GM maize and glyphosate: new evidence from Mexican scientists calls for precaution

Webinar organized by:

Collaborative for Health & Environment

U. S. Right to Know

Dr. María Elena Álvarez-Buylla Roces
Erica L. Hagman Aguilar

> 30 YEARS: GMOs HAVE INVOLVED PUBLIC DAMAGE AND PRIVATE PROFITS

- Coexistence without contamination is not possible: Centers of Origin and Diversity are affected.
- The health impacts are already irrefutable as well: Hundreds of scientific references, free of conflict of interest.
- GMOs also violate the public and common access nature of seeds and the right of people to maintain GMO-free crops and food.
- Agrobiodiversity belongs to all, and should not be privatized; the best varieties should not be left for elitist markets; community dispossession that threatens the dynamic process of open breeding in the face of challenges such as Climate Change.

GMOs: a tool that, together with hybrids, privatizes seeds for profit at every link in the food chain (seeds, processing, and distribution).

Destructive colonialism in the guise of promoting good nutrition

Despoilment of the biocultural wealth of Mexican farmers

IN CDMX:
1 nixtamalized blue corn tortilla = $ 3 pesos

In the United States purchased online
1 tortilla = $ 10.225 pesos - 1 kg of flour = $ 245.4 pesos

¡¡¡¡In Mexico purchased online via Amazon
1 kg of flour = $ 1,173.00 pesos !!!!

Capitalist destruction of community life; appropriation of common resources and millenary community developments

The Governments of the 4T: Care for Biocultural Wealth, Environmental Health & Food Sovereignty for Mexico and the World

- Constitution: Corn planted in our country must be free of genetically modifications, including transgenic and other that overcomes the barriers of intercrossing or recombination . Other uses must demonstrate harmlessness to our biocultural wealth, health, environment.

- Long struggle of many sectors and collectives: GMO-free native corn.

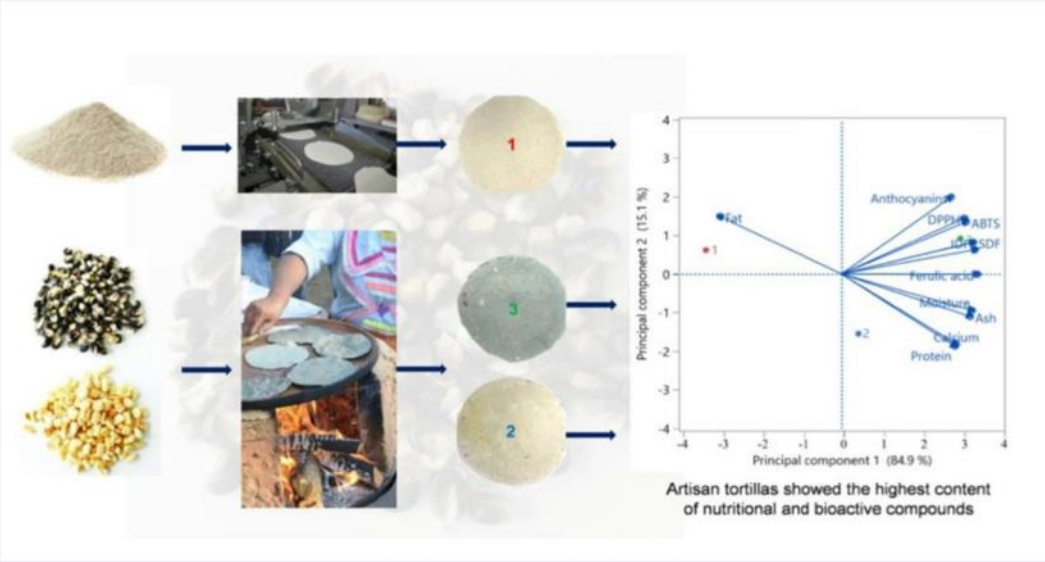
- Despite CONAHCYT's Scientific Dossier with hundreds of references from >3 years of rigorous work, the USMCA Panel ignored. It also ignored the Mexican context of corn, its biocultural role and staple food.

Native Maize: Healthier and without the risks of GMOs

Staple food: cultural and gastronomic relevance

Loss of diversity also implies damage to food quality and quality.

Standardization with corn derivatives such as oils, high fructose syrups, starches and others → very harmful impact on health.

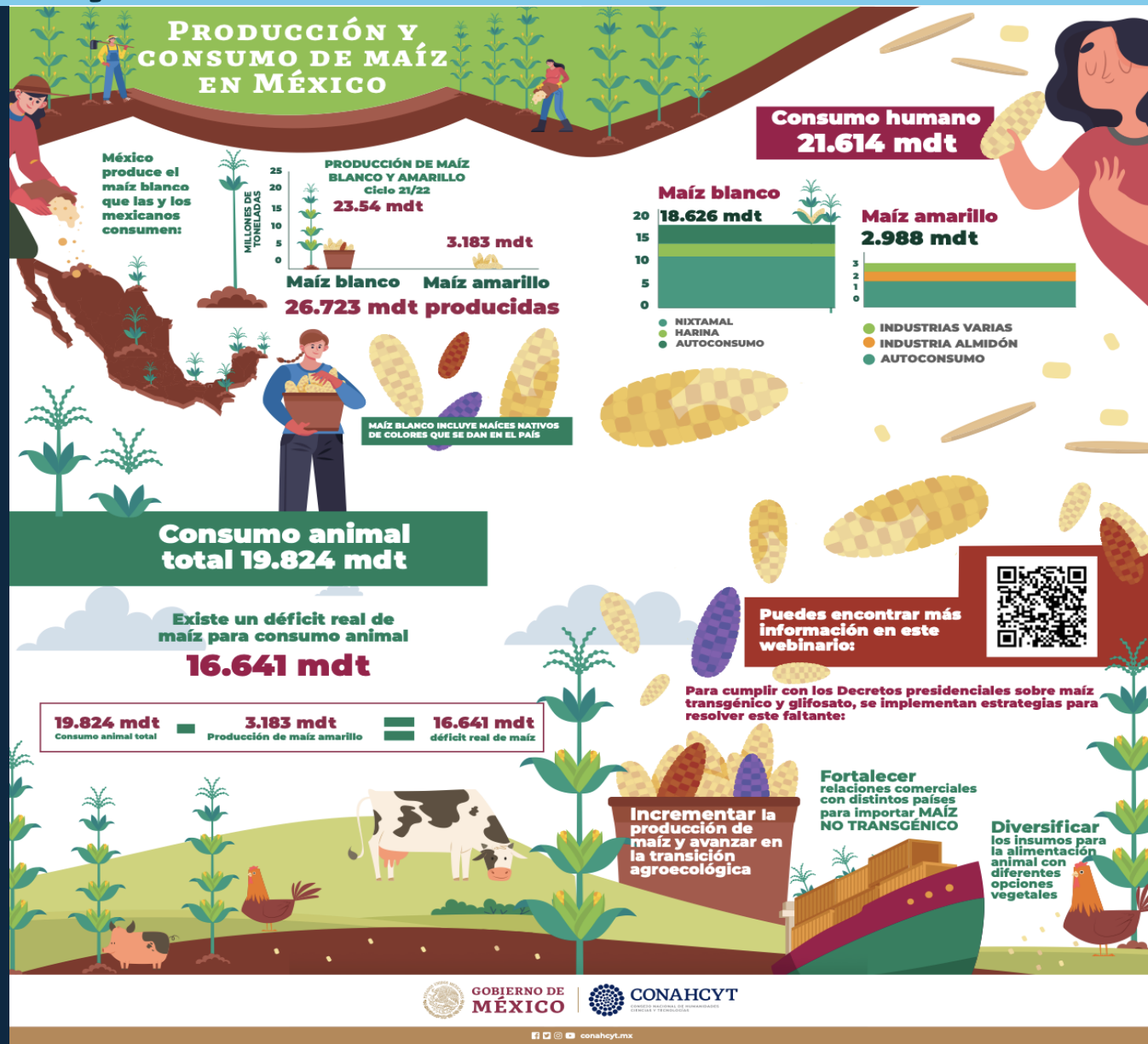


Conahcyt. (2023). Nutritional Quality and Nutraceutical Properties of Corn. Infografía. National Council of Humanities, Sciences and Technologies. Available at: https://secihti.mx/calidad-nutricional-y-propiedades-nutraceuticas-del-maiz/

Colín-Chávez, C., Virgen-Ortiz, J.J, Serrano-Rubio, L.E., Martínez-Téllez, M.A. and Astier, M. (2020). "Comparison of nutritional properties and bioactive compounds between industrial and artisan fresh tortillas from maize landraces", Current Research in Food Science. Available at: https://doi.org/10.1016/j.crfs.2020.05.004

Mexico:
Produces enough quality corn for human food

- Daily consumption: 0.3 to 1kg of corn per day almost without processing
- National annual production: > 26 million tons
- Covers the entire national demand for human consumption, including industrial uses (high fructose syrups, cereals, cookies, starches, including baby food, among others).

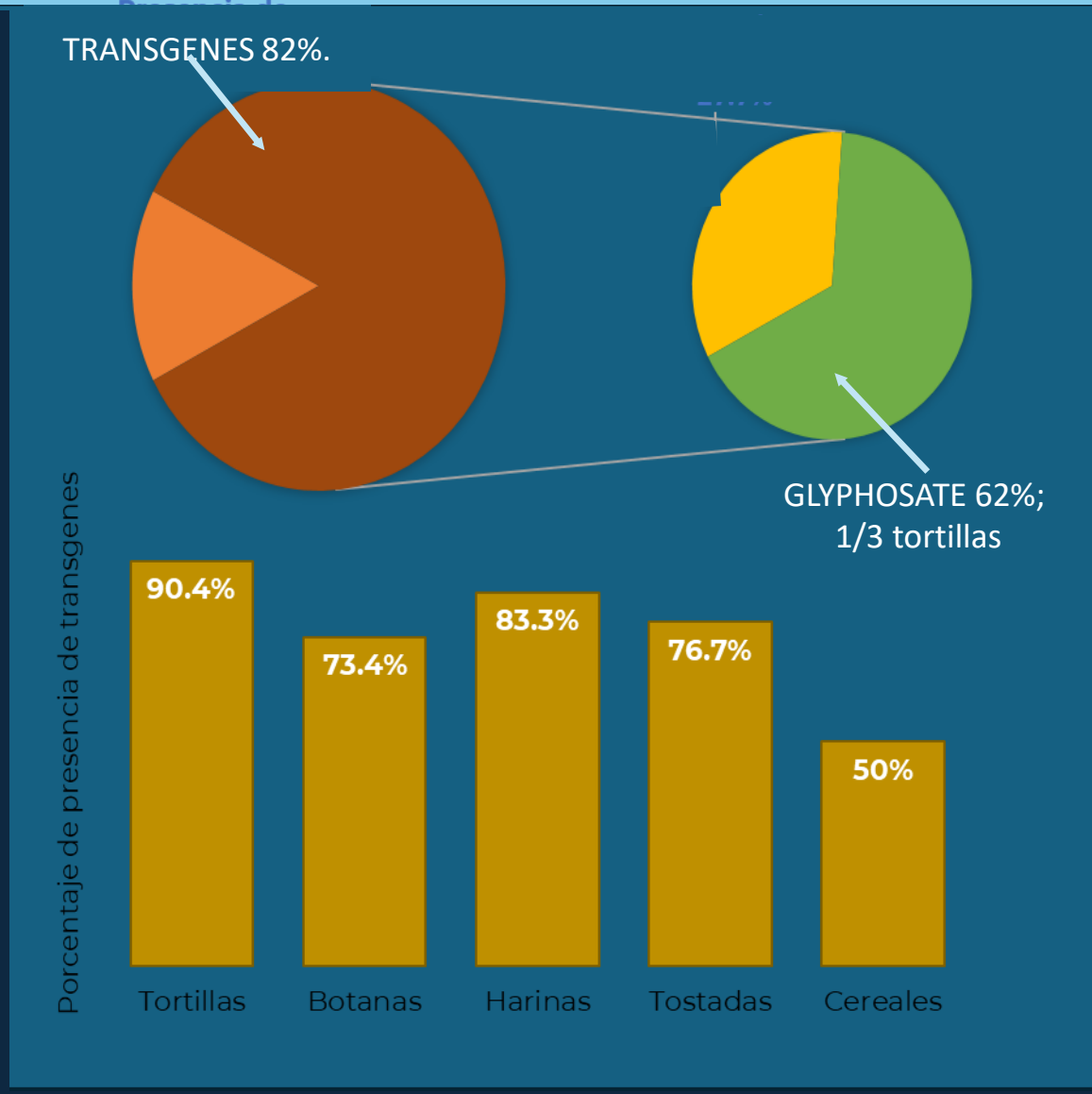


Conahcyt. (2023). Corn production and consumption in Mexico. Infografía. National Council of Humanities, Sciences and Technologies. Available at: https://secihti.mx/wp-content/uploads/publicaciones_conacyt/infografias/04_Produccion_y_consumo_de_Maiz_en_Mexico_Infografia_optimizado.pdf

Tortillas and other products derived from: Presence of transgenes and residues of highly hazardous pesticides

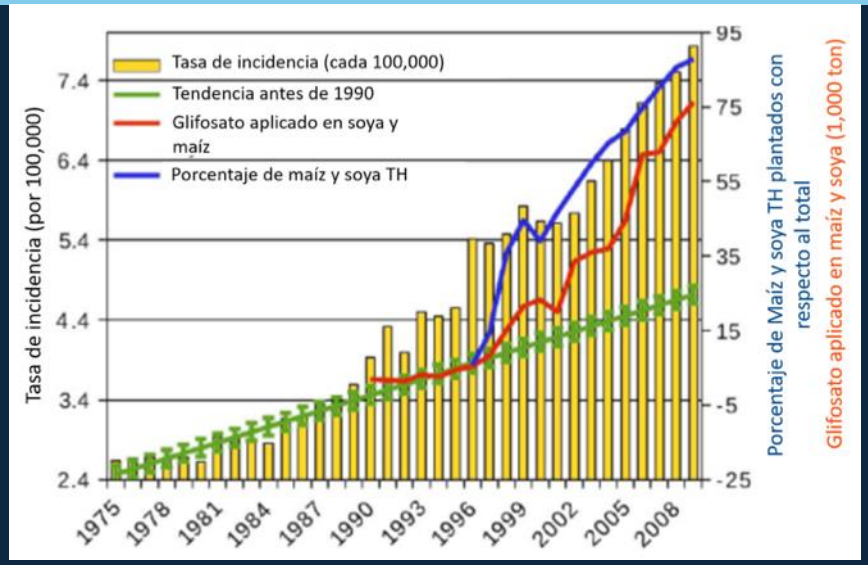
- 2017: Study from my lab documented presence of transgenes and glyphosate in 90% and 30% of tortillas, respectively. It is still a challenge to ensure that it is only our T- and G-free corn that is used for food.

- There is now incontrovertible evidence of the risks and harms of GMO and glyphosate consumption, and of glyphosate exposure and its presence in human fluids. Rigorous studies have provided scientific evidence of the mechanisms involved (e.g., studies by Andrés Carrasco, argentinean developmental biologist).

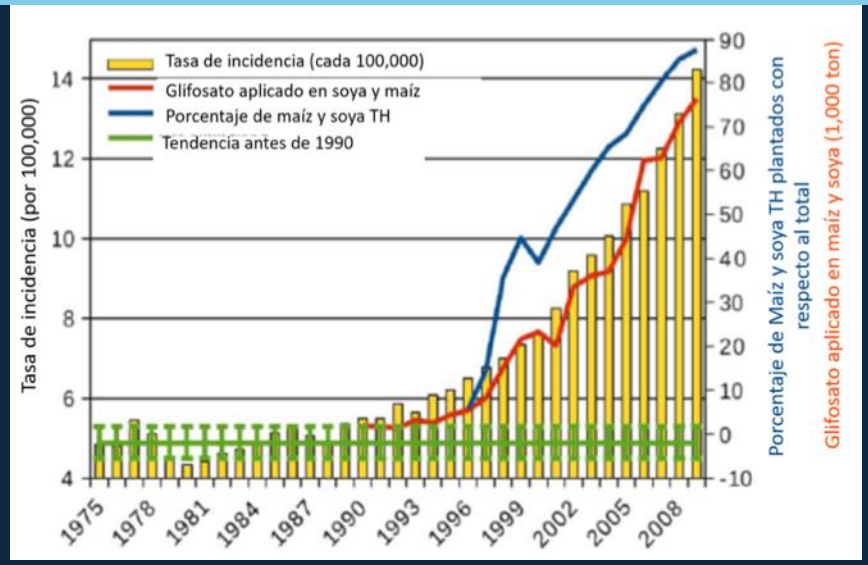


González-Ortega, E., Piñeyro-Nelson, A., Gómez-Hernández, E., Monterrubio-Vázquez, E., Arleo, M., Dávila-Velderrain, J., Martínez-Debat C. and Álvarez-Buylla E. R. (2017). "Pervasive presence of transgenes and glyphosate in maize-derived food in Mexico," J. Agroecology and Sustainable Food Systems, 1146-1161.

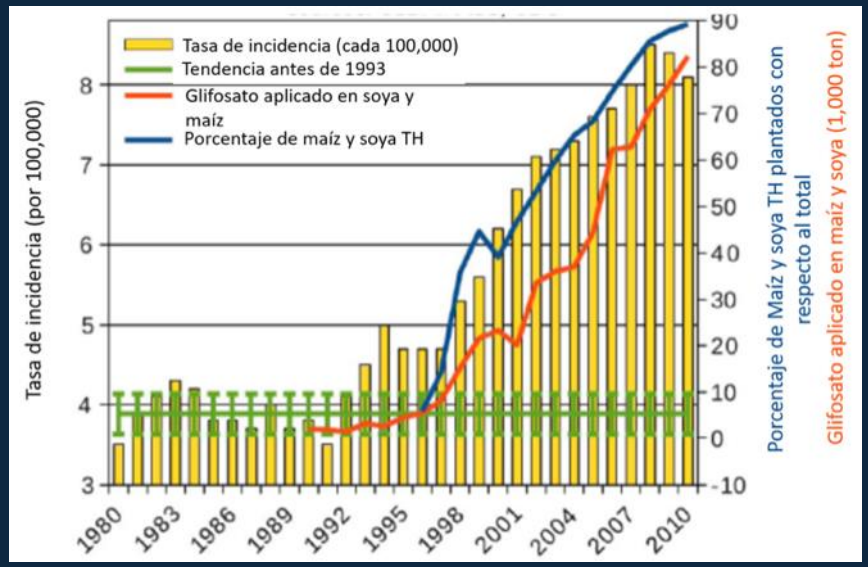
Undeniable scientific evidence on health impacts of GMOs



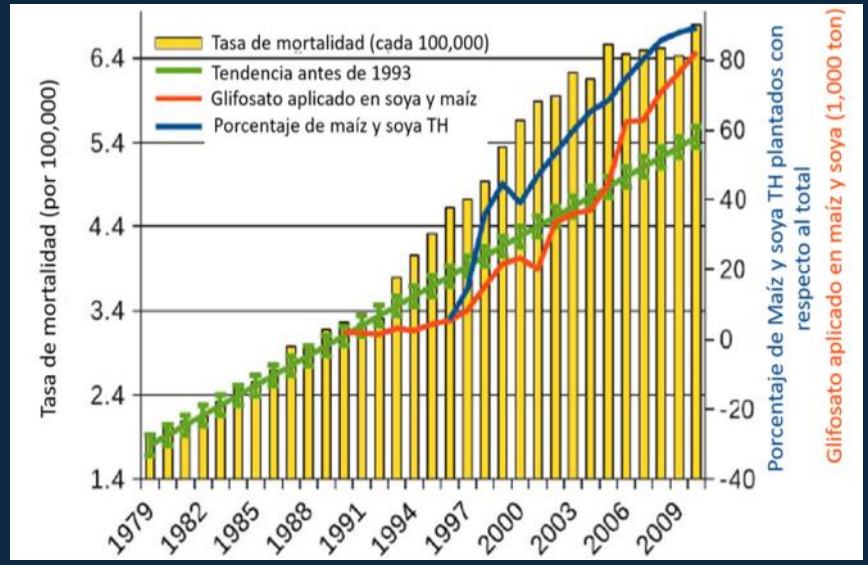
Age-adjusted incidence of liver and bile duct cancer. Correlation plot versus glyphosate use in corn and soybeans and percentage of corn and soybeans planted. Modified from Swanson *et al*. (2014).



Age-adjusted incidence rate of thyroid cancer. Correlation plot versus glyphosate use in corn and soybeans and percentage of corn and soybeans planted. Modified from Swanson *et al*. (2014).



Annual age-adjusted incidence of diabetes. Correlation plot versus glyphosate use in corn and soybeans and percentage of corn and soybeans planted. Modified from Swanson *et al*. (2014).



Age-adjusted Parkinson's-related deaths. Correlation plot versus glyphosate use in corn and soybeans and percentage of corn and soybeans planted. Modified from Swanson *et al*. (2014).

Swanson, N. L., A. Leu, J. Abrahamson & B. Wallet (2014). "Genetically Engineered Crops, Glyphosate and the Deterioration of Health in the United States of America," Journal of Organic Systems. 9(2): 6-37

Seneff, S., Swanson, N. and Li, C. (2015). "Aluminum and Glyphosate Can Synergistically Induce Pineal Gland Pathology: Connection to Gut Dysbiosis and Neurological Disease," Agricultural Sciences. 06. 42-70. Available at: 10.4236/ as.2015.61005.

U.S. corporations and the U.S. government have not demonstrated the safety of GMOs to our health and environment

- CONAHCYT during the term of former President AMLO conducted the most exhaustive review of the existing scientific literature. We concluded that the evidence was more than sufficient to restrict, as a precaution, the use of transgenic corn and its associated agrochemical, glyphosate, in the country's food supply chains.

- The U.S. cannot ensure the safety of its GM corn exports for our population. Their regulatory processes and evidence are based on studies influenced or even done by biotech companies.

Context of the elaboration of the Scientific Dossier

Prepared at the request of the Ministry of Economy as part of Conahcyt's collaboration.
In response to the controversy over transgenic corn in the context of T-MEC

GOBIERNO DE MÉXICO | CONAHCYT
CONSEJO NACIONAL DE HUMANIDADES CIENCIAS Y TECNOLOGÍAS

EXPEDIENTE CIENTÍFICO SOBRE EL MAÍZ GENÉTICAMENTE MODIFICADO Y SUS EFECTOS

Efectos del maíz GM sobre la salud humana, el ambiente y la diversidad biológica, incluida la riqueza biocultural de los maíces nativos en México

Conahcyt conducted an exhaustive review of the scientific literature through a transdisciplinary group of researchers. The dossier **systematizes more than 1201 citations.**

More than enough evidence to restrict, as a precautionary measure, the use of transgenic corn and its main associated pesticide, glyphosate, in the country's food supply chains.

We present in this paper some of the most outstanding and recent examples. The evidence of harms and risks associated with exposure to glyphosate and its presence in human fluids or food continues to increase and corroborate previous correlative studies. I leave you for this, with Maestra Erica Hagman; who had a key role in Cibiogem (2018-2025).

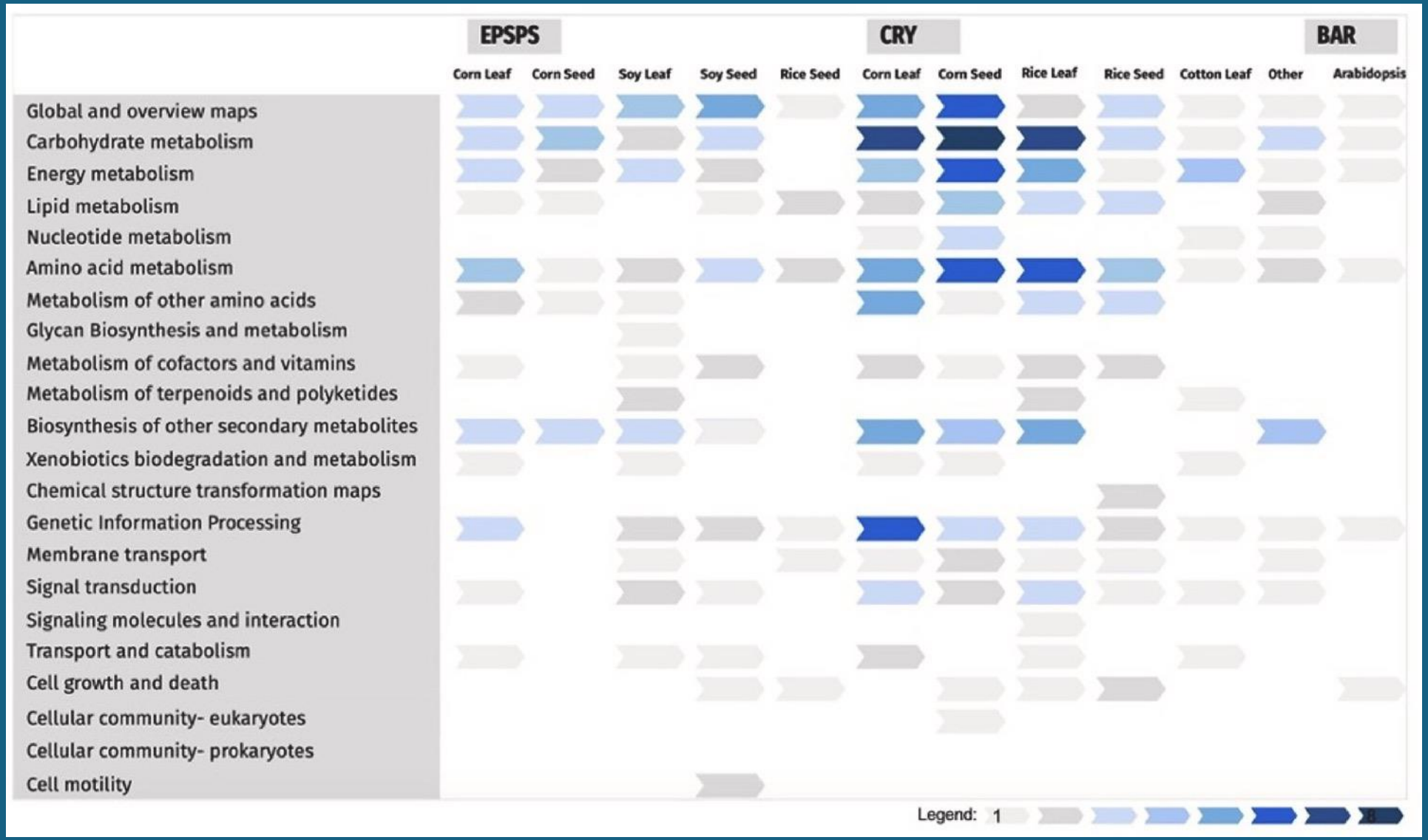
Inherent effects of transgenesis techniques

Main transgenesis techniques: by biolistics and Agrobacterium tumefaciens.

Both involve imprecision: insertion of transgenes at random *loci* and multiple unexpected insertions, as well as rearrangements and even deletions

→ **UNWANTED EXPRESSIONS**

Main GMO treatments: herbicide tolerance (HT) and insect resistance (Bt)

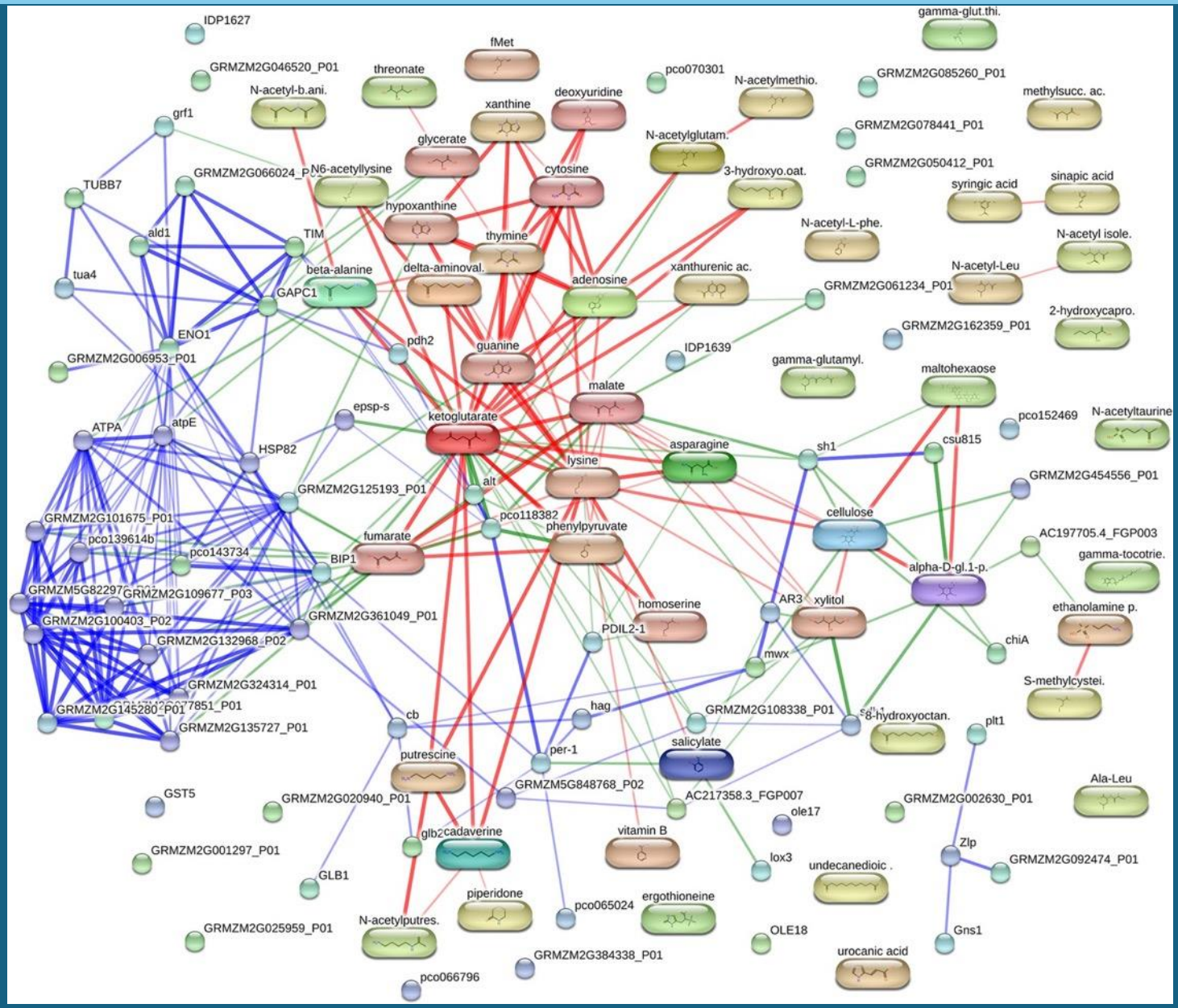


Benevenuto, R. F., Venter, H. J., Zanatta, C. B., Nodari, R. O. and Agapito-Tenfen, S. Z. (2022). Alterations in genetically modified crops assessed by omics studies: systematic review and meta-analysis. Trends in Food Science & Technology, 120, 325-337. https://doi.org/10.1016/j.tifs.2022.01.002.

Inherent effects of transgenesis techniques

Omics evidence shows that there are **multiple changes at the proteomic and metabolomic level** in GMOs

→ THE SO-CALLED "SUBSTANTIAL EQUIVALENCE" IS INSUFFICIENT AND IS NOT A TEST OF GMO SAFETY



Mesnage, R., Agapito-Tenfen, S., Vilperte, V. et al. (2016). An integrated multi-omics analysis of the NK603 Roundup-tolerant GM maize reveals metabolism disturbances caused by the transformation process. Sci Rep 6, 37855. https://doi.org/10.1038/srep37855.

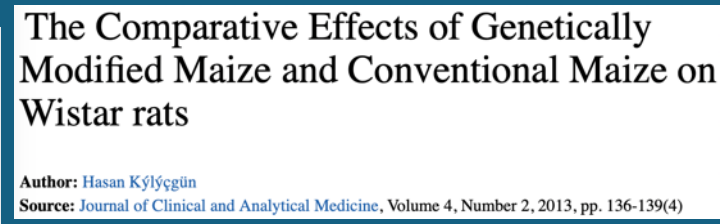
Effects of transgenic Bt-type maize

Health impacts due to the consumption of Bt transgenic crops

Cry proteins have insecticidal activity. Bt GMOs produce these proteins

Among the main effects reported are: inflammatory processes, exacerbated reactions of the immune system, allergenicity and oxidative stress associated with the expression of exogenous proteins in organisms.

May affect human mucous membranes and intestinal activity



Effects of HT-type transgenic maize

Health impacts of the consumption of HT transgenic crops

Glyphosate in organs, muscles and fluids of farm animals fed GMO-based feed.

Alterations in various systems and organs (especially the digestive system, liver biochemistry and kidneys).

Increased mortality, development of tumors or cancer, low fertility, and decreased learning ability

Int J Biol Sci 2009; 5(7):706-726. doi:10.7150/ijbs.5.706 This issue Cite

Research Paper

A Comparison of the Effects of Three GM Corn Varieties on Mammalian Health

Joël Spiroux de Vendômois[1], François Roullier[1], Dominique Cellier[1,2], Gilles-Eric Séralini[1,3]

Turkish Journal of Biology

Biological impact of feeding rats with a genetically modified-based diet

HANAA ORABY
MAHROUSA KANDIL
NERMEEN SHAFFIE
INAS GHALY

Article | Open access | Published: 19 December 2016

An integrated multi-omics analysis of the NK603 Roundup-tolerant GM maize reveals metabolism disturbances caused by the transformation process

Robin Mesnage, Sarah Z. Agapito-Tenfen, Vinicius Vilperte, George Renney, Malcolm Ward, Gilles-Eric Séralini, Rubens O. Nodari & Michael N. Antoniou

Scientific Reports **6**, Article number: 37855 (2016) | Cite this article

Food and Nutrition Sciences > Vol.9 No.6, June 2018

Histopathological Investigation of the Stomach of Rats Fed a 60% Genetically Modified Corn Diet

Irena M. Zdziarski[1*], Judy A. Carman[2,3#], John W. Edwards[3]

[1]Discipline of Anatomy and Pathology, School of Medicine, University of Adelaide, Australia.

[2]The Institute of Health and Environmental Research (IHER), Kensington Park, Australia.

[3]Health and Environment, College of Science and Engineering, Flinders University, Bedford Park, Australia.

Research | Open access | Published: 24 June 2014

Republished study: long-term toxicity of a Roundup herbicide and a Roundup-tolerantgenetically modified maize

Gilles-Eric Séralini, Emilie Clair, Robin Mesnage, Steeve Gress, Nicolas Defarge, Manuela Malatesta, Didier Hennequin & Joël Spiroux de Vendômois

Environmental Sciences Europe **26**, Article number: 14 (2014) | Cite this article

Scholarly Journal of Agricultural Science Vol. 6(1), pp. 1-8 January 2016
Available online at http:// www.scholarly-journals.com/SJAS
ISSN 2276-7118 © 2016 Scholarly-Journals

Full Length Research Paper

Pathology reports on the first cows fed with Bt176 maize (1997–2002)

Gottfried Glöckner[1] and Gilles-Éric Séralini[2*]

A long-term toxicology study on pigs fed a combined genetically modified (GM) soy and GM maize diet

Judy A. Carman[1,2*], Howard R. Vlieger[3], Larry J. Ver Steeg[4], Verlyn E. Sneller[3], Garth W. Robinson[5**], Catherine A. Clinch-Jones[1], Julie I. Haynes[6], John W. Edwards[2]

Evaluation of adverse effects/events of genetically modified food consumption: a systematic review of animal and human studies

Chen Shen, Xiang-Chang Yin, Bo-Yang Jiao, Jing Li, Peng Jia, Xiao-Wen Zhang, Xue-Hao Cheng, Jian-Xin Ren, Hui-Di Lan, Wen-Bin Hou, Min Fang, Xun Li, Yu-Tong Fei, Nicola Robinson & Jian-Ping Liu

Environmental Sciences Europe **34**, Article number: 8 (2022) | Cite this article

There is no scientific consensus on the safety of GMOs

Science, Technology, & Human Values
1-32

DOI: 10.1177/0162243915598381
sthv.sagepub.com
SAGE

An Illusory Consensus behind GMO Health Assessment

Sheldon Krimsky[1]

Abstract

Prominent scientists and policymakers assert with confidence that there is no scientific controversy over the health effects of genetically modified organisms (GMOs)—that genetically modified crops currently in commercial use and those yet to be commercialized are inherently safe for human consumption and do not have to be tested. Those who disagree are cast as "GMO deniers." This article examines scientific reviews and papers on GMOs, compares the findings of professional societies, and discusses the treatment of scientists who have reported adverse effects in animal feeding experiments. This article concludes by exploring the role that politics and corporate interests have had in distorting an honest inquiry into the health effects of GMO crops.

Hilbeck *et al. Environmental Sciences Europe* (2015) 27:4
DOI 10.1186/s12302-014-0034-1

No scientific consensus on GMO safety

Angelika Hilbeck[1,2*], Rosa Binimelis[1,3], Nicolas Defarge[1,4,5], Ricarda Steinbrecher[1,6], András Székács[1,7], Fern Wickson[1,3], Michael Antoniou[8], Philip L Bereano[9], Ethel Ann Clark[10], Michael Hansen[11], Eva Novotny[12], Jack Heinemann[13], Hartmut Meyer[1], Vandana Shiva[14] and Brian Wynne[15]

Environmental Sciences Europe
a SpringerOpen Journal

Abstract

A broad community of independent scientific researchers and scholars challenges recent claims of a consensus over the safety of genetically modified organisms (GMOs). In the following joint statement, the claimed consensus is shown to be an artificial construct that has been falsely perpetuated through diverse fora. Irrespective of contradictory evidence in the refereed literature, as documented below, the claim that there is now a consensus on the safety of GMOs continues to be widely and often uncritically aired. For decades, the safety of GMOs has been a hotly controversial topic that has been much debated around the world. Published results are contradictory, in part due to the range of different research methods employed, an inadequacy of available procedures, and differences in the analysis and interpretation of data. Such a lack of consensus on safety is also evidenced by the agreement of policymakers from over 160 countries - in the UN's Cartagena Biosafety Protocol and the Guidelines of the *Codex Alimentarius* - to authorize careful case-by-case assessment of each GMO by national authorities to determine whether the particular construct satisfies the national criteria for 'safe'. Rigorous assessment of GMO safety has been hampered by the lack of funding independent of proprietary interests. Research for the public good has been further constrained by property rights issues, and by denial of access to research material for researchers unwilling to sign contractual agreements with the developers, which confer unacceptable control over publication to the proprietary interests.

The joint statement developed and signed by over 300 independent researchers, and reproduced and published below, does not assert that GMOs are unsafe or safe. Rather, the statement concludes that the scarcity and contradictory nature of the scientific evidence published to date prevents conclusive claims of safety, or of lack of safety, of GMOs. Claims of consensus on the safety of GMOs are not supported by an objective analysis of the refereed literature.

Relationship between GMOs and Highly Hazardous Pesticides

Indisoluble relation with PAP (FAO/WHO)

Main herbicides:

Glyphosate
Glufosinate-ammonium
2,4-D
Dicamba

Other PAPs:

Paraquat
Atrazine
Fipronil
Chlorpyrifos
Other pesticides

WHO/FAO. (2019). *International Code of Conduct on Pesticide Management. Guidelines on Highly Hazardous Pesticides*. World Health Organization and Food and Agriculture Organization of the United Nations. Rome. https://www.fao.org/publications/card/en/c/CA2894ES

Relationship between GMOs and Highly Hazardous Pesticides

Some data

Glyphosate → Cancer (different pathways), endocrine disruptor, etc.
Glufosinate-ammonium → Cancer (genotoxicity), nervous system damage, altered sperm quality, fetal damage, etc.
2,4-D → Cancer (genotoxicity), damage to blood, liver, kidneys, blood cells; 50% of agent orange
Dicamba → Cancer (mutagenicity); currently banned in the U.S.

Paraquat → Parkinson's; U.S. sues Syngenta and paraquat papers
Atrazine → Malformations in fetuses, altered sexual development, genotoxicity, diabetes.

Fipronil → Neurotoxic effects; recent mass die-off of bees
Chlorpyrifos → Nervous system damage; banned in 40 countries

PRESENT IN THE ENVIRONMENT, MAY BE PRESENT IN FOODS TOGETHER WITH PAPRIKA AND PAPAYA.

Compilations of scientific information from Cibiogem https://cibiogem.secihti.mx/sistema-nacional-de-informacion/documentos-y-actividades-en-bioseguridad/

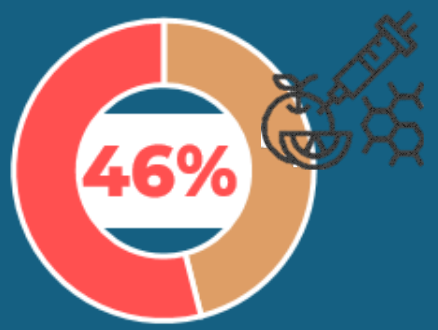
Transgenic events and their relationship with glyphosate

Why do we emphasize glyphosate?

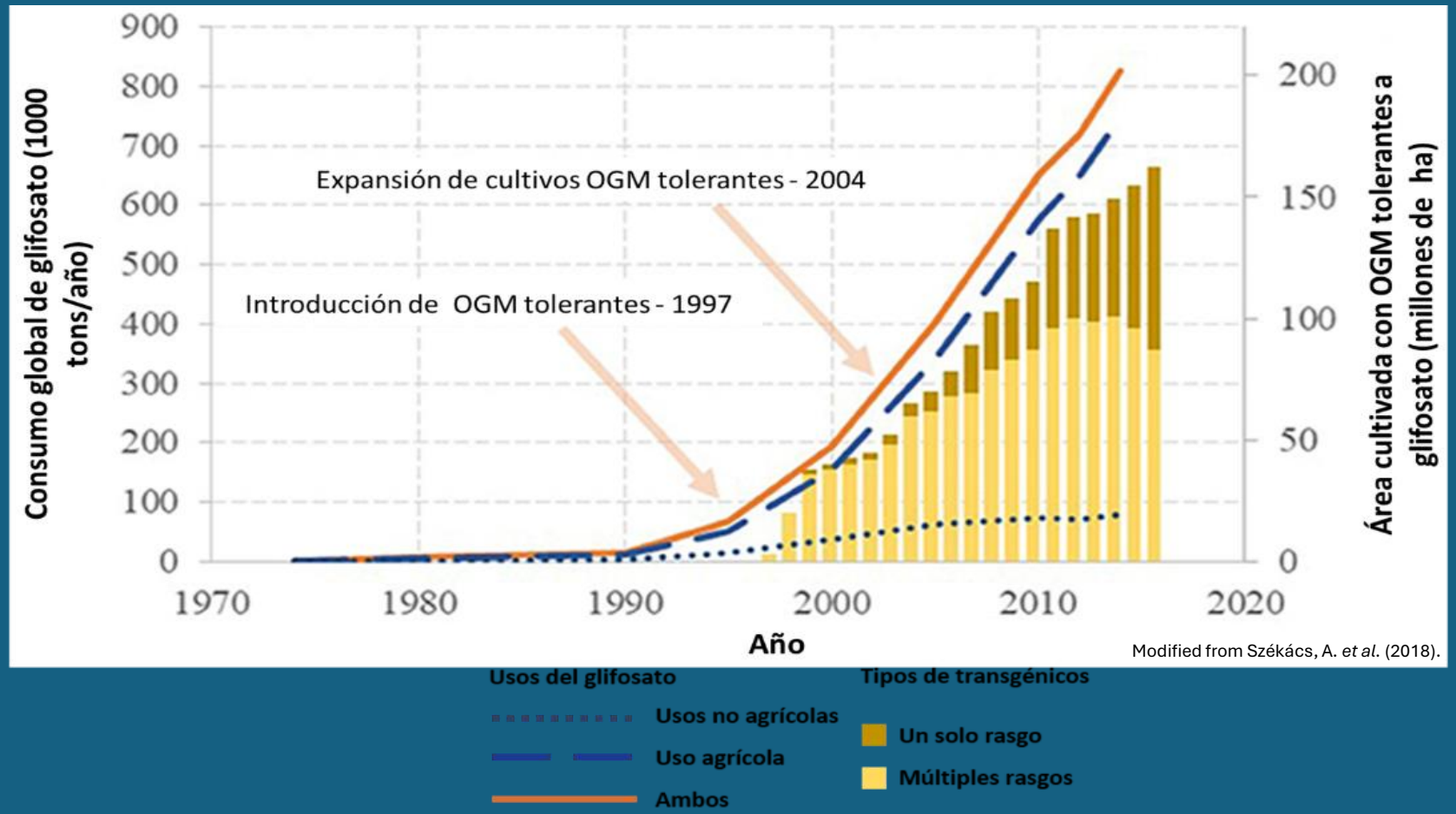
It is the most widely used synthetic herbicide molecule in the world.

Increased exposure → increases damage

Indissoluble relationship with transgenics



About 50% of global glyphosate use is for GM corn, cotton, canola and HT soybean crops.



Modified from Székács, A. *et al.* (2018).

Székács, András, Darvas, & Béla (2018). "Re-registration challenges of glyphosate in the european union," Frontiers in Environmental Science, 6, July 31. Available at: doi:10.3389/ fenvs.2018.00078.

Transgenic maize events and their relationship with glyphosate

General trend of transgenic crops, in particular T corn → use of herbicides, especially glyphosate

International level

HT transgenic crops **63%** are tolerant to glyphosate

NK603 and MON810 are the events with the most approvals; are present in ~ 20% and 11% of maize events, respectively.

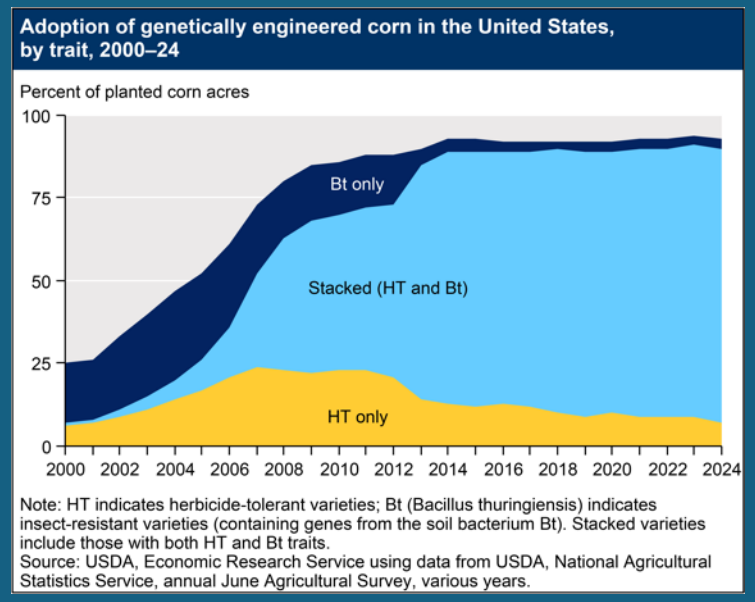
NK603: Tolerant to glyphosate

MON810: Insect resistant

United States

65% of GM maize events are herbicide tolerant.

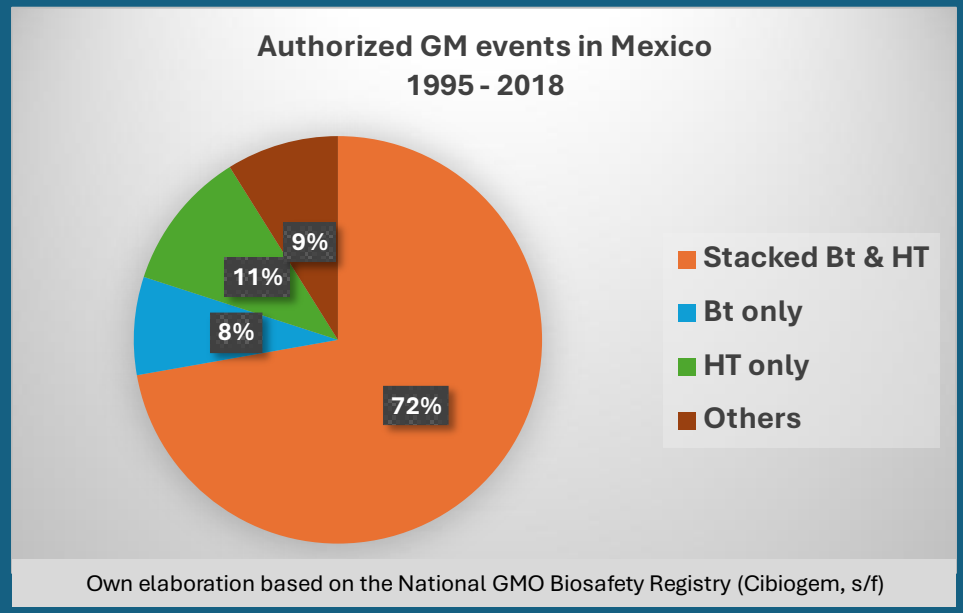
42% are tolerant to glyphosate



Mexico

50% of authorized GMO events, are corn

90% are tolerant to glyphosate



Own elaboration based on the National GMO Biosafety Registry (Cibiogem, s/f)

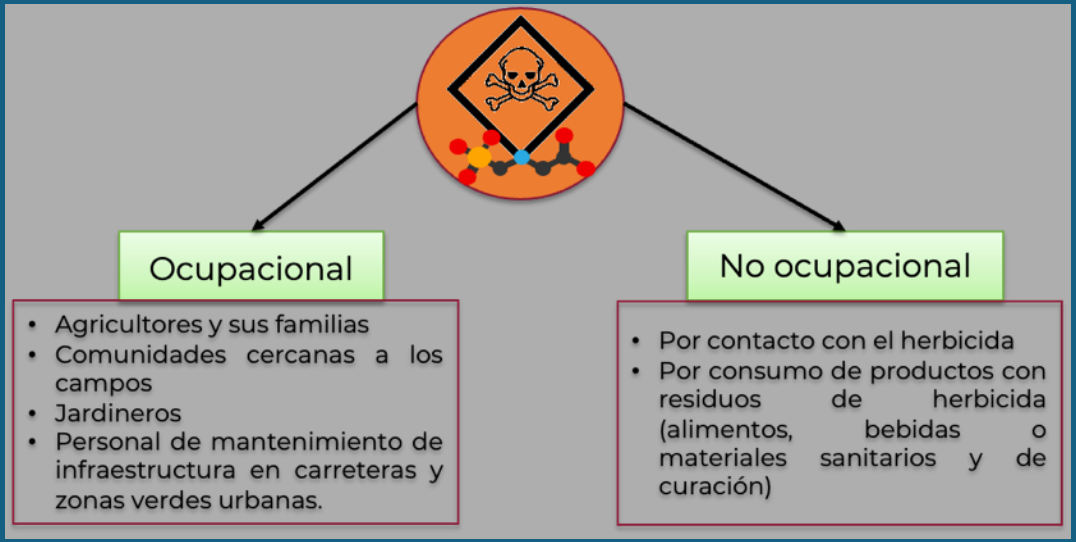
ISAAA (n.d.). GM Approval Database. International Service for the Acquisition of Agri-biotech Applications. Retrieved December 2023 https://www.isaaa.org/gmapprovaldatabase/default.asp

USDA (2023). Adoption of Genetically Engineered Crops in the U.S [Dataset]. Economic Research Service. U.S. Department of Agriculture. Retrieved December 2023 https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-u-s/

CIBIOGEM (n.d.). National Registry of GMOs. Comisión Intersecretarial de Bioseguridad de los Organismos Genéticamente Modificados. Retrieved January 2024 https://conacyt.mx/cibiogem/index.php/sistema-nacional-de-informacion/registro-nacional-bioseguridad-ogms

Glyphosate case

Types of exposure



Everyone is exposed to glyphosate, although the industry tries to minimize exposure

Types of toxicity

Acute toxicity

Skin sensitivity reactions and poisoning: respiratory and cardiac difficulties, ataxia, convulsions, spontaneous abortions and death

Chronic toxicity

Cancer of different types in various organs, through FIVE mechanisms, even at low doses

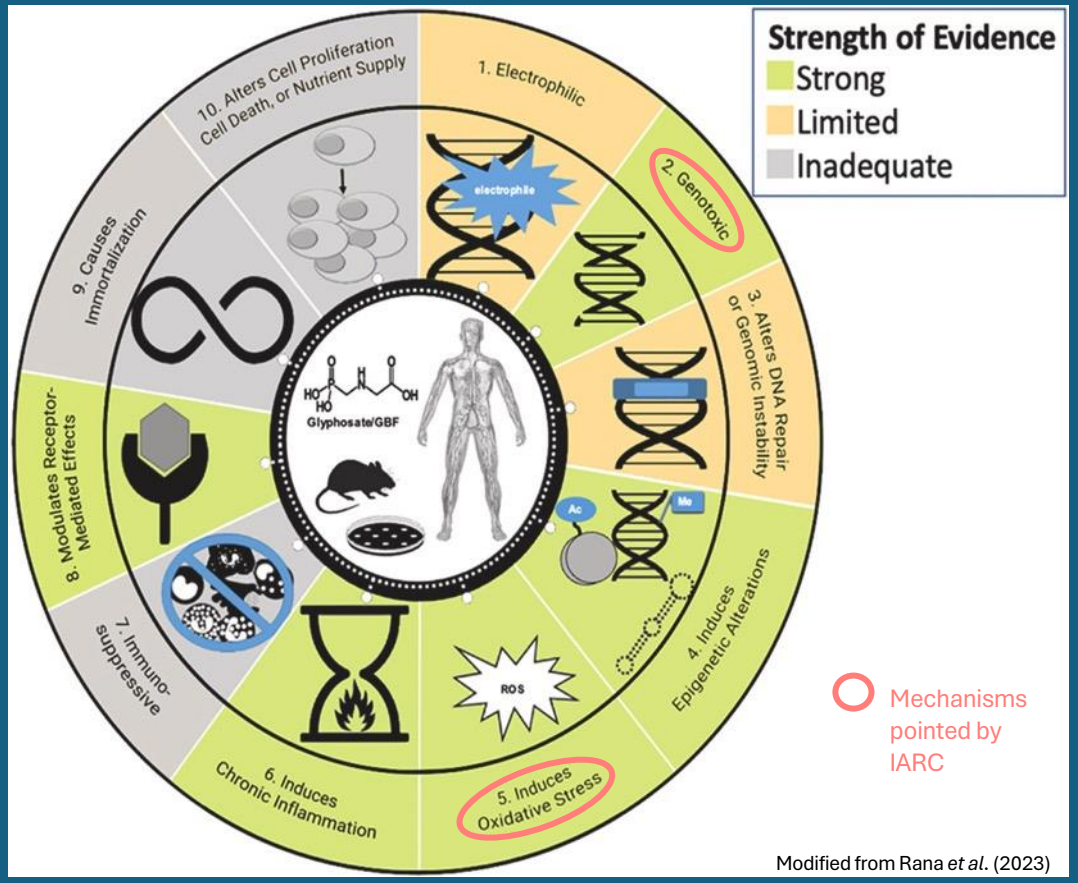
Oxidative stress (OS) linked to the development of a variety of chronic degenerative diseases such as Parkinson's disease

Alterations in sex hormones, it is considered an endocrine disruptor, even at low doses. Causes reproductive disorders for up to three generations after exposure

Affects various organs and systems, especially the digestive system; penetrates the blood-brain barrier

Acts as an antibiotic, destabilizing the intestinal microbiome

Pathways of glyphosate carcinogenicity



Modified from Rana *et al.* (2023)

Mechanisms pointed by IARC

> J Natl Cancer Inst. 2023 Apr 11;115(4):394-404. doi: 10.1093/jnci/djac242.

Glyphosate exposure and urinary oxidative stress biomarkers in the Agricultural Health Study

Conclusions: Our findings contribute to the weight of evidence supporting an association between glyphosate exposure and oxidative stress in humans and may inform evaluations of the carcinogenic potential of this herbicide.

agrochemicals MDPI

Article

Genotoxicity Assays Published since 2016 Shed New Light on the Oncogenic Potential of Glyphosate-Based Herbicides

Charles Benbrook [1,*], Robin Mesnage [2] and William Sawyer [3]

Table 6. Overall Results of Genotoxicity Assays Published Since the 2015 EPA and IARC Reviews of Glyphosate and GBH Oncogenicity.

Glyphosate Technical	Number of Assays	33
	Positive	24
	Percent Positive	73%
Formulated GBHs	Number of Assays	61
	Positive	58
	Percent Positive	95%
All New Studies	Number of Assays	94
	Positive	82
	Percent Positive	87%

Source: Supplemental Table S4.

80% of the US population has glyphosate in their urine according to NHANES

SSGLYPL - Glyphosate comment code

Variable Name: SSGLYPL

SAS Label: Glyphosate comment code

English Text: Glyphosate comment code

Target: Both males and females 6 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	1885	1885	
1	Below lower detection limit	425	2310	
.	Missing	6	2316	

Rana, I., P. K. Nguyen, G. Rigutto, A. Louie, J. Lee, M. T. Smith & L. Zhang (2023). Mapping the key characteristics of carcinogens for glyphosate and its formulations: A systematic review. full text links. *Chemosphere*. Oct:339:139572. doi: 10.1016/j.chemosphere.2023.139572.

NCHS. (2022). Glyphosate (GLYP) - Urine (SSGLYP_H). National Health and Nutrition Examination Survey [Database]. National Center of Health Statistics At CDC. https://wwwn.cdc.gov/Nchs/Nhanes/2013-2014/SSGLYP_H.htm. https://wwwn.cdc.gov/Nchs/Nhanes/2013-2014/SSGLYP_H.htm

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Food and products with GMO and HHP residues

Transgenic crops → ULTRAPROCESSED FOOD AND CHATARRE FOOD

The increase in production, through intensive GM crop farming systems, is related to the generation of raw material to produce large quantities of ultra-processed, high-calorie, but nutritionally deficient foods, rather than to combating hunger.

It corresponds to the change in the eating habits of the inhabitants of the so-called "developed" countries.

In December 2023, the American Academy of Pediatrics published a clinical report, prepared by specialist physicians who are part of the Committee on Nutrition:

- Glyphosate's close relationship with GMOs is indicated.
- They warn about measurable amounts of this herbicide in a wide variety of foods made from GMOs, accessible to children and adolescents.
- They show that GM crop technology has been focused on agronomic aspects related to yield, leaving aside the nutritional quality of the products, which are mainly intended for the manufacture of ultra-processed foods.
- They allude to the relevant role of pediatricians in informing families about the potential risks of GMO and glyphosate ingestion, as well as recommending the consumption of organic foods.

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ARE TRANSGENICS FEEDING THE WORLD'S POPULATION?

Of the 195 internationally recognized countries, 85% do not plant GMOs.

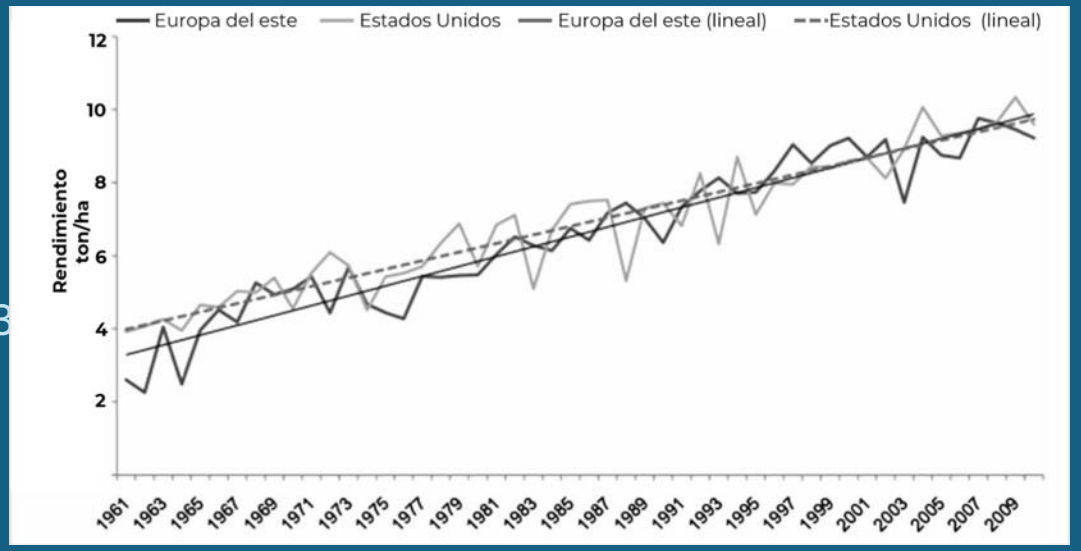
By region, the only 29 that have GM crops in their territories are distributed as follows: 10 in Latin America, the 2 in North America, 9 in Asia and the Pacific, 6 in Africa, and 2 in the European Union.

Nearly 80% of the world's countries do not import GMOs for any use; only 43 countries (22%) import them for human food, animal feed or industrial uses.

In 2019, only 14 countries (8.5%) planted GM corn: USA, Brazil, Argentina, South Africa, Canada, Philippines, Paraguay, Uruguay, Spain, Vietnam, Colombia, Honduras, Chile and Portugal.

These data indicate that there is no widespread or worldwide preference for GM crops, particularly for GM maize, or for approving their importation for food, feed or industrial processing.

GM maize does not have better yields than conventional maize



Yields of transgenic and non-GM corn in the United States in Eastern Europe during the period 1961-2010. Modified from: Heinemann *et* al. (2013)

Over the past two decades, many journals, including this one, have published papers describing how modifying one or a few genes can result in substantial increases in crop yields (see 'Genes and yield'). The reported increases range from 10% to 68%, and the crops analysed include rice, maize (corn), tobacco and soya bean[1–4].

These studies have contributed important insights in molecular biology and gene discovery. But many are the results of tests conducted in greenhouses or in small-scale field trials — the latter typically involving plants grown in small plots. Few, if any, have used the experimental designs needed to evaluate crop performance in real-world environments. And hardly any findings have translated into yield increases on actual farms.

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WHO FEEDS THE WORLD'S POPULATION?

According to biotech industry data, in 2019, 17 million farmers planted GMOs, on a total of 190.4 million hectares, and more than 65 million people "benefited" from GM crops.

Tiny numbers, when considering that, in 2019, around the world, approximately 1.23 billion people were employed in the world's agri-food systems and that more than three times that number, or nearly half of the world's population, live in households linked to agri-food systems, according to FAO.

Of these 1.23 billion people, 857 million worked in primary agricultural production, while 375 million worked in the off-farm segments of agrifood systems.

The exercise of the right to food is NOT linked to GMOs:

Are not designed to adequately feed humans
Pesticide residues

Dionglay, C. (2022). Commercially available biotech crops and where to find them. International Service for the Acquisition of Agri-biotech Applications. https://www.isaaa.org/blog/entry/default.asp?BlogDate=5/11/2022
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IMPORTANCE OF PRECAUTION

PRINCIPLE 15 of the Rio de Janeiro Earth Summit

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation… and health

The precautionary principle in international human rights treaties

- **International Covenant on Civil and Political Rights:** Right to **life** (e.g., DCP Committee GC-36, 2017)
- **International Covenant on Economic, Social and Cultural Rights:** Rights to enjoy the **benefits of scientific progress** (e.g., GC-25 of the ICESCR Committee, 2020); to a **clean, healthy and sustainable environment** (e.g., OC-23/17, IACHR, 2017; UN GA Accord, 2022); to the enjoyment of the **highest attainable standard of health** (GC-14 of the ESCR Committee, 2000); and to **adequate food** (e.g., GC-12 of the ESCR Committee, 1999)

In Mexico Constitution: Constitutional Articles 1°, 3° and 4°.

General Law on Adequate and Sustainable Food, General Law on Humanities, Science, Technology and Innovation, Law on Biosafety of GMOs

IMPORTANCE OF PRECAUTION

PRECAUTIONARY PRINCIPLE: Indispensable its application in three senses:

1. The PP intensifies the development of research, free of conflicts of interest, on the harms and risks associated with technologies; it encourages universal access to this information.
2. The PP stimulates innovation that is truly sustainable in environmental, social, economic and cultural terms; to direct technological developments in a way that does not harm people and the environment, does not affect human rights, and does not affect the environment.
3. CP leads to the promotion, access and scaling up of sustainable technologies, as well as to the dissemination of information on their benefits.

THANK YOU