Transgênicos: fatos, mitos, vantagens, desvantagens

Francisco J. L. Aragão

Embrapa Recursos Genéticos e Biotecnologia

XXI CONGRESSO PET
11 E 12 DE MAIO | 2022

Embrapa
Ministério da Agricultura, Pecuária e Abastecimento
PÁTRIA AMADA BRASIL
GOVERNO FEDERAL

Brassica oleracea L.

Brassica oleracea L.

Sec 6 BC Couve

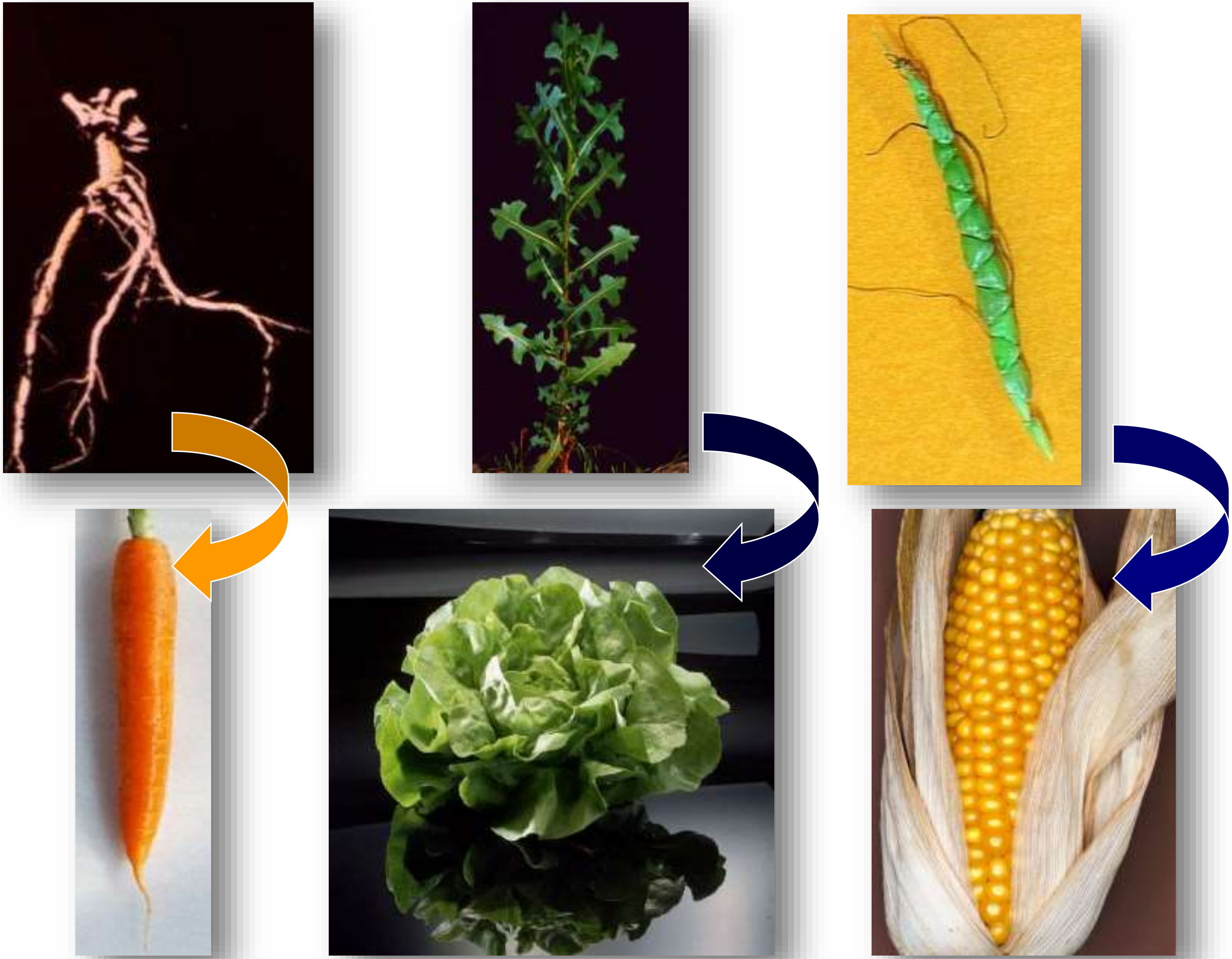
Sec 1 Repolho

Sec 1 Kohlrabi - Germania

Sec 15 Couve-flor

Sec 16 Brócolis

Sec 18 Couve de Bruxelas

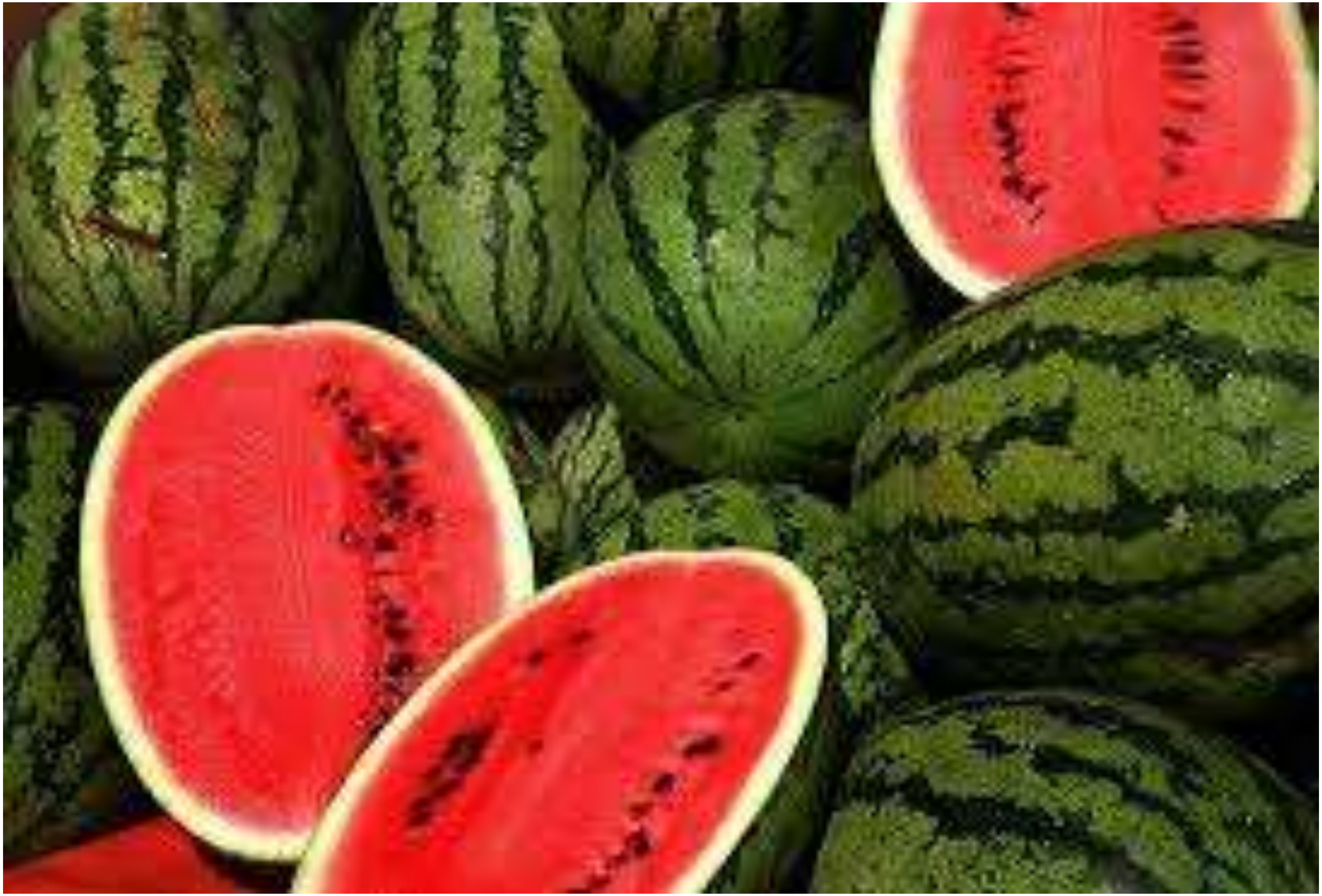


Embrapa

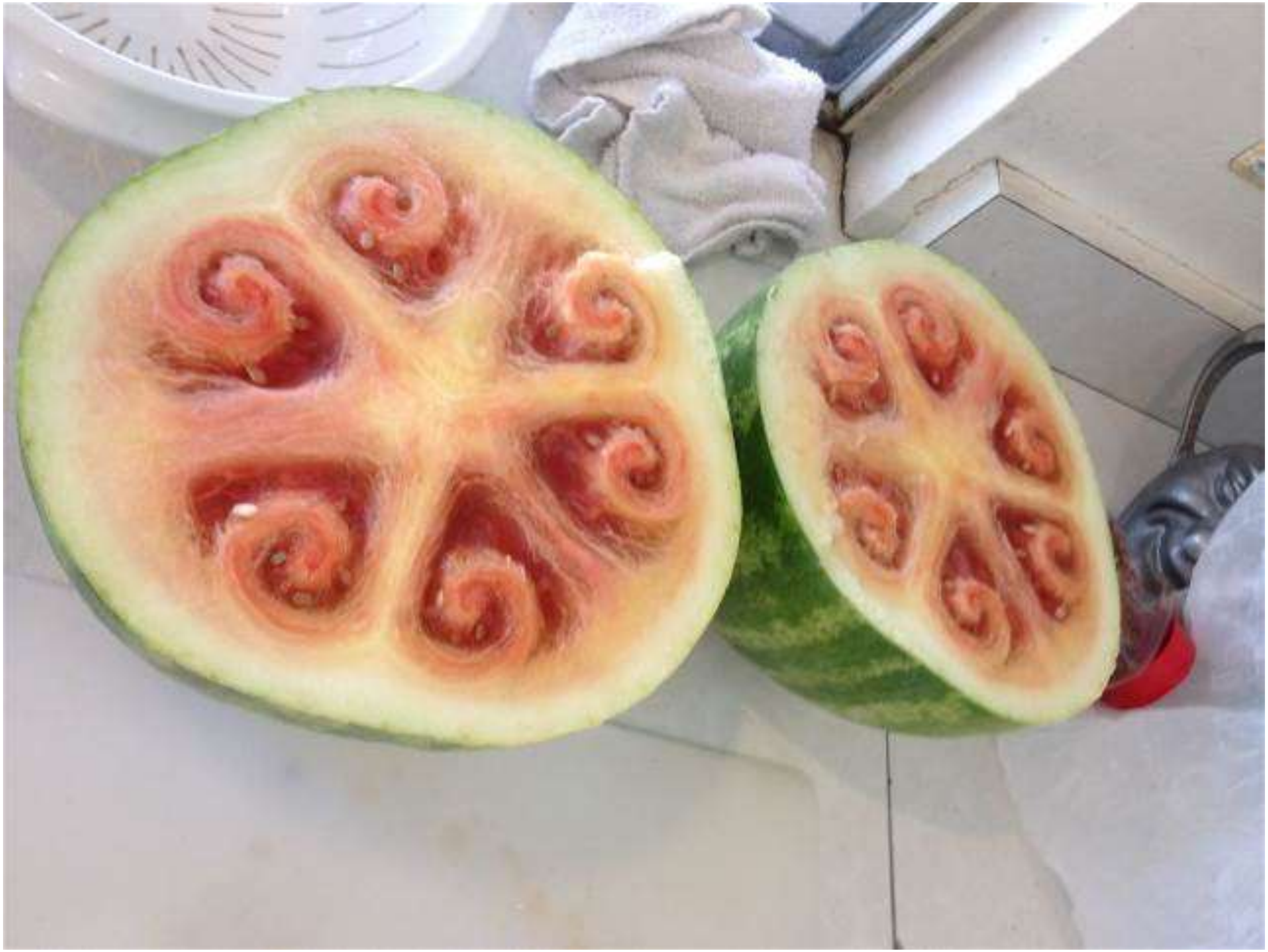
Pieter Brueghel, (ca. 1525–1569)

Embrapa

Giovanni Stanchi (Rome c. 1645-1672)



Embrapa



Embrapa

The Nobel Prize in Chemistry 1980

Paul Berg
Walter Gilbert
Frederick Sanger

Share this

Paul Berg
Facts

Photo from the Nobel Foundation archive.

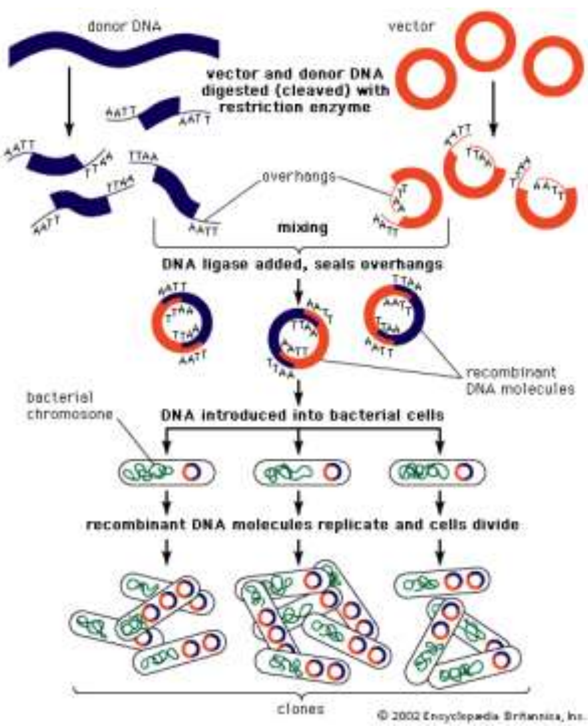
Paul Berg
The Nobel Prize in Chemistry 1980

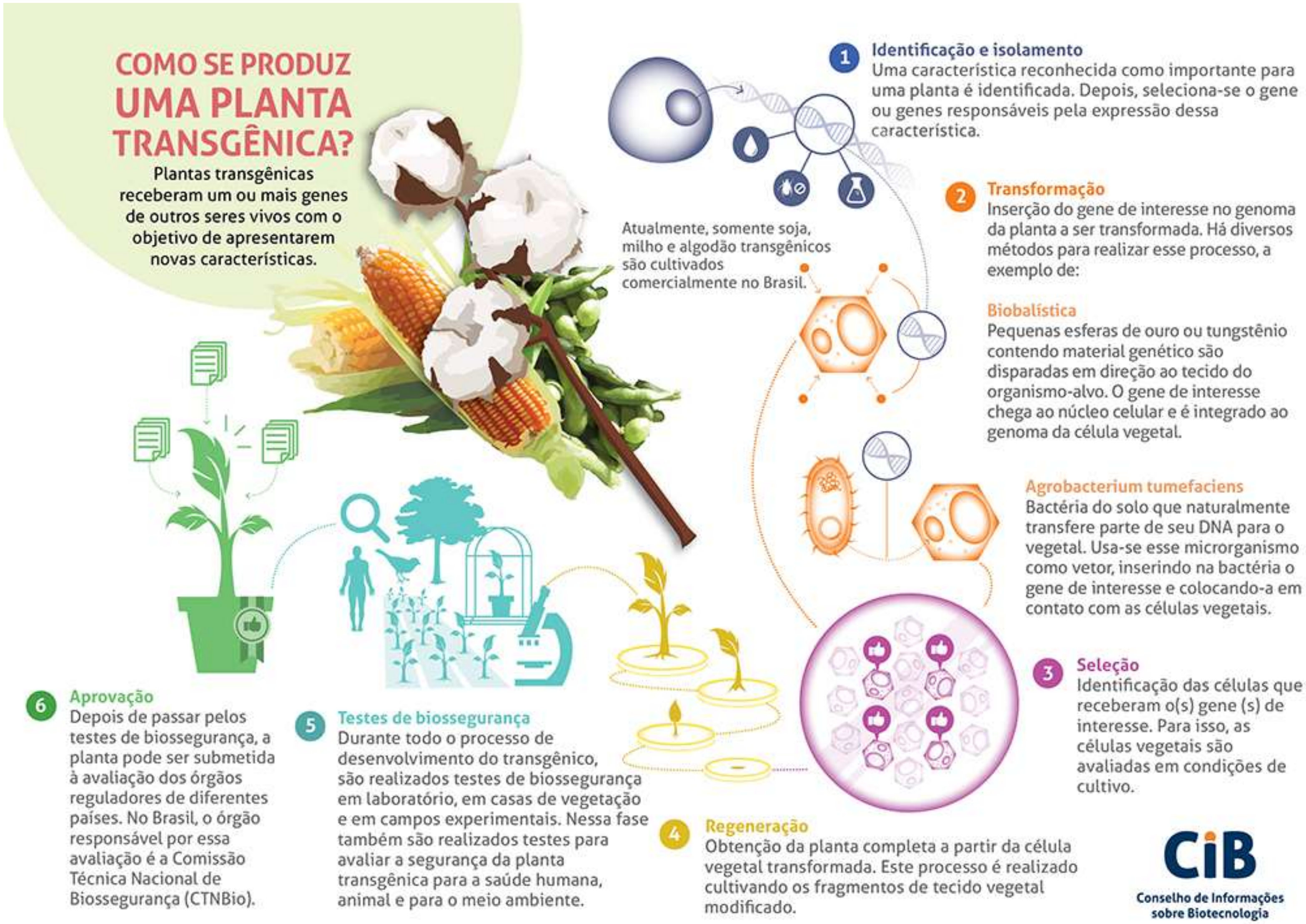
Born: 30 June 1926, New York, NY, USA

Affiliation at the time of the award: Stanford University, Stanford, CA, USA

Prize motivation: "for his fundamental studies of the biochemistry of nucleic acids, with particular regard to recombinant-DNA."

Prize share: 1/2




COMO SE PRODUZ UMA PLANTA TRANSGÊNICA?
Plantas transgênicas receberam um ou mais genes de outros seres vivos com o objetivo de apresentarem novas características.
Atualmente, somente soja, milho e algodão transgênicos são cultivados comercialmente no Brasil.
1 Identificação e isolamento
Uma característica reconhecida como importante para uma planta é identificada. Depois, seleciona-se o gene ou genes responsáveis pela expressão dessa característica.
2 Transformação
Inserção do gene de interesse no genoma da planta a ser transformada. Há diversos métodos para realizar esse processo, a exemplo de:
Biobalística
Pequenas esferas de ouro ou tungstênio contendo material genético são disparadas em direção ao tecido do organismo-alvo. O gene de interesse chega ao núcleo celular e é integrado ao genoma da célula vegetal.
Agrobacterium tumefaciens
Bactéria do solo que naturalmente transfere parte de seu DNA para o vegetal. Usa-se esse microrganismo como vetor, inserindo na bactéria o gene de interesse e colocando-a em contato com as células vegetais.
3 Seleção
Identificação das células que receberam o(s) gene (s) de interesse. Para isso, as células vegetais são avaliadas em condições de cultivo.
4 Regeneração
Obtenção da planta completa a partir da célula vegetal transformada. Este processo é realizado cultivando os fragmentos de tecido vegetal modificado.
5 Testes de biossegurança
Durante todo o processo de desenvolvimento do transgênico, são realizados testes de biossegurança em laboratório, em casas de vegetação e em campos experimentais. Nessa fase também são realizados testes para avaliar a segurança da planta transgênica para a saúde humana, animal e para o meio ambiente.
6 Aprovação
Depois de passar pelos testes de biossegurança, a planta pode ser submetida à avaliação dos órgãos reguladores de diferentes países. No Brasil, o órgão responsável por essa avaliação é a Comissão Técnica Nacional de Biossegurança (CTNBio).
CiB
Conselho de Informações sobre Biotecnologia

Embrapa

Proteínas recombinantes
para medicina e
indústria alimentícia

Embrapa

Legislação Brasileira de Biossegurança de OGM

Lei Nr. 8.975 Janeiro de 1995
"Primeira lei de biossegurança"

Lei Nr. 11.105 Março 2005
"Lei de Biossegurança"

Decreto Nr. 6.925, Agosto 2009
Cartagena Protocol of Biosafety to the Convention on Biotech Diversity

Decreto Nr. 5.591, Novembro 2005

CTNBio
Resoluções Normativas
Instruções Normativas

CTNBio
Comunicados

Lei de rotulagem

Decreto Nr. 4,680 (Abril 2003)
Limite de 1%

Embrapa

USA

- "USDA estimates that the costs … would range from $569 million to $3.9 billion for the first year"
- Annualized cost in perpetuity $68 million to $391 million
- "is not expected to have any benefits to human health or the environment"

- Wayne Parrot –University of Georgia

Embrapa


Embrapa Sede
Embrapa
NO OGM
LIVRE DE TRANSGÊNICOS
CAMPANHA NACIONAL
POR UM BRASIL LIVRE
DE TRANSGÊNICOS

Embrapa


STOP
GGO INVASIE
Stop
GMO invasion
GREENPEACE
Zastavme
inváziu
GMO!


Farm Writers
SEEDS OF SCIENCE
Why we got it so wrong
on GMOs
Mark Lynas

Embrapa

Contents lists available at SciVerse ScienceDirect

Food and Chemical Toxicology

journal homepage: www.elsevier.com/locate/foodchemtox

RETRACTED

Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize

Gilles-Eric Séralini[a,*], Emilie Clair[a], Robin Mesnage[a], Steeve Gress[a], Nicolas De[illegible]rge[a], Manuela Malatesta[b], Didier Hennequin[c], Joël Spiroux de Vendômois[a]

[a] University of Caen, Institute of Biology, CRIIGEN and Risk Pole, MRSH-CNRS, EA 2608, Esplanade de la Paix, Caen Cedex [illegible]032, France
[b] University of Verona, Department of Neurological, Neuropsychological, Morphological and Motor Sciences, Verona [illegible], Italy
[c] University of Caen, UR ABTE, EA 4651, Bd Maréchal Juin, Caen Cedex 14032, France

ARTICLE INFO

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Keywords:
GMO
Roundup
NK603
Rat
Glyphosate-based herbicides
Endocrine disrupting effects

ABSTRACT

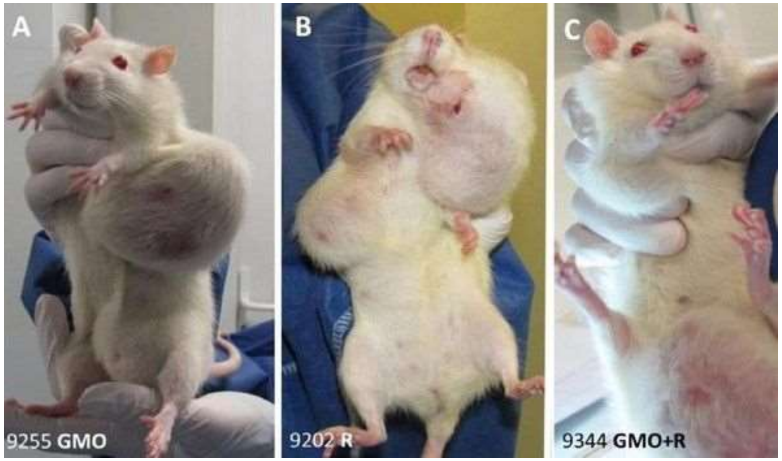
The health effects of a Roundup-t[illegible] genetically [illegible]dified maize (from 11% in the diet), cultivated with or without Roundup, and [illegible]undup alone (from [illegible]ppb in water), were studied 2 years in rats. In females, all treated groups die[illegible]–3 times mo[illegible] than controls, and more rapidly. This difference was visible in 3 male groups fed GM[illegible]. All results we[illegible] hormone and sex dependent, and the pathological profiles were comparable. Female[illegible]eveloped la[illegible] mammary tumors almost always more often than and before controls, the pituitary wa[illegible] second [illegible]ost disabled organ; the sex hormonal balance was modified by GMO and [illegible] treatme[illegible] treated males, liver congestions and necrosis were 2.5–5.5 times higher. This [illegible] confirmed by optic and transmission electron microscopy. Marked and severe kidney ne[illegible] also generally 1.3–2.3 greater. Males presented 4 times more large palpable [illegible] than [illegible]ols which occurred up to 600 days earlier. Biochemistry data confirmed very signif[illegible] chro[illegible] deficiencies; for all treatments and both sexes, 76% of the altered parameters we[illegible]idney r[illegible]ted. The[illegible] results can be explained by the non linear endocrine-disrupting effects of R[illegible]dup, b[illegible] the [illegible]verexpression of the transgene in the GMO and its metabolic consequences.

1. Introduction

There is an ongoing [illegible]ernatio[illegible] debate as to the necessary length of mammalian tox[illegible] [illegible]dies in [illegible]ation to the consumption of genetically [illegible]ified [illegible]M) plant[illegible]including regular metabolic analyses [illegible]ralini et al., [illegible]01[illegible]. Currently, no regulatory authority re[illegible]sts ma[illegible]atory ch[illegible]ic animal feeding studies to be performe[illegible] [illegible]r ed[illegible] and formulated pesticides. However, several st[illegible] consisting of 90 day rat feeding trials have been conducted [illegible] the biotech industry. These investigations mostly concern GM s[illegible] and maize that are rendered either herbicide tolerant (to Roundup (R) in 80% of cases), or engineered to produce a modified *Bt* toxin insecticide, or both. As a result these GM crops contain new pesticide residues for which new maximal residual levels (MRL) have been established in some countries.

If the petitioners conclude in general that there is no major change in genetically modified organism (GMO) subchronic toxicity studies (Domingo and Giné Bordonaba, 2011; Hammond et al., 2004, 2006a,b), significant disturbances have been found and may be interpreted differently (Séralini et al., 2009; Spiroux de Vendômois et al., 2010). Detailed analyses have revealed alterations in kidney and liver functions that may be the signs of early chronic diet intoxication, possibly explained at least in part by pesticide residues in the GM feed (Séralini et al., 2007; Spiroux de Vendômois et al., 2009). Indeed, it has been demonstrated that R concentrations in the range of 10^3 times below the MRL induced endocrine disturbances in human cells (Gasnier et al., 2009) and toxic effects thereafter (Benachour and Seralini, 2009), including

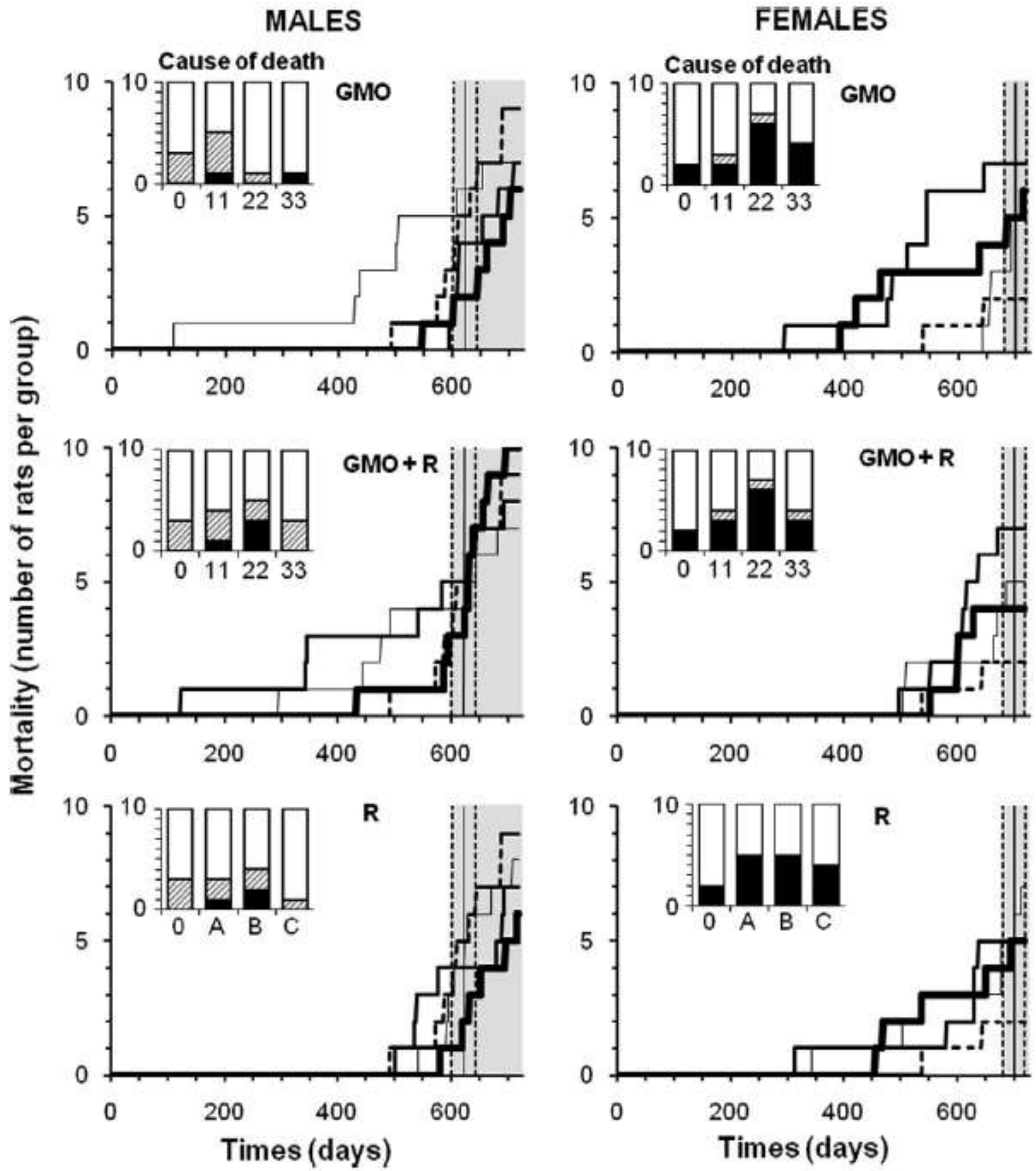
Abbreviations: GM, genetically modified; R, Roundup; MRL, maximal residual levels; GMO, genetically modified organism; OECD, Organization for Economic Co-operation and Development; GT, glutamyl-transferase; PCA, principal component analysis; PLS, partial least-squares; OPLS, orthogonal partial least-squares; NIPALS, Nonlinear Iterative Partial Least Squares; OPLS-DA, Orthogonal Partial Least Squares Discriminant Analysis; G, glycogen; L, lipid droplet; N, nucleus; R, rough endoplas-



Milho NK603

Davis et al. **Tumor Incidence in Normal Sprague-Dawley Female Rats,** *Cancer Res 1956;16:194-197.*

Hardisty 1985. **Factors Influencing Laboratory Animal Spontaneous Tumor Profiles.** *Toxicol Pathol 1985 13: 95*

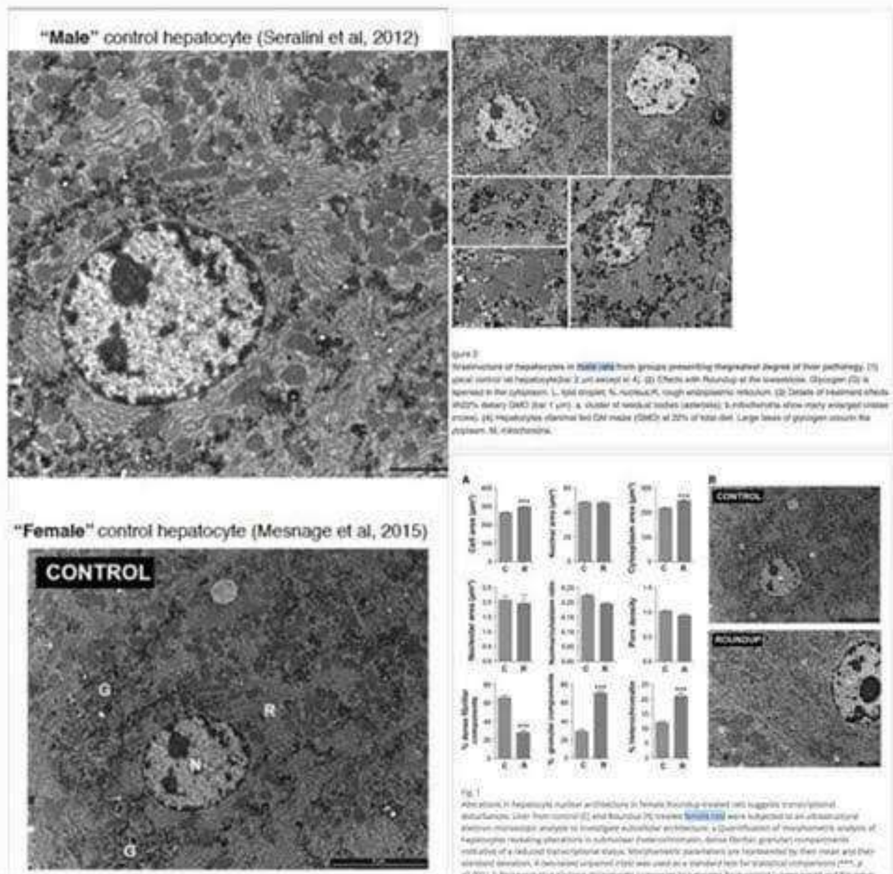


Séralini et al. 2012

Embrapa

C. S. Prakash
@AgBioWorld

#Seralini reused images between his two papers, simply changing the labels - Nice detective work there @chadn737!



SCIENTIFIC REPORTS
natureresearch

OPEN

The Impact of Bt Corn on Aflatoxin-Related Insurance Claims in the United States

Jina Yu[1,2], David A. Hennessy[2] & Felicia Wu[2,3] ✉

Previous field studies have reached no collective consensus on whether Bt corn, one of the most commonly planted transgenic crops worldwide, has significantly lower aflatoxin levels than non-Bt isolines. Aflatoxin, a mycotoxin contaminating corn and other commodities, causes liver cancer in humans and can pose severe economic losses to farmers. We found that from 2001–2016, a significant inverse correlation existed between Bt corn planting and aflatoxin-related insurance claims in the United States, when controlling for temperature and drought. Estimated benefits of aflatoxin reduction resulting from Bt corn planting are about $120 million to $167 million per year over 16 states on average. These results suggest that Bt corn use is an important strategy in reducing aflatoxin risk, with corresponding economic benefits. If the same principles hold true in other world regions, then Bt corn hybrids adapted to diverse agronomic regions may have a role in reducing aflatoxin in areas prone to high aflatoxin contamination, and where corn is a dietary staple.

Embrapa

Lei de Biossegurança no.8.974/95

Decreto no. 1.752/95

MP no. 2.191/01

Substitutivo - C.Moura PL nº. 2905/97

Lei nº 10.688/ 2003

Decreto Rotulagem no.4.074/03

Lei de Agro-Tóxicos no.7.802 /89

Lei Ambiental no. 6.938 /81

Lei no. 10.165/00

RET IN 2002

Resolução 305 CONAMA 2002

IN - IBAMA/03

<u>Resultado</u>: Arcabouço Legal extremamente complexo

Embrapa

Depois de 20 anos de desenvolvimento, a tecnologia de OGM ainda se baseia em processos do tipo "tentativa e erro", portanto imprecisos e pouco científicos. Assim, os cientistas têm poucas condições de prever o comportamento do novo gene no organismo hospedeiro, sendo inadequado chamar-se esta tecnologia de baseada na ciência. Em suma, a engenharia genética encontra-se em seu estágio básico de pesquisa e ciência, sendo prematura a liberação comercial de plantas transgênicas (Guerra e Nodari, no prelo).

É dever dos cientistas atuarem como debatedores, decodificadores e facilitadores deste debate abrangente e polêmico, atual e de extrema importância para o país. Análises com bases em dados científicos evitam a promiscuidade dos debates e permitem a distinção entre ciência e crença.

Rubens Nodari & Miguel Guerra

Embrapa

1. Organismo

1.1 Nº do processo ANVISA: 25351.223099/2002-37	1.2 Nº do comunicado e do processo CTNBio: Não se aplica – fase I
1.3 Gene(s) inserido(s): CP-PVY e *nptII*	1.4 Organismo(s) doador(es): PVY, estirpe internacional "o" *Escherichia coli* (*nptII*)
1.5 Organismo receptor: *Solanum tuberosum* L (batata)	1.6 Procedência do(s) gene(s) inserido(s): Peru (CP-PVY) e EUA (*nptII*)
1.7 Método de transformação: Agrobacterium tumefaciens	1.8 Fase do experimento/tamanho de área autorizada: Fase I, de acordo com a Instrução Normativa Conjunta Nº 2, de 30/09/2002 / **pesquisa em regime de contenção.**
1.9 Validade: 02 a contar da data do deferimento do RET	1.10 Quantidade a ser importada/utilizada: 1.000 plantas a cada três meses e até 10.000 tubérculos sementes por ano
1.11 Classificação toxicológica preliminar no que se refere aos cuidados com manipulação e uso: Classe I – **EXTREMAMENTE TÓXICO**	

Agência Nacional de Vigilância Sanitária
Diretoria de Alimentos e Toxicologia
Gerência Geral de Toxicologia

5. Finalidade(s) da pesquisa e experimentação:

- Caracterizar fenotípica e molecularmente o clone 1P e outros clones derivados da transformação utilizando-se a mesma construção gênica;
- Comprovar ausência da expressão de proteína traduzida do gene [illegible];
- Avaliar a estabilidade da [illegible] em gerações sequenciais (em regime de contenção);
- Avaliar a interferência do OGM em organismos não alvo, como entomofauna, doenças não alvo, microbiota de solo, flora;
- Manter e multiplicar tubérculos do OGM em contenção (manutenção *in vitro* e por tubérculos em casa

Precauções:

Na manipulação e uso: Use macacão ou roupas com mangas compridas, chapéu de aba larga, óculos ou viseira facial, luvas, botas e máscara apropriada (no caso de manipulação com pólen).

Nas atividades com o OGM: Mantenha o restante do organismo adequadamente fechado em local trancado, longe do alcance das pessoas, crianças e animais. Tome banho, troque e lave suas roupas.

Biossegurança.

Diante dos fatos acima expostos, considerando a avaliação toxicológica, somos pelo **DEFERIMENTO** do processo em questão.

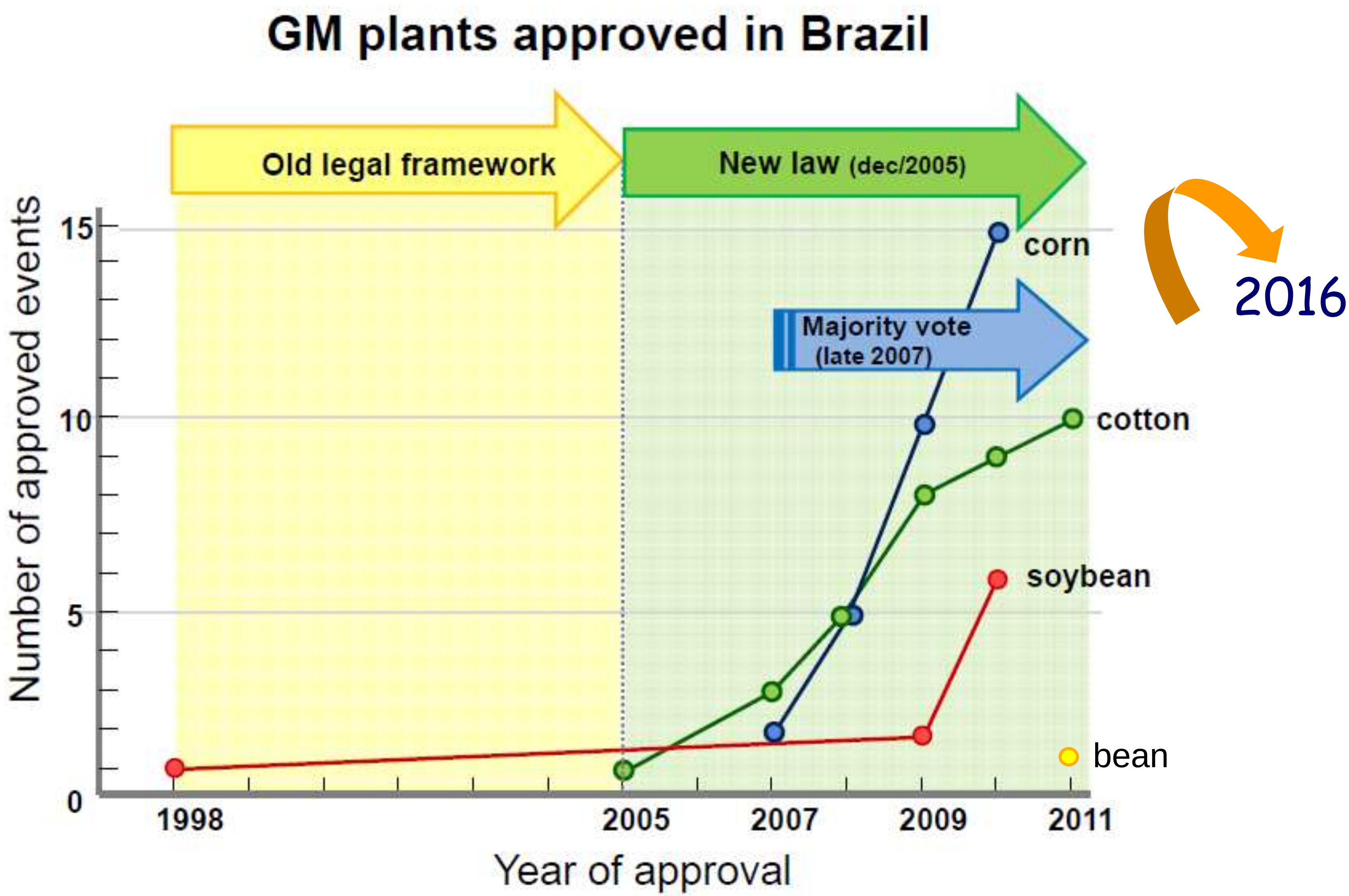
Ana Maria Vekic
Gerente de Análise Toxicológica

Luiz Cláudio Meirelles
Gerente Geral de Toxicologia

A empresa poderá importar ou manipular, somente a quantidade autorizada neste parecer.

Brasília, 28 de maio de 2003.

Ricardo Oliva
Diretor de Alimentos e Toxicologia



Timing in important

Aprovações comerciais

1	Algodão	MON531 (Bollgard I)
2	Algodão	LLCotton25 (Liberty Link)
3	Algodão	MON1445 (Roundup Ready)
4	Algodão	281-24-236/3006-210-23 (Widestrike)
5	Algodão	MON15985 (Bolgard II)
6	Algodão	MON531 x MON1445 (Bolgard I Roundup Ready)
7	Algodão	GHB614 (GlyTol®)
8	Algodão	GHB119 x T304-40 (TwinLink)
9	Algodão	MON88913 (Roundup Ready® Flex)
10	Algodão	GHB614 x T304-40 x GHB119 (GlyTol x TwinLink)
11	Algodão	GHB614 x LLCotton25 (Gt x LL)
12	Algodão	MON15985 x MON88913 (Bollgard II Roundup Ready Flex)
13	Algodão	COT102 x MON15985 x MON88913 (Bollgard® III x Roundup Ready™ Flex™)
14	Algodão	GHB614 x T304-40 x GHB119 x COT102 (GlyTol x TwinLink x COT102)
15	Algodão	MON88701
16	Algodão	DAS-21023-5 × DAS-24236-5 × SYN-IR102-7
17	Feijão	EMBRAPA 5.1
18	Milho	T25 (Liberty Link)
19	Milho	MON810 (Yeldgard)
20	Milho	Bt11
21	Milho	NK603 (Roundup Ready 2)
22	Milho	GA21 (TG)
23	Milho	TC1507 (Herculex)
24	Milho	MIR162 (Viptera)
25	Milho	MON810 x NK603 (YieldGard/ RR2)
26	Milho	Bt11 x GA21 (TL/TG)
27	Milho	MON89034 (YieldGard™ VT Pro™)
28	Milho	NK603 x TC1507 (Herculex™ I RR)
29	Milho	Bt11 x MIR162 X GA21 (Agrisure® Viptera™ 3110 TGTL Viptera)
30	Milho	MON89034 X NK603 (YieldGard VT Pro 2)
31	Milho	MON88017 (YieldGard VT Rootworm/RR2)
32	Milho	MON89034 x TC1507 x NK603 (Power Core)
33	Milho	TC1507 x MON810 x NK603 (Optimum Intrasect)
34	Milho	TC1507 x MON810
35	Milho	MON89034 x MON88017 (Genuity® VT Triple Pro™)
36	Milho	TC1507 x DAS-59122-7 (Herculex XTRA™)
37	Milho	MIR604 (Agrisure™ RW)
38	Milho	Bt11 x MIR162 x MIR604 x GA21 (Agrisure® Viptera™ 3111, Agrisure® Viptera™ 4)
39	Milho	DAS-40278-9 (Enlist)
40	Milho	NK603 x T25 (Roundup Ready™ Liberty Link™ Maize)
41	Milho	TC1507 x MON810 x MIR162
42	Milho	TC1507 x MON810 x MIR162 x NK603
43	Milho	DAS-40278-9 x NK603
44	Milho	5307 (Agrisure®)
45	Milho	Bt11 x MIR162 x MIR604 x TC1507 x 5307 x GA21 (Agrisure® Duracade™ 5222)
46	Milho	Bt11 x MIR162 (Agrisure® Viptera™ 2100)
47	Milho	SPT -32138
48	Milho	MON89034 x TC1507 x NK603 x DAS-40278-9
49	Milho	MON89034 x MON88017 x TC1507 x DAS-59122-7 (Genuity® SmartStax™)
50	Milho	MON87411

https://cib.org.br/produtos-aprovados/

Aprovações comerciais

51	Milho	MON87427 (Roundup Ready™ Maize)
52	Milho	3272 (Enogen™)
53	Milho	MON87460 (Genuity® DroughtGard™)
54	Milho	Bt11 x MIR162 x MON89034 x GA21
55	Milho	Bt11 x MIR162 x MON89034
56	Milho	MIR162 x MON89034
57	Milho	MON89034 x TC1507 x NK603 x MIR162
58	Soja	GTS-40-3-2 (Roundup Ready™)
59	Soja	BSP-CV127-9 (Cultivance)
60	Soja	A2704-12 (Liberty Link™)
61	Soja	A5547-127 (Liberty Link ou LL)
62	Soja	MON87701 x MON89788 (Intacta™ Roundup Ready™ 2 Pro)
63	Soja	DAS68416-4 (Enlist™)
64	Soja	FG72
65	Soja	DAS-44406-6
66	Soja	FG72 x A55547-I27
67	Soja	DAS-81419-2
68	Soja	MON87708
69	Soja	MON87708 x MON89788
70	Soja	MON87751
71	Soja	DAS-44406-6 x DAS-81419-2
72	Soja	DP-305423-1
73	Soja	DP-305423-1 x MON 04032-6
74	Soja	MON 87751 x MON 87708 x MON 87701 x MON 89788
75	Eucalipto	H421
76	Cana-de-açúcar	CTB141175/01-A (CTC20BT)

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The Chemical Company

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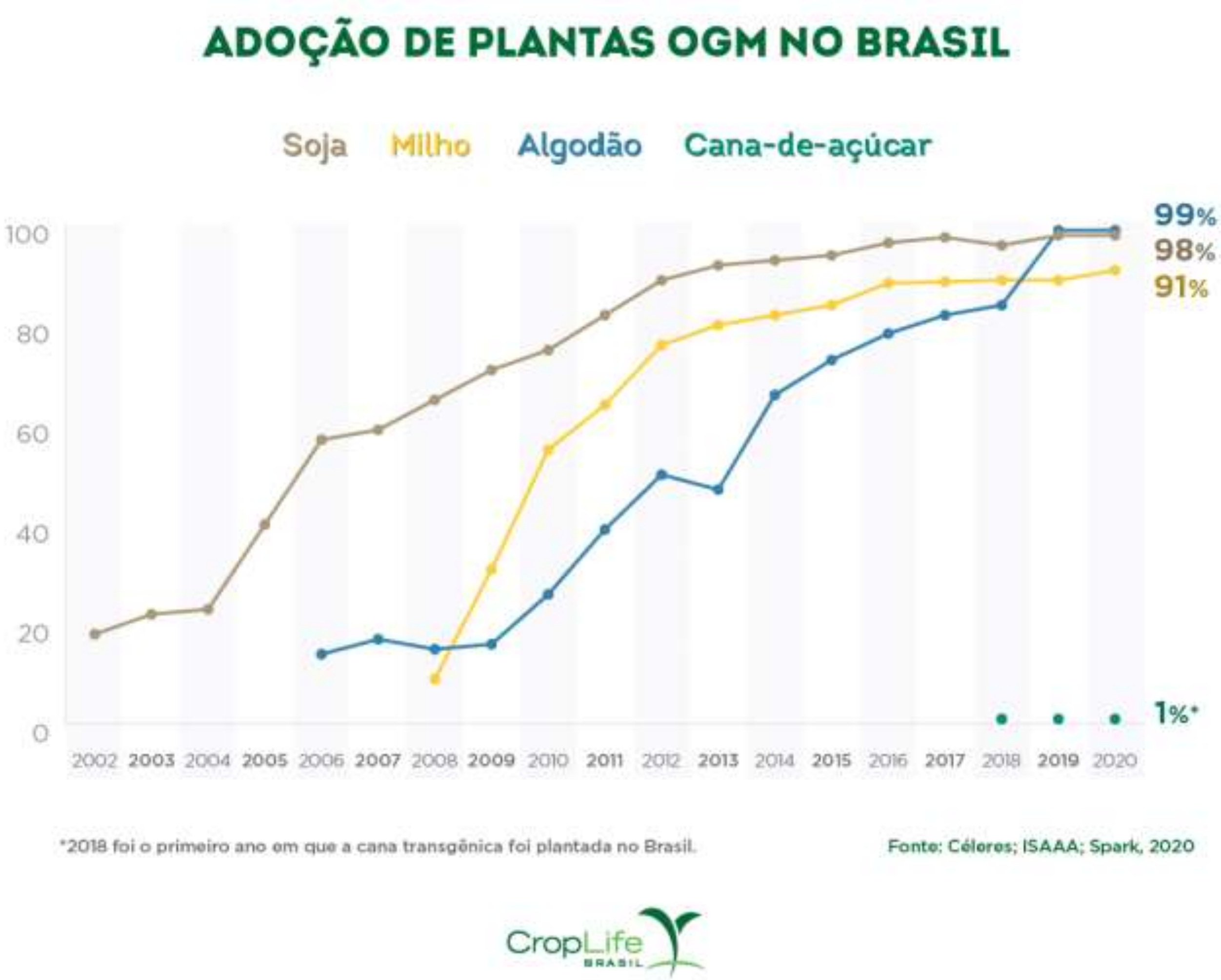
Adoção

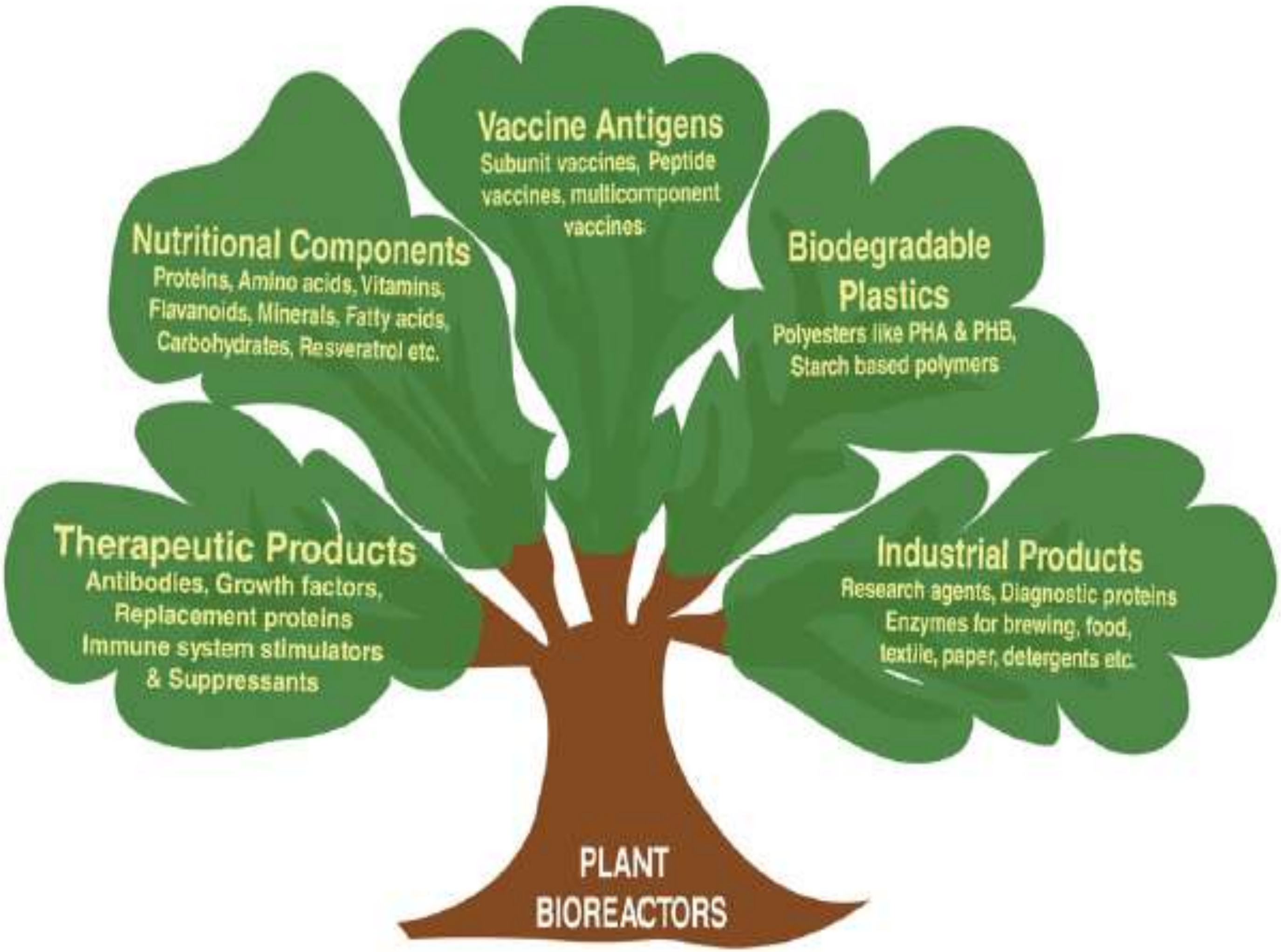


Embrapa

Tempo de desenvolvimento

NUMBER OF YEARS FROM DISCOVERY OF TRAIT TO FIRST COMMERCIAL SALE (MEAN VALUES)

Canola	Corn	Cotton	Soybean	All crops
11.7	12.0	12.7	16.3	13.1


Vaccine Antigens
Subunit vaccines, Peptide vaccines, multicomponent vaccines
Nutritional Components
Proteins, Amino acids, Vitamins, Flavanoids, Minerals, Fatty acids, Carbohydrates, Resveratrol etc.
Biodegradable Plastics
Polyesters like PHA & PHB, Starch based polymers
Therapeutic Products
Antibodies, Growth factors, Replacement proteins
Immune system stimulators & Suppressants
Industrial Products
Research agents, Diagnostic proteins
Enzymes for brewing, food, textile, paper, detergents etc.
PLANT BIOREACTORS

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FLORIGENE Moonshade™

FLORIGENE Moonlite™

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SUNTORY

Million Bell

The world's first blue carnation,Moondust Lilac Blue(left) and Moondust Deep blue(right).

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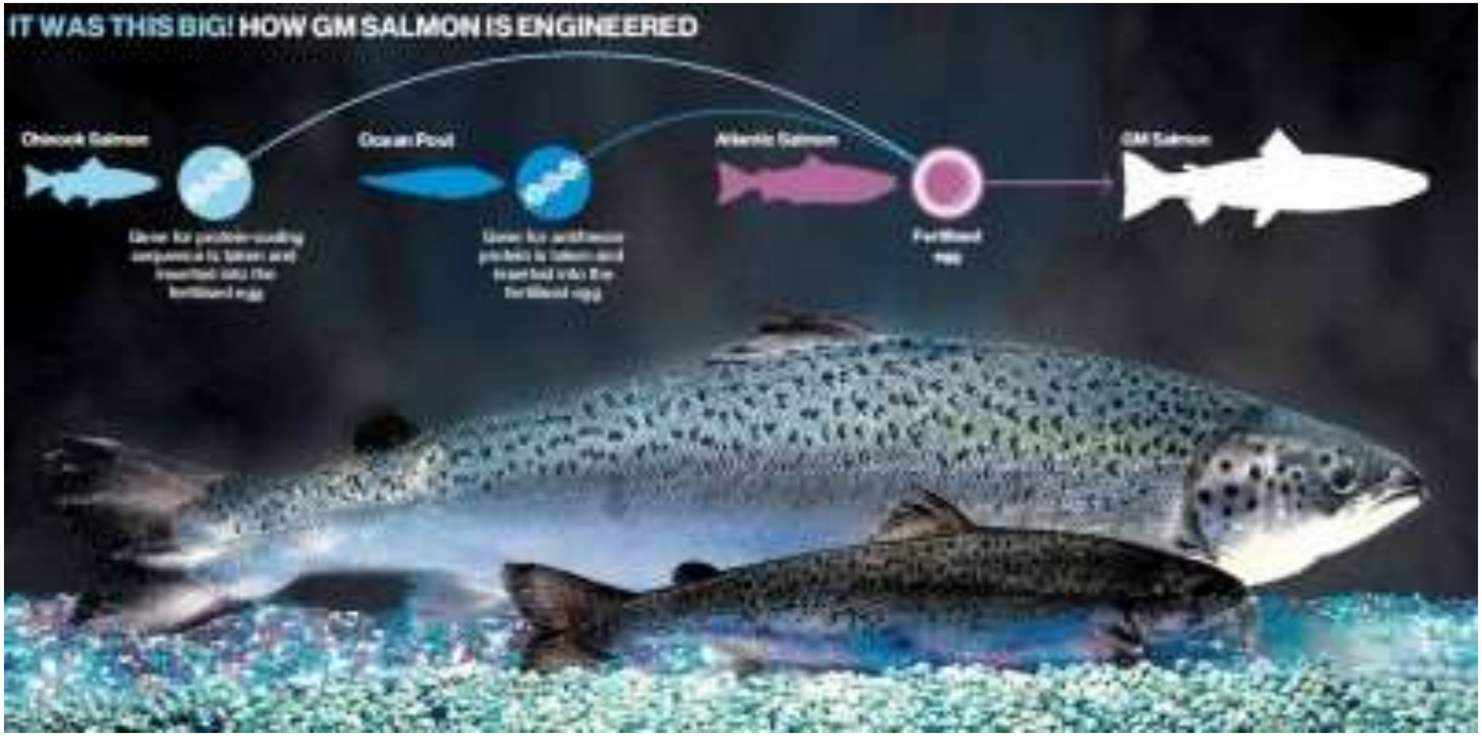


AquaBounty

Arroz dourado (golden rice II)

Embrapa

Golden rice: 1.6 μg/g of carotenoides.

Golden Rice 2 : 37 μg/g carotenoides

Embrapa

People Pope Blesses Golden Rice

ASPB NEWS | VOLUME 41, NUMBER 1

BY TYRONE SPADY ASPB
Legislative and Public Affairs Director

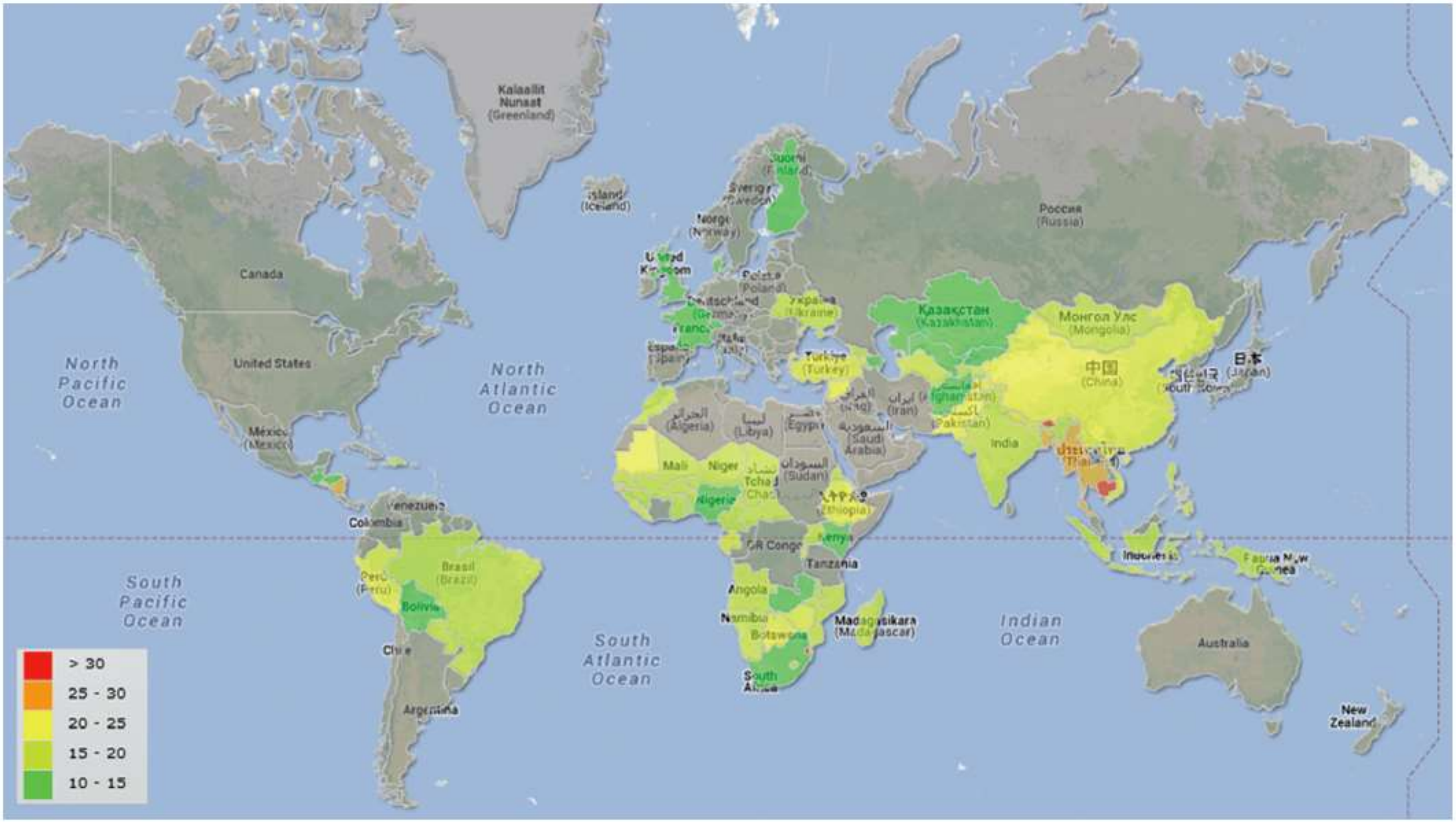
On November 7, 2013, Pope Francis gave his personal blessing to Golden Rice (GR). Why is this significant? Vitamin A deficiency (VAD) is responsible for 500,000 cases of irreversible blindness and up to 2 million deaths each year. Particularly susceptible are pregnant women and children. Across the globe, an estimated 19 million pregnant women and 190 million children suffer from the condition. The good news, however, is that dietary supplementation of vitamin A can eliminate VAD. One way that holds particular promise is the administration via GR, which had been engineered to produce large amounts of vitamin A. A 2012 study by Tang et al. (http://bit.ly/1bc6FJx) published in the American Journal of Clinical Nutrition found that 100-150 g of cooked GR provided 60% of the Chinese Recommended Intake of vitamin A. Estimates suggest that supplementing GR for 20% of the diet of children and 10% for pregnant women and mothers will be enough to combat the effects of VAD.

Unfortunately, public misconceptions about genetically modified (GM) organisms have prevented GR from being available to the countries most affected by VAD. One such country is the Philippines, where more than 80% of the population identifies as Roman Catholic and field trials of GR are nearing completion. An official blessing of the church, therefore, could do a great deal to build support, allowing the Philippines to serve as a model for many of its neighbors on the potential health impacts of widespread availability and consumption of the golden grain.

http://www.goldenrice.org/

Enriquecimento com folatos

80% da IDR de folatos para adultos (porção média)



Risk regions of folate deficiency based on NTD prevalence (expressed as number of NTDs per 10 000 births). Own compilation by TargetMap, on: World Bank (2011), UNICEF (2004), and EUROCAT (2011).

Brasília, Janeiro de 2014

Embrapa

BASF
The Chemical Company

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Goiás, 2016

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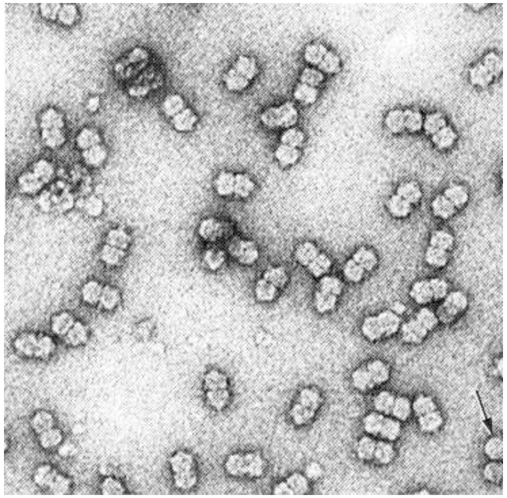
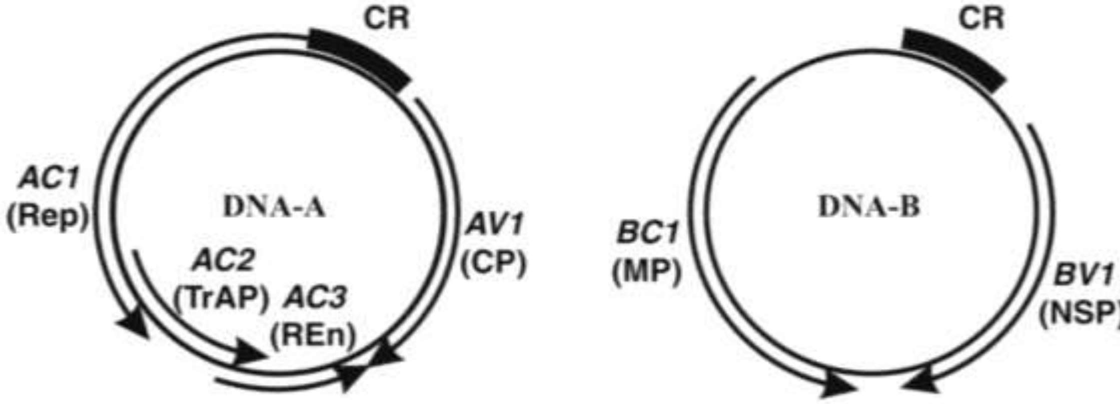




Controle químico

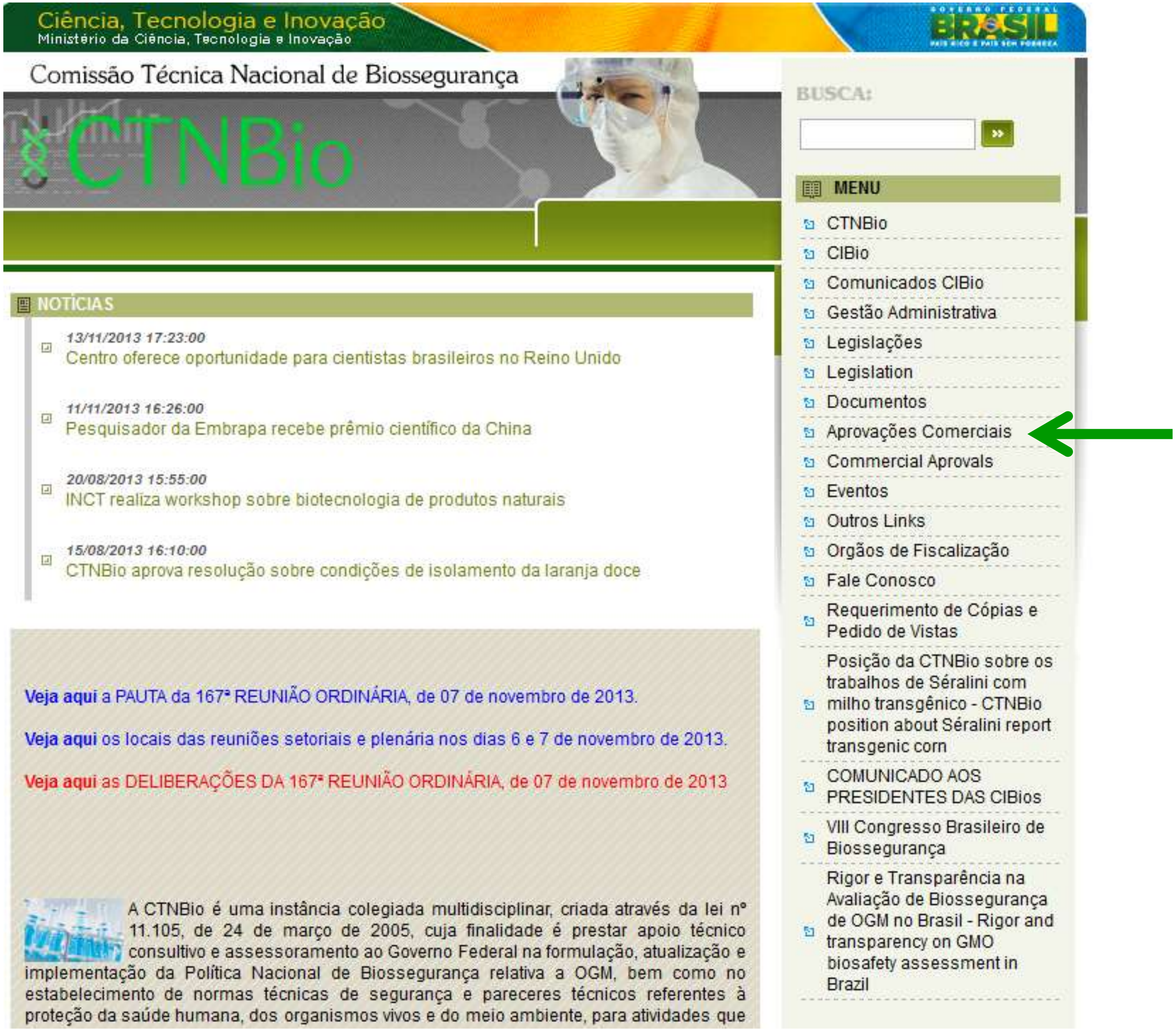
BGMV : transmitido por mosca-branca (*Bemisia tabaci*) de forma persistente a circulativa

Embrapa

Tecnologia RMD
Manejo Integrado de Pragas
38% a 78% mais rentável
3 e não 15-20 aplicações
de inseticidas

Embrapa

Fonte: CÉLERES®


Ciência, Tecnologia e Inovação
Ministério da Ciência, Tecnologia e Inovação
GOVERNO FEDERAL BRASIL
PAÍS RICO É PAÍS SEM POBREZA
Comissão Técnica Nacional de Biossegurança
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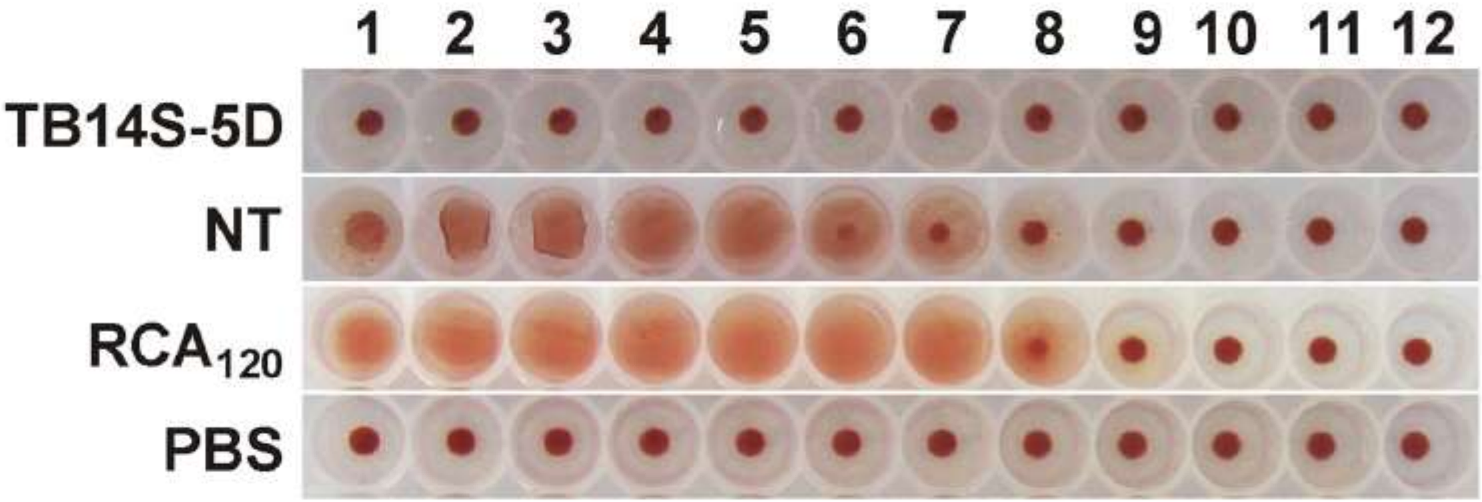
Posição da CTNBio sobre os trabalhos de Séralini com milho transgênico - CTNBio position about Séralini report transgenic corn
COMUNICADO AOS PRESIDENTES DAS CIBios
VIII Congresso Brasileiro de Biossegurança
Rigor e Transparência na Avaliação de Biossegurança de OGM no Brasil - Rigor and transparency on GMO biosafety assessment in Brazil
NOTÍCIAS
13/11/2013 17:23:00
Centro oferece oportunidade para cientistas brasileiros no Reino Unido
11/11/2013 16:26:00
Pesquisador da Embrapa recebe prêmio científico da China
20/08/2013 15:55:00
INCT realiza workshop sobre biotecnologia de produtos naturais
15/08/2013 16:10:00
CTNBio aprova resolução sobre condições de isolamento da laranja doce
Veja aqui a PAUTA da 167ª REUNIÃO ORDINÁRIA, de 07 de novembro de 2013.
Veja aqui os locais das reuniões setoriais e plenária nos dias 6 e 7 de novembro de 2013.
Veja aqui as DELIBERAÇÕES DA 167ª REUNIÃO ORDINÁRIA, de 07 de novembro de 2013
A CTNBio é uma instância colegiada multidisciplinar, criada através da lei nº 11.105, de 24 de março de 2005, cuja finalidade é prestar apoio técnico consultivo e assessoramento ao Governo Federal na formulação, atualização e implementação da Política Nacional de Biossegurança relativa a OGM, bem como no estabelecimento de normas técnicas de segurança e pareceres técnicos referentes à proteção da saúde humana, dos organismos vivos e do meio ambiente, para atividades que

Embrapa

Mamona sem ricina

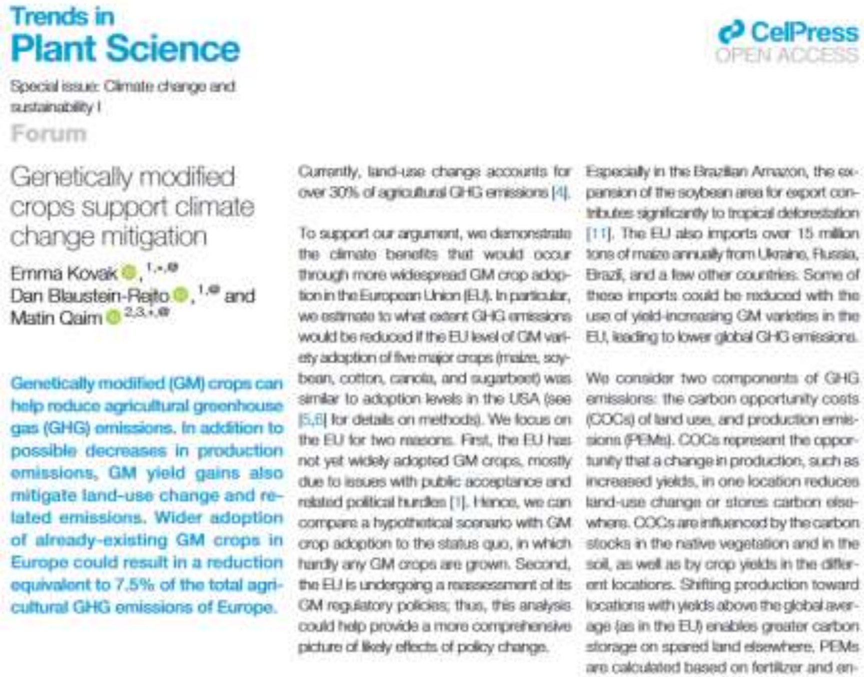
Embrapa

Mamona sem ricina



Mamona sem ricina

552 µg ricina/kg = consumo de 52% do peso
Usualmente animais consumem 1-2% peso/dia



Trends in Plant Science

CellPress OPEN ACCESS

Special issue: Climate change and sustainability I

Forum

Genetically modified crops support climate change mitigation

Emma Kovak [1,*,@], Dan Blaustein-Rejto [1,@] and Matin Qaim [2,3,*,@]

Genetically modified (GM) crops can help reduce agricultural greenhouse gas (GHG) emissions. In addition to possible decreases in production emissions, GM yield gains also mitigate land-use change and related emissions. Wider adoption of already-existing GM crops in Europe could result in a reduction equivalent to 7.5% of the total agricultural GHG emissions of Europe.

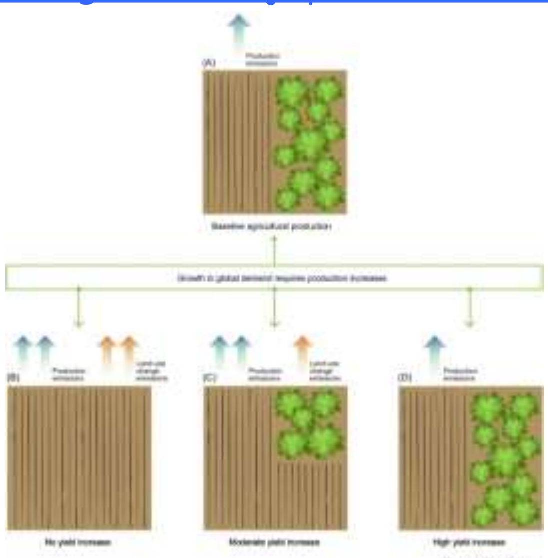
Currently, land-use change accounts for over 30% of agricultural GHG emissions [4].

To support our argument, we demonstrate the climate benefits that would occur through more widespread GM crop adoption in the European Union (EU). In particular, we estimate to what extent GHG emissions would be reduced if the EU level of GM variety adoption of five major crops (maize, soybean, cotton, canola, and sugarbeet) was similar to adoption levels in the USA (see [5,6] for details on methods). We focus on the EU for two reasons. First, the EU has not yet widely adopted GM crops, mostly due to issues with public acceptance and related political hurdles [1]. Hence, we can compare a hypothetical scenario with GM crop adoption to the status quo, in which hardly any GM crops are grown. Second, the EU is undergoing a reassessment of its GM regulatory policies; thus, this analysis could help provide a more comprehensive picture of likely effects of policy change.

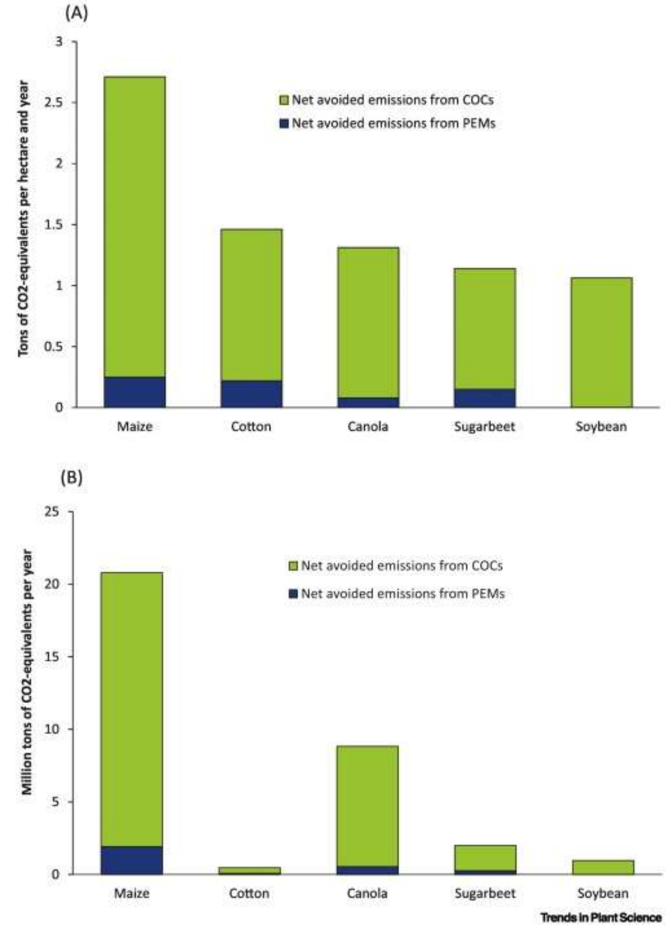
Especially in the Brazilian Amazon, the expansion of the soybean area for export contributes significantly to tropical deforestation [11]. The EU also imports over 15 million tons of maize annually from Ukraine, Russia, Brazil, and a few other countries. Some of these imports could be reduced with the use of yield-increasing GM varieties in the EU, leading to lower global GHG emissions.

We consider two components of GHG emissions: the carbon opportunity costs (COCs) of land use, and production emissions (PEMs). COCs represent the opportunity that a change in production, such as increased yields, in one location reduces land-use change or stores carbon elsewhere. COCs are influenced by the carbon stocks in the native vegetation and in the soil, as well as by crop yields in the different locations. Shifting production toward locations with yields above the global average (as in the EU) enables greater carbon storage on spared land elsewhere. PEMs are calculated based on fertilizer and en-

https://doi.org/10.1016/j.tplants.2022.01.004



Increasing crop yields decrease the land conversion needed for agricultural production.



Potential avoided greenhouse gas (GHG) emissions resulting from yield increases of genetically modified (GM) crops in the European Union (EU).

Plant genetics

Natural transgenic plants

Bacteria may have modified the genomes of thousands of plants

Michael Le Page

IMAGINE CHINA/SHUTTERSTOCK

Some tea plants have been found to contain genes from a bacterium

ABOUT one in 20 flowering plants are naturally transgenic, carrying bacterial DNA within their genomes. The added genes can make them produce unusual chemicals, and the species they have been found in include tea, bananas and peanuts.

Other plants that carry bacterial genes include sweet potatoes, yams, American cranberries, Surinam cherries and the hops used to flavour beer. What effect the added genes have on the plants that contain them is still far from clear. "We are only at the start of this," says Léon Otten at the Institute of Molecular Biology of Plants in Strasbourg, France.

The culprit is a microbe called *Agrobacterium* that infects plants. When this bacterium gets inside a plant cell, it inserts a "cassette" of DNA containing hundreds of genes into the genome of the cell. These genes include ones that encode hormones that make plants grow tumour-like lumps called crown galls (pictured, below right) and enzymes that make chemicals the bacteria feed on.

Agrobacterium is the main tool used to create the genetically engineered crops grown globally. Biologists swap out the microbe's

Until now, the only known examples of *Agrobacterium* DNA persisting in a plant genome were in tobacco and the sweet potato. Otten and Tatiana Matveeva of St Petersburg State University in Russia have now found dozens more by analysing the genomes of hundreds of plants (*Plant Molecular Biology*, doi.org/dcdn).

5%

of flowering plants may carry DNA inserted by bacteria

Plants that are transgenic in this way don't count as genetically modified under European Union regulations, which specifically exclude organisms modified by "natural" processes.

The discovery is good news for Henrik Lütken at the University of Copenhagen in Denmark, who plans to test the limits of this definition.

He is creating new plant varieties using natural strains of *Agrobacterium*. For instance, he has created a compact variety of

this process could drive the evolution of new plant species. His research suggests that tobacco plants have been modified by *Agrobacterium* several times in the past few million years, and these events seem to have coincided with the emergence of new species.

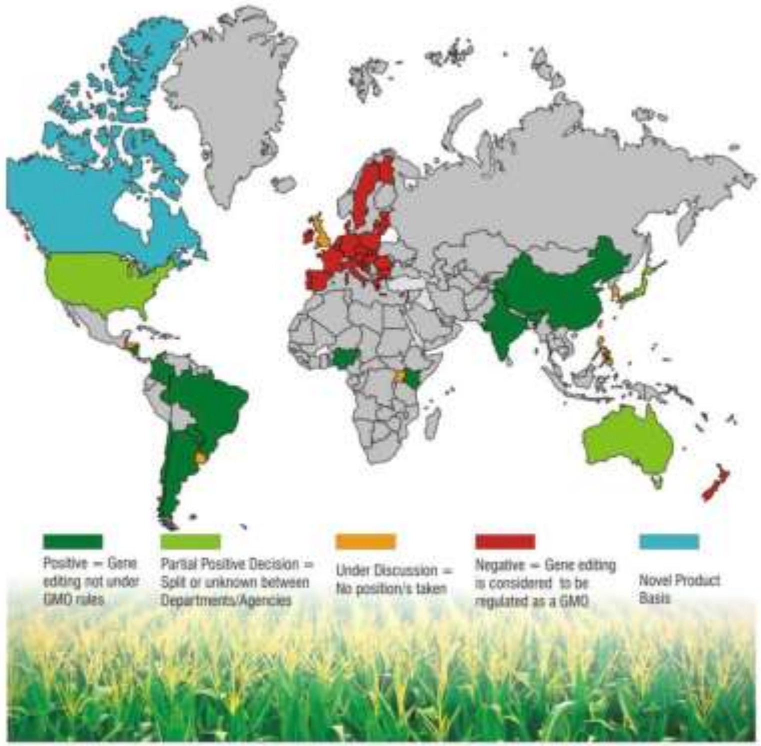
Infection by *Agrobacterium* isn't the only way that transgenic

https://doi.org/10.1016/S0262-4079(19)31893-7

Embrapa

14 Are gene edited plants regulated ?

The regulations for gene edited plants are evolving globally. There is a growing consensus that gene edited plants that do not contain exogenous foreign DNA should not be regulated under the same rules that apply to genetically engineered or transgenic plants.These kinds of gene edited plants are typically exempt from biosafety assessment and are regulated in the same way as products of conventional plant breeding. As of now, 52 percent of the world's population live in countries with positive or partial positive decisions on exempting SDN-1 and SDN-2 gene edited plants from biosafety regulation.



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