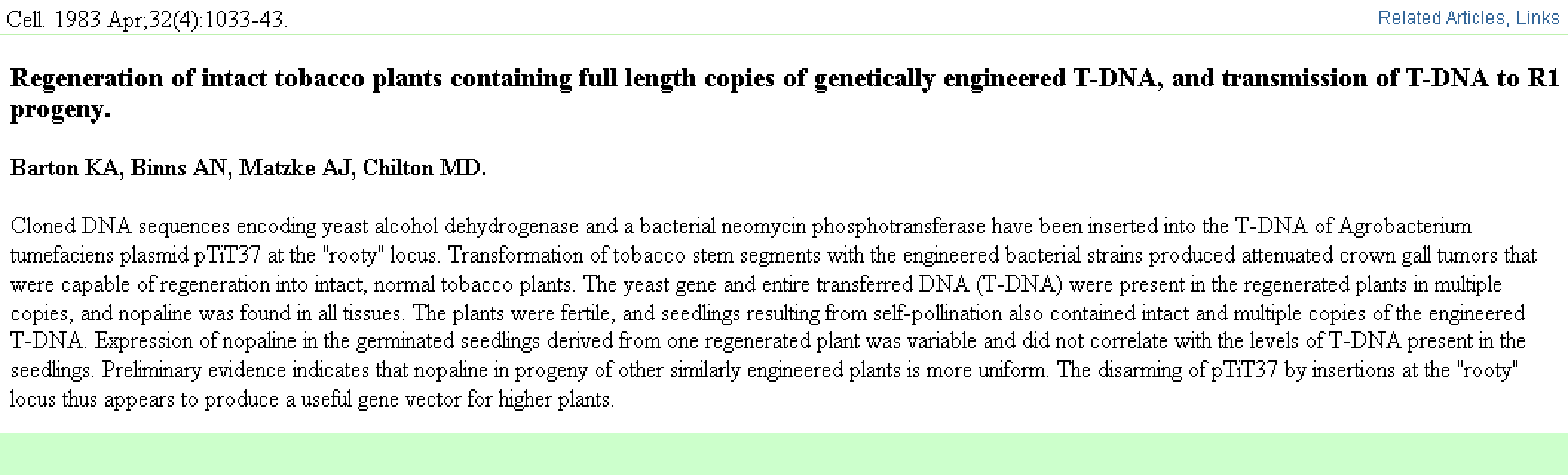
Nature **303**, 209 - 213 (19 May 1983); doi:10.1038/303209a0

Expression of chimaeric genes transferred into plant cells using a Ti-plasmid-derived vector

LUIS HERRERA-ESTRELLA[*], ANN DEPICKER[*], MARC VAN MONTAGU[*] & JEFF SCHELL[*†]

[*] Laboratorium voor Genetica, Rijksuniversiteit Gent, B-9000 Gent, Belgium
[†] Max-Planck-Institut für Züchtungsforschung, D-5000 Köln 30, FRG

Foreign genes introduced into plant cells with Ti-plasmid vectors are not expressed. We have constructed an expression vector derived from the promoter sequence of nopaline synthase, and have inserted the coding sequences of the octopine synthase gene and a chloramphenicol acetyltransferase gene into this vector. These chimaeric genes are functionally expressed in plant cells after their transfer via a Ti-plasmid of *Agrobacterium tumefaciens*.



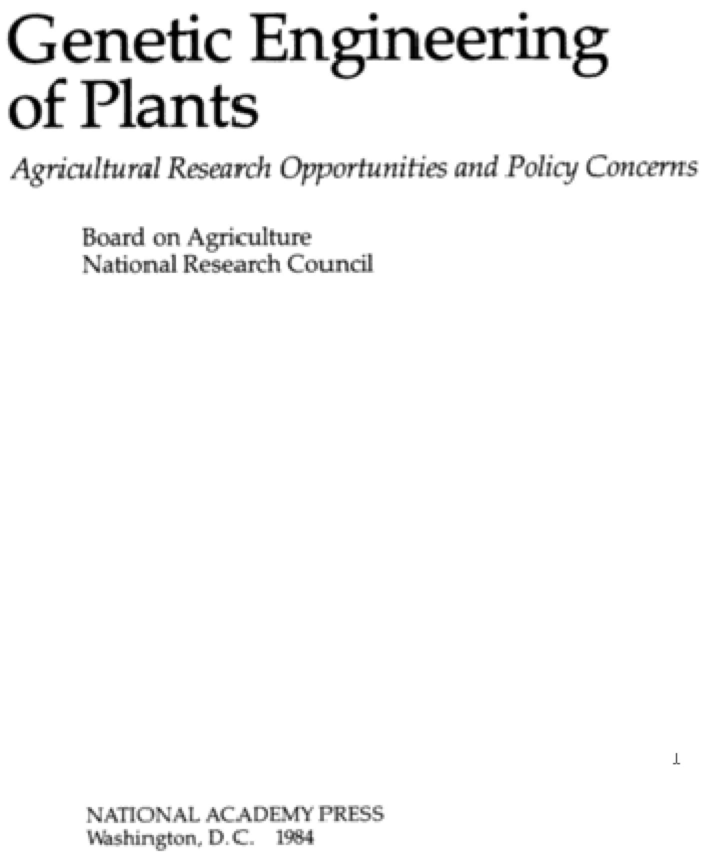
Cell. 1983 Apr;32(4):1033-43.

Related Articles, Links

Regeneration of intact tobacco plants containing full length copies of genetically engineered T-DNA, and transmission of T-DNA to R1 progeny.

Barton KA, Binns AN, Matzke AJ, Chilton MD.

Cloned DNA sequences encoding yeast alcohol dehydrogenase and a bacterial neomycin phosphotransferase have been inserted into the T-DNA of Agrobacterium tumefaciens plasmid pTiT37 at the "rooty" locus. Transformation of tobacco stem segments with the engineered bacterial strains produced attenuated crown gall tumors that were capable of regeneration into intact, normal tobacco plants. The yeast gene and entire transferred DNA (T-DNA) were present in the regenerated plants in multiple copies, and nopaline was found in all tissues. The plants were fertile, and seedlings resulting from self-pollination also contained intact and multiple copies of the engineered T-DNA. Expression of nopaline in the germinated seedlings derived from one regenerated plant was variable and did not correlate with the levels of T-DNA present in the seedlings. Preliminary evidence indicates that nopaline in progeny of other similarly engineered plants is more uniform. The disarming of pTiT37 by insertions at the "rooty" locus thus appears to produce a useful gene vector for higher plants.



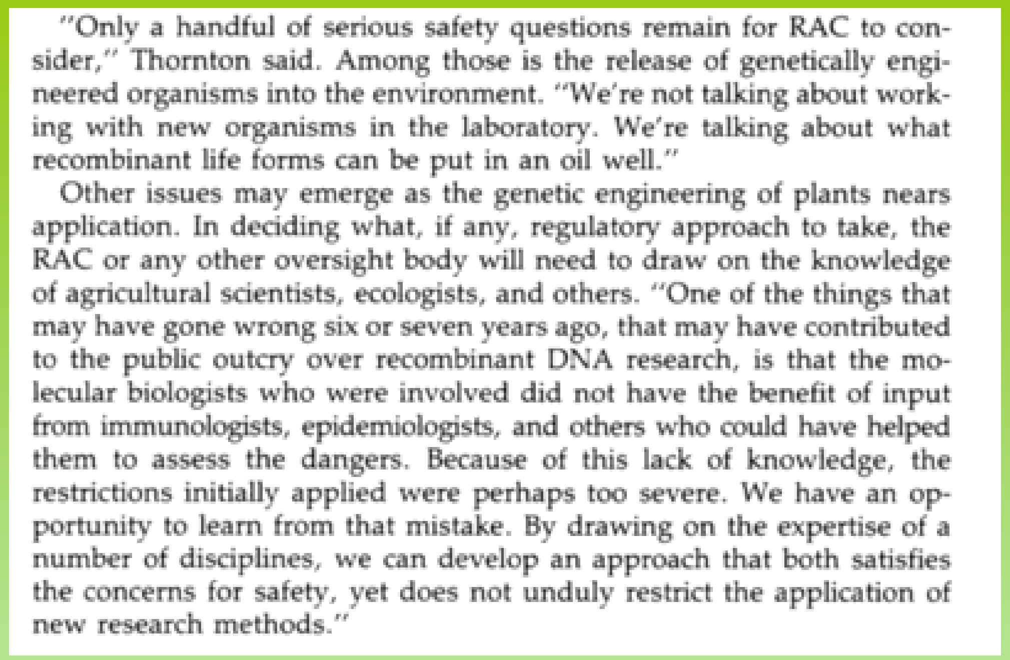
Genetic Engineering of Plants

Agricultural Research Opportunities and Policy Concerns

Board on Agriculture
National Research Council

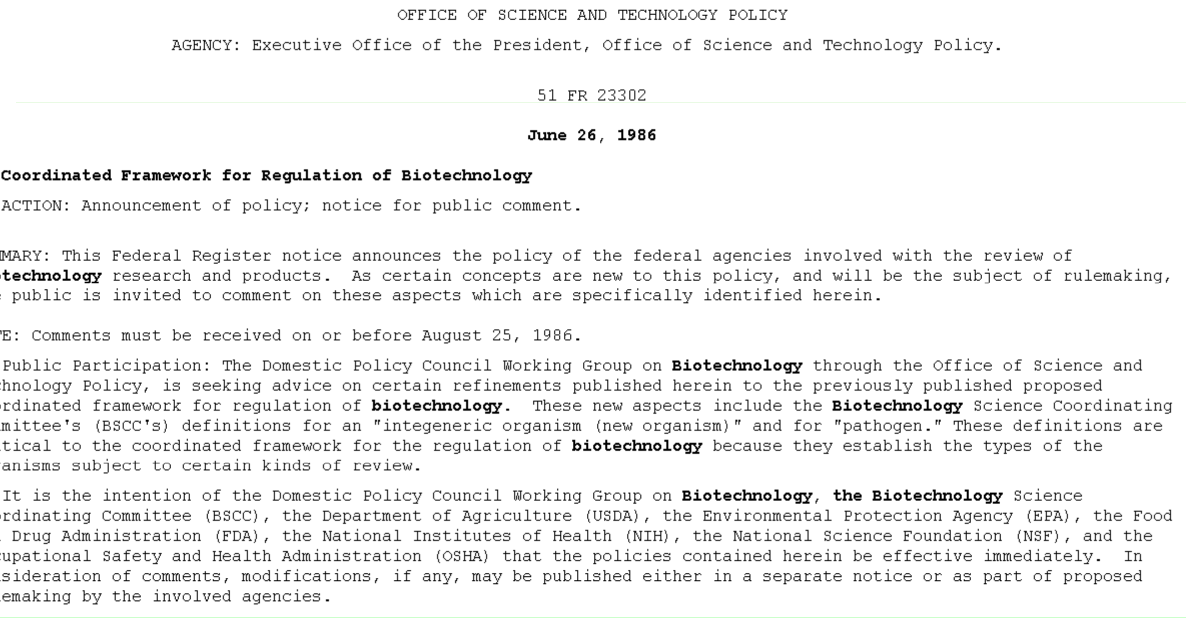
1

NATIONAL ACADEMY PRESS
Washington, D.C. 1984



"Only a handful of serious safety questions remain for RAC to consider," Thornton said. Among those is the release of genetically engineered organisms into the environment. "We're not talking about working with new organisms in the laboratory. We're talking about what recombinant life forms can be put in an oil well."

Other issues may emerge as the genetic engineering of plants nears application. In deciding what, if any, regulatory approach to take, the RAC or any other oversight body will need to draw on the knowledge of agricultural scientists, ecologists, and others. "One of the things that may have gone wrong six or seven years ago, that may have contributed to the public outcry over recombinant DNA research, is that the molecular biologists who were involved did not have the benefit of input from immunologists, epidemiologists, and others who could have helped them to assess the dangers. Because of this lack of knowledge, the restrictions initially applied were perhaps too severe. We have an opportunity to learn from that mistake. By drawing on the expertise of a number of disciplines, we can develop an approach that both satisfies the concerns for safety, yet does not unduly restrict the application of new research methods."



OFFICE OF SCIENCE AND TECHNOLOGY POLICY

AGENCY: Executive Office of the President, Office of Science and Technology Policy.

51 FR 23302

June 26, 1986

Coordinated Framework for Regulation of Biotechnology

ACTION: Announcement of policy; notice for public comment.

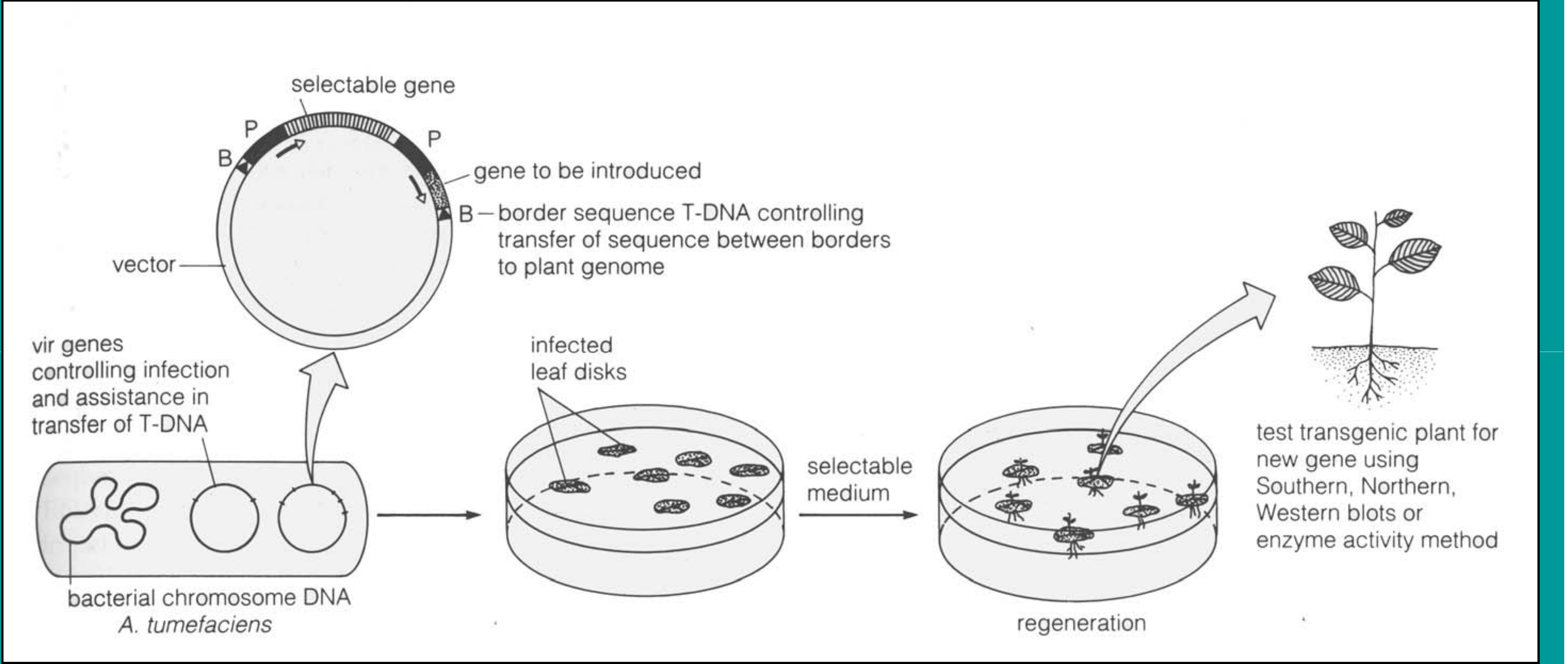
SUMMARY: This Federal Register notice announces the policy of the federal agencies involved with the review of **biotechnology** research and products. As certain concepts are new to this policy, and will be the subject of rulemaking, the public is invited to comment on these aspects which are specifically identified herein.

DATE: Comments must be received on or before August 25, 1986.

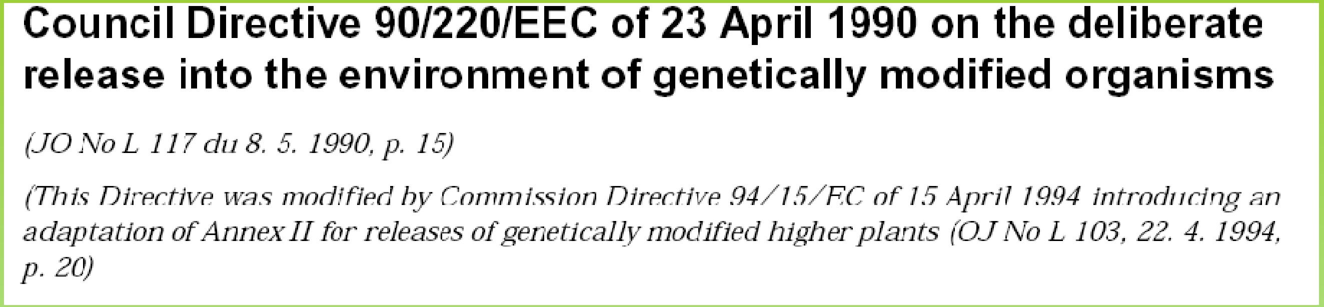
Public Participation: The Domestic Policy Council Working Group on **Biotechnology** through the Office of Science and Technology Policy, is seeking advice on certain refinements published herein to the previously published proposed coordinated framework for regulation of **biotechnology**. These new aspects include the **Biotechnology** Science Coordinating Committee's (BSCC's) definitions for an "integeneric organism (new organism)" and for "pathogen." These definitions are critical to the coordinated framework for the regulation of **biotechnology** because they establish the types of the organisms subject to certain kinds of review.

It is the intention of the Domestic Policy Council Working Group on **Biotechnology, the Biotechnology** Science Coordinating Committee (BSCC), the Department of Agriculture (USDA), the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the National Institutes of Health (NIH), the National Science Foundation (NSF), and the Occupational Safety and Health Administration (OSHA) that the policies contained herein be effective immediately. In consideration of comments, modifications, if any, may be published either in a separate notice or as part of proposed rulemaking by the involved agencies.

Transformación de discos de hoja mediante infección con *A. tumefaciens*



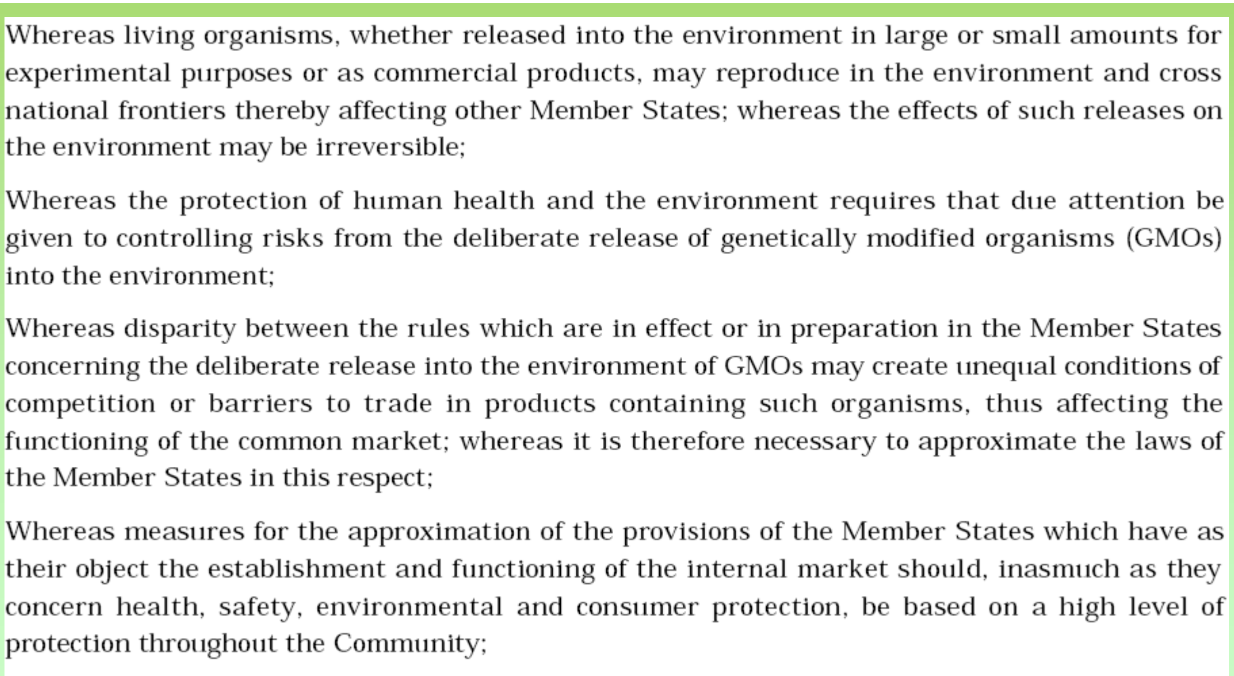
Directiva Europea 90/220



Council Directive 90/220/EEC of 23 April 1990 on the deliberate release into the environment of genetically modified organisms

(JO No L 117 du 8. 5. 1990, p. 15)

(This Directive was modified by Commission Directive 94/15/EC of 15 April 1994 introducing an adaptation of Annex II for releases of genetically modified higher plants (OJ No L 103, 22. 4. 1994, p. 20)

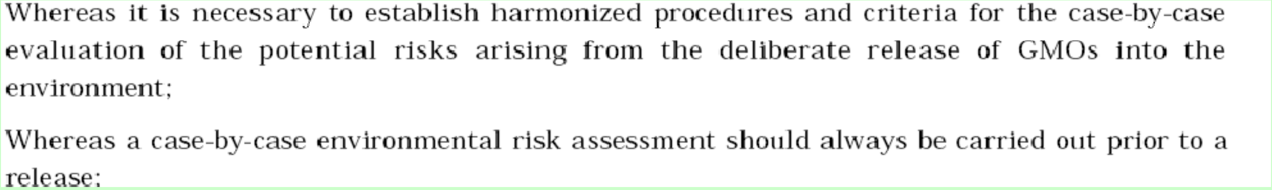


Whereas living organisms, whether released into the environment in large or small amounts for experimental purposes or as commercial products, may reproduce in the environment and cross national frontiers thereby affecting other Member States; whereas the effects of such releases on the environment may be irreversible;

Whereas the protection of human health and the environment requires that due attention be given to controlling risks from the deliberate release of genetically modified organisms (GMOs) into the environment;

Whereas disparity between the rules which are in effect or in preparation in the Member States concerning the deliberate release into the environment of GMOs may create unequal conditions of competition or barriers to trade in products containing such organisms, thus affecting the functioning of the common market; whereas it is therefore necessary to approximate the laws of the Member States in this respect;

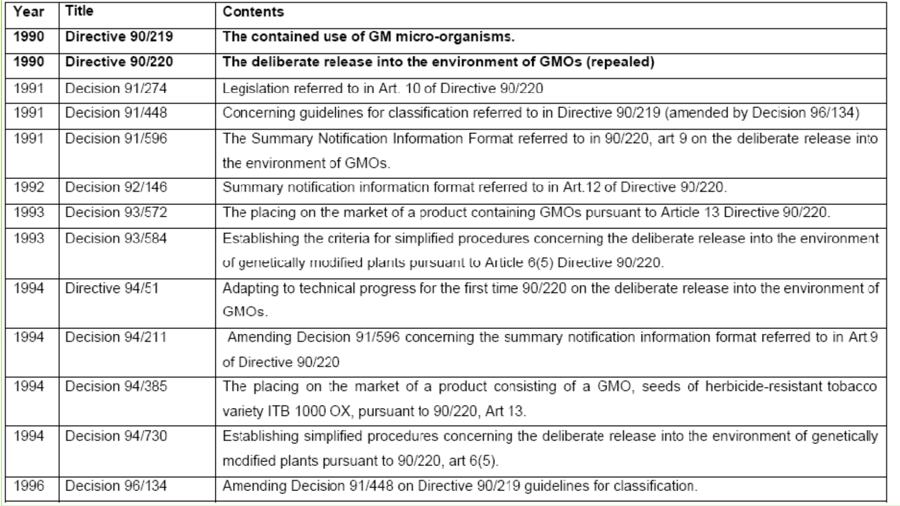
Whereas measures for the approximation of the provisions of the Member States which have as their object the establishment and functioning of the internal market should, inasmuch as they concern health, safety, environmental and consumer protection, be based on a high level of protection throughout the Community;



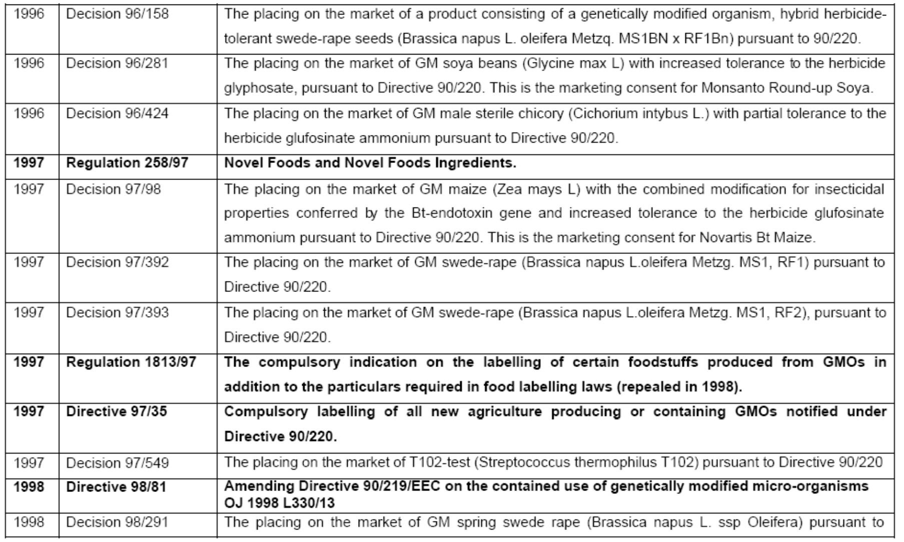
Whereas it is necessary to establish harmonized procedures and criteria for the case-by-case evaluation of the potential risks arising from the deliberate release of GMOs into the environment;

Whereas a case-by-case environmental risk assessment should always be carried out prior to a release;

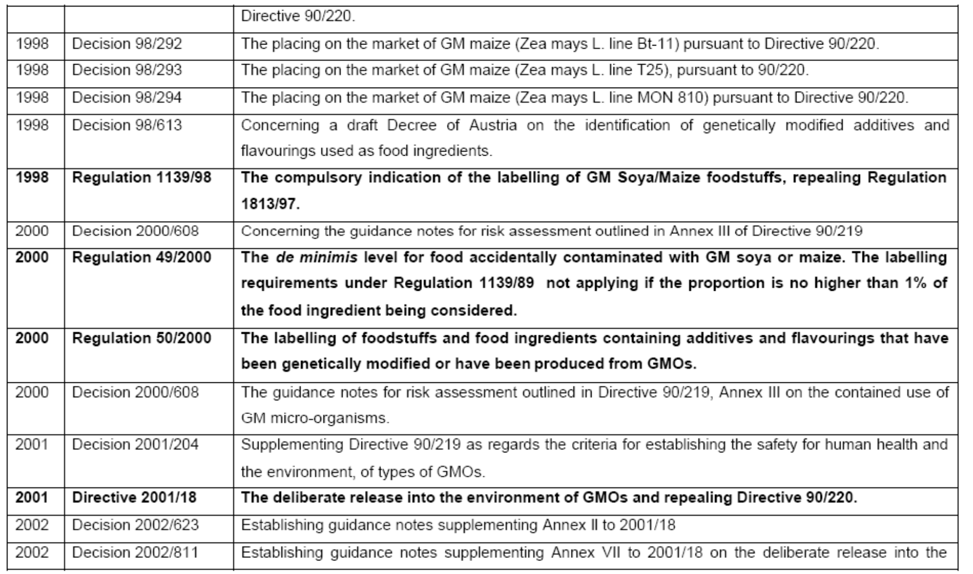
Una larga historia



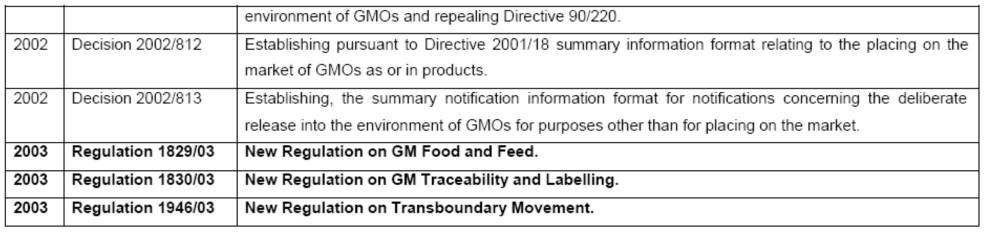
Year	Title	Contents
1990	**Directive 90/219**	**The contained use of GM micro-organisms.**
1990	**Directive 90/220**	**The deliberate release into the environment of GMOs (repealed)**
1991	Decision 91/274	Legislation referred to in Art. 10 of Directive 90/220
1991	Decision 91/448	Concerning guidelines for classification referred to in Directive 90/219 (amended by Decision 96/134)
1991	Decision 91/596	The Summary Notification Information Format referred to in 90/220, art 9 on the deliberate release into the environment of GMOs.
1992	Decision 92/146	Summary notification information format referred to in Art.12 of Directive 90/220.
1993	Decision 93/572	The placing on the market of a product containing GMOs pursuant to Article 13 Directive 90/220.
1993	Decision 93/584	Establishing the criteria for simplified procedures concerning the deliberate release into the environment of genetically modified plants pursuant to Article 6(5) Directive 90/220.
1994	Directive 94/51	Adapting to technical progress for the first time 90/220 on the deliberate release into the environment of GMOs.
1994	Decision 94/211	Amending Decision 91/596 concerning the summary notification information format referred to in Art 9 of Directive 90/220
1994	Decision 94/385	The placing on the market of a product consisting of a GMO, seeds of herbicide-resistant tobacco variety ITB 1000 OX, pursuant to 90/220, Art 13.
1994	Decision 94/730	Establishing simplified procedures concerning the deliberate release into the environment of genetically modified plants pursuant to 90/220, art 6(5).
1996	Decision 96/134	Amending Decision 91/448 on Directive 90/219 guidelines for classification.



1996	Decision 96/158	The placing on the market of a product consisting of a genetically modified organism, hybrid herbicide-tolerant swede-rape seeds (Brassica napus L. oleifera Metzg. MS1BN x RF1Bn) pursuant to 90/220.
1996	Decision 96/281	The placing on the market of GM soya beans (Glycine max L) with increased tolerance to the herbicide glyphosate, pursuant to Directive 90/220. This is the marketing consent for Monsanto Round-up Soya.
1996	Decision 96/424	The placing on the market of GM male sterile chicory (Cichorium intybus L.) with partial tolerance to the herbicide glufosinate ammonium pursuant to Directive 90/220.
1997	**Regulation 258/97**	**Novel Foods and Novel Foods Ingredients.**
1997	Decision 97/98	The placing on the market of GM maize (Zea mays L) with the combined modification for insecticidal properties conferred by the Bt-endotoxin gene and increased tolerance to the herbicide glufosinate ammonium pursuant to Directive 90/220. This is the marketing consent for Novartis Bt Maize.
1997	Decision 97/392	The placing on the market of GM swede-rape (Brassica napus L.oleifera Metzg. MS1, RF1) pursuant to Directive 90/220.
1997	Decision 97/393	The placing on the market of GM swede-rape (Brassica napus L.oleifera Metzg. MS1, RF2), pursuant to Directive 90/220.
1997	**Regulation 1813/97**	**The compulsory indication on the labelling of certain foodstuffs produced from GMOs in addition to the particulars required in food labelling laws (repealed in 1998).**
1997	**Directive 97/35**	**Compulsory labelling of all new agriculture producing or containing GMOs notified under Directive 90/220.**
1997	Decision 97/549	The placing on the market of T102-test (Streptococcus thermophilus T102) pursuant to Directive 90/220
1998	**Directive 98/81**	**Amending Directive 90/219/EEC on the contained use of genetically modified micro-organisms OJ 1998 L330/13**
1998	Decision 98/291	The placing on the market of GM spring swede rape (Brassica napus L. ssp Oleifera) pursuant to

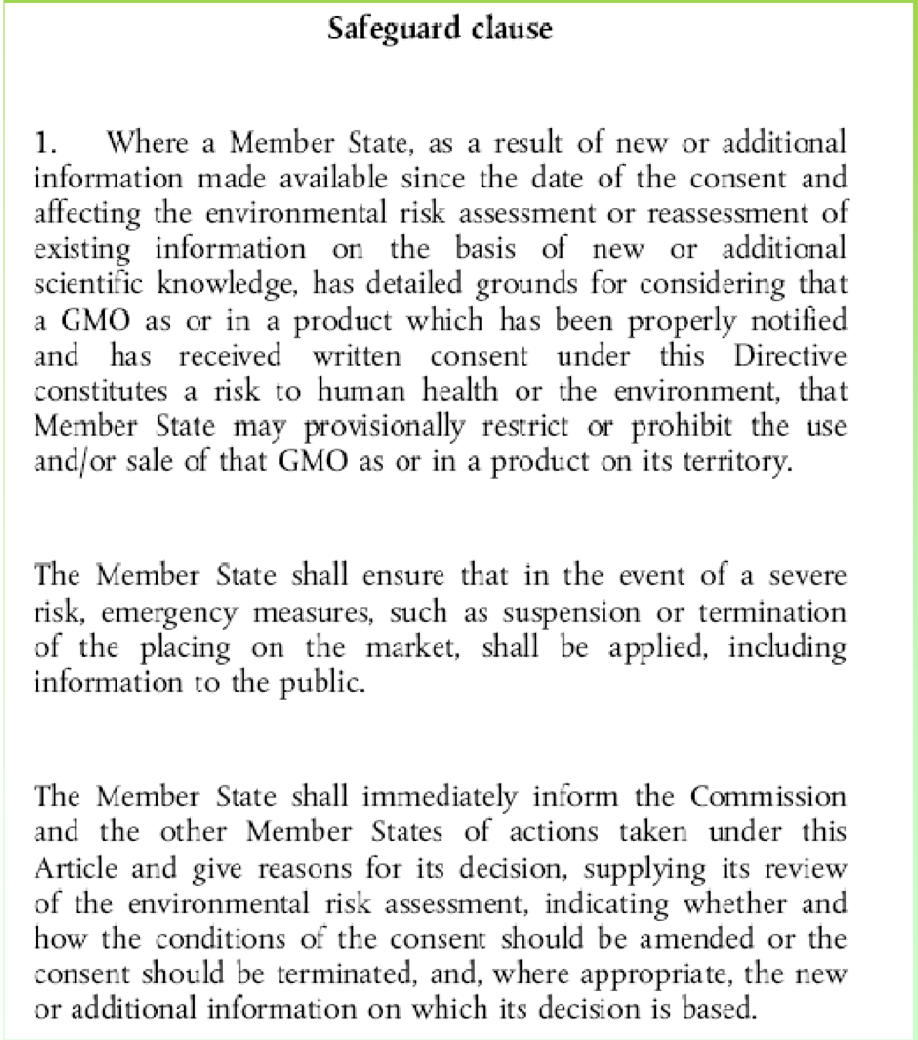


		Directive 90/220.
1998	Decision 98/292	The placing on the market of GM maize (Zea mays L. line Bt-11) pursuant to Directive 90/220.
1998	Decision 98/293	The placing on the market of GM maize (Zea mays L. line T25), pursuant to 90/220.
1998	Decision 98/294	The placing on the market of GM maize (Zea mays L. line MON 810) pursuant to Directive 90/220.
1998	Decision 98/613	Concerning a draft Decree of Austria on the identification of genetically modified additives and flavourings used as food ingredients.
1998	**Regulation 1139/98**	**The compulsory indication of the labelling of GM Soya/Maize foodstuffs, repealing Regulation 1813/97.**
2000	Decision 2000/608	Concerning the guidance notes for risk assessment outlined in Annex III of Directive 90/219
2000	**Regulation 49/2000**	**The *de minimis* level for food accidentally contaminated with GM soya or maize. The labelling requirements under Regulation 1139/89 not applying if the proportion is no higher than 1% of the food ingredient being considered.**
2000	**Regulation 50/2000**	**The labelling of foodstuffs and food ingredients containing additives and flavourings that have been genetically modified or have been produced from GMOs.**
2000	Decision 2000/608	The guidance notes for risk assessment outlined in Directive 90/219, Annex III on the contained use of GM micro-organisms.
2001	Decision 2001/204	Supplementing Directive 90/219 as regards the criteria for establishing the safety for human health and the environment, of types of GMOs.
2001	**Directive 2001/18**	**The deliberate release into the environment of GMOs and repealing Directive 90/220.**
2002	Decision 2002/623	Establishing guidance notes supplementing Annex II to 2001/18
2002	Decision 2002/811	Establishing guidance notes supplementing Annex VII to 2001/18 on the deliberate release into the



		environment of GMOs and repealing Directive 90/220.
2002	Decision 2002/812	Establishing pursuant to Directive 2001/18 summary information format relating to the placing on the market of GMOs as or in products.
2002	Decision 2002/813	Establishing, the summary notification information format for notifications concerning the deliberate release into the environment of GMOs for purposes other than for placing on the market.
2003	**Regulation 1829/03**	**New Regulation on GM Food and Feed.**
2003	**Regulation 1830/03**	**New Regulation on GM Traceability and Labelling.**
2003	**Regulation 1946/03**	**New Regulation on Transboundary Movement.**

Aplicación de la directiva 2001/18

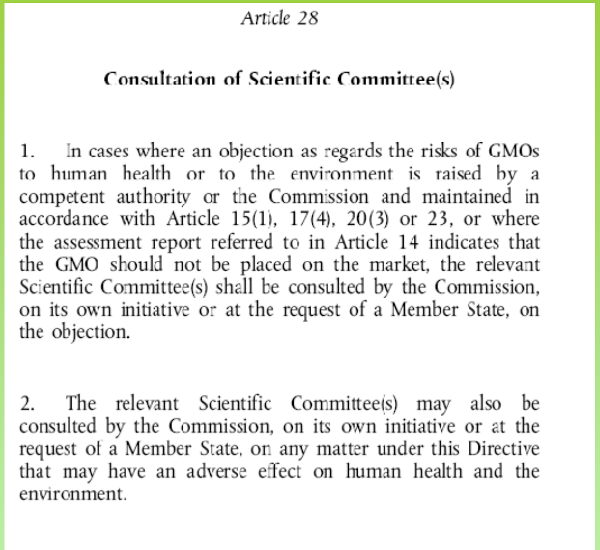


Safeguard clause

1. Where a Member State, as a result of new or additional information made available since the date of the consent and affecting the environmental risk assessment or reassessment of existing information on the basis of new or additional scientific knowledge, has detailed grounds for considering that a GMO as or in a product which has been properly notified and has received written consent under this Directive constitutes a risk to human health or the environment, that Member State may provisionally restrict or prohibit the use and/or sale of that GMO as or in a product on its territory.

The Member State shall ensure that in the event of a severe risk, emergency measures, such as suspension or termination of the placing on the market, shall be applied, including information to the public.

The Member State shall immediately inform the Commission and the other Member States of actions taken under this Article and give reasons for its decision, supplying its review of the environmental risk assessment, indicating whether and how the conditions of the consent should be amended or the consent should be terminated, and, where appropriate, the new or additional information on which its decision is based.

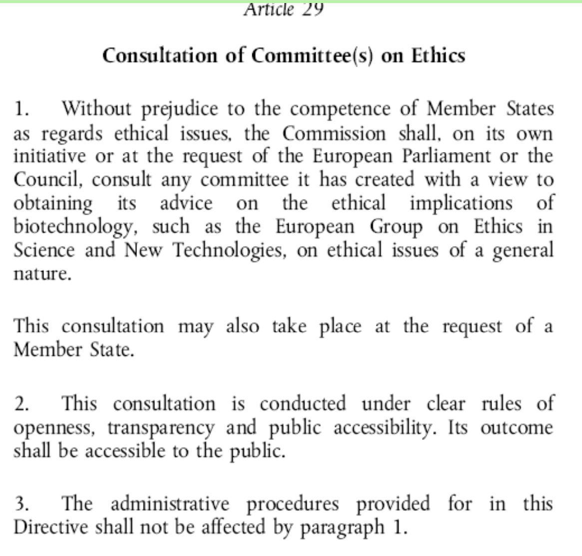


Article 28

Consultation of Scientific Committee(s)

1. In cases where an objection as regards the risks of GMOs to human health or to the environment is raised by a competent authority or the Commission and maintained in accordance with Article 15(1), 17(4), 20(3) or 23, or where the assessment report referred to in Article 14 indicates that the GMO should not be placed on the market, the relevant Scientific Committee(s) shall be consulted by the Commission, on its own initiative or at the request of a Member State, on the objection.

2. The relevant Scientific Committee(s) may also be consulted by the Commission, on its own initiative or at the request of a Member State, on any matter under this Directive that may have an adverse effect on human health and the environment.



Article 29

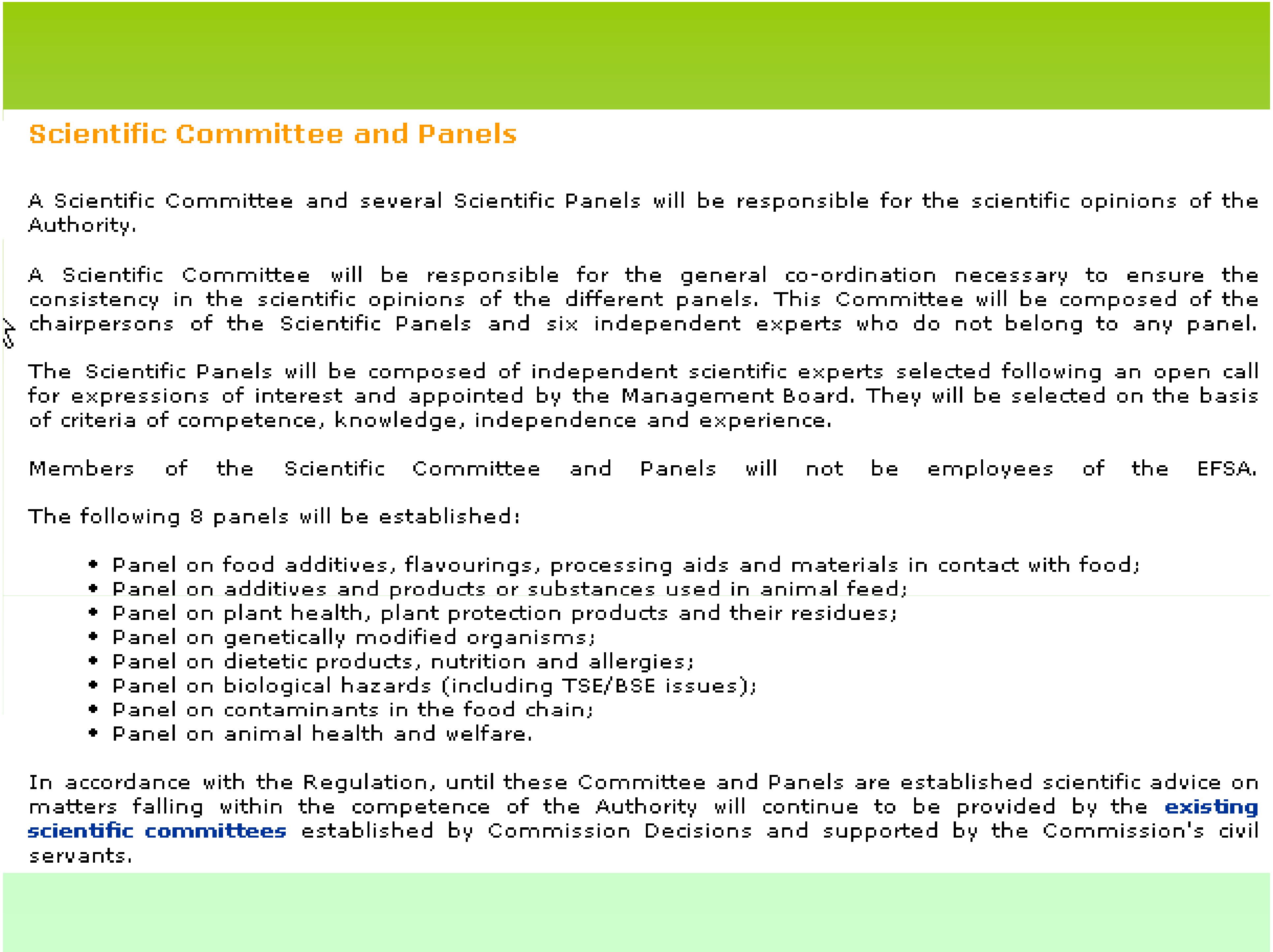
Consultation of Committee(s) on Ethics

1. Without prejudice to the competence of Member States as regards ethical issues, the Commission shall, on its own initiative or at the request of the European Parliament or the Council, consult any committee it has created with a view to obtaining its advice on the ethical implications of biotechnology, such as the European Group on Ethics in Science and New Technologies, on ethical issues of a general nature.

This consultation may also take place at the request of a Member State.

2. This consultation is conducted under clear rules of openness, transparency and public accessibility. Its outcome shall be accessible to the public.

3. The administrative procedures provided for in this Directive shall not be affected by paragraph 1.



Scientific Committee and Panels

A Scientific Committee and several Scientific Panels will be responsible for the scientific opinions of the Authority.

A Scientific Committee will be responsible for the general co-ordination necessary to ensure the consistency in the scientific opinions of the different panels. This Committee will be composed of the chairpersons of the Scientific Panels and six independent experts who do not belong to any panel.

The Scientific Panels will be composed of independent scientific experts selected following an open call for expressions of interest and appointed by the Management Board. They will be selected on the basis of criteria of competence, knowledge, independence and experience.

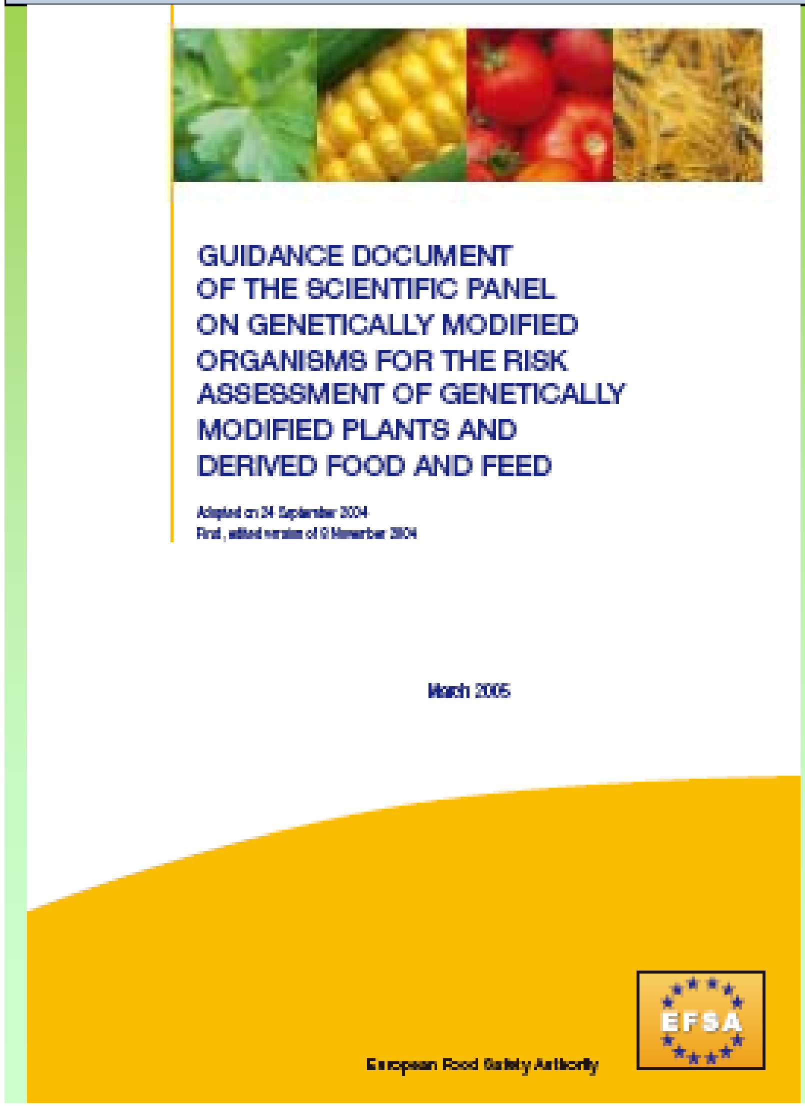
Members of the Scientific Committee and Panels will not be employees of the EFSA.

The following 8 panels will be established:

- Panel on food additives, flavourings, processing aids and materials in contact with food;
- Panel on additives and products or substances used in animal feed;
- Panel on plant health, plant protection products and their residues;
- Panel on genetically modified organisms;
- Panel on dietetic products, nutrition and allergies;
- Panel on biological hazards (including TSE/BSE issues);
- Panel on contaminants in the food chain;
- Panel on animal health and welfare.

In accordance with the Regulation, until these Committee and Panels are established scientific advice on matters falling within the competence of the Authority will continue to be provided by the **existing scientific committees** established by Commission Decisions and supported by the Commission's civil servants.

Guía de EFSA para el análisis del riesgo asociado a las plantas transgénicas y productos derivados para consumo animal o humano



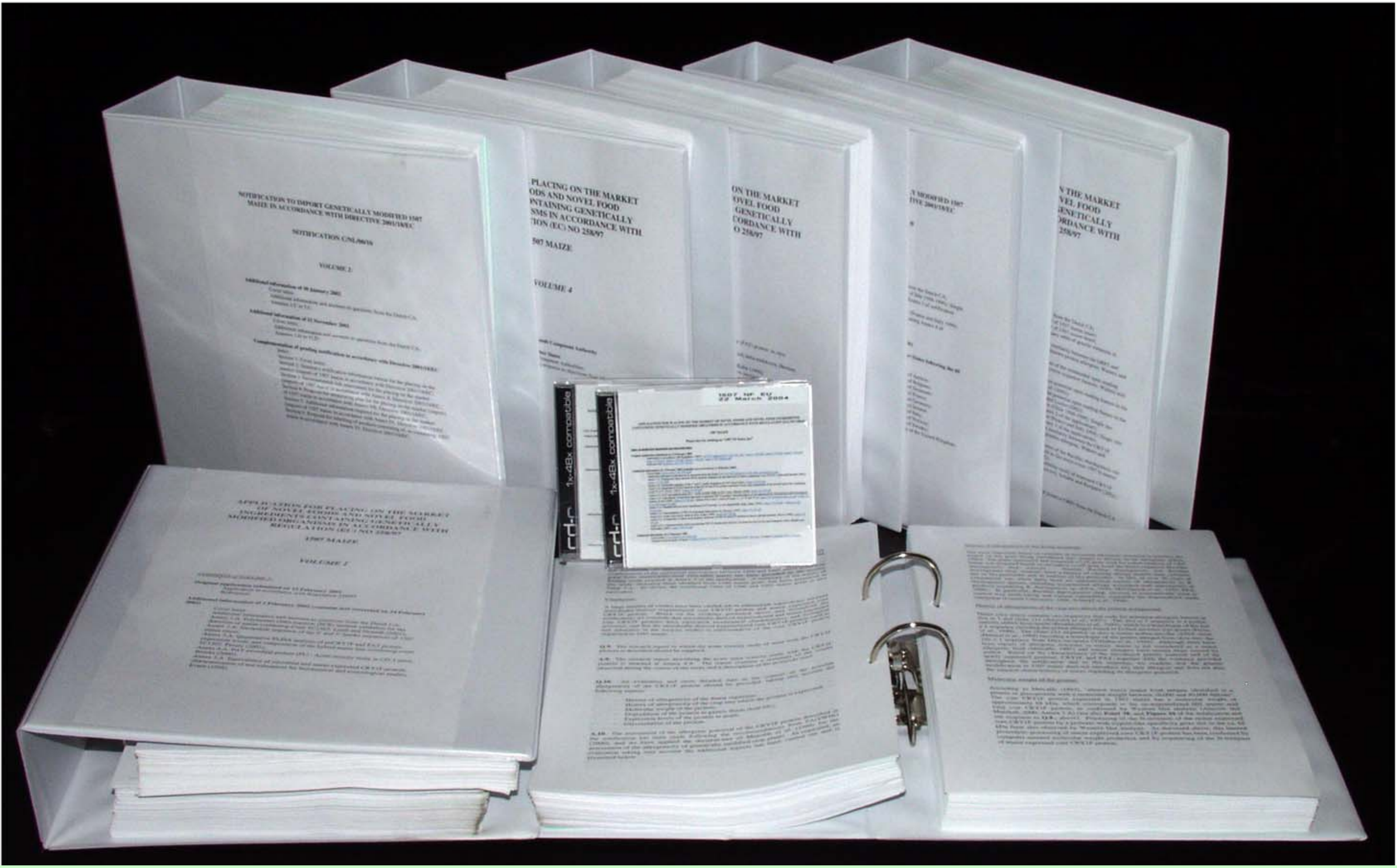
GUIDANCE DOCUMENT
OF THE SCIENTIFIC PANEL
ON GENETICALLY MODIFIED
ORGANISMS FOR THE RISK
ASSESSMENT OF GENETICALLY
MODIFIED PLANTS AND
DERIVED FOOD AND FEED

Adopted on 24 September 2004
First, edited version of 9 November 2004

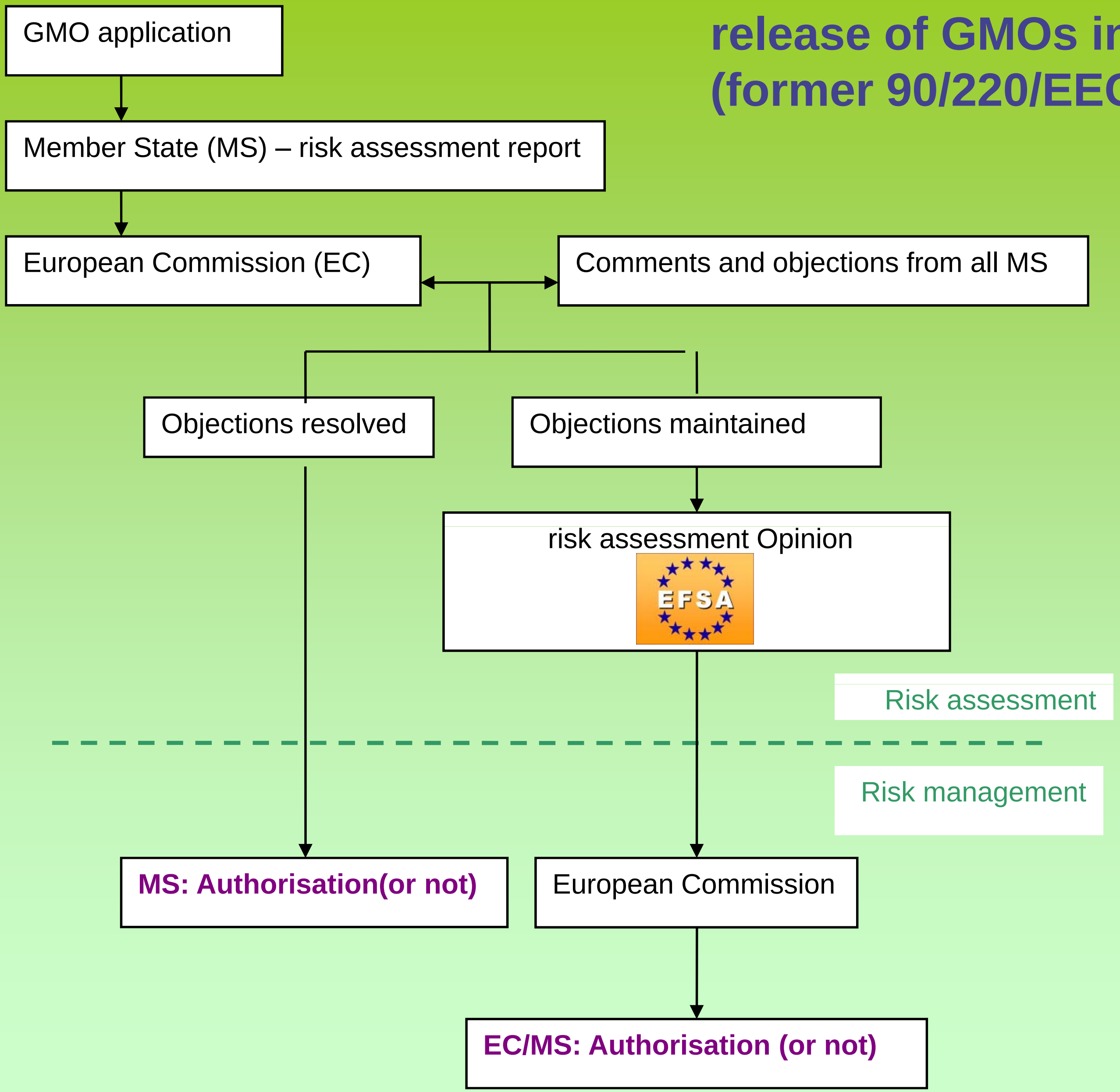
March 2005

European Food Safety Authority

- Adoptada el 24 de septiembre de 2004,
- Revisada el deciembre 2005 (PMEM)
- Nueva revisión en curso (2008)
- Completada
  - Diciembre 2006 (Renovaciones)
  - Marzo 2007 (Eventos combinados)


NOTIFICATION TO IMPORT GENETICALLY MODIFIED 1507 MAIZE IN ACCORDANCE WITH DIRECTIVE 2001/18/EC
VOLUME 2
APPLICATION FOR PLACING ON THE MARKET OF NOVEL FOODS AND NOVEL FOOD INGREDIENTS CONTAINING GENETICALLY MODIFIED ORGANISMS IN ACCORDANCE WITH REGULATION (EC) NO 258/97
1507 MAIZE
VOLUME 1
VOLUME 4
1x-48x compatible
1507 NF EU
22 March 2004

Directive 2001/18/EC – deliberate release of GMOs into environment (former 90/220/EEC)



GMO application

Member State (MS) – risk assessment report

European Commission (EC)

Comments and objections from all MS

Objections resolved

Objections maintained

risk assessment Opinion

EFSA

Risk assessment

Risk management

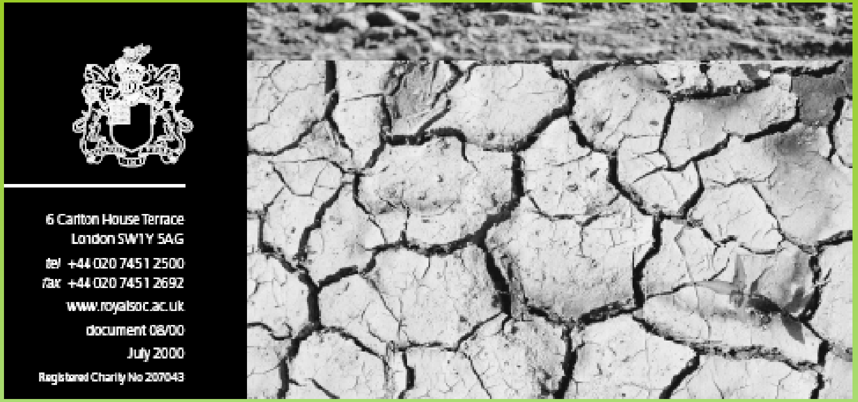
MS: Authorisation(or not)

European Commission

EC/MS: Authorisation (or not)

Brazilian Academy of Sciences
Chinese Academy of Sciences
Indian National Science Academy
Mexican Academy of Sciences
National Academy of Sciences of the USA
The Royal Society (UK)
The Third World Academy of Sciences

Transgenic plants and world agriculture



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document 08/00
July 2000
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2 Summary

2.1 It is essential that we improve food production and distribution in order to feed and free from hunger a growing world population, while reducing environmental impacts and providing productive employment in low-income areas. This will require a proper and responsible utilisation of scientific discoveries and new technologies. The developers and overseers of GM technology applied to plants and micro-organisms should make sure that their efforts address such needs.

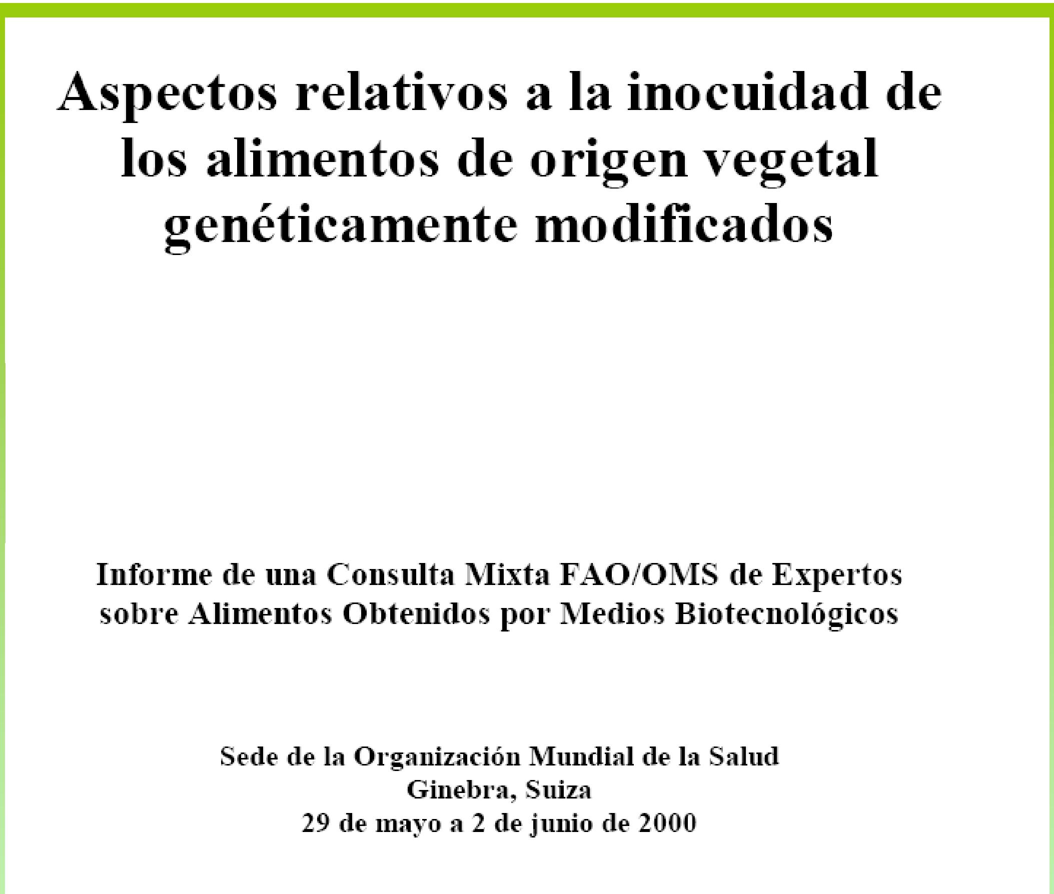
2.2 Foods can be produced through the use of GM technology that are more nutritious, stable in storage and in principle, health promoting - bringing benefits to consumers in both industrialised and developing nations.

2.3 New public sector efforts are required for creating transgenic crops that benefit poor farmers in developing nations and improve their access to food through employment-intensive production of staples such as maize, rice, wheat, cassava, yams, sorghum, plantains and sweet potatoes. Cooperative efforts between the private and public sectors are needed to develop new transgenic crops that benefit consumers, especially in the developing world.

2.4 Concerted, organised efforts must be undertaken to investigate the potential environmental effects, both positive and negative, of GM technologies in their specific applications. These must be assessed against the background of effects from conventional agricultural technologies that are currently in use.

2.5 Public health regulatory systems need to be put in place in every country to identify and monitor any potential adverse human health effects of transgenic plants, as for any other new variety.

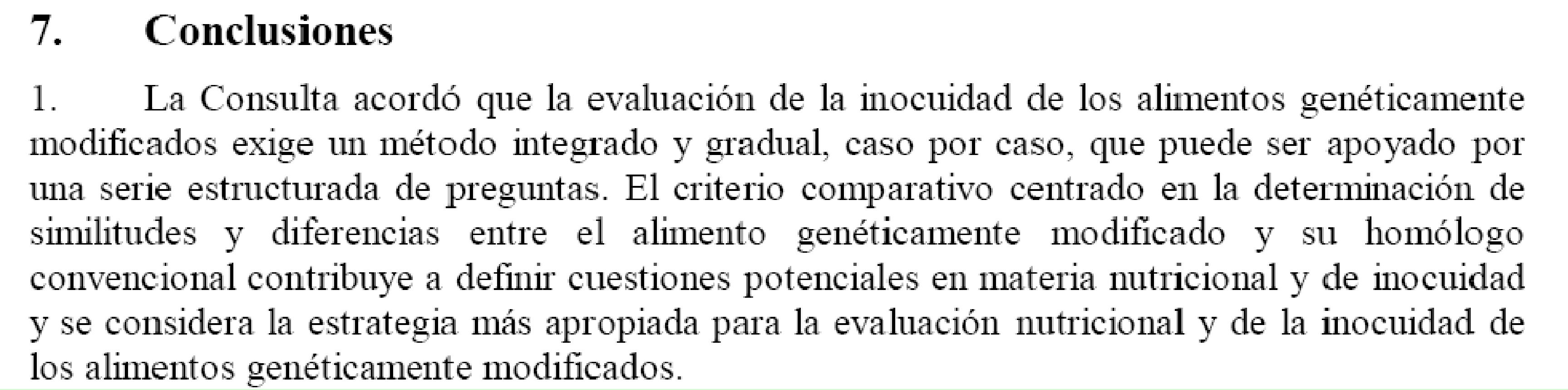
2.6 Private corporations and research institutions should make arrangements to share GM technology, now held under strict patents and licensing agreements, with responsible scientists for use for hunger alleviation and to enhance food security in developing countries. In addition, special exemptions should be given to the world's poor farmers to protect them from inappropriate restrictions in propagating their crops.



Aspectos relativos a la inocuidad de los alimentos de origen vegetal genéticamente modificados

Informe de una Consulta Mixta FAO/OMS de Expertos sobre Alimentos Obtenidos por Medios Biotecnológicos

Sede de la Organización Mundial de la Salud
Ginebra, Suiza
29 de mayo a 2 de junio de 2000



7. Conclusiones

1. La Consulta acordó que la evaluación de la inocuidad de los alimentos genéticamente modificados exige un método integrado y gradual, caso por caso, que puede ser apoyado por una serie estructurada de preguntas. El criterio comparativo centrado en la determinación de similitudes y diferencias entre el alimento genéticamente modificado y su homólogo convencional contribuye a definir cuestiones potenciales en materia nutricional y de inocuidad y se considera la estrategia más apropiada para la evaluación nutricional y de la inocuidad de los alimentos genéticamente modificados.

Legislación sobre etiquetado

- Se necesitan métodos para la detección de plantas modificadas genéticamente

Examples of samples analyzed

Productos en los que se ha detectado DNA del inserto

Maiz

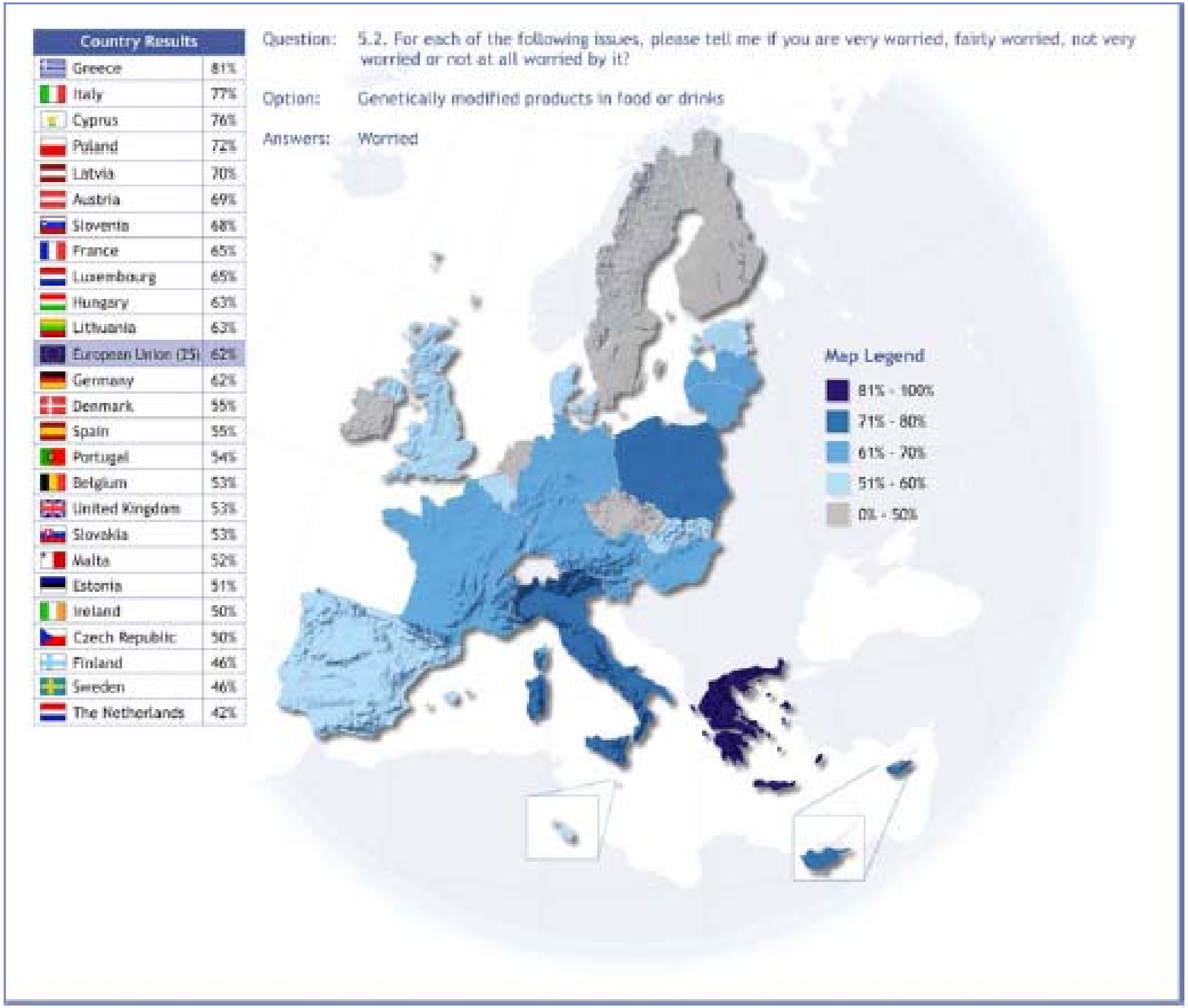
- Grano de maíz
- Harina de maíz
- Harinas mezcladas (con trigo y arroz)
- Maíz dulce en grano
- Sémola
- Polenta
- Papilla infantil
- Carne picada
- Crema de champiñones
- Cacao en polvo
- Cereales extrudados
- Maíz frito
- Fritos
- Palomitas
- Barquillo
- Aceite crudo
- Galletas
- Pan rallado
- Magdalenas
- Cobertura
- Crema de licor
- Almidones
- Fécula de maíz
- Sorbitol
- Gluten
- Glucosa atomizada
- Dextrosa
- Extracto de malta
- Fructosa
- Colorante (especia con harina de maíz)
- Cervezas
- Tomate tipo “ketchup”

Soja

- Habas de soja
- Aislado de soja
- Lecitina
- Concentrados proteicos
- Proteína texturizada
- Complementos dietéticos
- Papilla infantil
- Embutidos
- Carne picada
- Galletas
- Paté
- Extractos enriquecidos en vitaminas o esteroides
- Aceite crudo

A pesar de ello…

Eurobarómetro 2006



Question: 5.2. For each of the following issues, please tell me if you are very worried, fairly worried, not very worried or not at all worried by it?

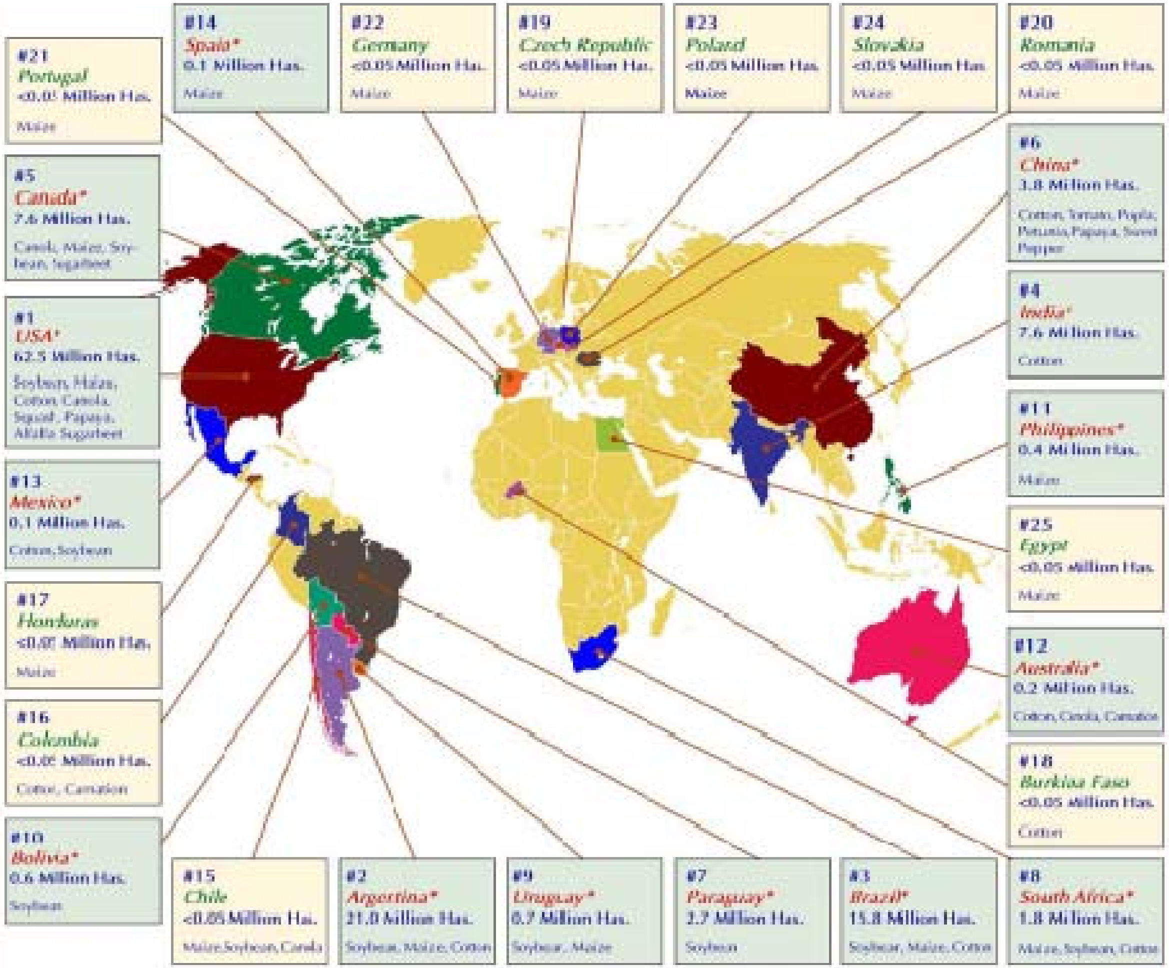
Option: Genetically modified products in food or drinks

Answers: Worried

Country Results	
Greece	81%
Italy	77%
Cyprus	76%
Poland	72%
Latvia	70%
Austria	69%
Slovenia	68%
France	65%
Luxembourg	65%
Hungary	63%
Lithuania	63%
European Union (25)	62%
Germany	62%
Denmark	55%
Spain	55%
Portugal	54%
Belgium	53%
United Kingdom	53%
Slovakia	53%
Malta	52%
Estonia	51%
Ireland	50%
Czech Republic	50%
Finland	46%
Sweden	46%
The Netherlands	42%

Situación en 2008

Biotech Crop Countries and Mega-Countries*, 2008

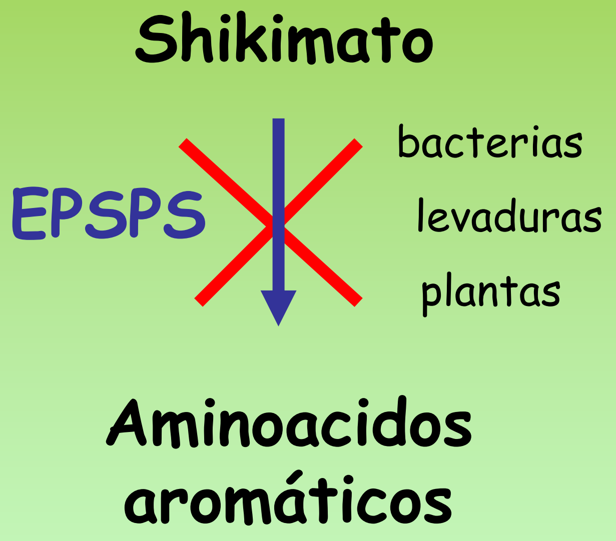


🟩 * 14 biotech mega-countries growing 50,000 hectares, or more, of biotech crops.

Source: Clive James, 2008.

Plantas resistentes a herbicidas

maiz (GA21), soja (GTS40-3-2), colza (GT73), algodón (MON14451698)



Shikimato

EPSPS

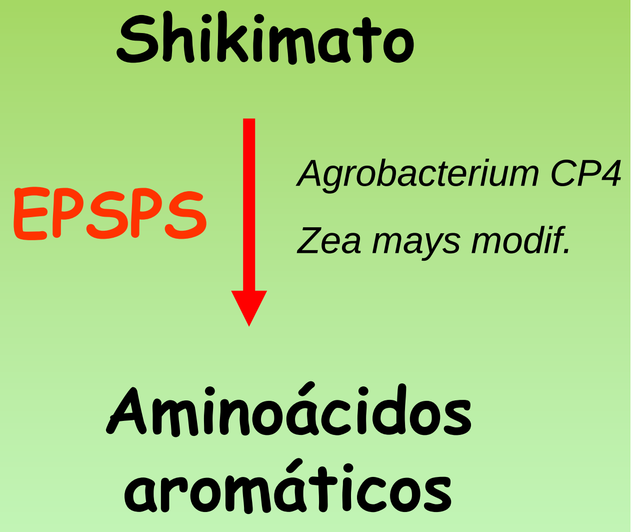
bacterias

levaduras

plantas

Aminoacidos aromáticos

Source: Monsanto



Shikimato

EPSPS

Agrobacterium CP4

Zea mays modif.

Aminoácidos aromáticos

Glifosato (Roundup®)

EPSPS: 5-enolpyruvylshikimate-3-phosphate synthase

Resistentes a insectos

maize Bt176, Bt11, YieldGard ® and cotton Bollgard ®

Bt protein crystals
Bacillus thuringiensis

Caterpillar-like insect larvae
Ostrinia nubilalis y *Sesamia nonagrioides*

cry IA(b)

↓

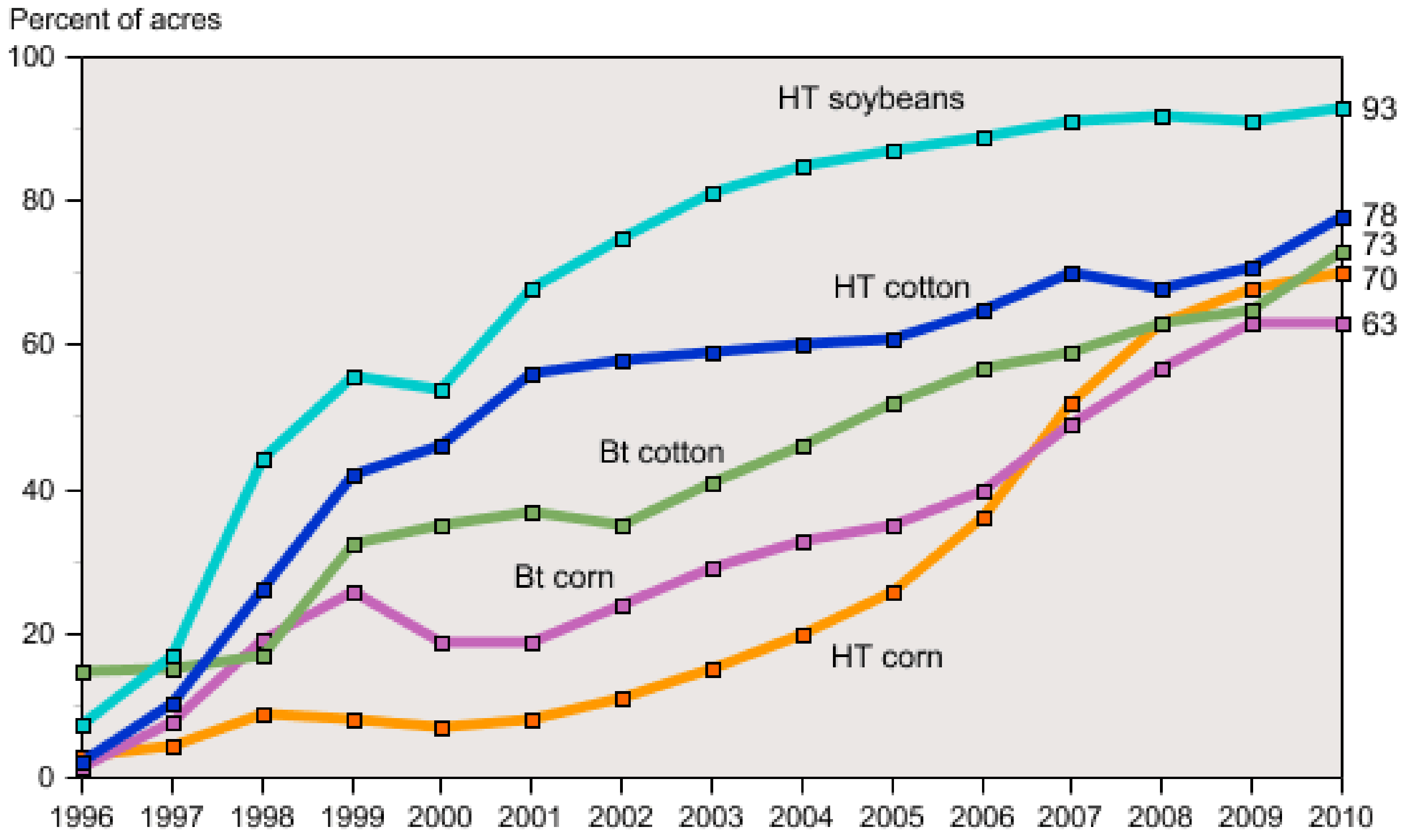
Bt protein
(δ-endotoxin)

↓

Binding to specific insect receptors causes paralysis of the digestive system

Datos para 2010. USA

Rapid growth in adoption of genetically engineered crops continues in the U.S.



Data for each crop category include varieties with both HT and Bt (stacked) traits.
Sources: 1996-1999 data are from Fernandez-Cornejo and McBride (2002). Data for 2000-10 are available in the ERS data product, Adoption of Genetically Engineered Crops in the U.S., tables 1-3.

Modificaciones de los aceites

Product Pipeline: *Vistive Soybeans*

Vistive™
a better soybean oil, naturally

Vistive™ soybeans represent the first of several food quality traits being developed by Monsanto to directly benefit consumers. Our robust pipeline of these in-demand products can help meet the needs of food companies and provide consumers with *healthier choices for years to come.*

Monsanto's advanced soybean breeding efforts enable development of foods that can deliver such benefits as improved nutrition, taste and choice. And all of these *quality improvements* are placed into seed with performance traits that help reduce the cost of production and make them more affordable for food manufacturing.

NOW AVAILABLE

Vistive Low-Linolenic Soybeans

Low-linolenic oil reduces the need for hydrogenation, lowering or eliminating trans fats from foods.

MID-TERM AVAILABILITY

Vistive High-Stearate

High-Stearate oil offers a healthier solution for food products that require solid fat for functionality such as margarines and shortenings.

Vistive Low-Linolenic Mid-Oleic

Low-linolenic mid-oleic oil increases oxidative stability, improves shelf life and flavor.

LONG-TERM AVAILABILITY

Vistive Low-Linolenic Mid-Oleic Low Saturates

Soybean oil provides a heart-healthy combination of lower saturated fats and increased monounsaturated fat designed to further lower cardiovascular health risk, eliminate trans fats and improve stability.

Vistive Omega-3

Enhanced oils represent an environmentally sustainable, economical source of Omega-3s, providing consumers with new options for omega-rich foods.

Concentración de compañías de semillas

MONSANTO

syngenta
GLOBAL

DUPONT
The miracles of science™

Seminis.

NFC
NEW FARM CROPS

PIONEER.
A DUPONT COMPANY

ASGROW
We Breed Better Beans™

S&G

DEKALB
STRONG ROOTS.
STRONG YIELDS.™

HILLESHÖG®

La discusión sobre las patentes

Biotechnology in European patents - threat or promise?

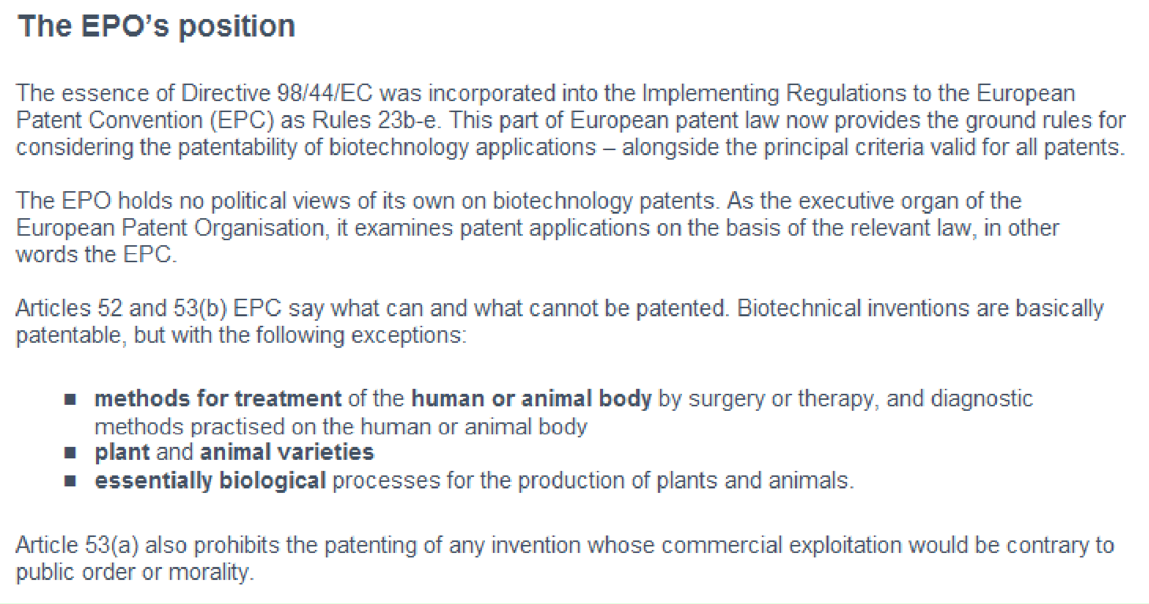
Split views and a growing market

Opinions on patents in this field are divided, with unfettered scientific progress at one end of the spectrum and the basic values accepted by society at the other. While many see an important contribution to social progress, others are mainly concerned by potential risks and ethical questions.

Despite all the disagreement, biotechnology is a growing discipline with a remarkably strong market. In 2006, global turnover was estimated at $60 billion, up 15 per cent from 2005.

This growth is also reflected in the number of biotechnology patents. For several years now, biotechnological inventions have consistently ranked among the ten largest technical fields in terms of patent applications filed with the European Patent Office (EPO).

History in patents



The EPO's position

The essence of Directive 98/44/EC was incorporated into the Implementing Regulations to the European Patent Convention (EPC) as Rules 23b-e. This part of European patent law now provides the ground rules for considering the patentability of biotechnology applications – alongside the principal criteria valid for all patents.

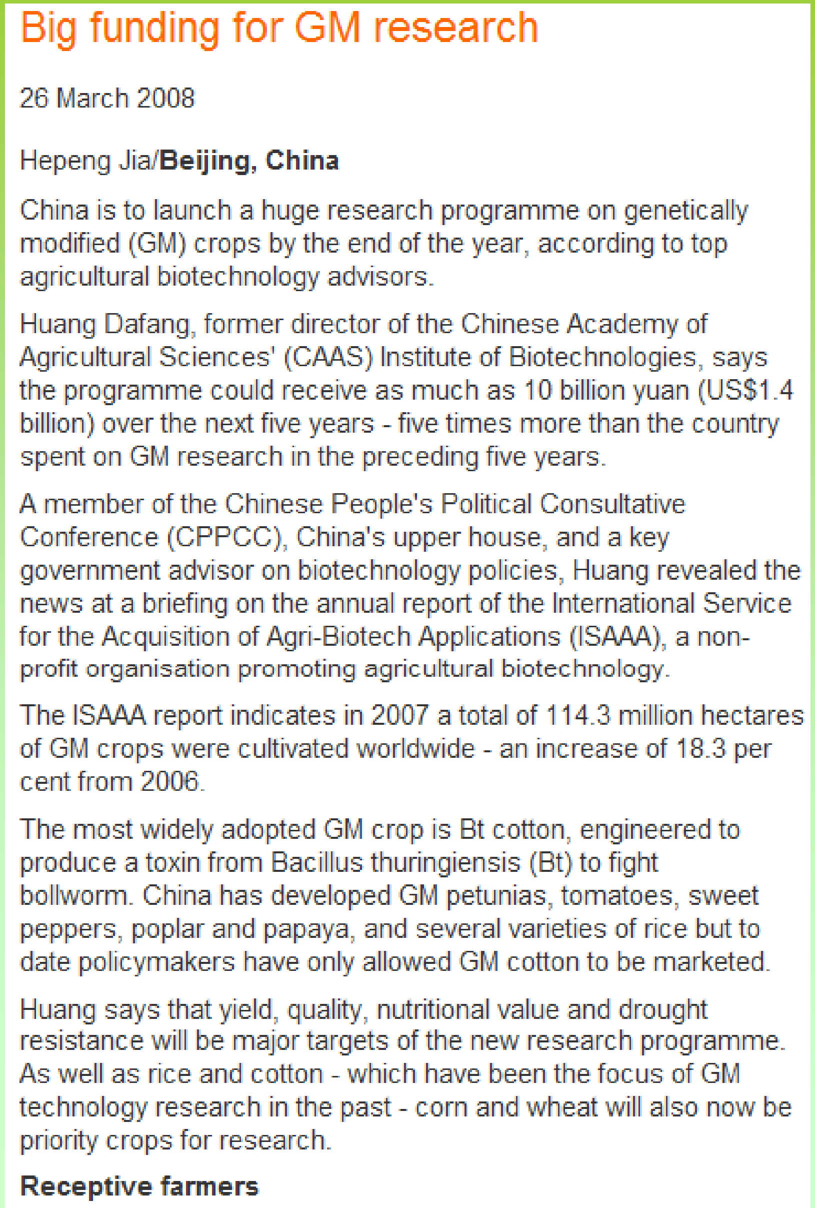
The EPO holds no political views of its own on biotechnology patents. As the executive organ of the European Patent Organisation, it examines patent applications on the basis of the relevant law, in other words the EPC.

Articles 52 and 53(b) EPC say what can and what cannot be patented. Biotechnical inventions are basically patentable, but with the following exceptions:

- **methods for treatment** of the **human or animal body** by surgery or therapy, and diagnostic methods practised on the human or animal body
- **plant** and **animal varieties**
- **essentially biological** processes for the production of plants and animals.

Article 53(a) also prohibits the patenting of any invention whose commercial exploitation would be contrary to public order or morality.

Inversiones en China!



Big funding for GM research

26 March 2008

Hepeng Jia/**Beijing, China**

China is to launch a huge research programme on genetically modified (GM) crops by the end of the year, according to top agricultural biotechnology advisors.

Huang Dafang, former director of the Chinese Academy of Agricultural Sciences' (CAAS) Institute of Biotechnologies, says the programme could receive as much as 10 billion yuan (US$1.4 billion) over the next five years - five times more than the country spent on GM research in the preceding five years.

A member of the Chinese People's Political Consultative Conference (CPPCC), China's upper house, and a key government advisor on biotechnology policies, Huang revealed the news at a briefing on the annual report of the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), a non-profit organisation promoting agricultural biotechnology.

The ISAAA report indicates in 2007 a total of 114.3 million hectares of GM crops were cultivated worldwide - an increase of 18.3 per cent from 2006.

The most widely adopted GM crop is Bt cotton, engineered to produce a toxin from Bacillus thuringiensis (Bt) to fight bollworm. China has developed GM petunias, tomatoes, sweet peppers, poplar and papaya, and several varieties of rice but to date policymakers have only allowed GM cotton to be marketed.

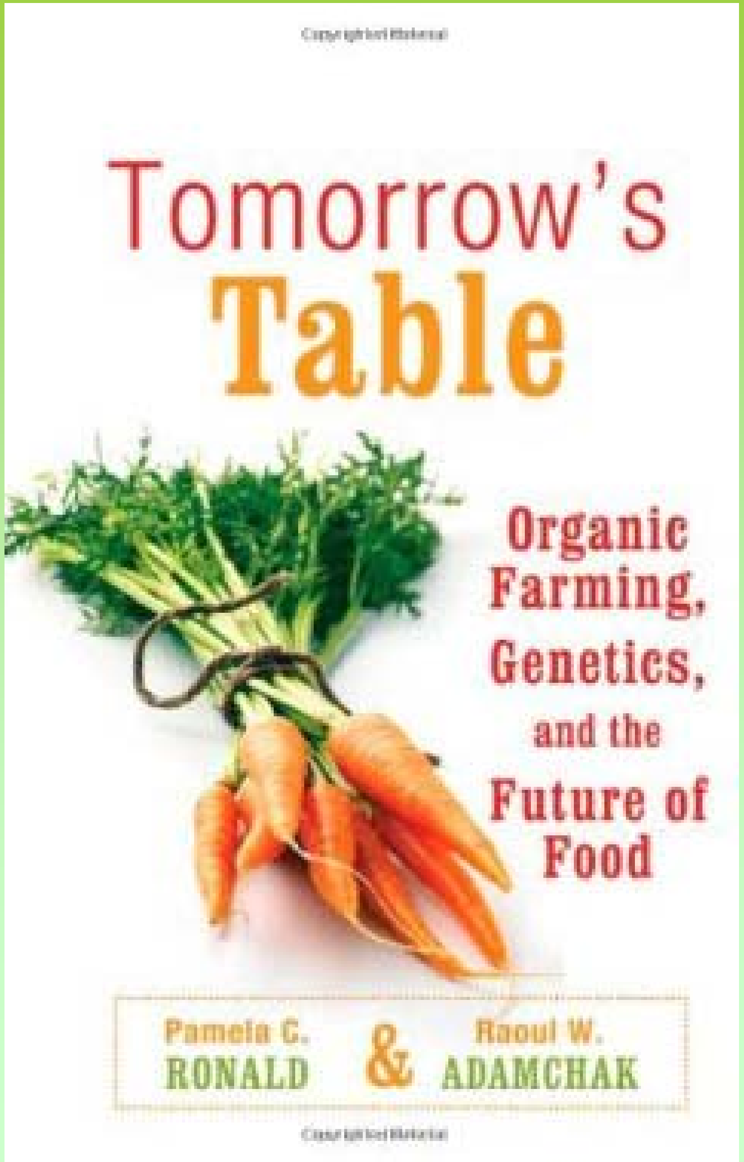
Huang says that yield, quality, nutritional value and drought resistance will be major targets of the new research programme. As well as rice and cotton - which have been the focus of GM technology research in the past - corn and wheat will also now be priority crops for research.

Receptive farmers

Coexistencia

- Recomendación de la Comisión
- de 23 de julio de 2003
- sobre las Directrices para la elaboración de estrategias y mejores prácticas nacionales con el fin de garantizar la coexistencia de los cultivos modificados genéticamente con la agricultura convencional y ecológica
- [notificada con el número C(2003) 2624]
- (2003/556/CE)
- 1. INTRODUCCIÓN
- 1.1. Concepto de coexistencia
- El cultivo de organismos modificados genéticamente (OMG) en la Unión Europea es probable que tenga consecuencias en la organización de la producción agrícola. Por un lado, la posibilidad de la presencia accidental (no intencionada) de cultivos modificados genéticamente (MG) en cultivos que no hayan sufrido esta modificación, y viceversa, plantea la cuestión de cómo se puede asegurar la elección del productor respecto a los diferentes tipos de producción. En principio, los agricultores deberían poder cultivar los tipos de cultivos agrícolas que escojan, ya se trate de cultivos modificados genéticamente, convencionales o ecológicos. Ninguno de estos tipos de agricultura debería excluirse en la Unión Europea.
- Por otro lado, este asunto está relacionado también con la elección de los consumidores. Para que los consumidores europeos puedan disfrutar de una auténtica capacidad de elección entre alimentos modificados genéticamente y alimentos que no hayan sufrido esta modificación, no sólo debería existir un sistema de trazabilidad y etiquetado que funcione correctamente, sino también un sector agrario que pueda suministrar los diferentes tipos de bienes. La capacidad del sector alimentario para ofrecer a los consumidores un elevado grado de elección es paralela a la capacidad del sector agrario de mantener diferentes sistemas de producción.
- La coexistencia se refiere a la capacidad de los agricultores de poder escoger en la práctica entre la producción de cultivos convencionales, ecológicos y modificados genéticamente, en cumplimiento de las obligaciones legales sobre etiquetado y las normas de pureza.

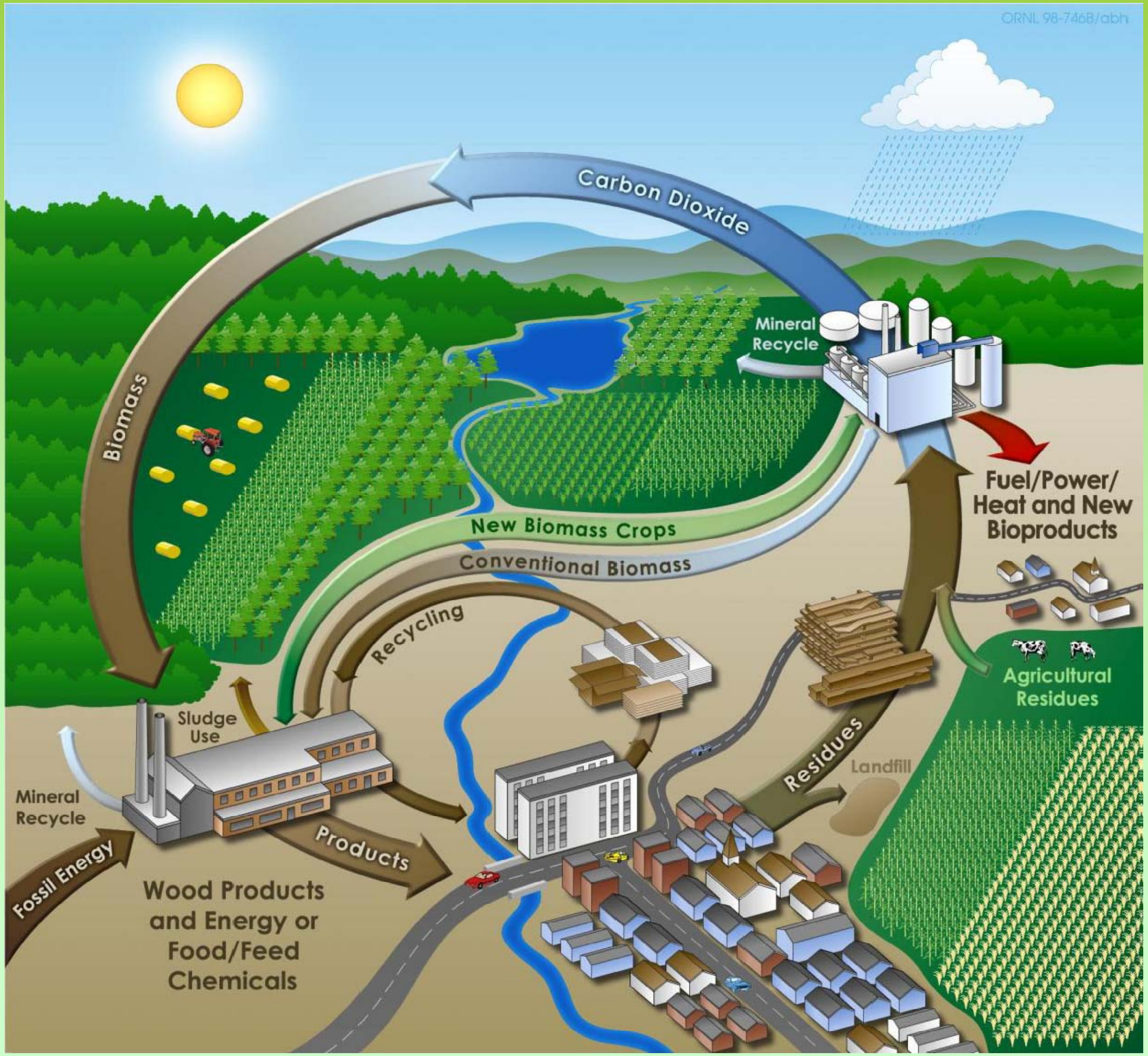
Ecológico + transgénico



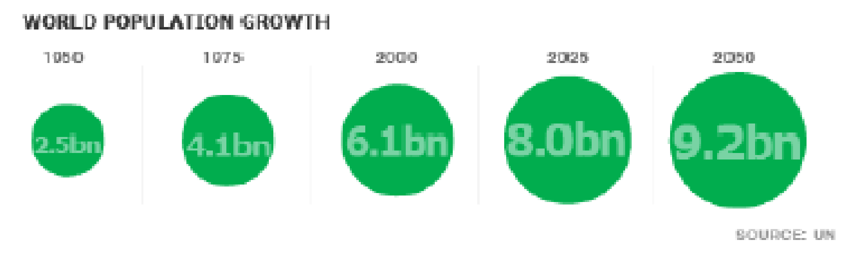
Discusiones actuales en Europa

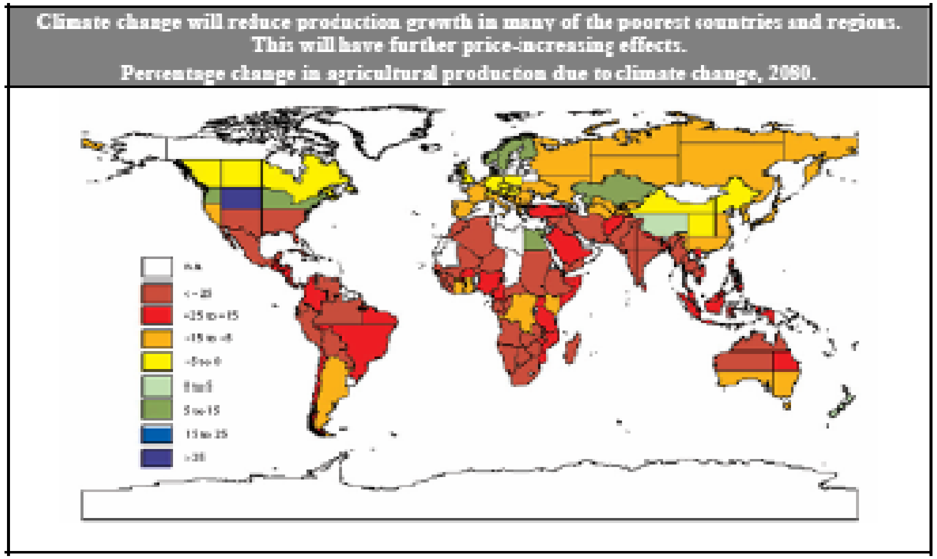
- Decisiones de la Comisión y de los Estados miembros
- Condiciones distintas en casos especiales (cisgénesis, mutagénesis, etc.)

Nuevos usos. Biocombustibles

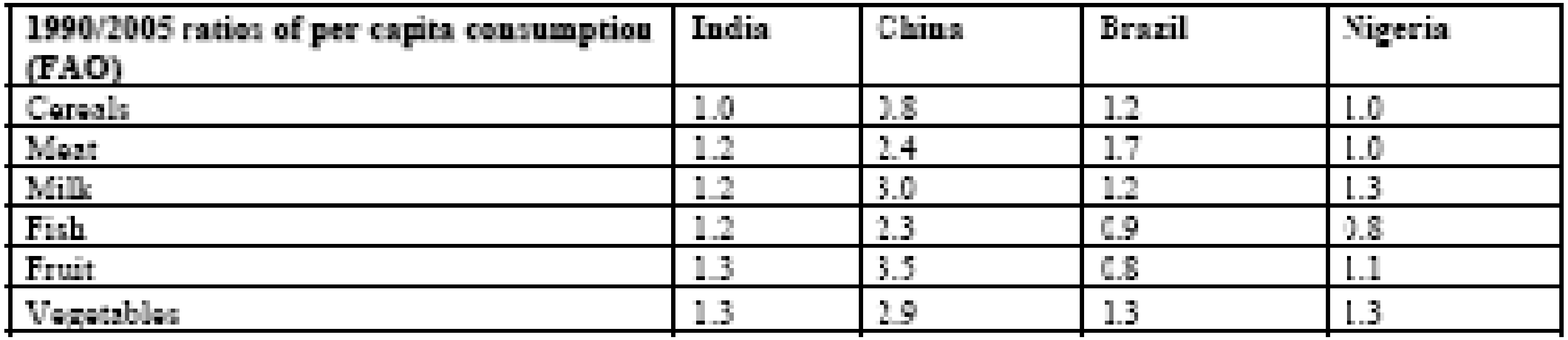


Una ecuación compleja

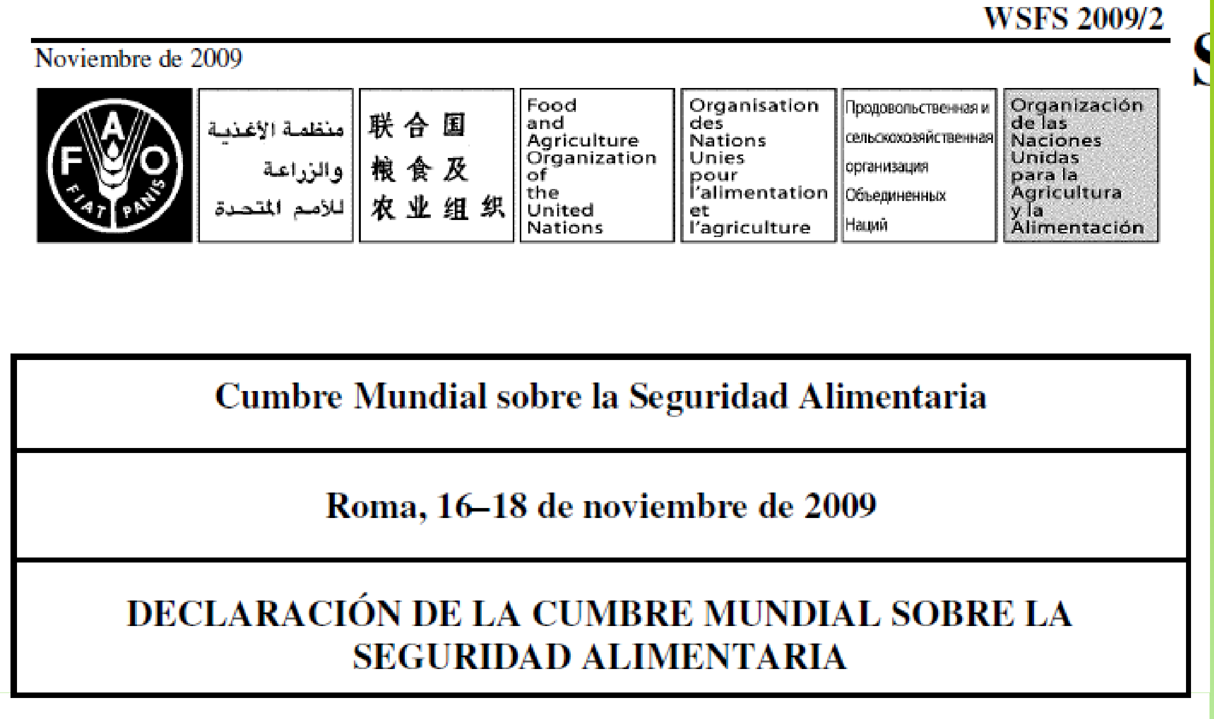



Climate change will reduce production growth in many of the poorest countries and regions. This will have further price-increasing effects.

Percentage change in agricultural production due to climate change, 2080.



1990/2005 ratios of per capita consumption (FAO)	India	China	Brazil	Nigeria
Cereals	1.0	0.8	1.2	1.0
Meat	1.2	2.4	1.7	1.0
Milk	1.2	3.0	1.2	1.3
Fish	1.2	2.3	0.9	0.8
Fruit	1.3	3.5	0.8	1.1
Vegetables	1.3	2.9	1.3	1.3



WSFS 2009/2

Noviembre de 2009

منظمة الأغذية والزراعة للأمم المتحدة

联合国粮食及农业组织

Food and Agriculture Organization of the United Nations

Organisation des Nations Unies pour l'alimentation et l'agriculture

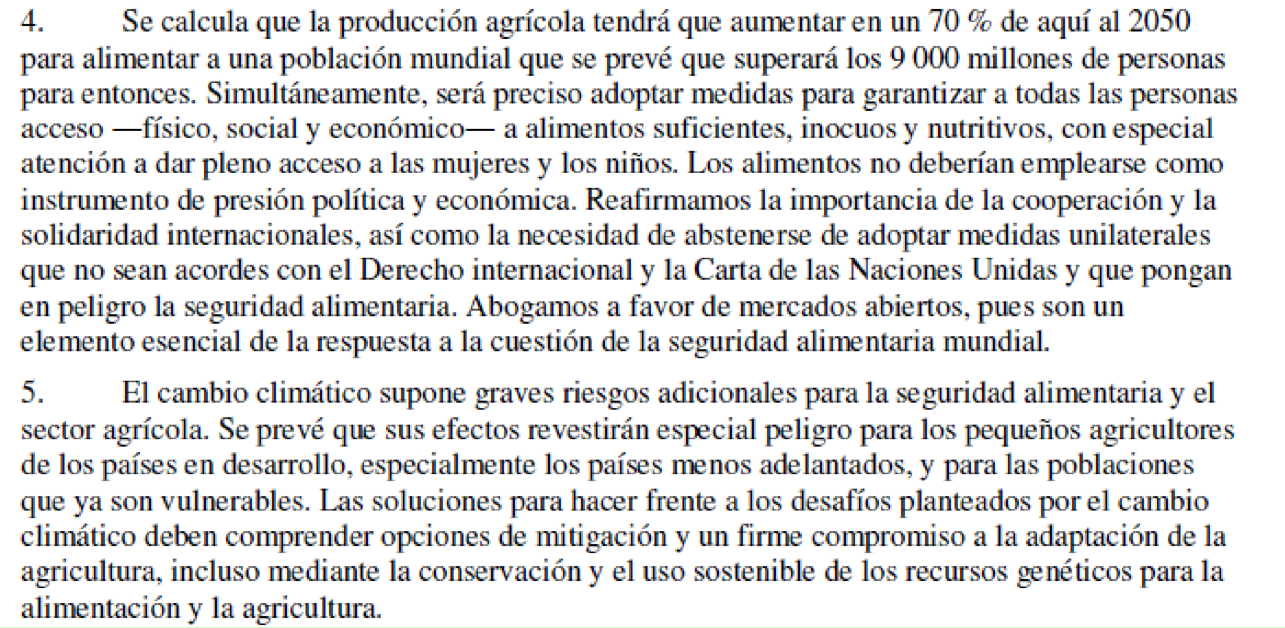
Продовольственная и сельскохозяйственная организация Объединенных Наций

Organización de las Naciones Unidas para la Agricultura y la Alimentación

Cumbre Mundial sobre la Seguridad Alimentaria

Roma, 16–18 de noviembre de 2009

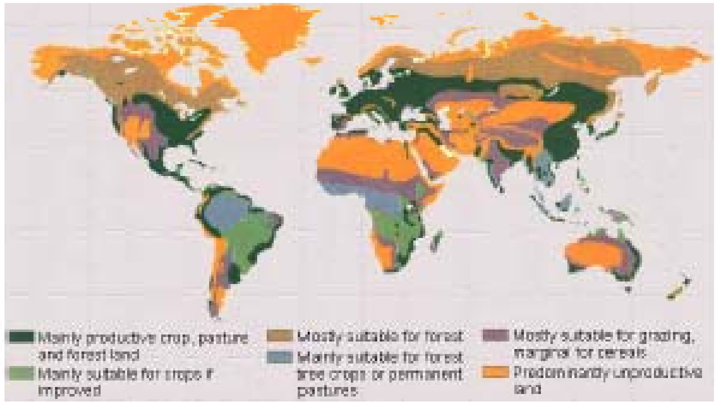
DECLARACIÓN DE LA CUMBRE MUNDIAL SOBRE LA SEGURIDAD ALIMENTARIA



4. Se calcula que la producción agrícola tendrá que aumentar en un 70 % de aquí al 2050 para alimentar a una población mundial que se prevé que superará los 9 000 millones de personas para entonces. Simultáneamente, será preciso adoptar medidas para garantizar a todas las personas acceso —físico, social y económico— a alimentos suficientes, inocuos y nutritivos, con especial atención a dar pleno acceso a las mujeres y los niños. Los alimentos no deberían emplearse como instrumento de presión política y económica. Reafirmamos la importancia de la cooperación y la solidaridad internacionales, así como la necesidad de abstenerse de adoptar medidas unilaterales que no sean acordes con el Derecho internacional y la Carta de las Naciones Unidas y que pongan en peligro la seguridad alimentaria. Abogamos a favor de mercados abiertos, pues son un elemento esencial de la respuesta a la cuestión de la seguridad alimentaria mundial.

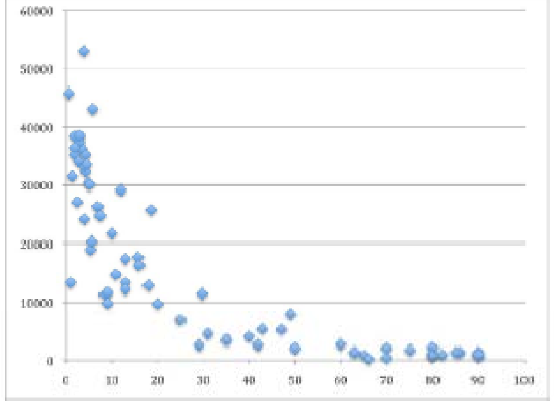
5. El cambio climático supone graves riesgos adicionales para la seguridad alimentaria y el sector agrícola. Se prevé que sus efectos revestirán especial peligro para los pequeños agricultores de los países en desarrollo, especialmente los países menos adelantados, y para las poblaciones que ya son vulnerables. Las soluciones para hacer frente a los desafíos planteados por el cambio climático deben comprender opciones de mitigación y un firme compromiso a la adaptación de la agricultura, incluso mediante la conservación y el uso sostenible de los recursos genéticos para la alimentación y la agricultura.

Una ecuación compleja

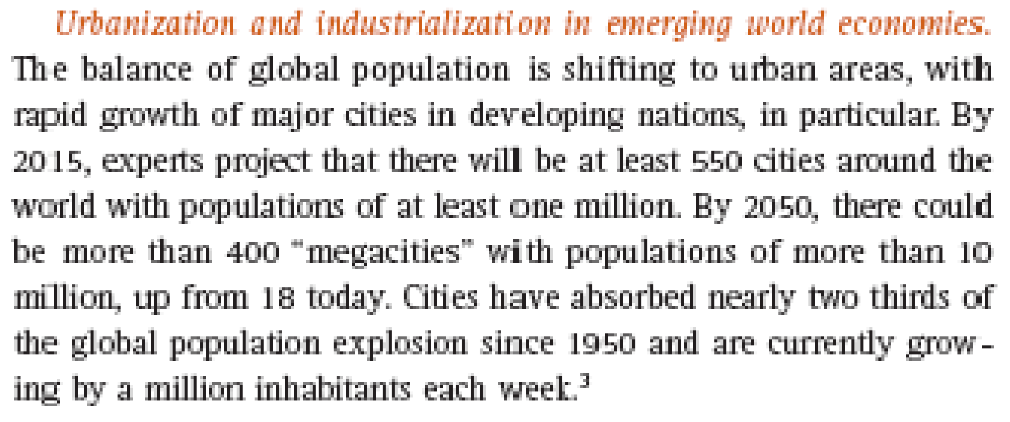

World potential land use capabilities


A critical challenge - Water
Proportion of water withdrawal for agriculture 2001
(from IAASTD ppt)

Rajeswari S. Raina, CPR,
New Delhi



Plot of GDP per capita against proportion of the population involved in agriculture. The graph demonstrates that the proportion of people involved in agriculture is much greater in poorer countries than in the richer countries. Data derived from the CIA World Factbook (July 2008), ISSN 1553-8133.


Urbanization and industrialization in emerging world economies. The balance of global population is shifting to urban areas, with rapid growth of major cities in developing nations, in particular. By 2015, experts project that there will be at least 550 cities around the world with populations of at least one million. By 2050, there could be more than 400 "megacities" with populations of more than 10 million, up from 18 today. Cities have absorbed nearly two thirds of the global population explosion since 1950 and are currently growing by a million inhabitants each week.[3]

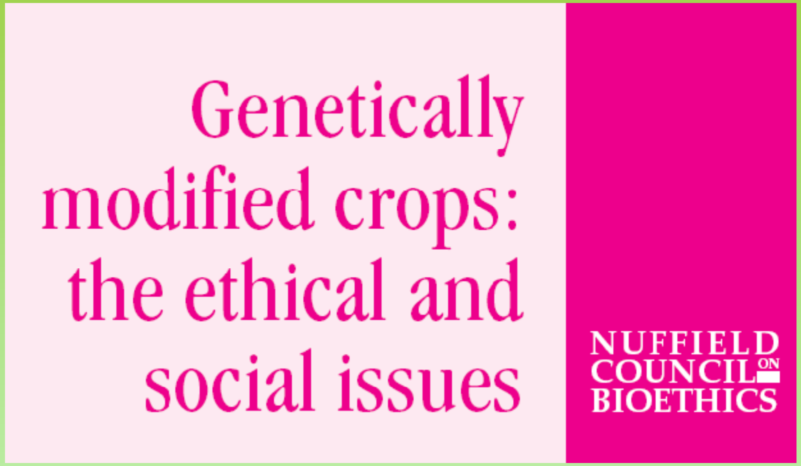
Discusiones éticas

FAO ETHICS SERIES

2

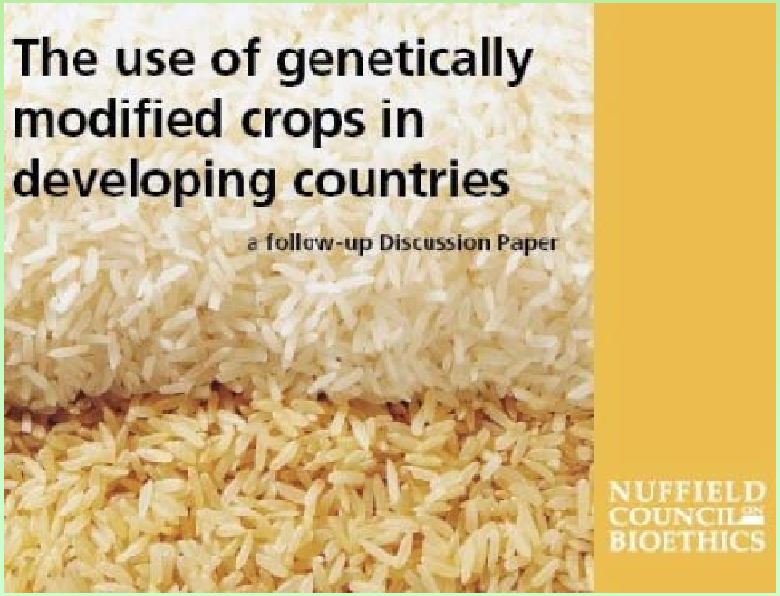
Genetically modified organisms,
consumers,
food safety and the environment

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2001



Genetically
modified crops:
the ethical and
social issues

NUFFIELD
COUNCIL ON
BIOETHICS

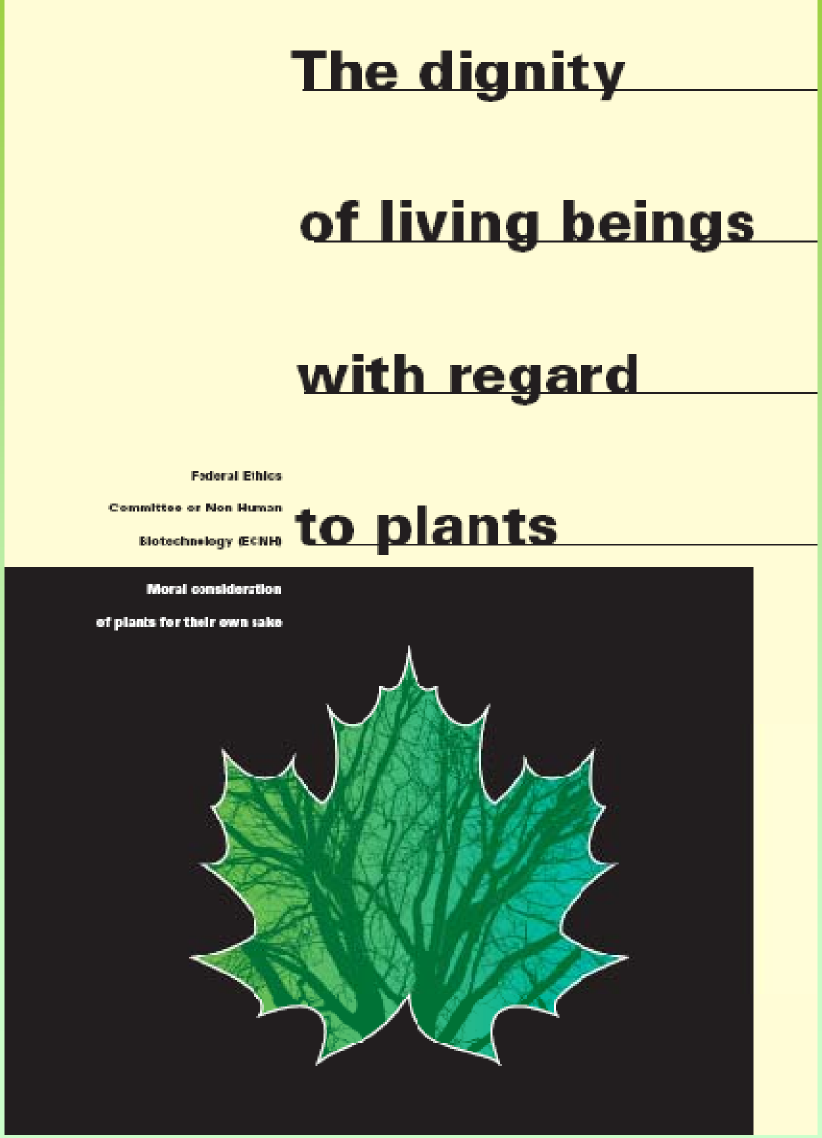


The use of genetically
modified crops in
developing countries

a follow-up Discussion Paper

NUFFIELD
COUNCIL ON
BIOETHICS

La dignidad de las plantas



The dignity

of living beings

with regard

to plants

Federal Ethics

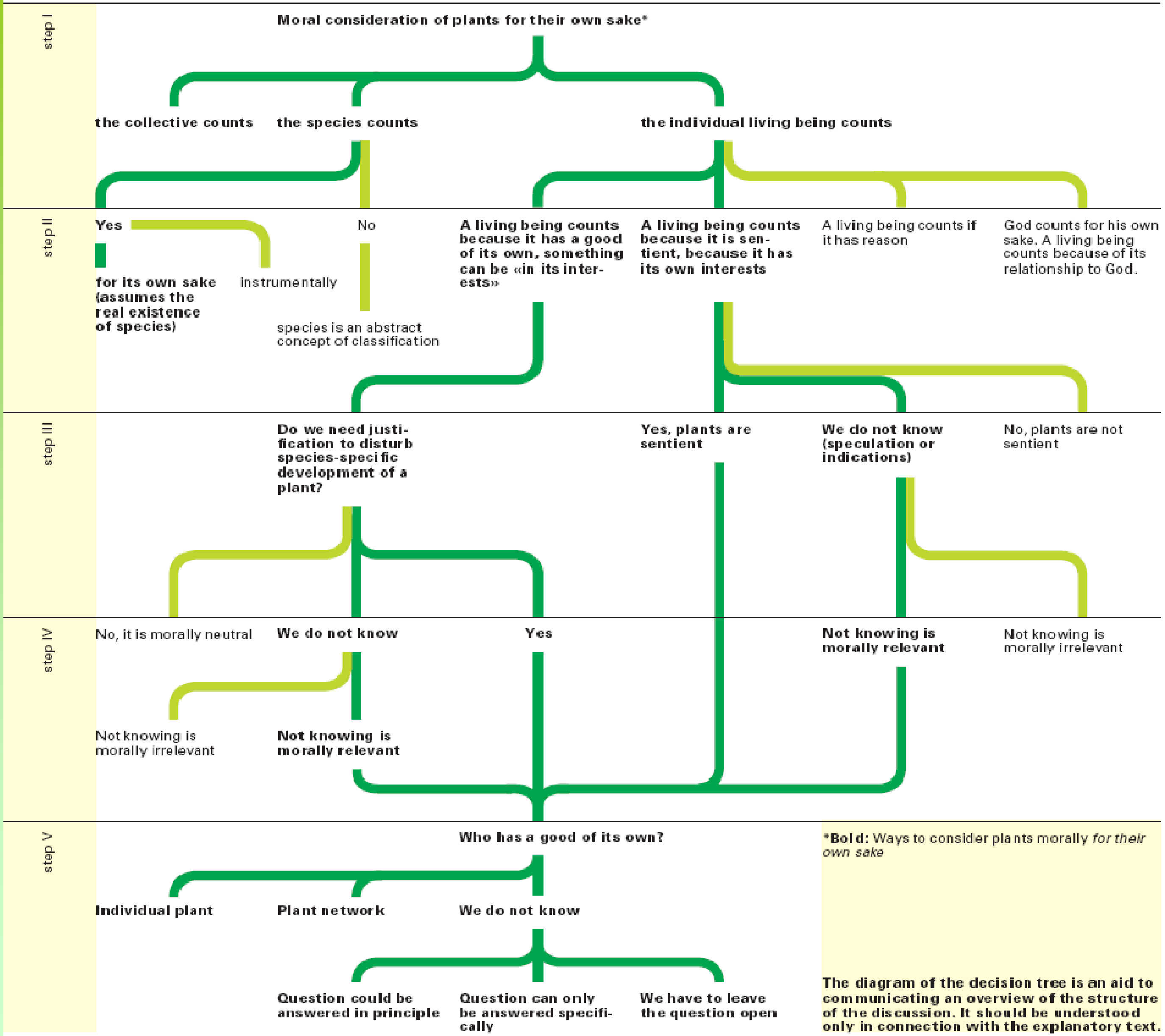
Committee on Non Human

Biotechnology (ECNH)

Moral consideration

of plants for their own sake

Decision tree



step I

Moral consideration of plants for their own sake*

the collective counts

the species counts

the individual living being counts

step II

Yes

for its own sake (assumes the real existence of species)

instrumentally

No

species is an abstract concept of classification

A living being counts because it has a good of its own, something can be «in its interests»

A living being counts because it is sentient, because it has its own interests

A living being counts if it has reason

God counts for his own sake. A living being counts because of its relationship to God.

step III

Do we need justification to disturb species-specific development of a plant?

Yes, plants are sentient

We do not know (speculation or indications)

No, plants are not sentient

step IV

No, it is morally neutral

We do not know

Yes

Not knowing is morally relevant

Not knowing is morally irrelevant

Not knowing is morally irrelevant

Not knowing is morally relevant

step V

Who has a good of its own?

Individual plant

Plant network

We do not know

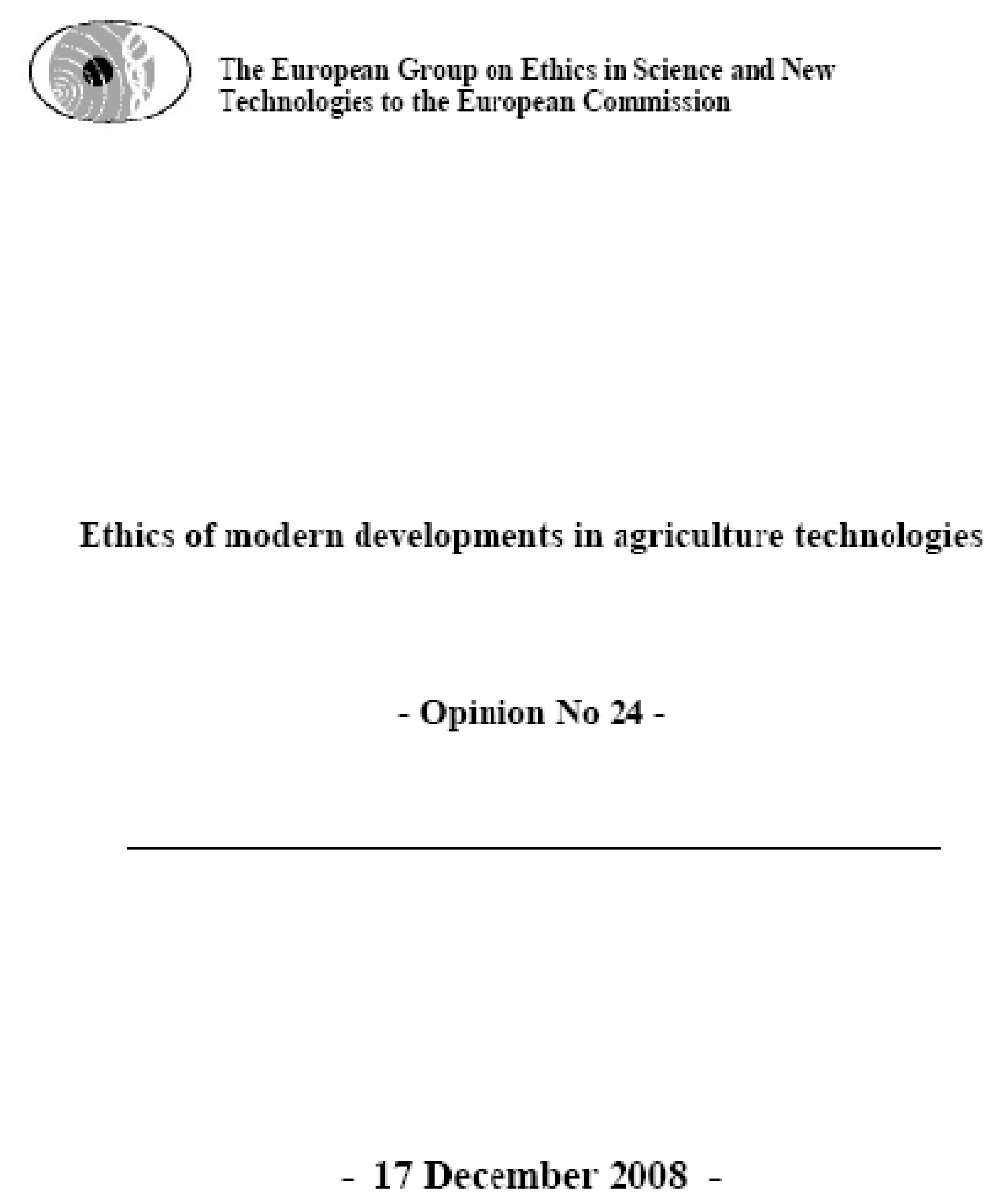
Question could be answered in principle

Question can only be answered specifically

We have to leave the question open

***Bold:** Ways to consider plants morally *for their own sake*

The diagram of the decision tree is an aid to communicating an overview of the structure of the discussion. It should be understood only in connection with the explanatory text.

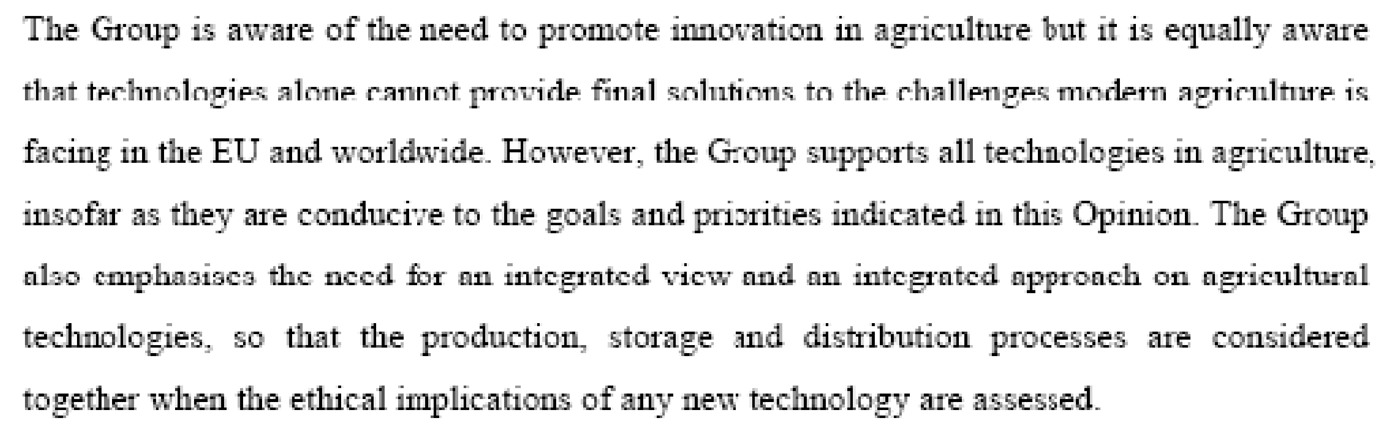


The European Group on Ethics in Science and New
Technologies to the European Commission

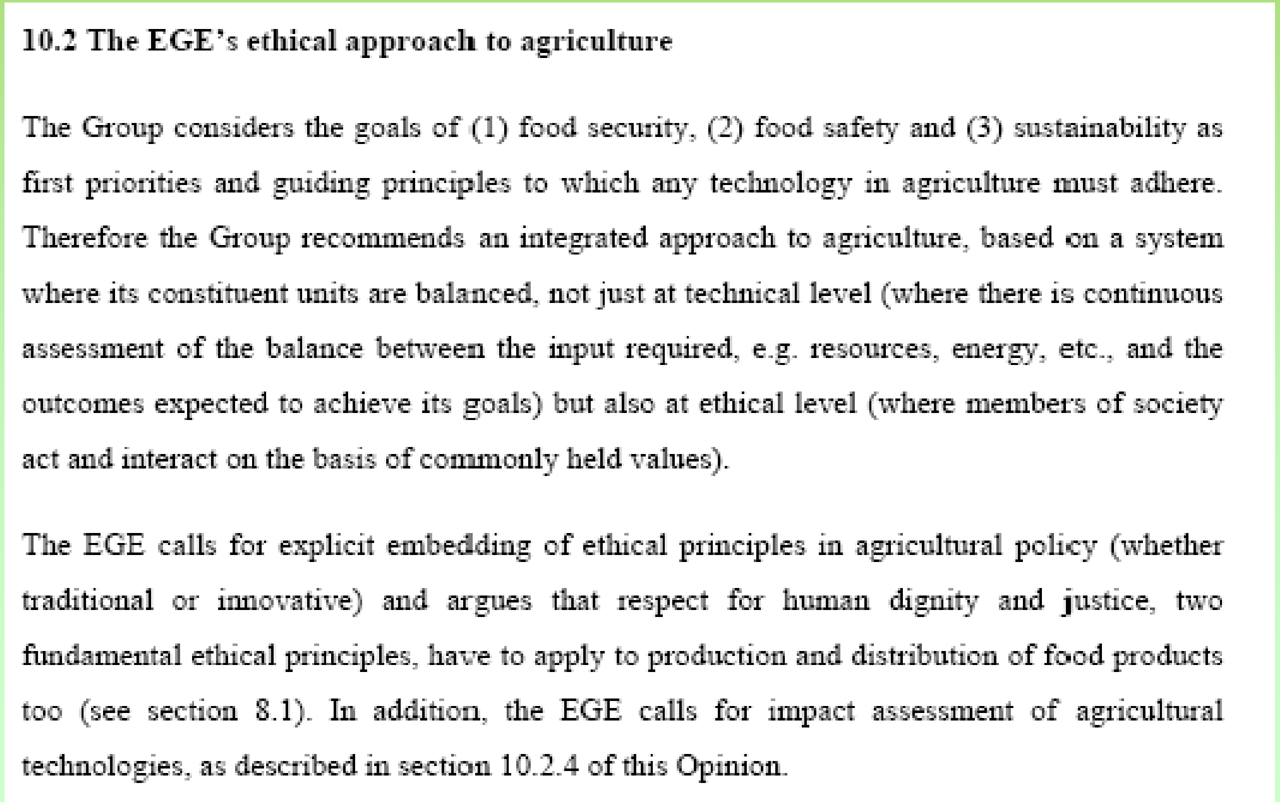
Ethics of modern developments in agriculture technologies

- Opinion No 24 -

- 17 December 2008 -



The Group is aware of the need to promote innovation in agriculture but it is equally aware that technologies alone cannot provide final solutions to the challenges modern agriculture is facing in the EU and worldwide. However, the Group supports all technologies in agriculture, insofar as they are conducive to the goals and priorities indicated in this Opinion. The Group also emphasises the need for an integrated view and an integrated approach on agricultural technologies, so that the production, storage and distribution processes are considered together when the ethical implications of any new technology are assessed.

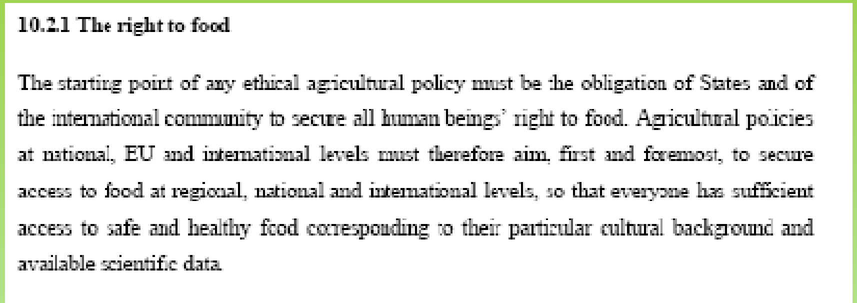


10.2 The EGE's ethical approach to agriculture

The Group considers the goals of (1) food security, (2) food safety and (3) sustainability as first priorities and guiding principles to which any technology in agriculture must adhere. Therefore the Group recommends an integrated approach to agriculture, based on a system where its constituent units are balanced, not just at technical level (where there is continuous assessment of the balance between the input required, e.g. resources, energy, etc., and the outcomes expected to achieve its goals) but also at ethical level (where members of society act and interact on the basis of commonly held values).

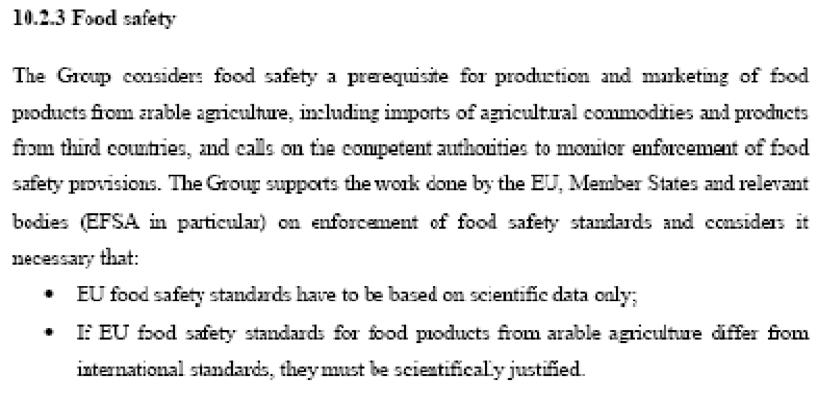
The EGE calls for explicit embedding of ethical principles in agricultural policy (whether traditional or innovative) and argues that respect for human dignity and justice, two fundamental ethical principles, have to apply to production and distribution of food products too (see section 8.1). In addition, the EGE calls for impact assessment of agricultural technologies, as described in section 10.2.4 of this Opinion.

Resumen de la opinión



10.2.1 The right to food

The starting point of any ethical agricultural policy must be the obligation of States and of the international community to secure all human beings' right to food. Agricultural policies at national, EU and international levels must therefore aim, first and foremost, to secure access to food at regional, national and international levels, so that everyone has sufficient access to safe and healthy food corresponding to their particular cultural background and available scientific data.

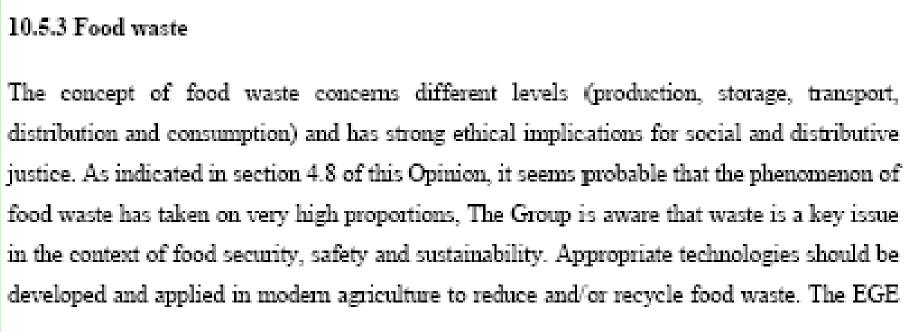


10.2.3 Food safety

The Group considers food safety a prerequisite for production and marketing of food products from arable agriculture, including imports of agricultural commodities and products from third countries, and calls on the competent authorities to monitor enforcement of food safety provisions. The Group supports the work done by the EU, Member States and relevant bodies (EFSA in particular) on enforcement of food safety standards and considers it necessary that:

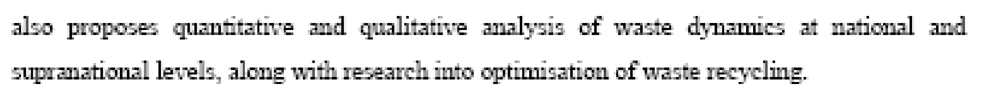
- EU food safety standards have to be based on scientific data only;
- If EU food safety standards for food products from arable agriculture differ from international standards, they must be scientifically justified.

- Importancia de crear tradiciones adecuadas con una comida segura y sana



10.5.3 Food waste

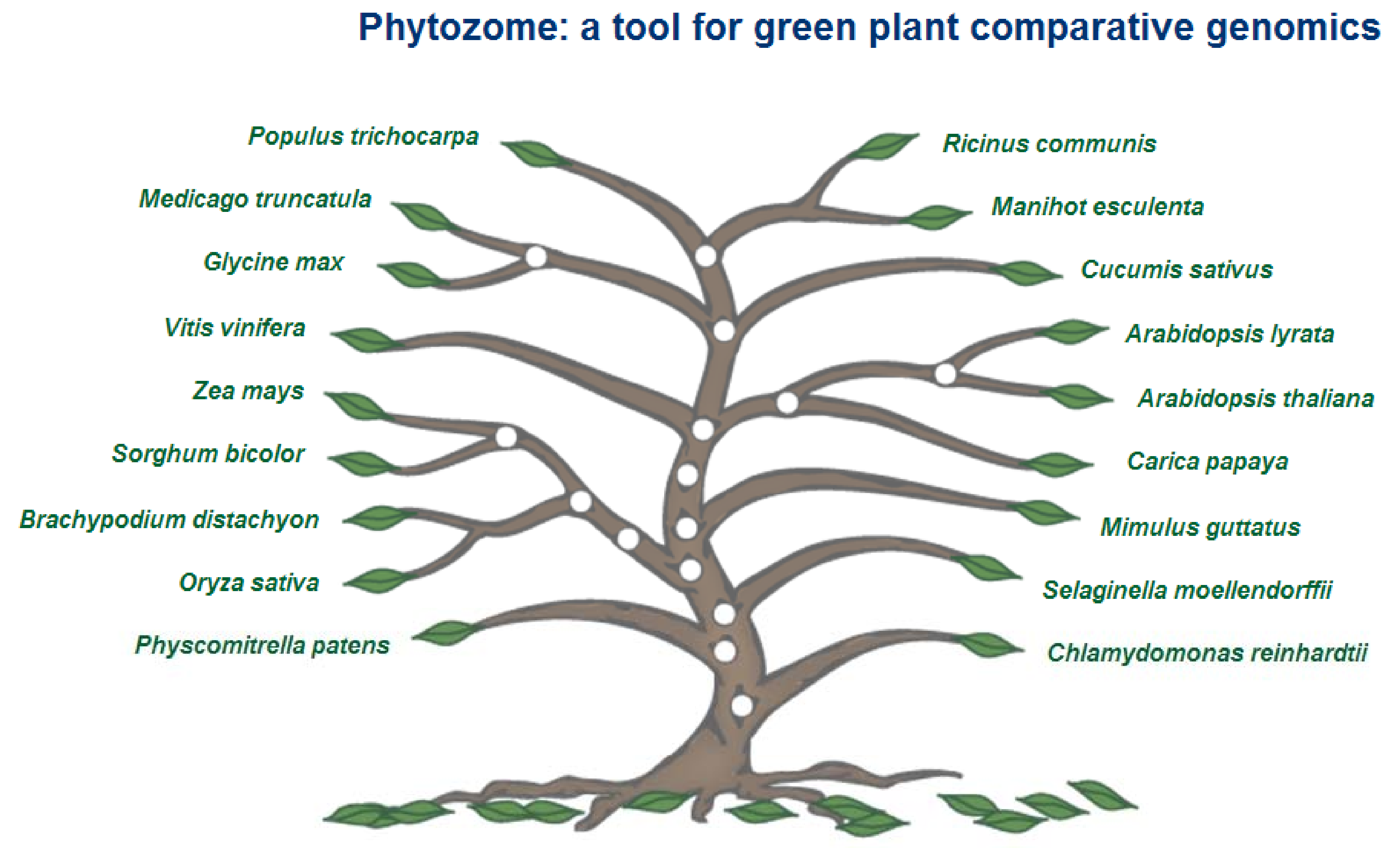
The concept of food waste concerns different levels (production, storage, transport, distribution and consumption) and has strong ethical implications for social and distributive justice. As indicated in section 4.8 of this Opinion, it seems probable that the phenomenon of food waste has taken on very high proportions, The Group is aware that waste is a key issue in the context of food security, safety and sustainability. Appropriate technologies should be developed and applied in modern agriculture to reduce and/or recycle food waste. The EGE



also proposes quantitative and qualitative analysis of waste dynamics at national and supranational levels, along with research into optimisation of waste recycling.

- Importancia de promover comportamientos responsables ante la comida

Los genomas de plantas. 2010



Arabidopsis thaliana

Chromosomes	5
DNA molecules lenght	115 Mb
Genes	25.498
Genes with EST	60 %
Gene density	4,5 Kb/g
Gene length	2 Kb

Populus genome

International Populus Genome Consortium

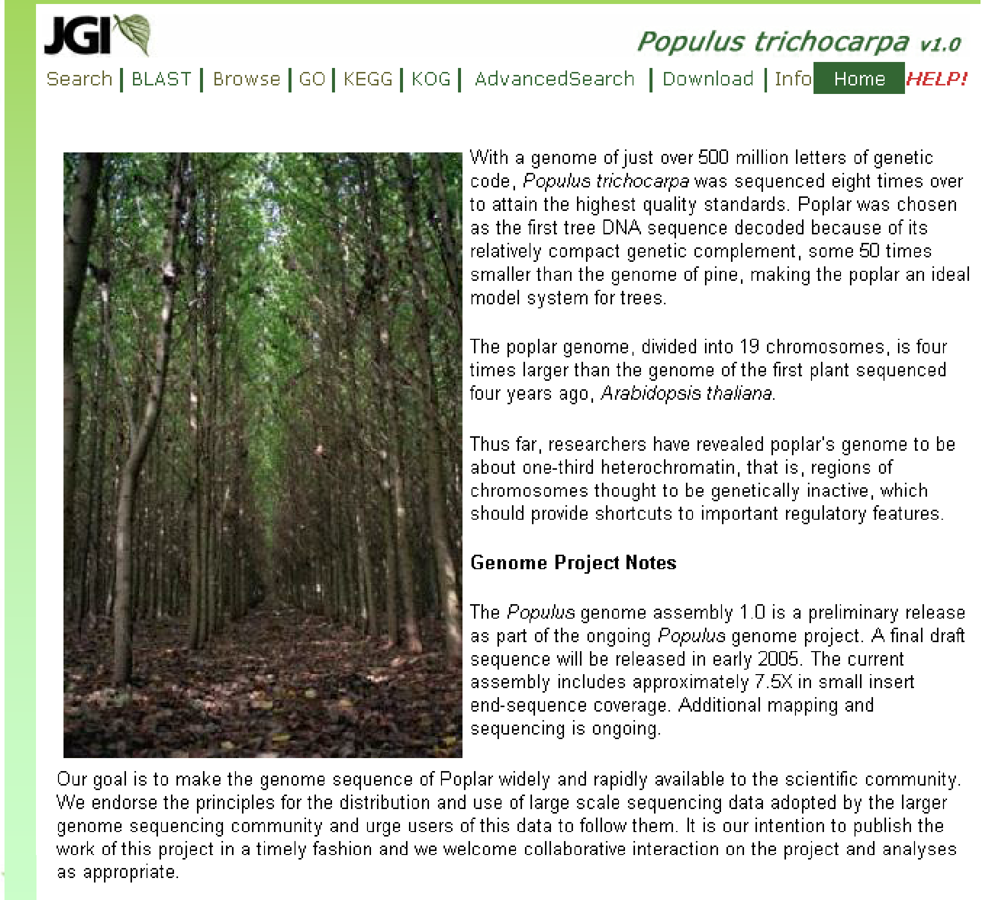
Creating a genetic resource for the plant science community

ANNOUNCEMENT

Public Release of the Populus Genome Database

http://www.jgi.doe.gov/poplar

September 21, 2004 9:00am PST



With a genome of just over 500 million letters of genetic code, *Populus trichocarpa* was sequenced eight times over to attain the highest quality standards. Poplar was chosen as the first tree DNA sequence decoded because of its relatively compact genetic complement, some 50 times smaller than the genome of pine, making the poplar an ideal model system for trees.

The poplar genome, divided into 19 chromosomes, is four times larger than the genome of the first plant sequenced four years ago, *Arabidopsis thaliana*.

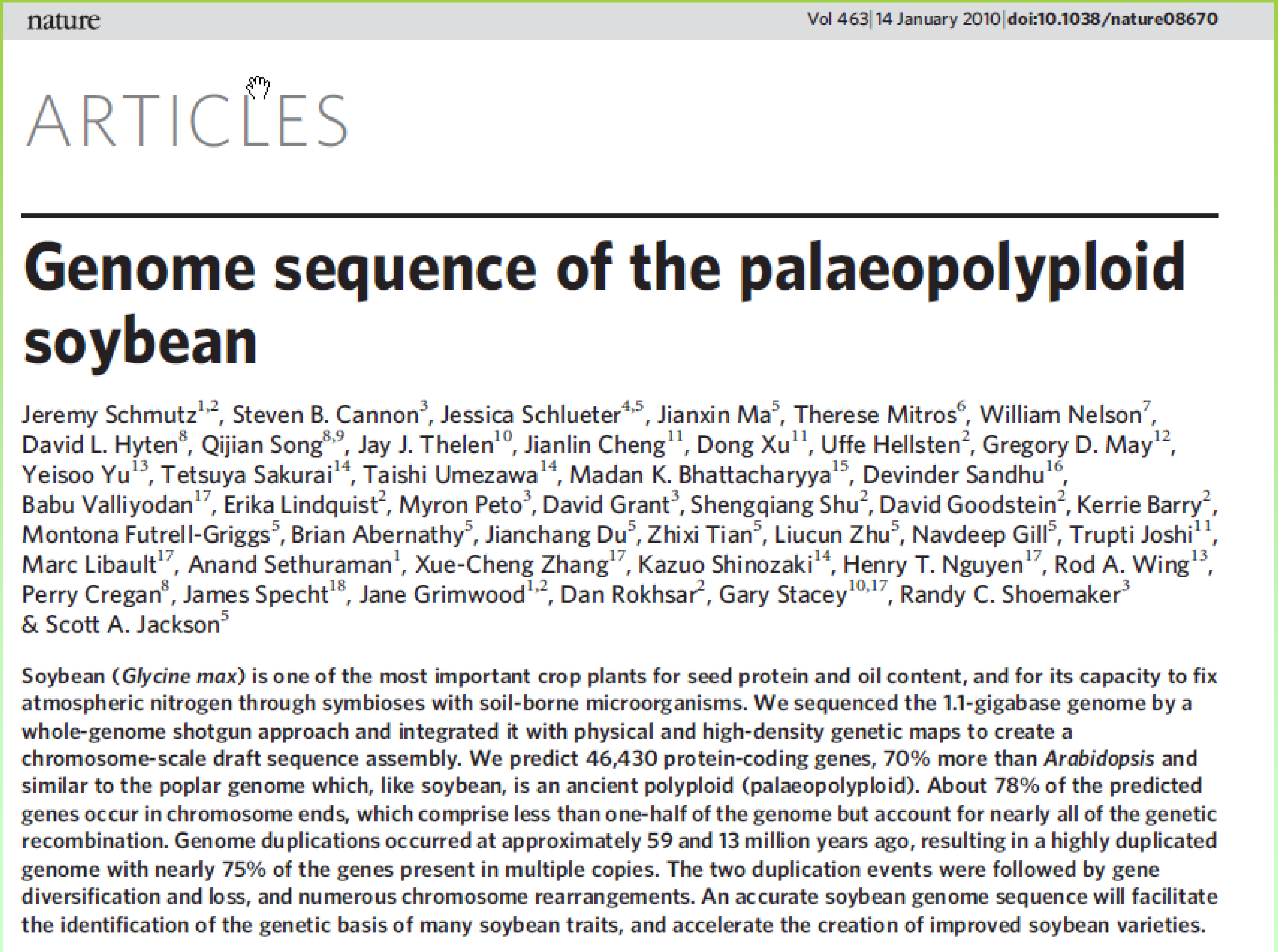
Thus far, researchers have revealed poplar's genome to be about one-third heterochromatin, that is, regions of chromosomes thought to be genetically inactive, which should provide shortcuts to important regulatory features.

Genome Project Notes

The *Populus* genome assembly 1.0 is a preliminary release as part of the ongoing *Populus* genome project. A final draft sequence will be released in early 2005. The current assembly includes approximately 7.5X in small insert end-sequence coverage. Additional mapping and sequencing is ongoing.

Our goal is to make the genome sequence of Poplar widely and rapidly available to the scientific community. We endorse the principles for the distribution and use of large scale sequencing data adopted by the larger genome sequencing community and urge users of this data to follow them. It is our intention to publish the work of this project in a timely fashion and we welcome collaborative interaction on the project and analyses as appropriate.

Genoma de la soja



nature

Vol 463 | 14 January 2010 | doi:10.1038/nature08670

ARTICLES

Genome sequence of the palaeopolyploid soybean

Jeremy Schmutz[1,2], Steven B. Cannon[3], Jessica Schlueter[4,5], Jianxin Ma[5], Therese Mitros[6], William Nelson[7], David L. Hyten[8], Qijian Song[8,9], Jay J. Thelen[10], Jianlin Cheng[11], Dong Xu[11], Uffe Hellsten[2], Gregory D. May[12], Yeisoo Yu[13], Tetsuya Sakurai[14], Taishi Umezawa[14], Madan K. Bhattacharyya[15], Devinder Sandhu[16], Babu Valliyodan[17], Erika Lindquist[2], Myron Peto[3], David Grant[3], Shengqiang Shu[2], David Goodstein[2], Kerrie Barry[2], Montona Futrell-Griggs[5], Brian Abernathy[5], Jianchang Du[5], Zhixi Tian[5], Liucun Zhu[5], Navdeep Gill[5], Trupti Joshi[11], Marc Libault[17], Anand Sethuraman[1], Xue-Cheng Zhang[17], Kazuo Shinozaki[14], Henry T. Nguyen[17], Rod A. Wing[13], Perry Cregan[8], James Specht[18], Jane Grimwood[1,2], Dan Rokhsar[2], Gary Stacey[10,17], Randy C. Shoemaker[3] & Scott A. Jackson[5]

Soybean (*Glycine max*) is one of the most important crop plants for seed protein and oil content, and for its capacity to fix atmospheric nitrogen through symbioses with soil-borne microorganisms. We sequenced the 1.1-gigabase genome by a whole-genome shotgun approach and integrated it with physical and high-density genetic maps to create a chromosome-scale draft sequence assembly. We predict 46,430 protein-coding genes, 70% more than *Arabidopsis* and similar to the poplar genome which, like soybean, is an ancient polyploid (palaeopolyploid). About 78% of the predicted genes occur in chromosome ends, which comprise less than one-half of the genome but account for nearly all of the genetic recombination. Genome duplications occurred at approximately 59 and 13 million years ago, resulting in a highly duplicated genome with nearly 75% of the genes present in multiple copies. The two duplication events were followed by gene diversification and loss, and numerous chromosome rearrangements. An accurate soybean genome sequence will facilitate the identification of the genetic basis of many soybean traits, and accelerate the creation of improved soybean varieties.

The grapevine genome sequence suggests ancestral hexaploidization in major angiosperm phyla

The French–Italian Public Consortium for Grapevine Genome Characterization*

Nature advance online publication 26 August 2007 | doi:10.1038/nature06148;
Received 5 April 2007; Accepted 7 August 2007; Published online 26 August 2007

Vitis GeNome Analysis
VIGNA

GENOSCOPE
Centre National de Séquençage

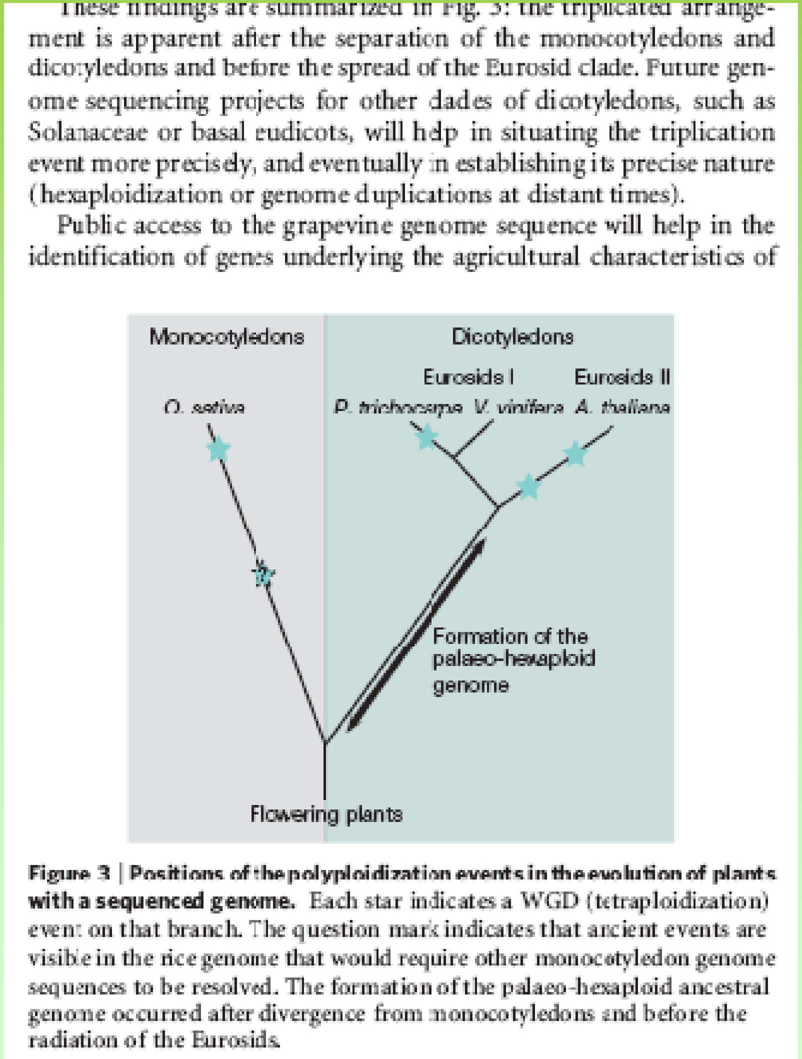
INRA

URGI
Génomique-info

URGV

Affiliations for participants: [1]Genoscope (CEA) and UMR 8030 CNRS-Genoscope-Université d'Evry, 2 rue Gaston Crémieux, BP5706, 91057 Evry, France. [2]Istituto di Genomica Applicata, Parco Scientifico e Tecnologico di Udine, Via Linussio 51, 33100 Udine, Italy. [3]Dipartimento di Matematica ed Informatica, Università degli Studi di Udine, via delle Scienze 208, 33100 Udine, Italy. [4]URGV, UMR INRA 1165, CNRS-Université d'Evry Genomique Végétale, 2 rue Gaston Crémieux, BP5708, 91057 Evry cedex, France. [5]Dipartimento di Scienze Agrarie ed Ambientali, Università degli Studi di Udine, via delle Scienze 208, 33100 Udine, Italy. [6]CRIBI, Università degli Studi di Padova, viale G. Colombo 3, 35121 Padova, Italy. [7]URGI, UR1164 Génomique Info, 523, Place des Terrasses, 91034 Evry Cedex, France. [8]UMR INRA 1131, Université de Strasbourg, Santé de la Vigne et Qualité du Vin, 28 rue de Herrlisheim, BP20507, 68021 Colmar, France. [9]Dipartimento di Scienze Biomolecolari e Biotecnologie, Università degli Studi di Milano, via Celoria 26, 20133 Milano, Italy. [10]Dipartimento di Biochimica e Biologia Molecolare, Università degli Studi di Bari, via Orabona 4, 70125 Bari, Italy. [11]Istituto Tecnologie Biomediche, Consiglio Nazionale delle Ricerche, via Amendola 122/D, 70125 Bari, Italy. [12]UMR INRA 1097, IRD-Montpellier SupAgro-Univ. Montpellier II, Diversité et Adaptation des Plantes Cultivées, 2 Place Pierre Viala, 34060 Montpellier Cedex 1, France. [13]UMR INRA 1098, IRD-Montpellier SupAgro-CIRAD, Développement et Amélioration des Plantes, 2 Place Pierre Viala, 34060 Montpellier Cedex 1, France. [14]Dipartimento Scientifico e Tecnologico, Università degli Studi di Verona Strada Le Grazie 15 – Ca' Vignal, 37134 Verona, Italy. [15]Dipartimento di Scienze, Tecnologie e Mercati della Vite e del Vino, Università degli Studi di Verona, via della Pieve, 70 37029 S. Floriano (VR), Italy. [16]VIGNA-CRA Initiative; Consorzio Interuniversitario Nazionale per la Biologia Molecolare delle Piante, c/o Università degli Studi di Siena, via Banchi di Sotto 55, 53100 Siena, Italy.

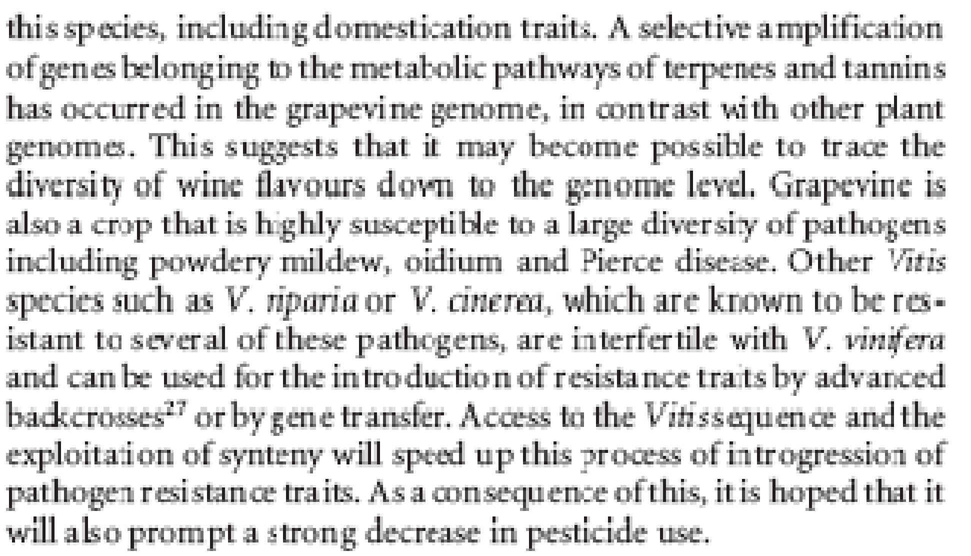
El genoma de la viña



These findings are summarized in Fig. 3: the triplicated arrangement is apparent after the separation of the monocotyledons and dicotyledons and before the spread of the Eurosid clade. Future genome sequencing projects for other clades of dicotyledons, such as Solanaceae or basal eudicots, will help in situating the triplication event more precisely, and eventually in establishing its precise nature (hexaploidization or genome duplications at distant times).

Public access to the grapevine genome sequence will help in the identification of genes underlying the agricultural characteristics of

Figure 3 | Positions of the polyploidization events in the evolution of plants with a sequenced genome. Each star indicates a WGD (tetraploidization) event on that branch. The question mark indicates that ancient events are visible in the rice genome that would require other monocotyledon genome sequences to be resolved. The formation of the palaeo-hexaploid ancestral genome occurred after divergence from monocotyledons and before the radiation of the Eurosids.



this species, including domestication traits. A selective amplification of genes belonging to the metabolic pathways of terpenes and tannins has occurred in the grapevine genome, in contrast with other plant genomes. This suggests that it may become possible to trace the diversity of wine flavours down to the genome level. Grapevine is also a crop that is highly susceptible to a large diversity of pathogens including powdery mildew, oidium and Pierce disease. Other *Vitis* species such as *V. riparia* or *V. cinerea*, which are known to be resistant to several of these pathogens, are interfertile with *V. vinifera* and can be used for the introduction of resistance traits by advanced backcrosses[27] or by gene transfer. Access to the *Vitis* sequence and the exploitation of synteny will speed up this process of introgression of pathogen resistance traits. As a consequence of this, it is hoped that it will also prompt a strong decrease in pesticide use.

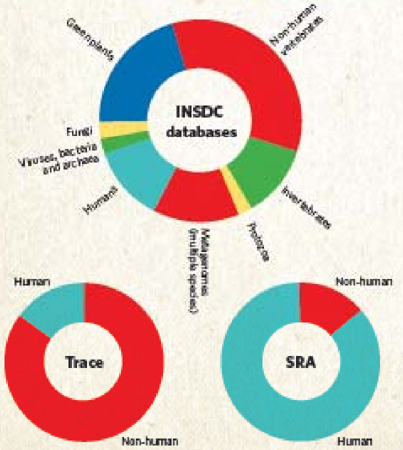
THE SEQUENCE EXPLOSION

At the time of the announcement of the first drafts of the human genome in 2000, there were 8 billion base pairs of sequence in the three main databases for 'finished' sequence: GenBank, run by the US National Center for Biotechnology Information; the DNA Databank of Japan; and the European Molecular Biology Laboratory (EMBL) Nucleotide Sequence Database. The databases share their data regularly as part of the International Nucleotide Sequence Database Collaboration (INSDC). In the subsequent first post-genome decade, they have added another 270 billion bases to the collection of finished sequence, doubling the size of the database roughly every 18 months. But this number is dwarfed by the amount of raw sequence that has been created and stored by researchers around the world in the Trace archive and Sequence Read Archive (SRA).

See Editorial, page 649, and human genome special at www.nature.com/humangenome

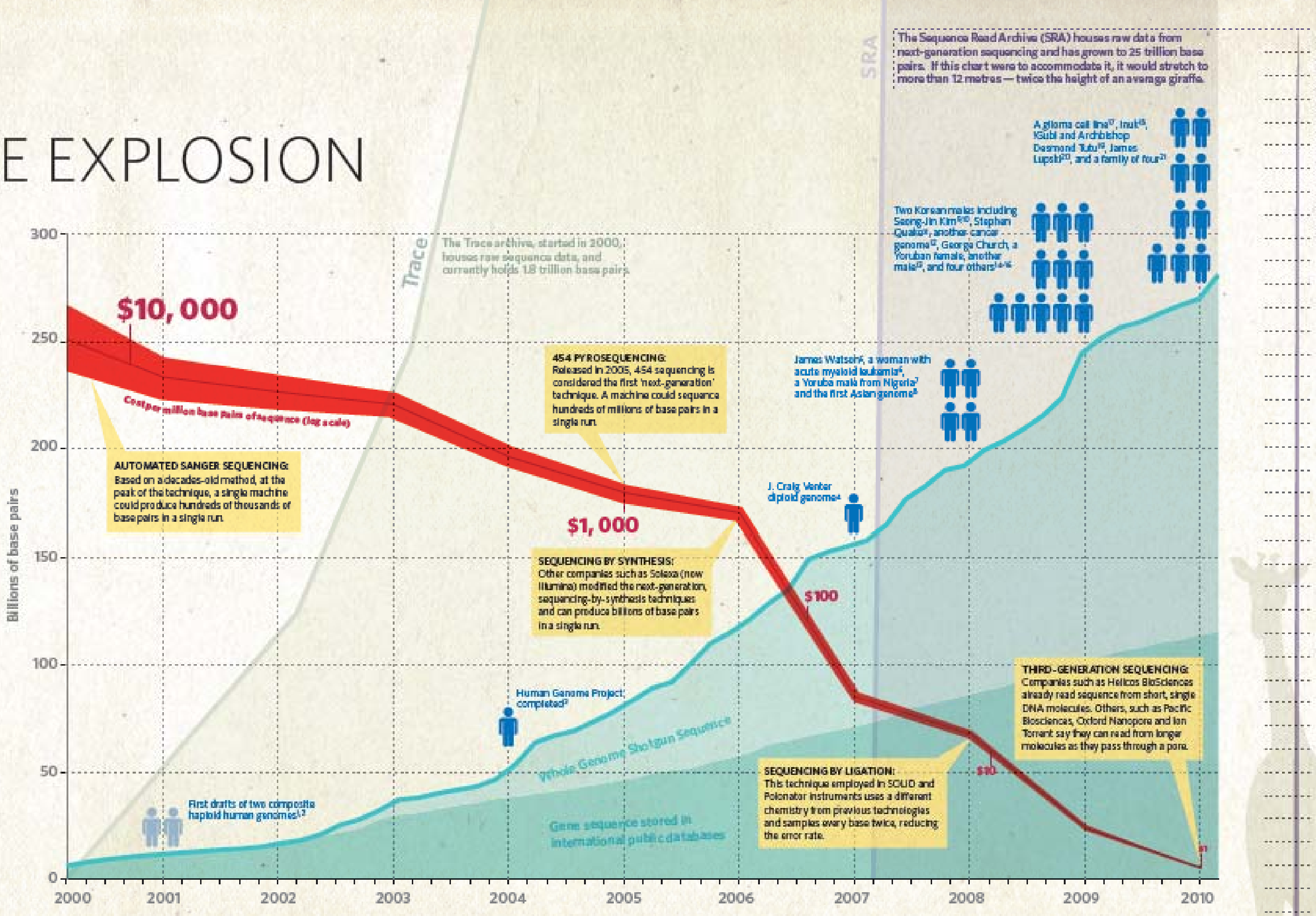
DNA SEQUENCES BY TAXONOMY

International Nucleotide Sequence Database Collaboration: The main repositories of 'finished' sequence span a wide range of organisms, representing the many priorities of scientists worldwide.



Trace Archive: Developed to house the raw output of high-throughput sequencers built in the late 1990s, the trace archive spans a wide range of taxa.

Sequence Read Archive: Houses raw data from next-generation sequencers. Dominated by human sequence, including multiple coverage for more than 170 people.



The Trace archive, started in 2000, houses raw sequence data, and currently holds 1.8 trillion base pairs.

The Sequence Read Archive (SRA) houses raw data from next-generation sequencing and has grown to 25 trillion base pairs. If this chart were to accommodate it, it would stretch to more than 12 metres — twice the height of an average giraffe.

AUTOMATED SANGER SEQUENCING: Based on a decades-old method, at the peak of the technique, a single machine could produce hundreds of thousands of base pairs in a single run.

454 PYROSEQUENCING: Released in 2005, 454 sequencing is considered the first 'next-generation' technique. A machine could sequence hundreds of millions of base pairs in a single run.

SEQUENCING BY SYNTHESIS: Other companies such as Solexa (now Illumina) modified the next-generation, sequencing-by-synthesis techniques and can produce billions of base pairs in a single run.

SEQUENCING BY LIGATION: This technique employed in SOLiD and Polonator instruments uses a different chemistry from previous technologies and samples every base twice, reducing the error rate.

THIRD-GENERATION SEQUENCING: Companies such as Helicos BioSciences already read sequence from short, single DNA molecules. Others, such as Pacific Biosciences, Oxford Nanopore and Ion Torrent say they can read from longer molecules as they pass through a pore.

First drafts of two composite haploid human genomes[1,2]

Human Genome Project completed[3]

J. Craig Venter diploid genome[4]

James Watson[5], a woman with acute myeloid leukemia[6], a Yoruba male from Nigeria[7] and the first Asian genome[8]

Two Korean males including Seong-Jin Kim[9,10], Stephen Quake[11], another cancer genome[12], George Church, a Yoruban female, another male[13], and four others[14-16]

A glioma cell line[17], Inuit[18], !Gubi and Archbishop Desmond Tutu[19], James Lupski[20], and a family of four[21]

Page size by comparison

SOURCE: NCBI. GRAPHICS BY N. SPENCER & W. FERNANDES

HOW MANY HUMAN GENOMES?

The graphic shows all published, fully sequenced human genomes since 2000, including nine from the first quarter of 2010. Some are resequencing efforts on the same person and the list does not include unpublished completed genomes.

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Reaping the benefits

Science and the sustainable intensification of global agriculture

October 2009

CELEBRATE
350 YEARS

THE ROYAL SOCIETY

1 Introduction

Summary
Food security is an urgent challenge. It is a global problem that is set to worsen with current trends of population, consumption, climate change and resource scarcity. The last 50 years have seen remarkable growth in global agricultural production, but the impact on the environment has been unsustainable. The benefits of this green revolution have also been distributed unevenly; growth in Asia and America has not been matched in Africa. Science can potentially continue to provide dramatic improvements to crop production, but it must do so sustainably. Science and technology must therefore be understood in their broader social, economic and environmental contexts. The sustainable intensification of crop production requires a clear definition of agricultural sustainability. Improvements to food crop production should aim to reduce rather than exacerbate global inequalities if they are to contribute to economic development. This report follows other recent analyses, all arguing that major improvements are needed to the way that scientific research is funded and used.

La Biotecnología vegetal

- Es la más antigua de las biotecnologías
- Las técnicas del DNA recombinante abren nuevas posibilidades y nuevos debates
- Han tenido un gran éxito y han afectado las industrias de semillas
- La modificación genética es una de las biotecnologías vegetales
- Son tecnologías que afectan la vida en diferentes aspectos

- No son tecnologías indiferentes para la sociedad en que vivimos

Gracias

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