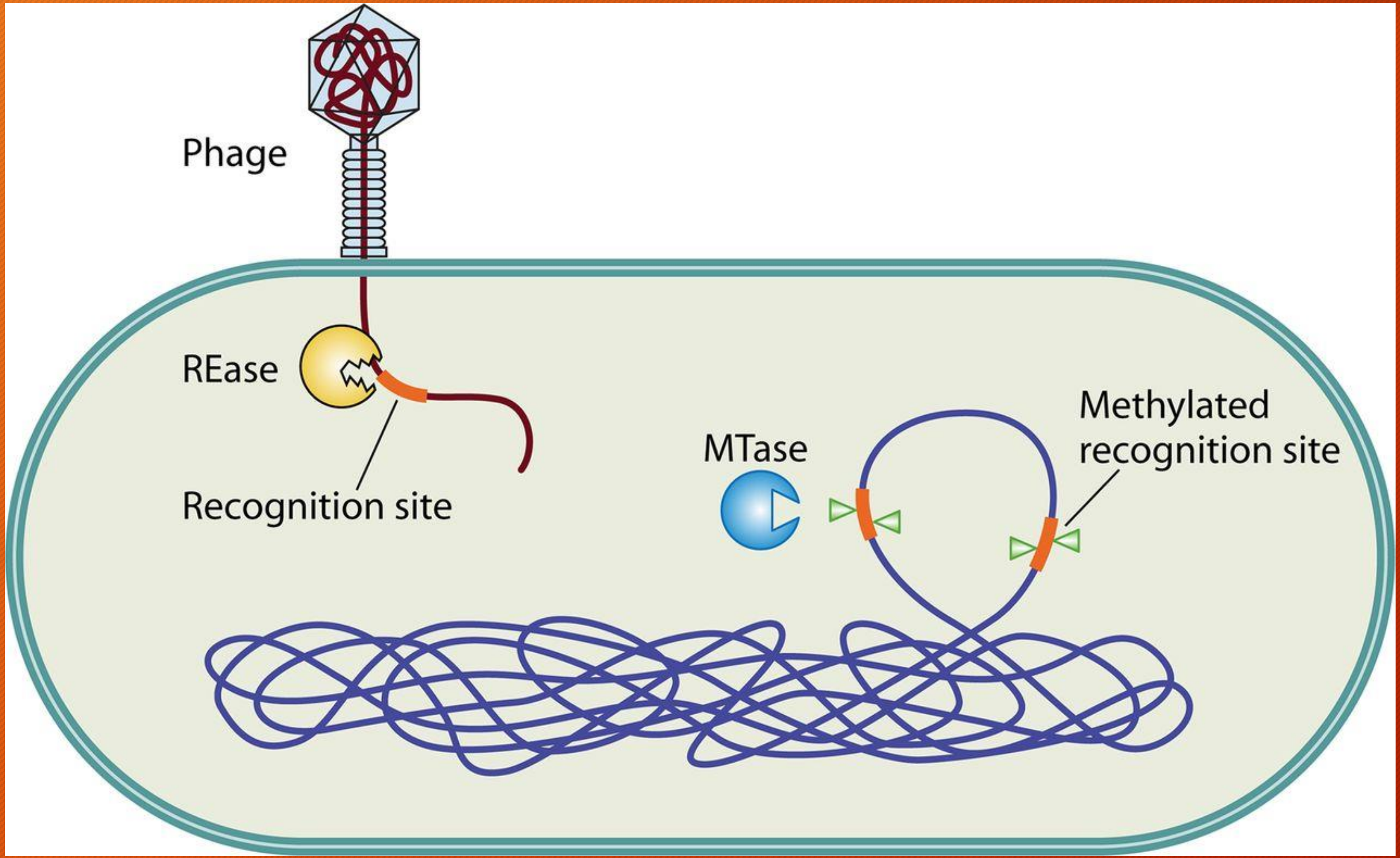
Los Organismos Genéticamente Modificados

Yuri Jorge Peña Ramírez

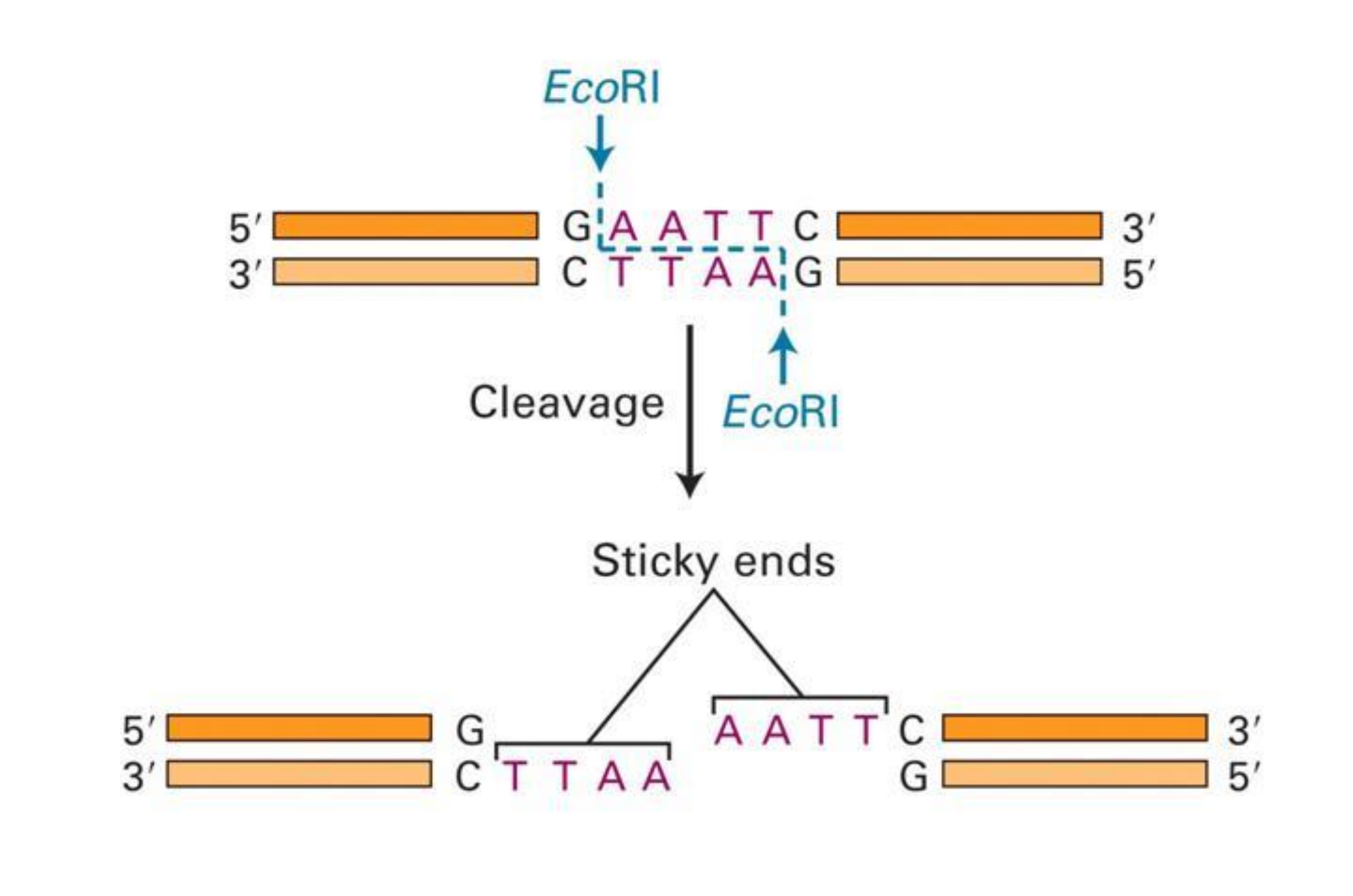
El Colegio de la Frontera Sur (ECOSUR) Unidad Campeche

Sistema de restricción / modificación



Herbert Boyer

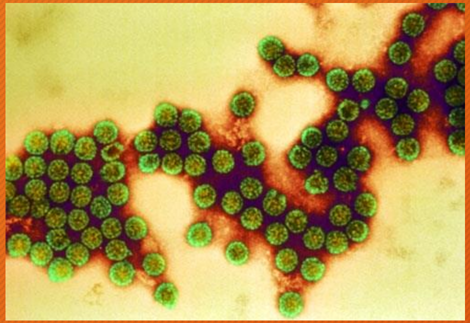
Enzimas de restricción tipo II

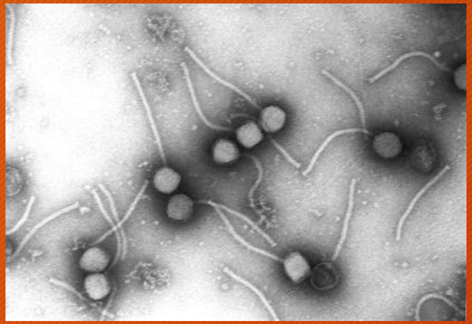


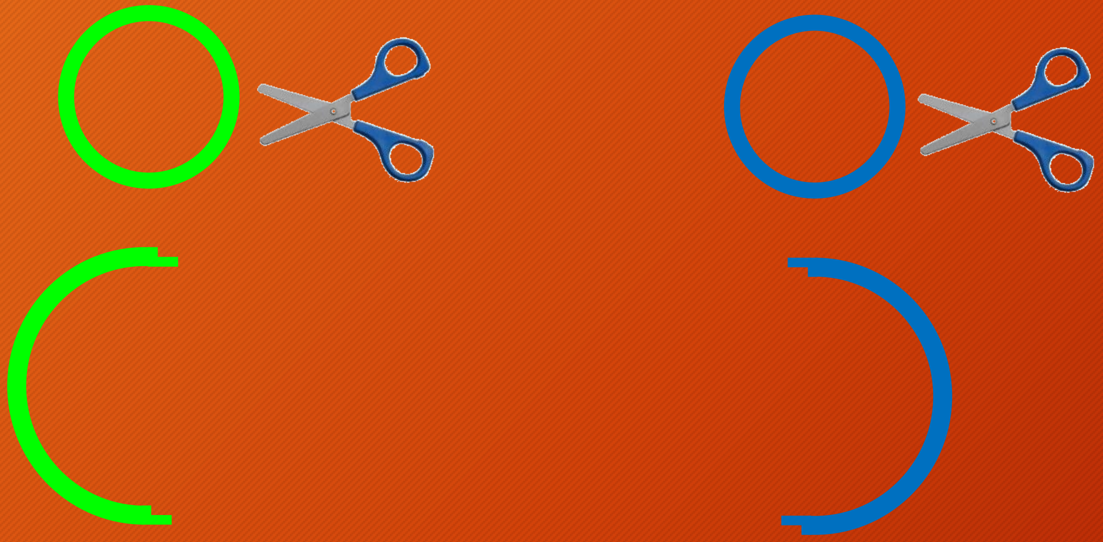
Enzimas de restricción tipo II

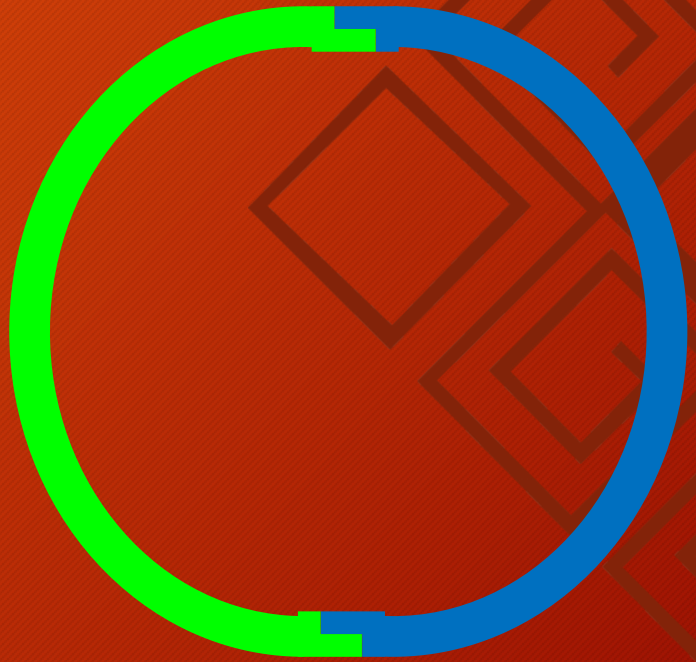
Microorganisms	Restriction enzymes	Cleavage sites	Cleavage products
Bacillus amyloliquefaciens H	*Bam* HI	5-G↓GATCC-3 3-CCTAGG↑G-5	5-G GATCC-3 3-CCTAG G-5
B. globigii	*Bgl* II	5-A↓GATCT-3 3-TCTAGA↑-5	5-A GATCT-3 3-TCTAG A-5
Escherchia coli RY13	*Eco* RI	5-G↓AATTC-3 3-CTTAAG↑-5	5-G AATTC-3 3-CTTAA G-5
Haemophilus influenzae Rd	*Hin* dIII	5-A↓AGCTT-3 3-TTCGAA↑-5	5-A AGCTT-3 3 -TTCGA A-5
H. parainfluenzae	*Hpa* I	5-GTT↓AAC-3 3-CAA↑TTG-5	5-GTT AAC-3 3-CAA TTG-5
Klebsiella pneumoniae OK 8	*Kpn* I	5-GGTAC↓C-5 3-C↑CATGG-3	5-GGTAC C-3 3-C CATGG-5
Streptomyces albus G	*Sal* I	5-G↓TCGAC-3 3-CAGCTG↑-5	5-G TCGAC-3 3-CAGCT G-5
Staphylococcus aureus 3AI	*Sau* 3AI	5-↓GATC-3 3-CTAG↑-5	5- GATC-3 3-CTAG 5

Nace la Ingeniería Genética



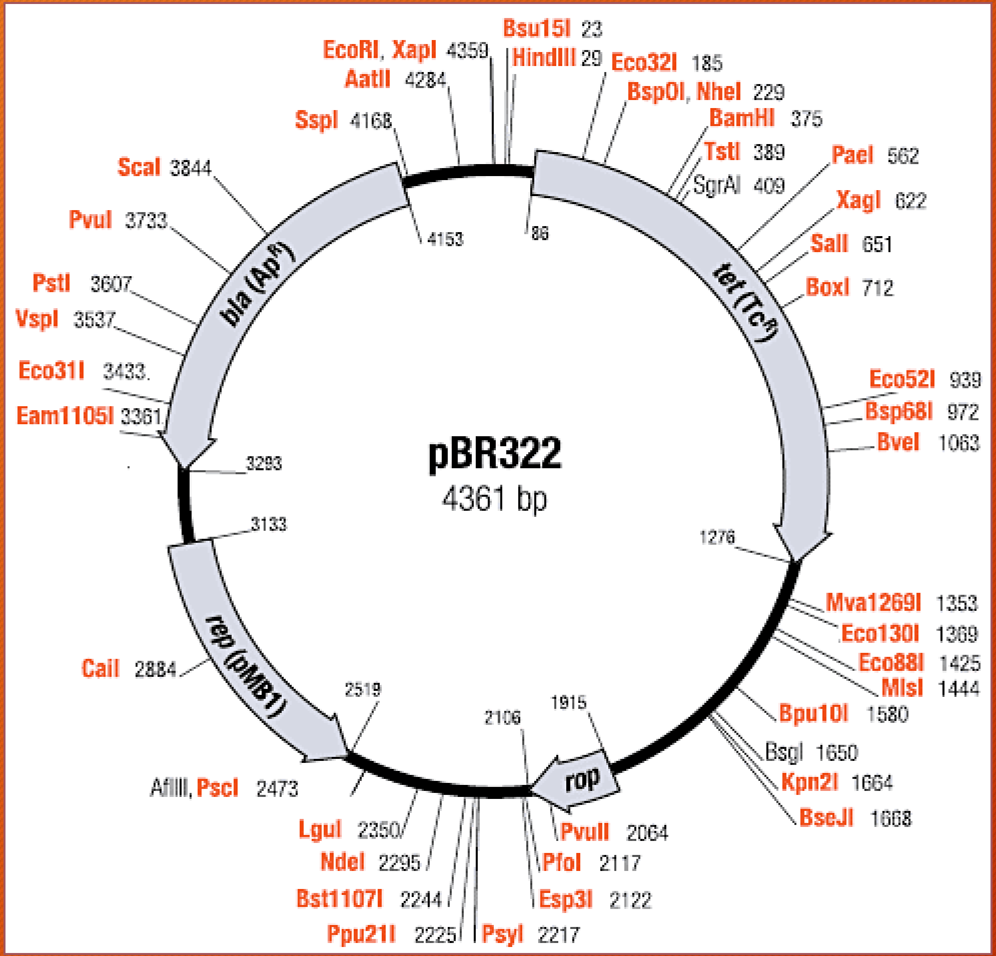






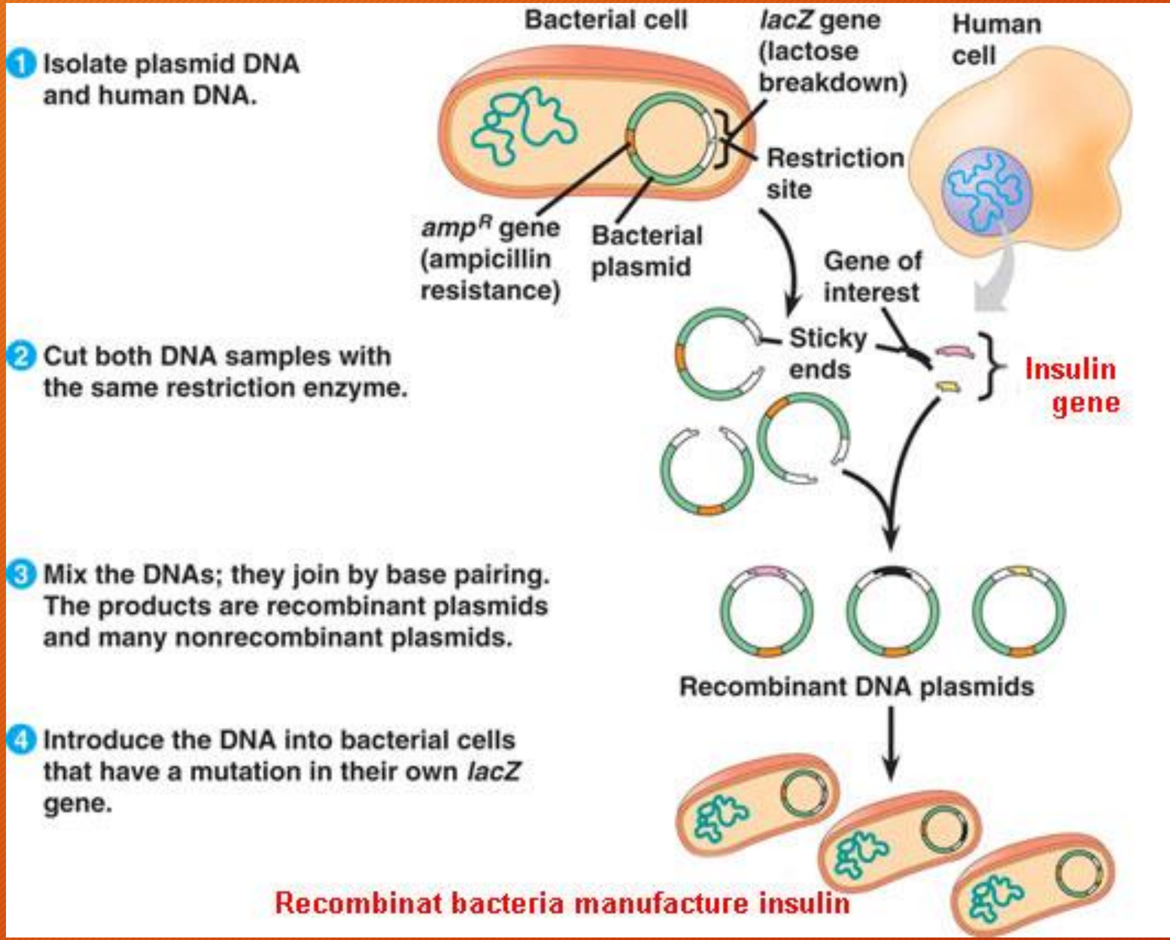
ADN recombinante

El vector pBR322

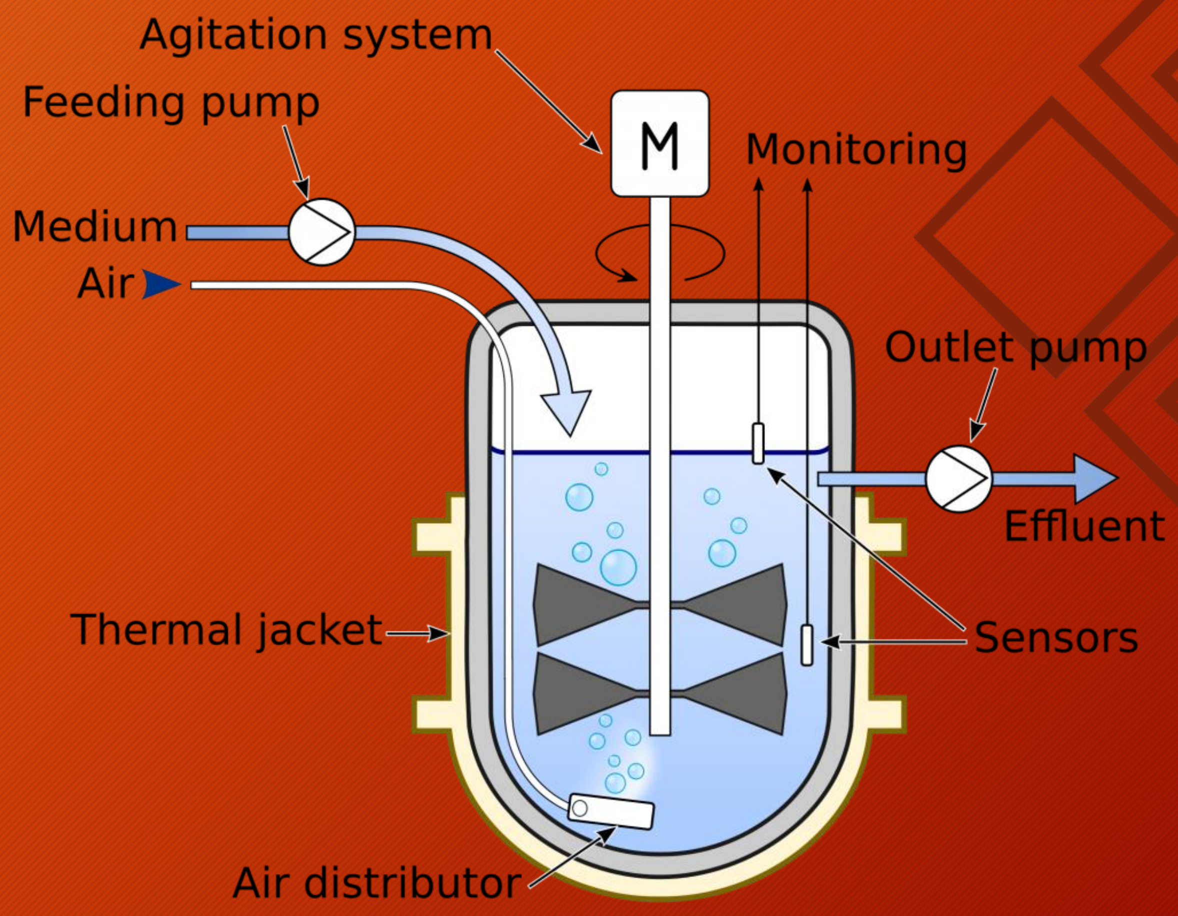


Francisco Bolívar Zapata

Desarrollo de la insulina recombinante



Producción de insulina humana en biorreactores

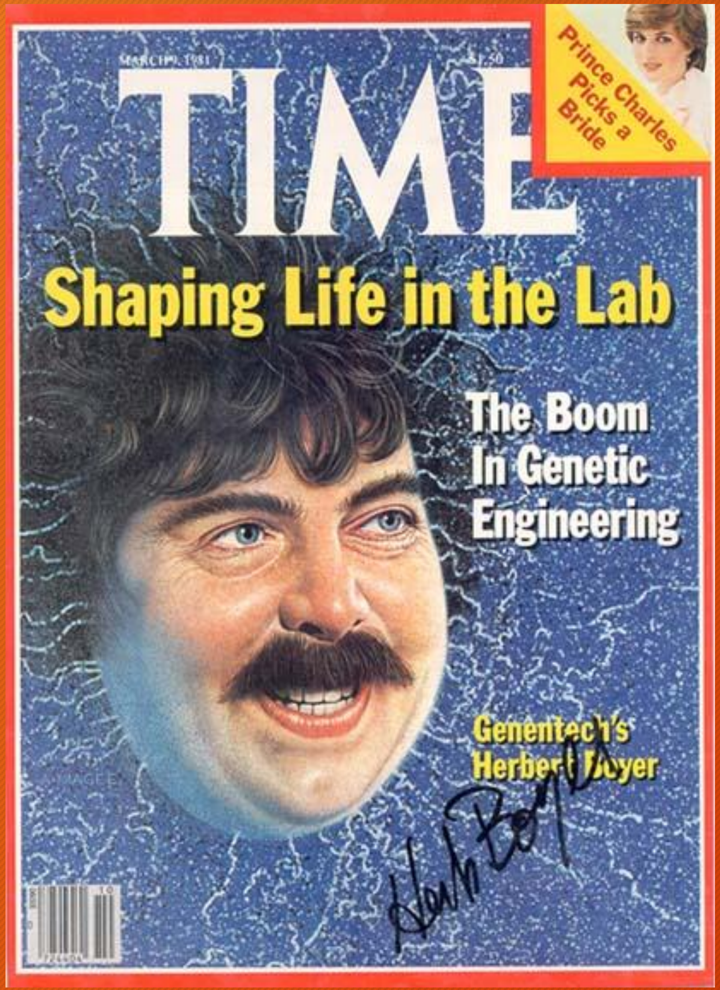


Nace la biotecnología moderna

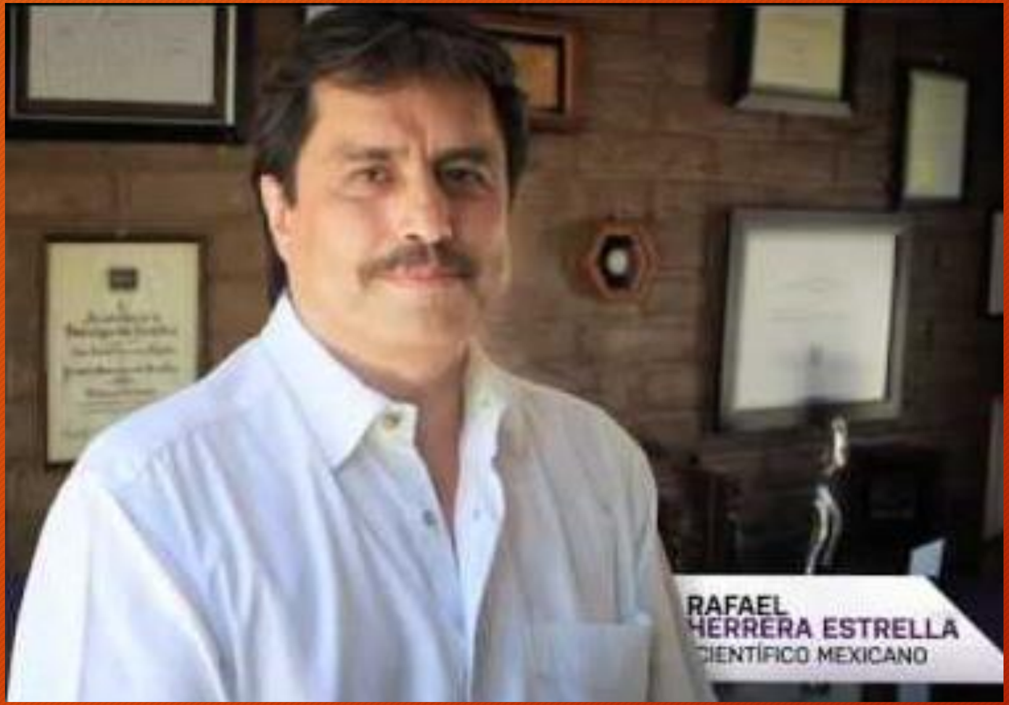
ECOSUR

Genentech

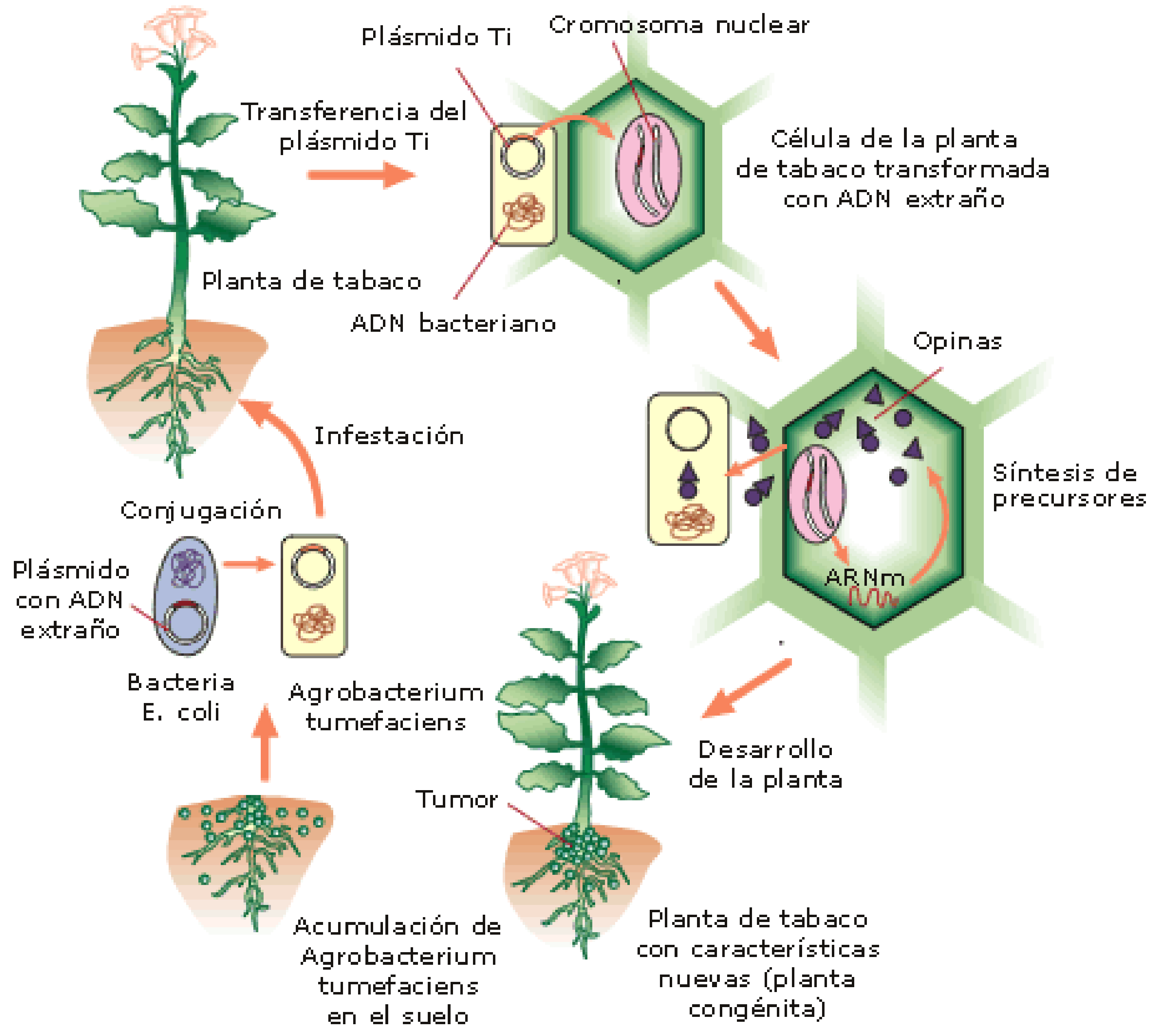
La insulina recombinante



La primera planta modificada genéticamente



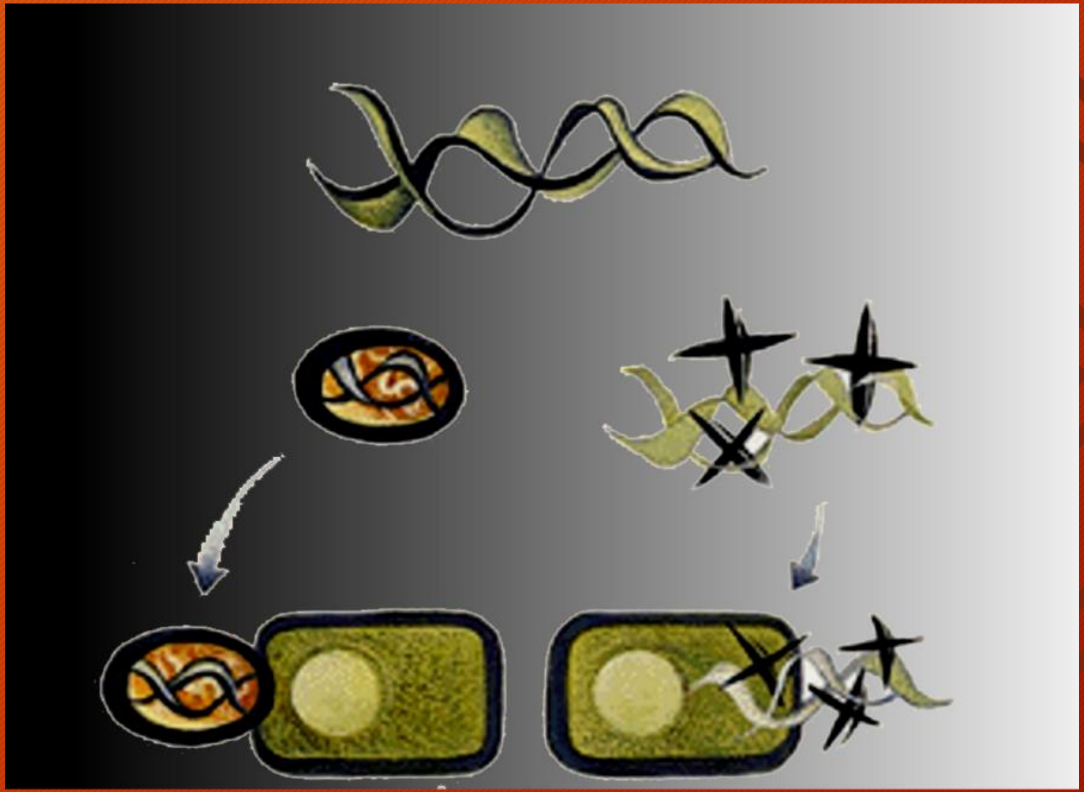
Transformación con Agrobacterium tumefaciens



Molécula de DNA con el gen de interés

Se inserta en una bacteria o se recubre con pequeñas partículas de metal

Y se introduce a células vegetales



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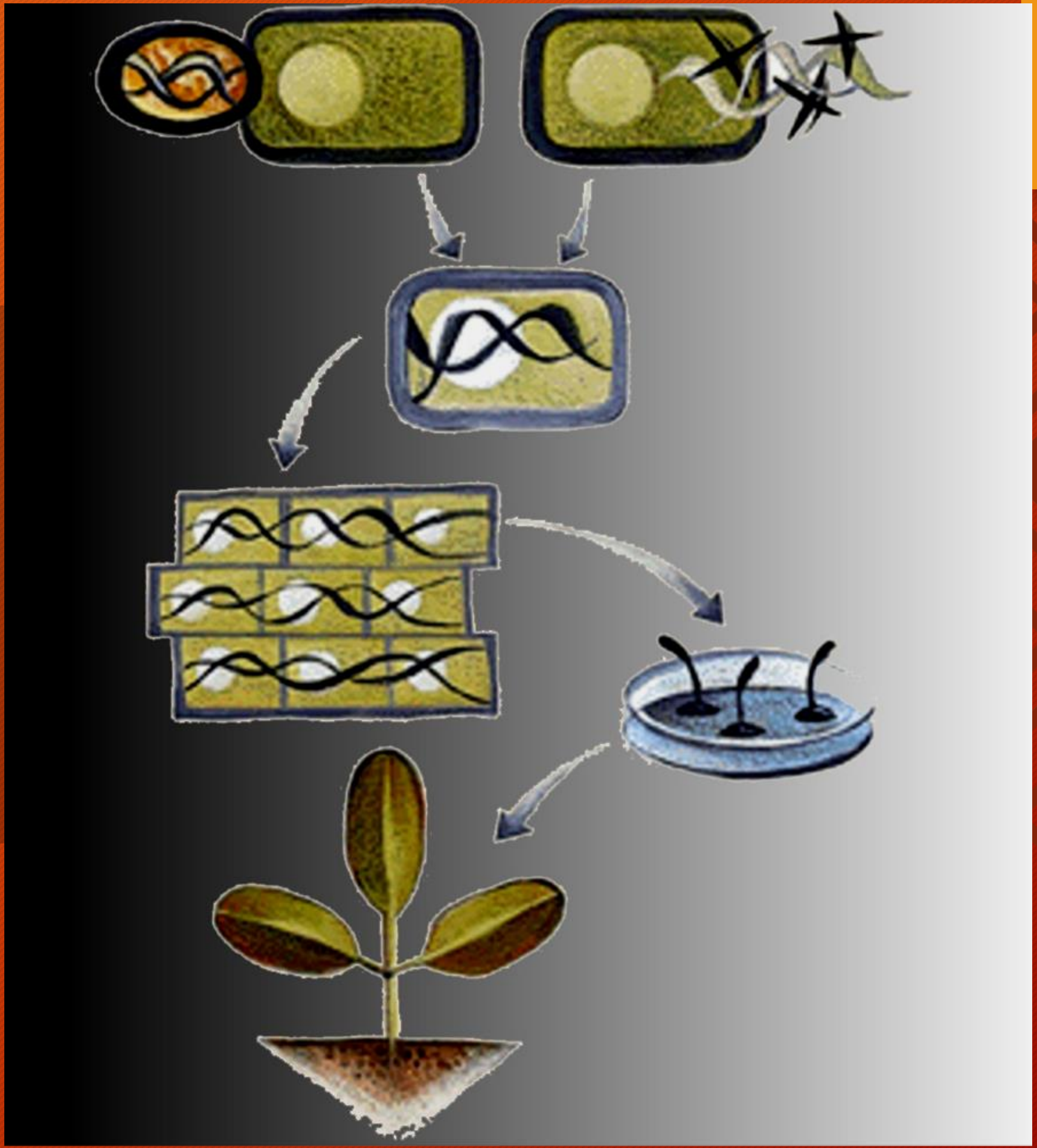
La célula que ha recibido el gen se selecciona

La célula se reproduce y se le induce para que regenere una planta completa

Y se transada a suelo



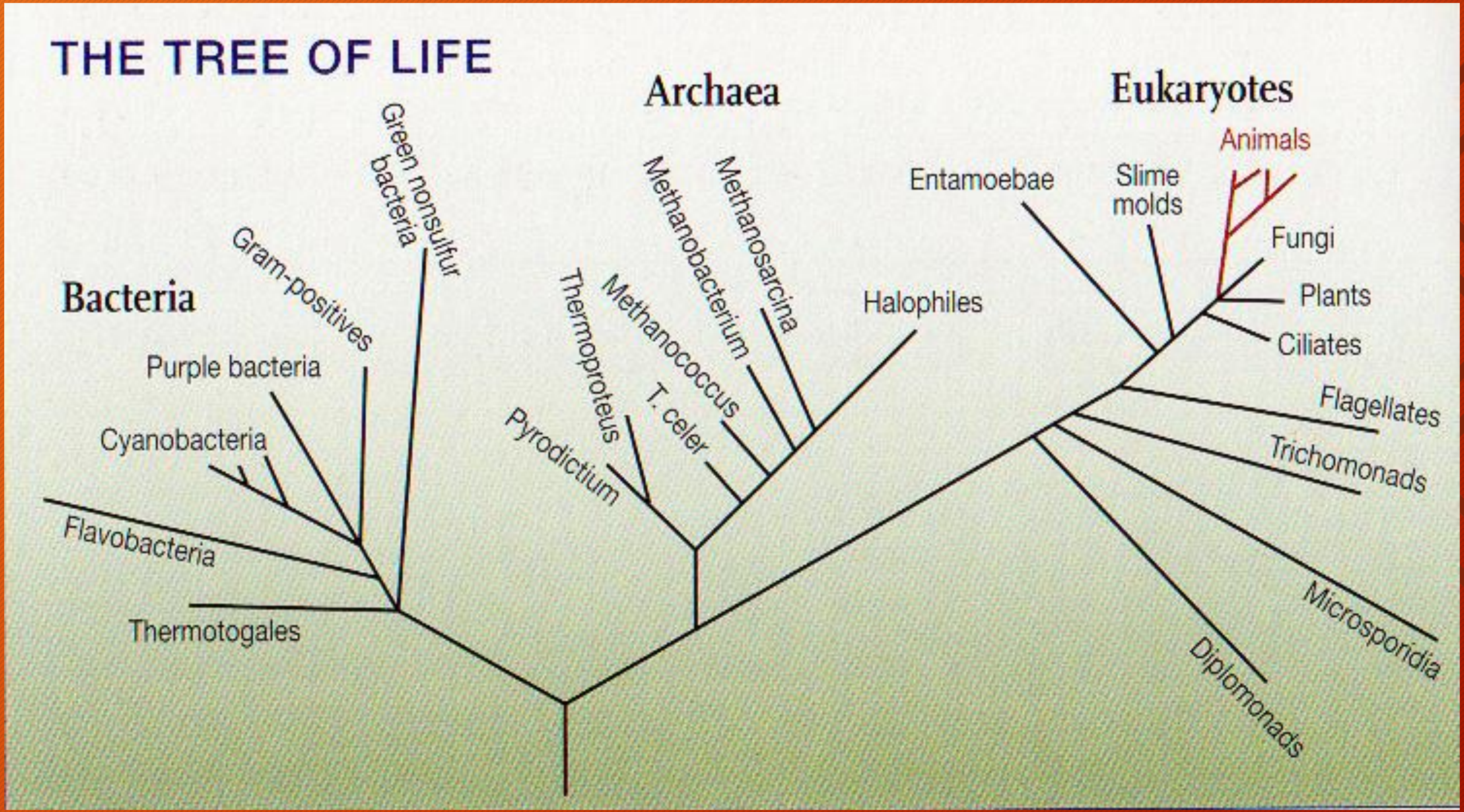
Mito # 1

Los organismos genéticamente modificados no tienen precedente en la naturaleza.

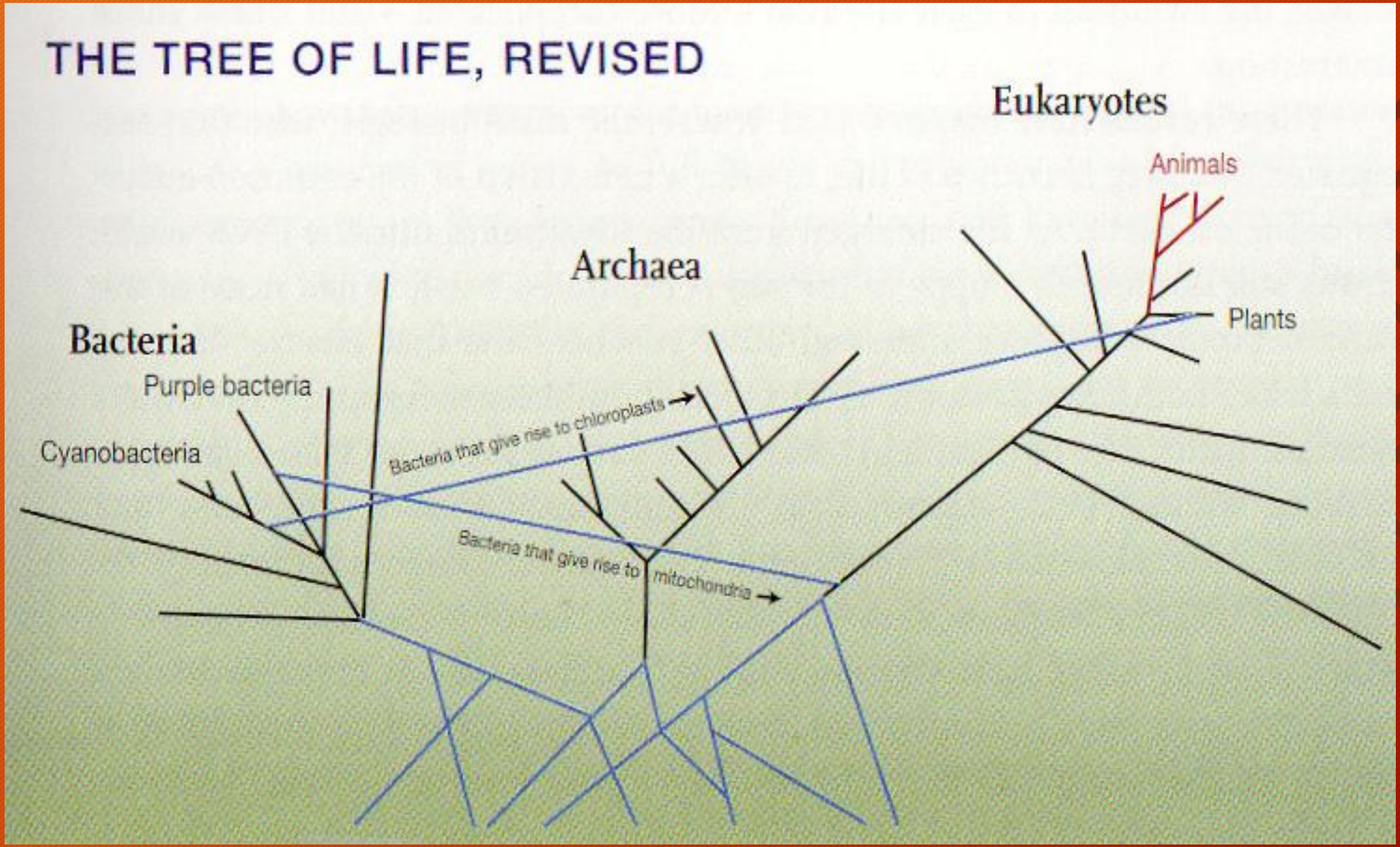
REALIDAD:

El flujo horizontal de genes más allá de la familia taxonómica es un mecanismo evolutivo que ha existido desde hace millones de años

El árbol de la vida



El "mangle" de la vida



PNAS

CrossMark
click for updates

The genome of cultivated sweet potato contains *Agrobacterium* T-DNAs with expressed genes: An example of a naturally transgenic food crop

Tina Kyndt[a,1], Dora Quispe[a,b,1], Hong Zhai[c], Robert Jarret[d], Marc Ghislain[b], Qingchang Liu[c], Godelieve Gheysen[a], and Jan F. Kreuze[b,2]

[a]Department of Molecular Biotechnology, Ghent University, 9000 Ghent, Belgium; [b]International Potato Center, Lima 12, Peru; [c]Beijing Key Laboratory of Crop Genetic Improvement/Laboratory of Crop Heterosis and Utilization, Ministry of Education, China Agricultural University, Beijing, China, 100193; and [d]Plant Genetic Resources Unit, US Department of Agriculture, Agricultural Research Service, Griffin, GA 30223

Edited by Eugene W. Nester, University of Washington, Seattle, WA, and approved March 16, 2015 (received for review October 13, 2014)

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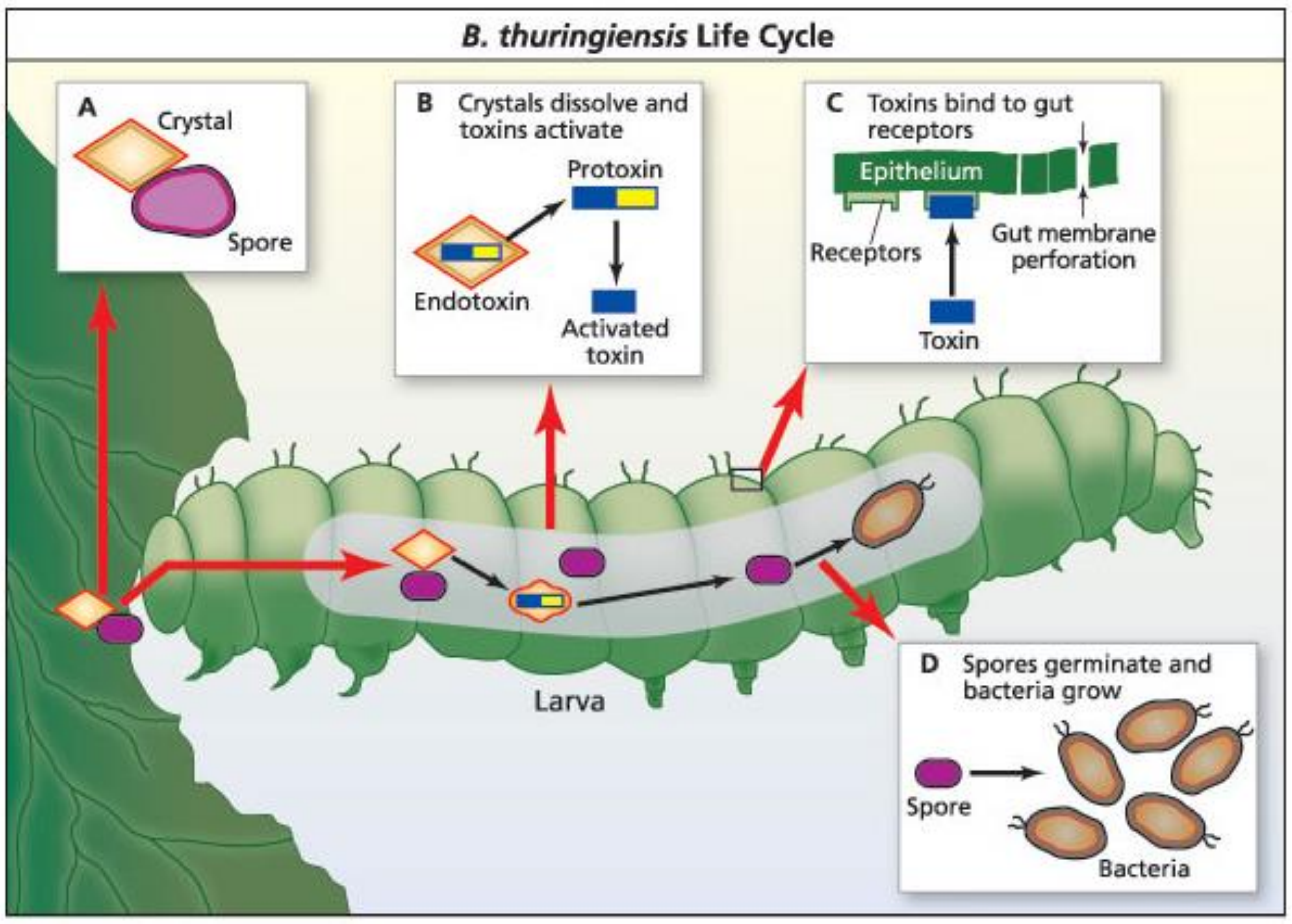
B. thuringiensis Life Cycle
A
Crystal
Spore
B Crystals dissolve and toxins activate
Protoxin
Endotoxin
Activated toxin
C Toxins bind to gut receptors
Epithelium
Receptors
Gut membrane perforation
Toxin
Larva
D Spores germinate and bacteria grow
Spore
Bacteria

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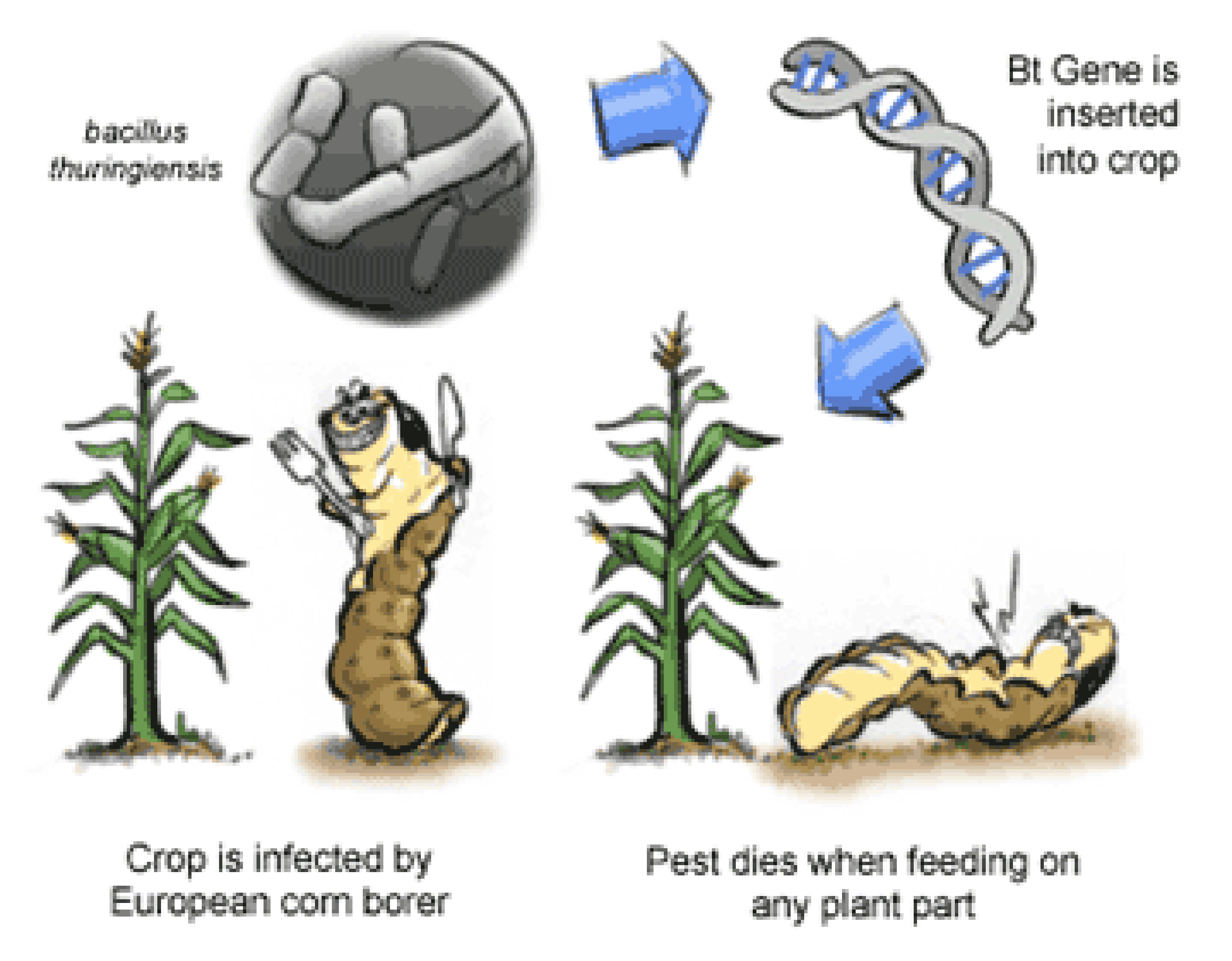

bacillus thuringiensis
Bt Gene is inserted into crop
Crop is infected by European corn borer
Pest dies when feeding on any plant part

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Incremento en la vida de anaquel

Convencional GM

Flavr Savr® de Calgene

Resistencia a insectos (Tecnología Bt)

Convencional

GM

Modificación de contenido nutricional

Convencional

GM

Resistencia a virus

Convencional

GM

Resistencia a herbicidas

No se puede mostrar la imagen en este momento.

Convencional GM

No se puede mostrar la imagen en este momento.

Biofarming

GM

Convencional

Producción de factores de coagulación sanguínea humana en hule

Expresión de antígenos orales en frutos (Vacunas)

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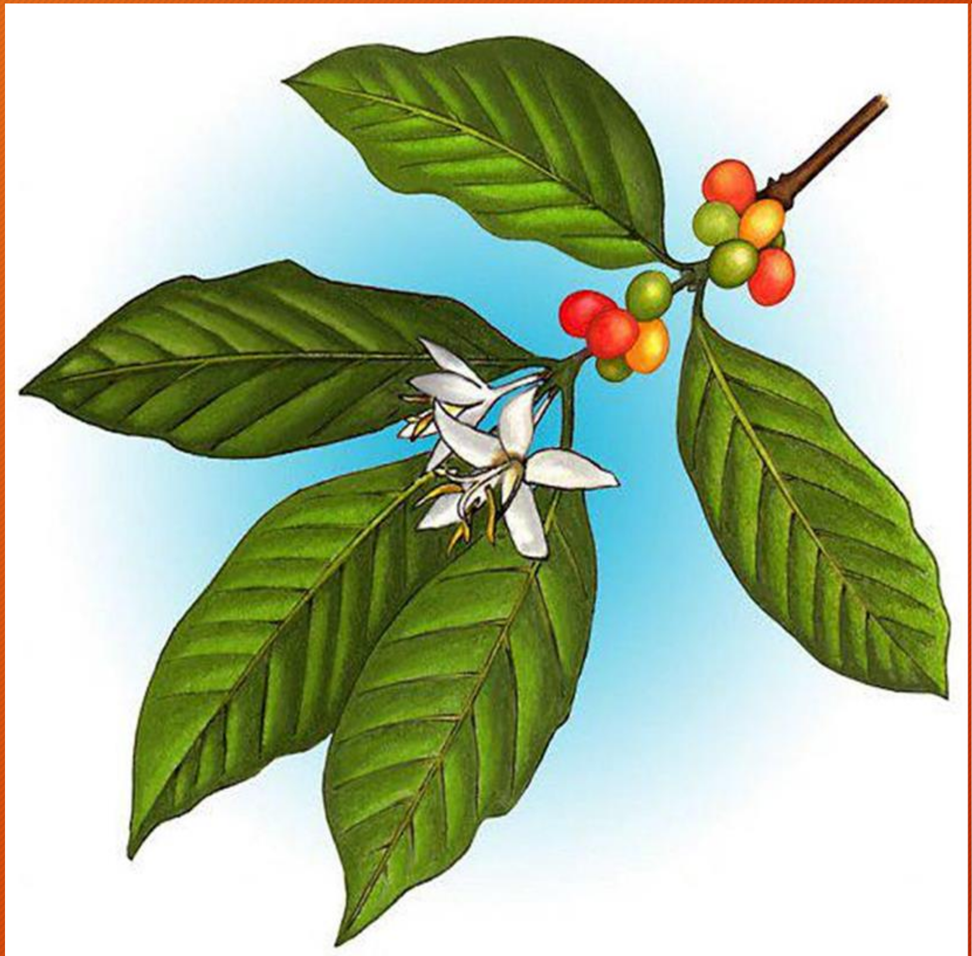
Modificación metabólica. Alcaloides

ECOSUR

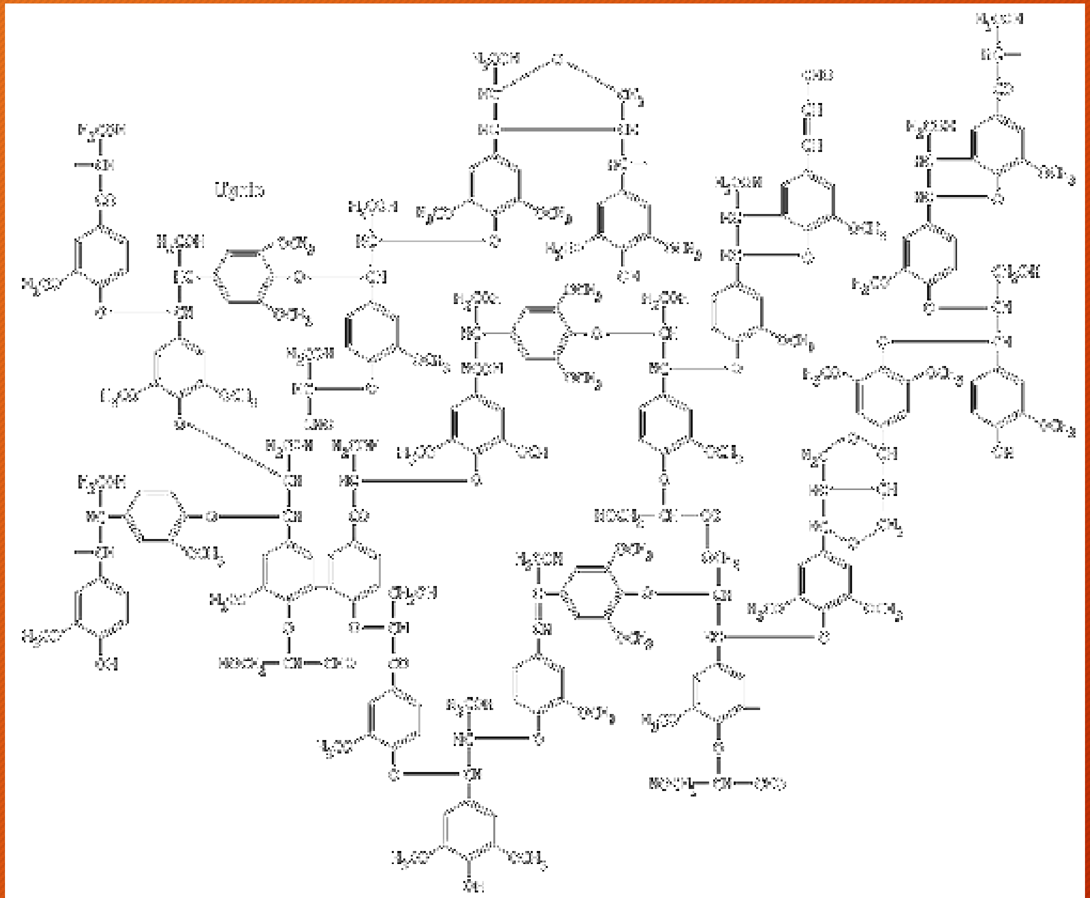


Modificación metabólica. Pigmentos y olores

ECOSUR

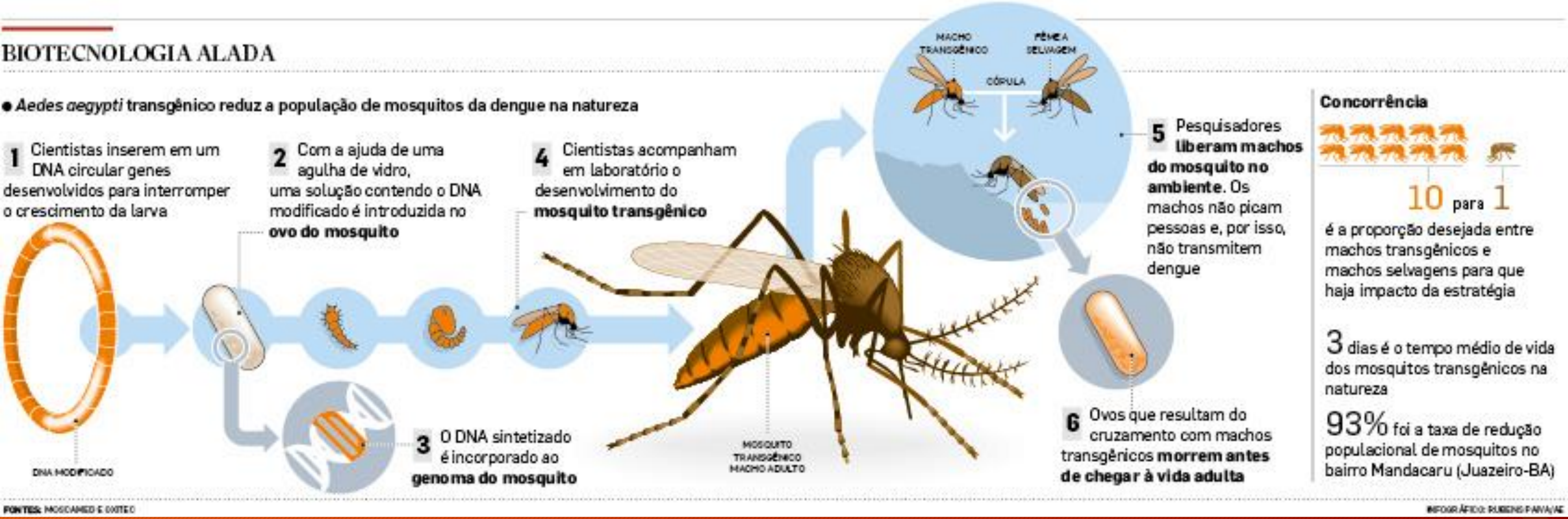


Modificación metabólica. Ligninas



Modificaciones genéticas en peces productividad y bioindicadores

Mosquitos GM para combatir el dengue



Posibilidades infinitas

Mito # 2

Los organismos genéticamente modificados requieren mayor control.

REALIDAD:

Los OGMs han sido fuertemente vigilados desde sus primeras introducciones hace 20 años

¿Cuál fue el proceso para acordar la legislación en materia de Bioseguridad?

abril de 1999

Iniciativa de Ley de bioseguridad y sanidad de organismos vivos y material genético

abril de 2000.

Iniciativa de Ley de bioseguridad

octubre de 2001

Iniciativa de Ley sobre la producción, distribución, comercialización, control y fomento de los productos transgénicos

abril de 2002

Iniciativa de ley de investigación, desarrollo biotecnológico y bioseguridad

mayo 2002

La Cámara de Senadores ratifica el Protocolo de Cartagena

ECOSUR

Noviembre 2002

Presenta iniciativa de Ley de Bioseguridad de OGMs ante el pleno de la Cámara de Senadores

Iniciativa del Senado consideró:

- Experiencia previa nacional y de otros países,
- Legislación nacional y compromisos internacionales,
- Elementos de otras iniciativas de ley (PVEM, PAN, PRD, PRI)
- Experiencia operativa de las instancias competentes
- Foro de consulta muti-sectorial: ambas cámaras, EF, investigadores, ONGs
- **Bases y recomendaciones de la Academia Mexicana de las Ciencias**

- ✓ **Única iniciativa sobre bioseguridad que se presentó por 18 Senadores de todas las fracciones parlamentarias (PRI, PAN PRD,PVEM y PCD)**
- ✓ Foro de consulta de noviembre 2002 a febrero 2003
- ✓ Se aprueba el Dictamen de Iniciativa en abril de 2003 (si 87, no 3 y abs 2)

En la cámara de Diputados:

- Recibe Minuta Proyecto de Ley el 28 de abril de 2003,
- Realizan diversos foros regionales, simposios, seminarios y dos Foros Nacionales
- Se crea subcomisión de trabajo con 9 diputados, se realizan sesiones de trabajo en centros de investigación
- Se escucha al Dr. Sarukhán, y al Dr. Herrera Estrella sobre los resultados del informe de la CCA caso Oaxaca
- Se vota 14 de diciembre de 2004 y se aprueba en Pleno (si 319, no 105 y 5 abstenciones).
- Se publica en mayo de 2005.

PNUMA

Programa de las Naciones Unidas para el Medio Ambiente

UNEP

1992

Declaración de Río sobre Medio Ambiente y Desarrollo

Agenda 21

Convenio sobre la Diversidad Biológica

2000

Protocolo de Cartagena sobre la Seguridad de la Biotecnología

2010

Protocolo de Nagoya-Kuala Lumpur sobre Responsabilidad y Compensación

2014

Protocolo de Nagoya sobre Acceso a los Recursos Genéticos

Artículo 2
Disposiciones generales

1. **Cada Parte tomará las medidas legislativas, administrativas y de otro tipo necesarias y convenientes para cumplir sus obligaciones dimanantes del presente Protocolo.**

2. Las Partes velarán por que el desarrollo, la manipulación, el transporte, la utilización, la transferencia y la liberación de cualesquiera organismos vivos modificados se realicen de forma que se eviten o se reduzcan los riesgos para la diversidad biológica, teniendo también en cuenta los riesgos para la salud humana.

LEY DE BIOSEGURIDAD DE ORGANISMOS GENÉTICAMENTE MODIFICADOS

TEXTO VIGENTE
Nueva Ley publicada en el Diario Oficial de la Federación el 18 de marzo de 2005

Al margen un sello con el Escudo Nacional, que dice: Estados Unidos Mexicanos.- Presidencia de la República.

VICENTE FOX QUESADA, Presidente de los Estados Unidos Mexicanos, a sus habitantes sabed:

Que el Honorable Congreso de la Unión, se ha servido dirigirme el siguiente

DECRETO

"EL CONGRESO DE LOS ESTADOS UNIDOS MEXICANOS, DECRETA:

SE EXPIDE LA LEY DE BIOSEGURIDAD DE ORGANISMOS GENÉTICAMENTE MODIFICADOS.

ARTÍCULO ÚNICO: Se expide la Ley de Bioseguridad de Organismos Genéticamente Modificados, para quedar como sigue:

LEY DE BIOSEGURIDAD DE ORGANISMOS GENÉTICAMENTE MODIFICADOS

TÍTULO PRIMERO
Disposiciones Generales

CAPÍTULO I
Objeto y Finalidades

ARTÍCULO 1.- La presente Ley es de orden público y de interés social, y tiene por objeto regular las actividades de utilización confinada, liberación experimental, liberación en programa piloto, liberación comercial, comercialización, importación y exportación de organismos genéticamente modificados, con el fin de prevenir, evitar o reducir los posibles riesgos que estas actividades pudieran ocasionar a la salud humana o al medio ambiente y a la diversidad biológica o a la sanidad animal, vegetal y acuícola.

ARTÍCULO 2.- Para cumplir su objeto, este ordenamiento tiene como finalidades:

I. Garantizar un nivel adecuado y eficiente de protección de la salud humana, del medio ambiente y la diversidad biológica y de la sanidad animal, vegetal y acuícola, respecto de los efectos adversos que pudiera causarles la realización de actividades con organismos genéticamente modificados;

II. Definir los principios y la política nacional en materia de bioseguridad de los OGMs y los instrumentos para su aplicación;

III. Determinar las competencias de las diversas dependencias de la Administración Pública Federal en materia de bioseguridad de los OGMs;

IV. Establecer las bases para la celebración de convenios o acuerdos de coordinación entre la Federación, por conducto de las Secretarías competentes y los gobiernos de las entidades federativas, para el mejor cumplimiento del objeto de esta Ley;

V. Establecer las bases para el funcionamiento de la Comisión Intersecretarial de Bioseguridad de los Organismos Genéticamente Modificados, a través de la cual las Secretarías que la integran deban

- Publicada en 2005 y vigente
- Considera compromisos internacionales
- Define principios de política nacional
- Establece instrumentos para su aplicación
- Determina competencias de las dependencias Federales
- Mecanismos de comunicación e información
- Bases para el contenido de normas
- Instrumentos de fomento a la investigación
- 124 artículos y artículos 12 transitorios

2005 Ley de Bioseguridad de Organismos Genéticamente Modificados se publica en el DOF en marzo. → Adecuación de regulación de las instancias competentes

2006 Reglamento de la CIBIOGEM

2007 Reglas de Operación de la CIBIOGEM

2008 Reglamento de la LBOGM

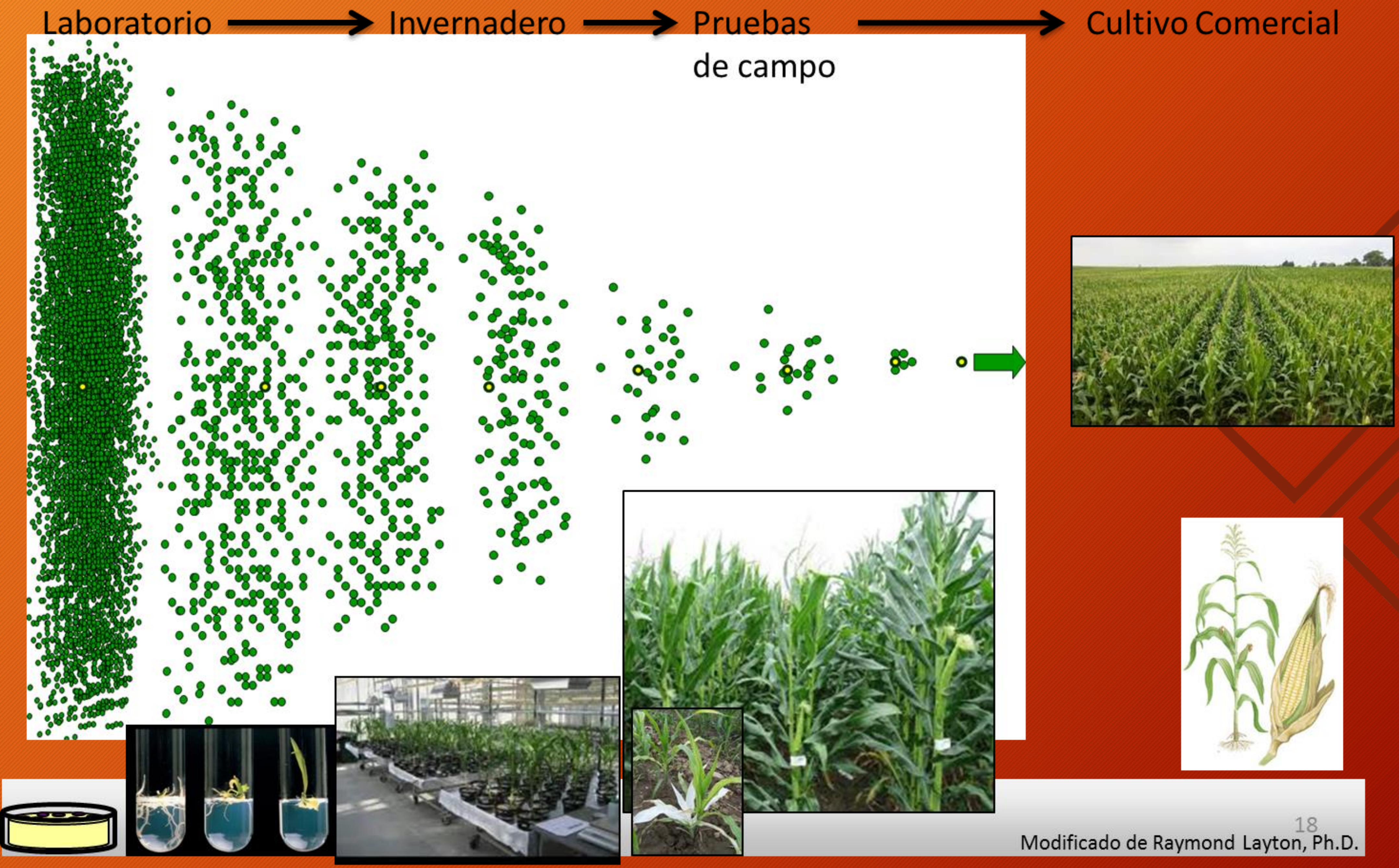
2009 Decreto de reforma al Reglamento de la LBOGM: Régimen de Protección Especial al Maíz, Reglas de Operación del Fondo para el Fomento y Apoyo a la Investigación C & T en Bioseguridad y Biotecnología, Reglas a Operación y Funcionamiento de la Red Mexicana de Monitoreo de OGMs.

2011 Formato Único de Avisos de Utilización Confinada de OGMS.

2012 Acuerdo de Centros de origen de maíz.

2014 Norma del Contenido del Reporte de Resultados

2015 Norma de Análisis de Riesgos para liberaciones Experimentales



Modificado de Raymond Layton, Ph.D.

Mito # 3

Los agricultores no quieren utilizar cultivos genéticamente modificados, quienes los usan son los grandes agricultores de países desarrollados.

ISAAA
International Service for the Acquisition of Agri-biotech Applications

EXECUTIVE SUMMARY

BRIEF 46

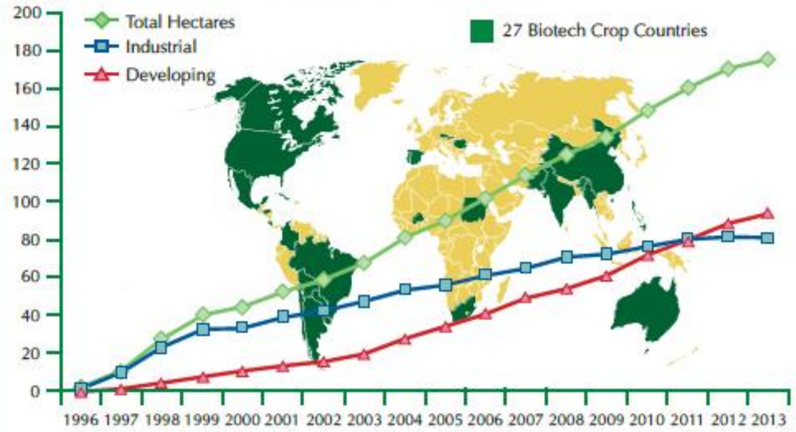
Global Status of Commercialized Biotech/GM Crops: 2013

By

Clive James
Founder and Emeritus Chair of ISAAA

Dedicated to the late Nobel Peace Laureate, Norman Borlaug, founding patron of ISAAA, on the centenary of his birth, 25 March 2014

GLOBAL AREA OF BIOTECH CROPS
Million Hectares (1996-2013)



A record 18 million farmers, in 27 countries, planted 175.2 million hectares (433 million acres) in 2013, a sustained increase of 3% or 5 million hectares (12 million acres) over 2012.

Source: Clive James, 2013.

No. 46 - 2013

ECOSUR

Durante el año 2014 los cultivos GM se sembraron a nivel comercial en:

- 179 millones de hectáreas
- 27 países
- 18 millones de agricultores
- Los últimos dos años predominan el cultivo en países en desarrollo

Mito # 4

Los científicos están en contra del uso de organismos genéticamente modificados, particularmente los europeos.

AgBioWorld

http://www.agbioworld.org/declaration

ECOSUR

Declaration

Scientists In Support Of Agricultural Biotechnology

We, the undersigned members of the scientific community, believe that **recombinant DNA techniques constitute powerful and safe means for the modification of organisms and can contribute substantially in enhancing quality of life by improving agriculture, health care, and the environment.** The responsible genetic modification of plants is neither new nor dangerous. Many characteristics, such as pest and disease resistance, have been routinely introduced into crop plants by traditional methods of sexual reproduction or cell culture procedures. The addition of new or different genes into an organism by **recombinant DNA techniques does not inherently pose new or heightened risks relative to the modification of organisms by more traditional methods, and the relative safety of marketed products is further ensured by current regulations intended to safeguard the food supply.** The novel genetic tools offer greater flexibility and precision in the modification of crop plants. No food products, whether produced with recombinant DNA techniques or with more traditional methods, are totally without risk. The risks posed by foods are a function of the biological characteristics of those foods and the specific genes that have been used, not of the processes employed in their development. Our goal as scientists is to ensure that any new foods produced from recombinant DNA are as safe or safer than foods already being consumed. Current methods of regulation and development have worked well. Recombinant DNA techniques have already been used to develop 'environmentally-friendly' crop plants with traits that preserve yields and allow farmers to reduce their use of synthetic pesticides and herbicides. The next generation of products promises to provide even greater benefits to consumers, such as enhanced nutrition, healthier oils, enhanced vitamin content, longer shelf life and improved medicines. Through judicious deployment, biotechnology can also address environmental degradation, hunger, and poverty in the developing world by providing improved agricultural productivity and greater nutritional security. Scientists at the international agricultural centers, universities, public research institutions, and elsewhere are already experimenting with products intended specifically for use in the developing world. We hereby express our support for the use of recombinant DNA as a potent tool for the achievement of a productive and sustainable agricultural system. We also urge policy makers to use sound scientific principles in the regulation of products produced with recombinant DNA, and to base evaluations of those products upon the characteristics of those products, rather than on the processes used in their development.

Los siguientes científicos, ganadores de Premios Nobel, han firmado la Declaración AgBioworld en apoyo a la Biotecnolgía Agrícola.

Entre ellos, nótese que firman Watson, Borlaug y Kornberg, que son los expertos más reconocidos en el área de la biología molecular. También Mario Molina asienta su firma.

Además, más de 3,400 personas han firmado la Declaración.

Norman Borlaug. Nobel Peace Prize 1970
James Watson. Nobel Prize in Phisiology or Medicine 1962
Timothy Hunt. Nobel Prize in Phisiology or Medicine 2001
Peter C. Doherty. Nobel Prize in Phisiology or Medicine 1996
Paul D. Boyer. Nobel Prize in Chemistry 1997
Oscar Arias Sanchez. Nobel Peace Prize 1987
Paul Berg. Nobel Prize in Chemistry 1980
Phillip A. Sharp. Nobel Prize in Phisiology or Medicine 1993
Douglas D. Osheroff. Nobel Prize in Physiscs 1996
Marshall Nirenberg. Nobel Prize in Phisiology or Medicine 1968
Richard E. Smalley. Nobel Prize in Chemistry 1996
Edward Lewis. Nobel Prize in Phisiology or Medicine 1995
Sydney Brenner. Nobel Prize in Phisiology or Medicine 2002
Eric Wieschaus. Nobel Prize in Phisiology or Medicine 1995
Leon N. Cooper. Nobel Prize in Physics 1972
Edmond H. Fischer. Nobel Prize in Phisiology or Medicine 1992
George A. Olah. Nobel Prize in Chemistry 1994
Christian de Duve. Nobel Prize in Phisiology or Medicine 1974
Mario Molina. Nobel Prize in Chemistry 1995
Arthur Kornberg. Nobel Prize in Phisiology or Medicine 1959
Donald A.Glaser. Nobel Prize in Physics 1960
Roger Guillemin. Nobel Prize in Phisiology or Medicine 1977
Sheldon Glashow. Nobel Prize in Physics 1979
Jean Marie Lehn. Nobel Prize in Chemistry 1987
Richard J. Roberts. Nobel Prize in Phisiology or Medicine 1993

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EASAC, the European Academies Science Advisory Council, consists of representatives of the following European national academies and academic bodies:

Academia Europaea
All European Academies (ALLEA)
The Austrian Academy of Sciences
The Royal Academies for Science and the Arts of Belgiu
The Bulgarian Academy of Sciences
The Academy of Sciences of the Czech Republic
The Royal Danish Academy of Sciences and Letters
The Estonian Academy of Sciences
The Council of Finnish Academies
The Académie des Sciences
The German Academy of Sciences Leopoldina
The Academy of Athens
The Hungarian Academy of Sciences
The Royal Irish Academy
The Accademia Nazionale dei Lincei
The Latvian Academy of Sciences
The Lithuanian Academy of Sciences
The Royal Netherlands Academy of Arts and Sciences
The Polish Academy of Sciences
The Academy of Sciences of Lisbon
The Romanian Academy
The Slovakian Academy of Sciences
The Slovenian Academy of Arts and Science
The Spanish Royal Academy of Sciences
The Royal Swedish Academy of Sciences
The Royal Society

The Norwegian Academy of Science and Letters
The Swiss Academies of Arts and Sciences

European Academies
easac
Science Advisory Council

Planting the future: opportunities and challenges for using crop genetic improvement technologies for sustainable agriculture

EASAC policy report 21

June 2013

ISBN: 978-3-8047-3181-3

This report can be found at
www.easac.eu

building science into EU policy

ECOSUR

La **EASAC (**the European Academies Science Advisory Council) formada por las Academias Nacionales de los Miembros de la Unión Europea (UE), colabora entre sí para dar consejo a los realizadores de las politicas Europeas como voz científica colectiva

Mito # 5

No hay suficiente información (generada por científicos independientes) que respalde que el uso de organismos genéticamente modificados es seguro.

La Comunidad Europea y la Inversión en Investigación sobre OGMs

ECOSUR

- Invasividad de las Plantas GM
- Flujo de genes
- Impacto ambiental
- Seguridad de los alimentos GM
- Eficacia e inocuidad de vacunas recombinantes
- Interacción planta-microorganismo

1995

- Enfoque más definido hacia la valoración de efectos asociados a transgenes específicos
- Utilidad de OGMs en aplicaciones biotecnológicas
- Investigación para respaldar Análisis y evaluación de riesgo

2000

- Enfoque al beneficio del consumidor, y construcción de una BIOsociedad y economía basada en el Bio-conocimiento.

2010

Enfoque hacia 4 áreas principales de Investigación:

1. Impactos Ambientales de los OGMs.
2. Inocuidad alimentaria de OGMs.
3. Tecnologías emergentes: Desarrollo de OGMs para biomateriales y biocombustibles
4. Evaluación y Gestión de riesgo:

   Apoyo a la toma de decisión y comunicación de riesgo.

http://ec.europa.eu/research/biosociety/index_en.htm

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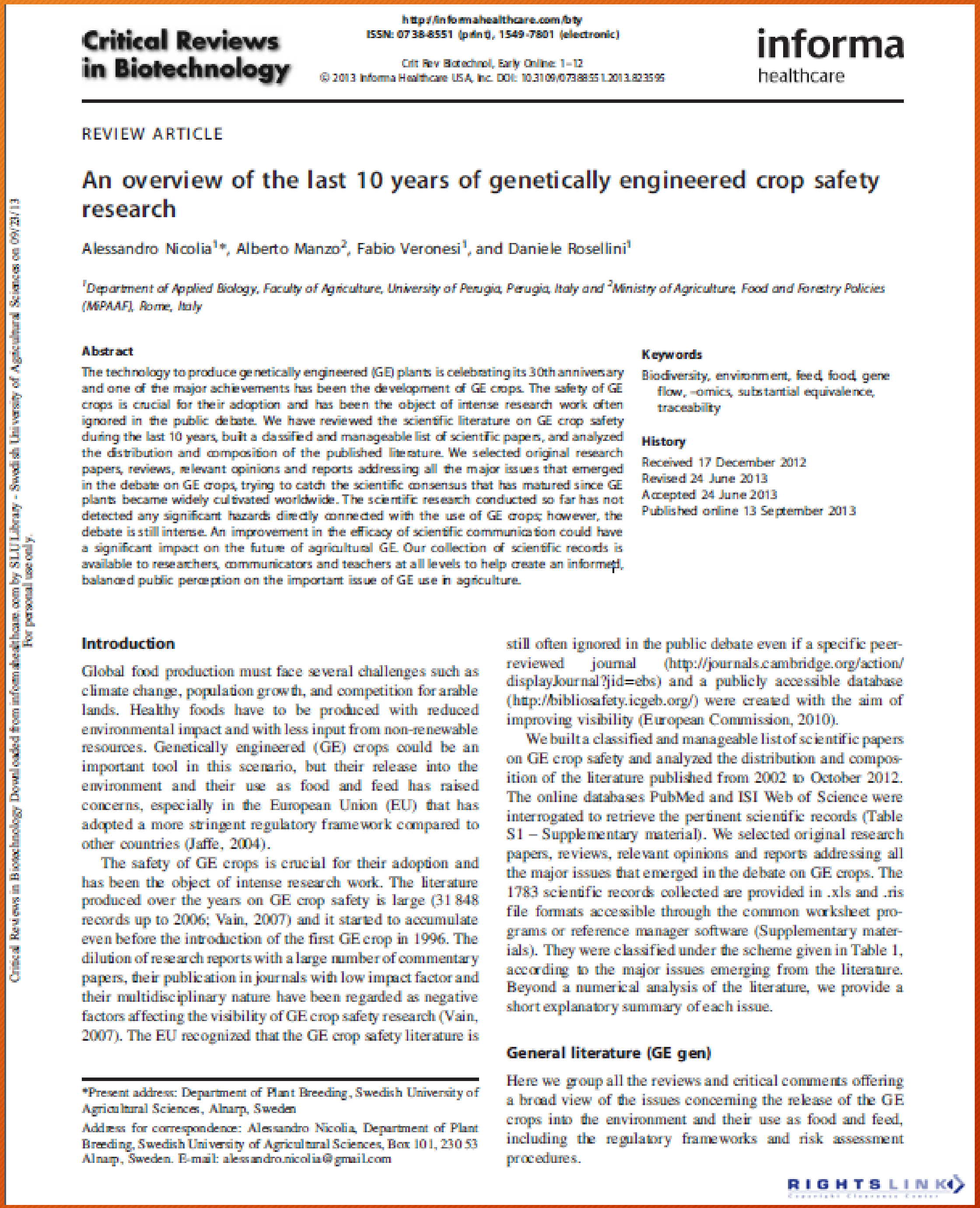

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REVIEW ARTICLE

An overview of the last 10 years of genetically engineered crop safety research

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Abstract

The technology to produce genetically engineered (GE) plants is celebrating its 30th anniversary and one of the major achievements has been the development of GE crops. The safety of GE crops is crucial for their adoption and has been the object of intense research work often ignored in the public debate. We have reviewed the scientific literature on GE crop safety during the last 10 years, built a classified and manageable list of scientific papers, and analyzed the distribution and composition of the published literature. We selected original research papers, reviews, relevant opinions and reports addressing all the major issues that emerged in the debate on GE crops, trying to catch the scientific consensus that has matured since GE plants became widely cultivated worldwide. The scientific research conducted so far has not detected any significant hazards directly connected with the use of GE crops; however, the debate is still intense. An improvement in the efficacy of scientific communication could have a significant impact on the future of agricultural GE. Our collection of scientific records is available to researchers, communicators and teachers at all levels to help create an informed, balanced public perception on the important issue of GE use in agriculture.

Keywords

Biodiversity, environment, feed, food, gene flow, -omics, substantial equivalence, traceability

History

Received 17 December 2012
Revised 24 June 2013
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Introduction

Global food production must face several challenges such as climate change, population growth, and competition for arable lands. Healthy foods have to be produced with reduced environmental impact and with less input from non-renewable resources. Genetically engineered (GE) crops could be an important tool in this scenario, but their release into the environment and their use as food and feed has raised concerns, especially in the European Union (EU) that has adopted a more stringent regulatory framework compared to other countries (Jaffe, 2004).

The safety of GE crops is crucial for their adoption and has been the object of intense research work. The literature produced over the years on GE crop safety is large (31 848 records up to 2006; Vain, 2007) and it started to accumulate even before the introduction of the first GE crop in 1996. The dilution of research reports with a large number of commentary papers, their publication in journals with low impact factor and their multidisciplinary nature have been regarded as negative factors affecting the visibility of GE crop safety research (Vain, 2007). The EU recognized that the GE crop safety literature is still often ignored in the public debate even if a specific peer-reviewed journal (http://journals.cambridge.org/action/displayJournal?jid=ebs) and a publicly accessible database (http://bibliosafety.icgeb.org/) were created with the aim of improving visibility (European Commission, 2010).

We built a classified and manageable list of scientific papers on GE crop safety and analyzed the distribution and composition of the literature published from 2002 to October 2012. The online databases PubMed and ISI Web of Science were interrogated to retrieve the pertinent scientific records (Table S1 – Supplementary material). We selected original research papers, reviews, relevant opinions and reports addressing all the major issues that emerged in the debate on GE crops. The 1783 scientific records collected are provided in .xls and .ris file formats accessible through the common worksheet programs or reference manager software (Supplementary materials). They were classified under the scheme given in Table 1, according to the major issues emerging from the literature. Beyond a numerical analysis of the literature, we provide a short explanatory summary of each issue.

General literature (GE gen)

Here we group all the reviews and critical comments offering a broad view of the issues concerning the release of the GE crops into the environment and their use as food and feed, including the regulatory frameworks and risk assessment procedures.

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En 2013, Nicolia y sus colaboradores publicaron una revisión que analizó la información científica publicada en los últimos 10 años en revistas científicas que cumplen como requisito el proceso de revisión por pares. Derivado de este **meta-análisis que incluyó 1783 estudios, concluyen que “con la investigación que se cuenta hasta ahora no se ha detectado ningún peligro significativo asociado directamente con el uso de cultivos genéticamente modificados”.**

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Mito # 6

Los cultivos de organismos genéticamente modificados dañan a la biodiversidad.

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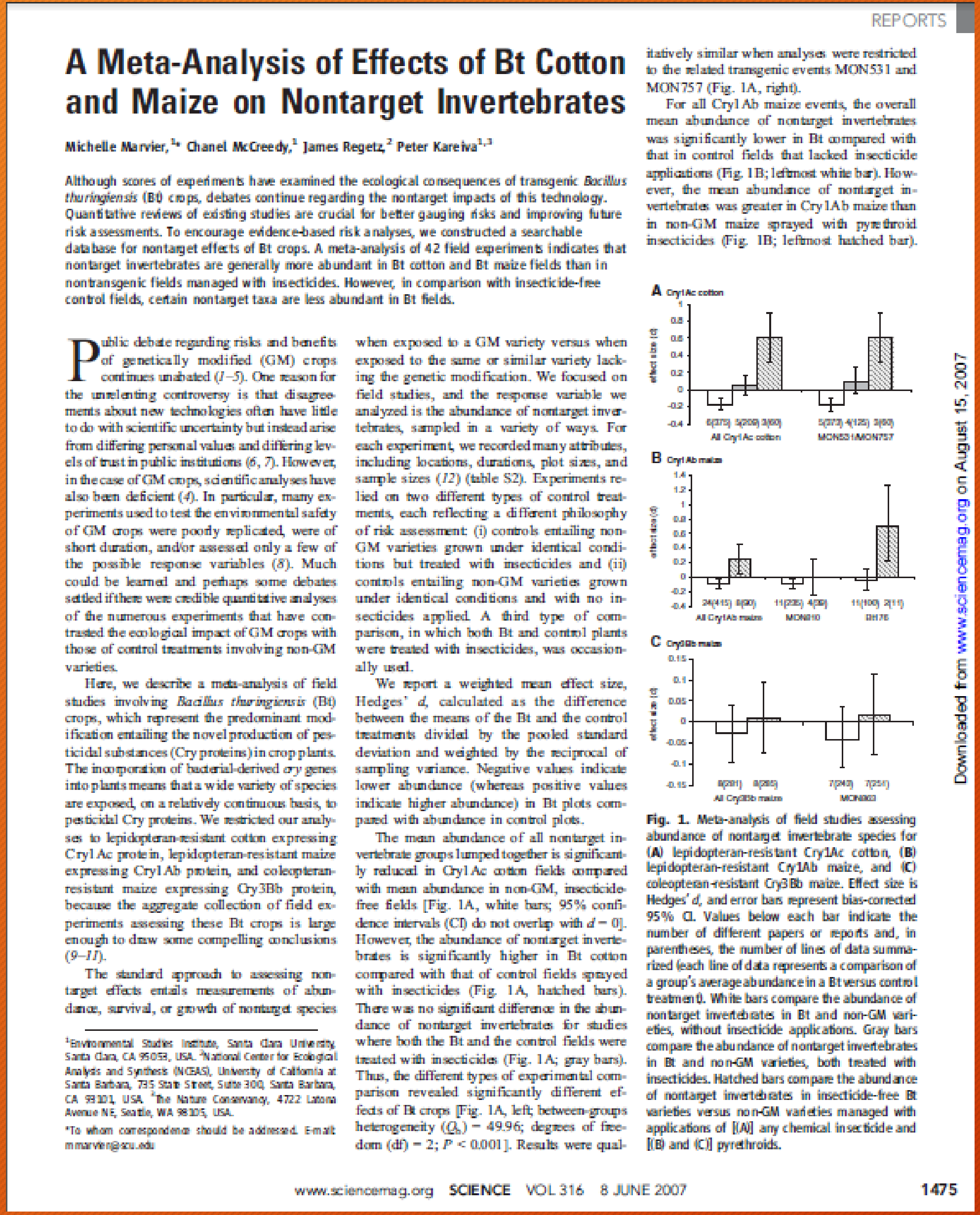
Aspectos de agricultura y medio ambiente



A Meta-Analysis of Effects of Bt Cotton and Maize on Nontarget Invertebrates

Michelle Marvier,[1*] Chanel McCreedy,[1] James Regetz,[2] Peter Kareiva[1,3]

Although scores of experiments have examined the ecological consequences of transgenic *Bacillus thuringiensis* (Bt) crops, debates continue regarding the nontarget impacts of this technology. Quantitative reviews of existing studies are crucial for better gauging risks and improving future risk assessments. To encourage evidence-based risk analyses, we constructed a searchable database for nontarget effects of Bt crops. A meta-analysis of 42 field experiments indicates that nontarget invertebrates are generally more abundant in Bt cotton and Bt maize fields than in nontransgenic fields managed with insecticides. However, in comparison with insecticide-free control fields, certain nontarget taxa are less abundant in Bt fields.

Public debate regarding risks and benefits of genetically modified (GM) crops continues unabated (*1–5*). One reason for the unrelenting controversy is that disagreements about new technologies often have little to do with scientific uncertainty but instead arise from differing personal values and differing levels of trust in public institutions (*6*, *7*). However, in the case of GM crops, scientific analyses have also been deficient (*4*). In particular, many experiments used to test the environmental safety of GM crops were poorly replicated, were of short duration, and/or assessed only a few of the possible response variables (*8*). Much could be learned and perhaps some debates settled if there were credible quantitative analyses of the numerous experiments that have contrasted the ecological impact of GM crops with those of control treatments involving non-GM varieties.

Here, we describe a meta-analysis of field studies involving *Bacillus thuringiensis* (Bt) crops, which represent the predominant modification entailing the novel production of pesticidal substances (Cry proteins) in crop plants. The incorporation of bacterial-derived *cry* genes into plants means that a wide variety of species are exposed, on a relatively continuous basis, to pesticidal Cry proteins. We restricted our analyses to lepidopteran-resistant cotton expressing Cry1Ac protein, lepidopteran-resistant maize expressing Cry1Ab protein, and coleopteran-resistant maize expressing Cry3Bb protein, because the aggregate collection of field experiments assessing these Bt crops is large enough to draw some compelling conclusions (*9–11*).

The standard approach to assessing nontarget effects entails measurements of abundance, survival, or growth of nontarget species when exposed to a GM variety versus when exposed to the same or similar variety lacking the genetic modification. We focused on field studies, and the response variable we analyzed is the abundance of nontarget invertebrates, sampled in a variety of ways. For each experiment, we recorded many attributes, including locations, durations, plot sizes, and sample sizes (*12*) (table S2). Experiments relied on two different types of control treatments, each reflecting a different philosophy of risk assessment: (i) controls entailing non-GM varieties grown under identical conditions but treated with insecticides and (ii) controls entailing non-GM varieties grown under identical conditions and with no insecticides applied. A third type of comparison, in which both Bt and control plants were treated with insecticides, was occasionally used.

We report a weighted mean effect size, Hedges' *d*, calculated as the difference between the means of the Bt and the control treatments divided by the pooled standard deviation and weighted by the reciprocal of sampling variance. Negative values indicate lower abundance (whereas positive values indicate higher abundance) in Bt plots compared with abundance in control plots.

The mean abundance of all nontarget invertebrate groups lumped together is significantly reduced in Cry1Ac cotton fields compared with mean abundance in non-GM, insecticide-free fields [Fig. 1A, white bars; 95% confidence intervals (CI) do not overlap with $d = 0$]. However, the abundance of nontarget invertebrates is significantly higher in Bt cotton compared with that of control fields sprayed with insecticides (Fig. 1A, hatched bars). There was no significant difference in the abundance of nontarget invertebrates for studies where both the Bt and the control fields were treated with insecticides (Fig. 1A; gray bars). Thus, the different types of experimental comparison revealed significantly different effects of Bt crops [Fig. 1A, left; between-groups heterogeneity (Q_b) = 49.96; degrees of freedom (df) = 2; $P < 0.001$]. Results were qualitatively similar when analyses were restricted to the related transgenic events MON531 and MON757 (Fig. 1A, right).

For all Cry1Ab maize events, the overall mean abundance of nontarget invertebrates was significantly lower in Bt compared with that in control fields that lacked insecticide applications (Fig. 1B; leftmost white bar). However, the mean abundance of nontarget invertebrates was greater in Cry1Ab maize than in non-GM maize sprayed with pyrethroid insecticides (Fig. 1B; leftmost hatched bar).

Fig. 1. Meta-analysis of field studies assessing abundance of nontarget invertebrate species for (**A**) lepidopteran-resistant Cry1Ac cotton, (**B**) lepidopteran-resistant Cry1Ab maize, and (**C**) coleopteran-resistant Cry3Bb maize. Effect size is Hedges' *d*, and error bars represent bias-corrected 95% CI. Values below each bar indicate the number of different papers or reports and, in parentheses, the number of lines of data summarized (each line of data represents a comparison of a group's average abundance in a Bt versus control treatment). White bars compare the abundance of nontarget invertebrates in Bt and non-GM varieties, without insecticide applications. Gray bars compare the abundance of nontarget invertebrates in Bt and non-GM varieties, both treated with insecticides. Hatched bars compare the abundance of nontarget invertebrates in insecticide-free Bt varieties versus non-GM varieties managed with applications of [(A)] any chemical insecticide and [(B) and (C)] pyrethroids.

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Resultado del meta-análisis, publicado por Marvier y colaboradores, en donde recopilaron más de **40 estudios en campo** sobre los efectos en la diversidad de invertebrados por el uso de algodón y maíz transgénicos en comparación con otros sistemas agrícolas, en el que **muestran que hay mayor diversidad de artrópodos en cultivos GM que en cultivos de agricultura convencional.**

Mito # 7

No hay beneficios para el ambiente del uso de cultivos genéticamente modificados.

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GM Crops and Food: Biotechnology in Agriculture and the Food Chain 3:2, 129–137; April/May/June 2012; © 2012 Landes Bioscience

Global impact of biotech crops

Environmental effects, 1996–2010

Graham Brookes* and Peter Barfoot

PG Economics; Dorchester, UK

Key words: GMO, pesticide, active ingredient, environmental impact quotient, carbon sequestration, biotech crops, no tillage

This paper updates the assessment of the impact commercialized agricultural biotechnology is having on global agriculture, from some important environmental perspectives. It focuses on the impact of changes in pesticide use and greenhouse gas emissions arising from the use of biotech crops. The technology has reduced pesticide spraying by 443 million kg (-9.1%) and, as a result, decreased the environmental impact associated with herbicide and insecticide use on these crops [as measured by the indicator the Environmental Impact Quotient (EIQ)] by 17.9%. The technology has also significantly reduced the release of greenhouse gas emissions from this cropping area, which, in 2010, was equivalent to removing 8.6 million cars from the roads.

Introduction

This study presents the findings of research into the global environmental impact of biotech crops since their commercial introduction in 1996. It updates the findings of earlier analysis presented by the authors in Agbio Forum 8:187–196,[1] 9:1–13,[2] 11:21–38,[3] and 13:76–94 [4] and GM Crops 2011; 12:34–49.[5] As such, the methodology remains largely unchanged from previous papers on this subject by the authors, with the key differences between each year's paper being the provision of additional (one more year) and updated analysis. The authors undertake this updated analysis to provide interested readers with on-going and current assessments of some of the key environmental impacts associated with the global adoption of biotech crops. By doing so, it is hoped that the data and analysis presented will contribute to wider and greater understanding of the impact of this technology adoption in agriculture and facilitate more informed decision making relating to the use of the technology, especially in countries where crop biotechnology is currently not permitted.

Readers should note that some data presented in this paper are not directly comparable with data presented in previous papers because the current paper takes into account the availability of new data and analysis (including revisions to data for earlier years).

The environmental impact analysis undertaken focuses on the following:

• The impacts associated with changes in the amount of insecticides and herbicides applied to the biotech crops relative to conventionally grown alternatives. Herbicides and insecticides are used to protect plants (crops) from pests and weeds and careful use of them can deliver important benefits for society, namely increasing the availability of good quality, reasonably priced foods and animal feed. However, insecticides and herbicides can, by their nature, be harmful to living organisms and therefore there are risks associated with their use. This means a balance has to be found relating to levels of use that contribute to delivering the important benefits referred to above while, at the same time, safeguarding human health, reducing contamination of water and reducing impacts on biodiversity. If biotech crops are better able to achieve this balance by delivering the same or higher levels of food production but with reduced risks to human health, of water contamination and to biodiversity, society benefits.

• The contribution of biotech crops toward reducing global greenhouse gas (GHG) emissions. It is widely accepted by governments around the world that increases in atmospheric levels of greenhouse gases due to human activity are detrimental to the global environment. Therefore if the adoption of crop biotechnology contributes to a reduction in the level of greenhouse gas emissions from agriculture, this represents a positive development for the world.

The analysis is mostly based on existing farm level impact data of biotech crops. Primary data for impacts of commercial biotech cultivation on both pesticide usage and greenhouse gas emissions are, however, limited and are not available for every crop, in every year and for each country. Nevertheless, all identified, representative, previous research has been utilized. This has been supplemented by the authors' own data collection and analysis. The analysis of pesticide usage also takes into consideration changes in the pattern of herbicide use in recent years that reflect measures taken by some farmers to address issues of weed resistance to the main herbicide (glyphosate) used with herbicide tolerant biotech crops.

*Correspondence to: Graham Brookes; Email: graham.brookes@btinternet.com
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http://dx.doi.org/10.4161/gmcr.20061

Aspectos de agricultura y medio ambiente

El uso de cultivos GM que cuentan con sus propios insecticidas biológicos, producto de la modificación genética, ha contribuido a la reducción del uso de insecticidas químicos.

La tecnología también ha reducido la emisión de gases de efecto invernadero.

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Mito # 8

No es ético utilizar cultivos genéticamente modificados en sus centros de origen.

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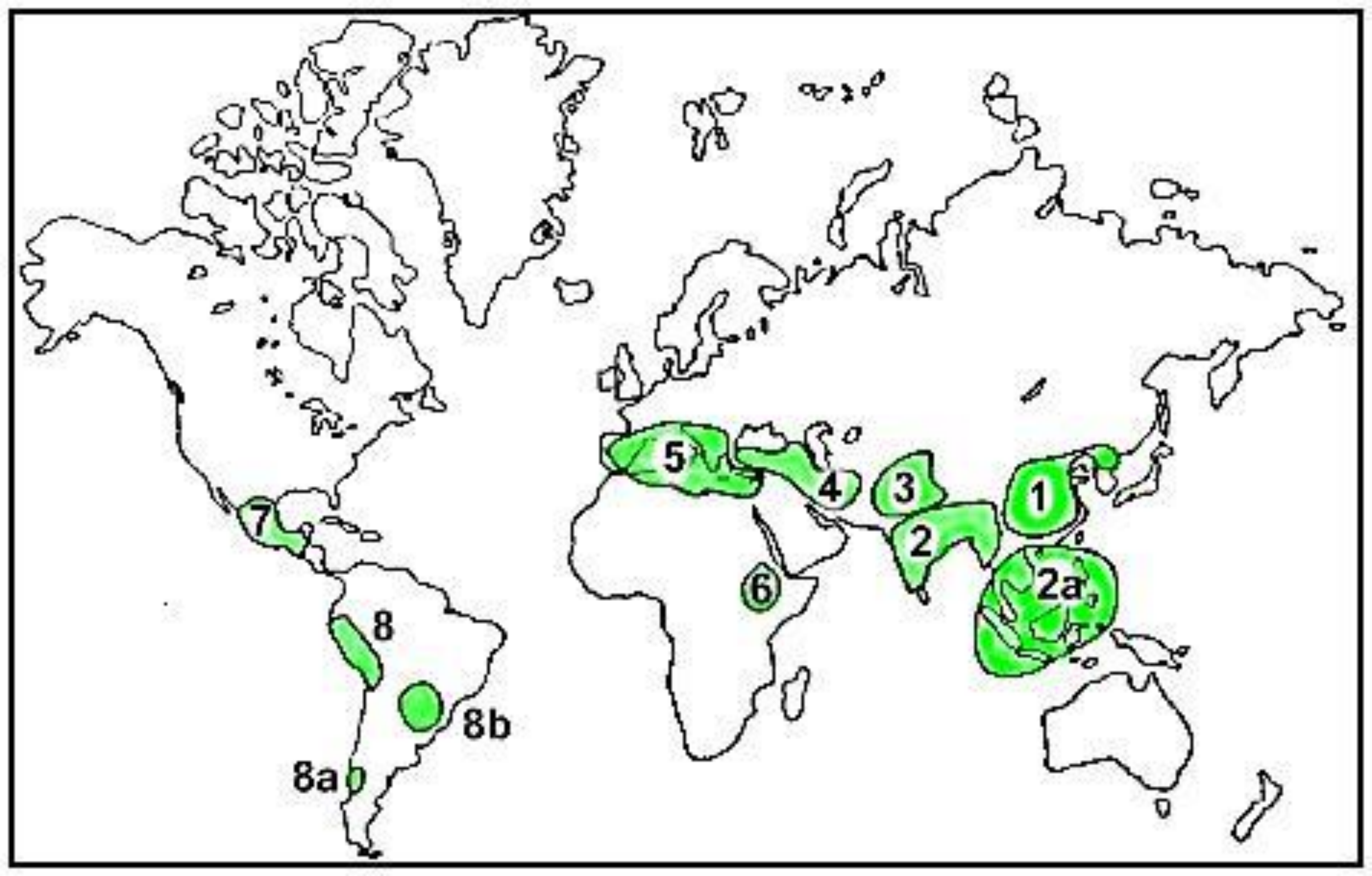

NUFFIELD COUNCIL ON BIOETHICS

Mito # 9

Países como Francia han prohibido el uso de cultivos genéticamente en su territorio por que son dañinos para la salud y el medio ambiente.

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efsa
European Food Safety Authority

EFSA Journal 2012;10(5):2705

SCIENTIFIC OPINION

Scientific Opinion on a request from the European Commission related to the emergency measure notified by France on genetically modified maize MON 810 according to Article 34 of Regulation (EC) No 1829/2003[1]

EFSA Panel on Genetically Modified Organisms (GMO)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

Following a request of the European Commission, the European Food Safety Authority's Panel on Genetically Modified Organisms (EFSA GMO Panel) evaluated the documentation submitted by France in support of its request for the prohibition of the placing on the market of the genetically modified maize MON 810 according to Article 34 of Regulation (EC) No 1829/2003. The EFSA GMO Panel notes that some publications referred to by France were already part of the submission package by France for its safeguard clause and emergency measure on maize MON 810 in 2008. Those publications were addressed previously by the EFSA GMO Panel in its 2008 Scientific Opinion on the safeguard clause and emergency measure notified by France on maize MON 810. In the remaining documentation provided by France in support of the current emergency measure on maize MON 810, the EFSA GMO Panel could not identify any new science-based evidence indicating that maize MON 810 cultivation in the EU poses a significant and imminent risk to the human and animal health or the environment. With regard to issues related to management and monitoring of maize MON 810, the EFSA GMO Panel refers to its recent recommendations for management and monitoring measures of maize MON 810. In conclusion, the EFSA GMO Panel considers that, based on the documentation submitted by France, there is no specific scientific evidence, in terms of risk to human and animal health or the environment, that would support the notification of an emergency measure under Article 34 of Regulation (EC) No 1829/2003 and that would invalidate its previous risk assessments of maize MON 810.

KEY WORDS

GMO, maize (*Zea mays*), MON 810, France, emergency measure, environment, Regulation (EC) No 1829/2003

[1] On request from the European Commission, Question No EFSA-Q-2012-00345, adopted on 7 May 2012.

[2] Panel members: Hans Christer Andersson, Salvatore Arpaia, Detlef Bartsch, Josep Casacuberta, Howard Davies, Patrick du Jardin, Gerhard Flachowsky, Lieve Herman, Huw Jones, Sirpa Kärenlampi, Jozsef Kiss, Gijs Kleter, Harry Kuiper, Antoine Messean, Kaare Magne Nielsen, Joe Perry, Annette Pöting, Jeremy Sweet, Christoph Tebbe, Atte Johannes von Wright and Jean-Michel Wal.
Correspondence: gmo@efsa.europa.eu

[3] Acknowledgement: The Panel wishes to thank the members of the Standing Environmental Working Group on Applications for the preparation of this Scientific Opinion; and EFSA staff: Yann Devos and Sylvie Mestdagh for the support provided to this Scientific Opinion.

Suggested citation: EFSA Panel on Genetically Modified Organisms (GMO); Scientific Opinion on a request from the European Commission related to the emergency measure notified by France on genetically modified maize MON 810 according to Article 34 of Regulation (EC) No 1829/2003. EFSA Journal 2012;10(5):2705. [21 pp.] doi:10.2903/j.efsa.2012.2705. Available online: www.efsa.europa.eu/efsajournal

La Autoridad Europea de Seguridad Alimentaria (EFSA) ha revisado periódicamente solicitudes de diferentes países –incluyendo Francia- buscando reevaluar los efectos del maíz transgénico sin encontrar evidencia de riesgo.

European Food Safety Authority

EFSA Journal 2014;12(8):3809

STATEMENT OF EFSA

Statement on a request from the European Commission related to an emergency measure notified by France under Article 34 of Regulation (EC) 1829/2003 to prohibit the cultivation of genetically modified maize MON 810[1]

European Food Safety Authority[2,3]

European Food Safety Authority (EFSA), Parma, Italy

Abstract

Following a request from the European Commission, the European Food Safety Authority (EFSA) evaluated the documentation submitted by France under Article 34 of Regulation (EC) 1829/2003 in support of its request to prohibit the cultivation of genetically modified maize MON 810 in the EU. Neither the scientific publications cited in the documentation submitted by France with relevance to maize MON 810 nor the arguments put forward by France reveal any new information that would invalidate the previous risk assessment conclusions and risk management recommendations made by the EFSA GMO Panel. EFSA considers that the previous GMO Panel risk assessment conclusions and risk management recommendations on maize MON 810 remain valid and applicable. Therefore, EFSA concludes that, based on the documentation submitted by France, there is no specific scientific evidence, in terms of risk to human and animal health or the environment, that would support the adoption of an emergency measure on the cultivation of maize MON 810 under Article 34 of Regulation (EC) 1829/2003.

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Mito # 10

Al permitir la experimentación con OGMs, solo se beneficia a las grandes transnacionales.

Experiencia previa en el fomento a la investigación científica y tecnológica:

Biotecnología

Plantas de maíz genéticamente modificadas con tolerancia a sequía.

- *Centro de Investigación y de Estudios Avanzados del IPN,*
- *Unidad Zacatenco.*

Cepa recombinante de granulovirus con mayor virulencia hacia el gusano falso medidor de la col.

- *Centro de Investigación y de Estudios Avanzados del IPN,*
- *Unidad Irapuato.*

Frijol (*Phaseolus vulgaris* L.) cv. Flor de Mayo Anita con tolerancia de amplio espectro a hongos fitopatógenos.

- *Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP).*

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FONDO CIBIOGEM, 2013

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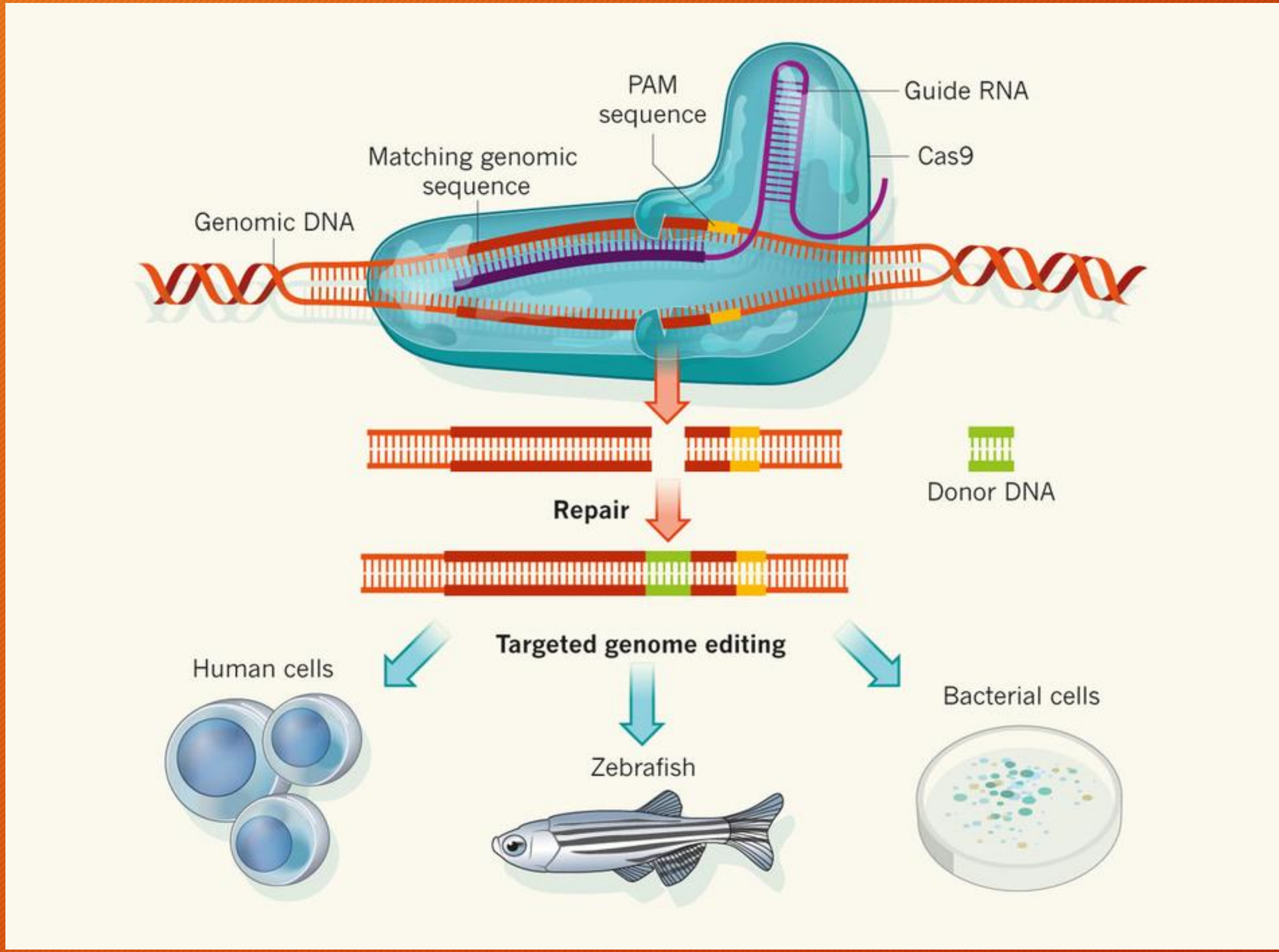
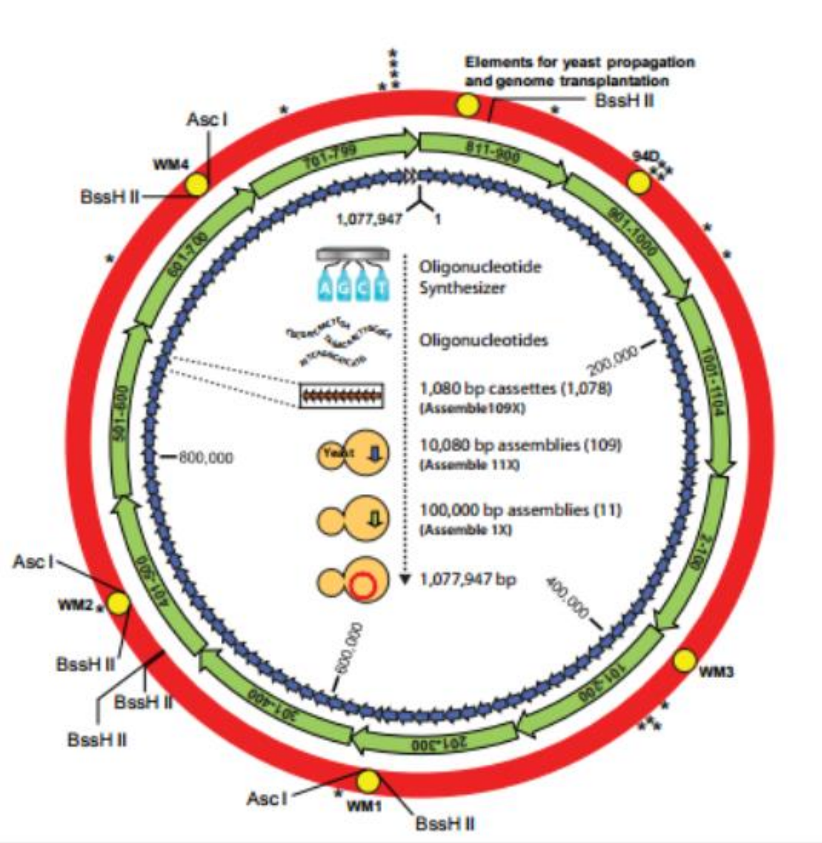


Biología sintética



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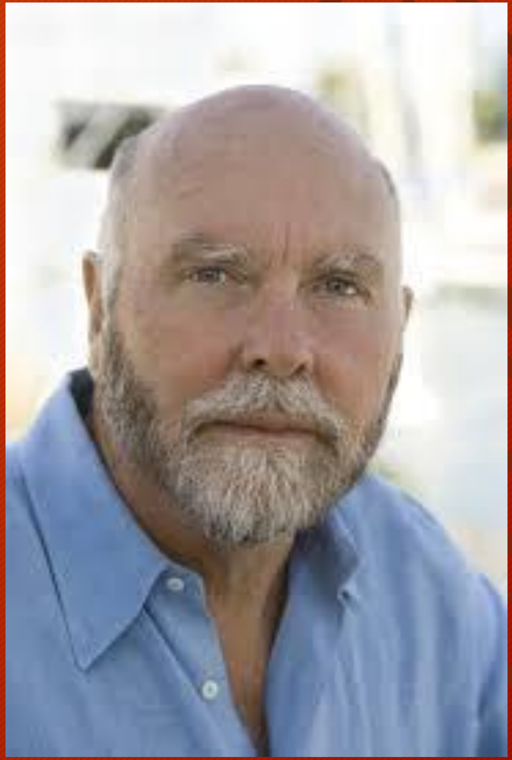

Craig Venter

GRACIAS POR SU ATENCIÓN

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