Jornadas Forestales de Gran Canaria

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

Glifosato:
Mitos y realidades

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SERTOX

¿Qué es el Glifosato?

Herbicida no selectivo de amplio espectro, desarrollado para eliminación de hierbas y de arbustos, en especial los perennes.

ES UN HERBICIDA TOTAL.

Es absorbido por las hojas y no por las raíces. Se puede aplicar a las hojas, inyectarse a troncos y tallos, o asperjarse a tocones como herbicida forestal.

La aplicación de glifosato mata las plantas debido a que suprime su capacidad de generar aminoácidos aromáticos (fenilalanina, tirosina, triptófano).

Monsanto

Muy efectivo* → amplísima introducción en el mercado

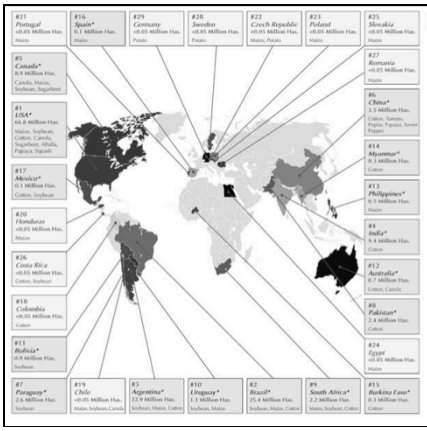
SERTOX

Glifosato: Usos

- **Cultivos transgénicos**
  - **Manipuladas para incorporar un gen que codifica para una versión resistente al glifosato del enzima EPSPS que sintetiza el precursor de los aminoácidos aromáticos (proviene de microorganismos)**

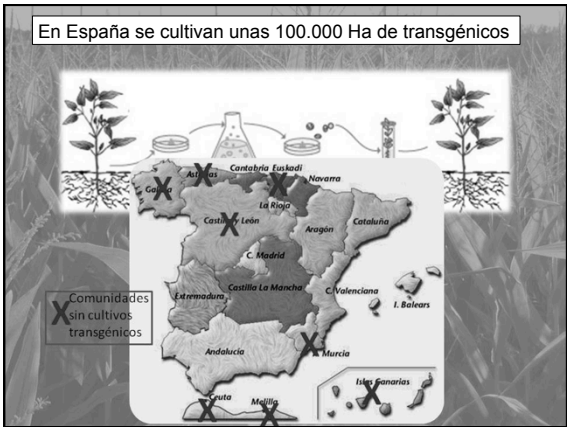
Principalmente cereales (soja)

Roundup Ready



Estrechamente vinculado al cultivo de transgénicos

En España se cultivan unas 100.000 Ha de transgénicos



Control del cultivo de coca

Glifosato: Usos

Otros cultivos agrícolas

(Canarias)

Jardinería

(Municipal, hostelería, doméstica)

Glifosato: Usos

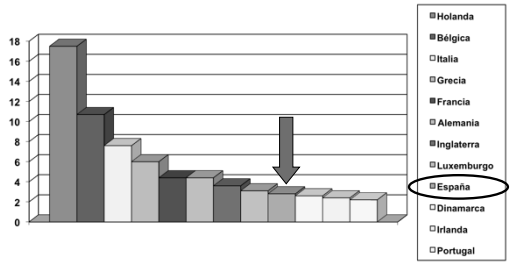
Mantenimiento de carreteras

(Canarias)

Control de cañaverales

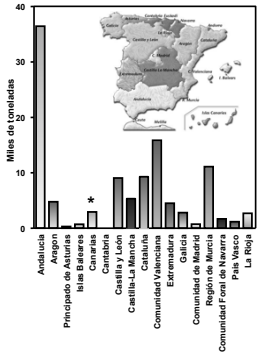
(Canarias)

Consumo Europeo de Productos Fitosanitarios (Kg/Ha)



AEPLA, 2005

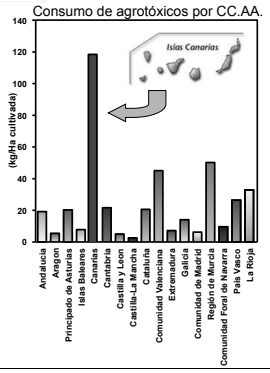
Consumo Total de Productos Fitosanitarios en España



AEPLA, 2010

Consumo Total de Productos Fitosanitarios por CC.AA.

(Normalización por hectárea cultivada)

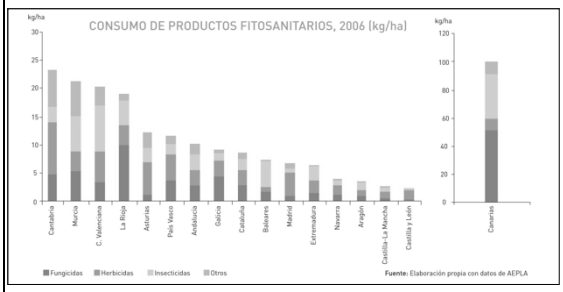


Canarias = 109.24 kg/Ha

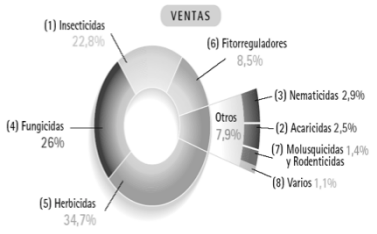
X 5 veces

SE ESTIMA QUE < 1% DEL TOTAL DE PLAGUICIDAS APLICADOS ATACA REALMENTE A LAS PLAGAS

Consumo Total de Productos Fitosanitarios por CC.AA.



SERTOX



Actualmente alrededor de un **70%** del total de venta de herbicidas corresponden con glifosato

AEPLA, 2010

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¿Y esto en términos económicos cómo se traduce?

Unos 2000 millones de litros/año

25.000 M€/año

(sólo con la venta del herbicida)

A esto hay que añadir:

- la venta de semillas de transgénicos
- Beneficio económico por mejores cosechas
- Mejora en nivel de vida de muchas comunidades agrícolas

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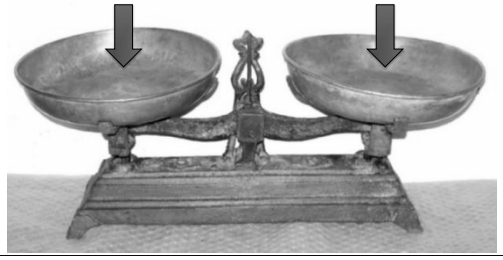
Beneficios económicos

Salud



Environmental Health Perspectives, 112(3), 321-6, 2004 Research | Article

Glyphosate Biomonitoring for Farmers and Their Families: Results from the Farm Family Exposure Study

John F. Acquavella,[1] Bruce H. Alexander,[2] Jack S. Mandel,[3] Christophe Gustin,[1] Beth Baker,[2] Pamela Chapman,[4] and Marian Bleeke[1]

[1]Monsanto Company, St. Louis, Missouri, USA; [2]School of Public Health, University of Minnesota, Minneapolis, Minnesota, USA; [3]Rollins School of Public Health, Emory University, Atlanta, Georgia, USA; [4]Exponent Corporation, Menlo Park, California, USA

Glyphosate is the active ingredient in Roundup agricultural herbicides and other herbicide formulations that are widely used for agricultural, forestry, and residential weed control. As part of the Farm Family Exposure Study, we evaluated urinary glyphosate concentrations for 48 farmers, their spouses, and their 79 children (6–18 years of age). We evaluated 24-hr composite urine samples for each family member the day before, the day of, and for 3 days after a glyphosate application. Sixty percent of farmers had detectable levels of glyphosate in their urine on the day of application. The geometric mean (GM) concentration was 3 ppb, the maximum value was 233 ppb, and the highest estimated systemic dose was 0.004 mg/kg. Farmers who did not use rubber gloves had higher GM urinary concentrations than did other farmers (10 ppb vs. 2.0 ppb). For spouses, 6% had detectable levels in their urine on the day of application. Their maximum value was 3 ppb. For children, 12% had detectable glyphosate in their urine on the day of application, with a maximum concentration of 29 ppb. All but one of the children with detectable concentrations had helped with the application or were present during herbicide mixing, loading, or application. None of the systemic doses estimated in this study approached the U.S. Environmental Protection Agency reference dose for glyphosate of 2 mg/kg/day. Nonetheless, it is advisable to minimize exposure to pesticides, and this study did identify specific practices that could be modified to reduce the potential for exposure. *Key words:* biomonitoring, epidemiologic studies, glyphosate, pesticide exposure. *Environ Health Perspect* 112:321–326 (2004). doi:10.1289/ehp.6667 available via *http://ehp.niehs.nih.gov/* [Online 3 December 2003]

Glyphosate [*N*-(phosphonomethyl)glycine] is the active ingredient in the Roundup (Monsanto Company, St. Louis, MO) brand of agricultural herbicides and in a variety of other herbicide formulations. These formulations provide nonselective, postemergent control of annual and perennial weeds and are used widely in agricultural, forestry, and residential markets. According to figures for 1999 [U.S. Environmental Protection Agency (EPA) 2002], glyphosate was second among pesticides in pounds applied in U.S. agriculture, and its use has been increasing with the

Materials and Methods

Subject selection. We recruited farm families by randomly selecting licensed pesticide applicators from state listings in South Carolina and Minnesota. An initial solicitation letter was sent to applicators, followed a week later by a telephone call from a trained interviewer to assess eligibility and interest in participating in the study. Applicators could call a toll-free phone number supplied in the solicitation letter if they did not want to be contacted. From among those willing to be contacted, we selected families who met the

were met, an informed consent visit was arranged and the appropriate consent forms were signed to enable use of the resulting data for research purposes. The Institutional Review Board of the University of Minnesota approved the study protocol.

Participating families were given a cash incentive of $300 and reimbursed for the pesticide used during the on-study application to a maximum of $1,000. The average reimbursement for pesticides was approximately $700.

Urine collection and preparation of composite samples. Forty-eight farm families, including 79 children, provided specimens relating to a glyphosate application. During the study period, defined as 24 hr before the start of on-study pesticide-related activities (day –1) and continuing for 4 consecutive 24-hr periods (days 0, 1, 2, and 3, respectively), participants collected individual urine voids in 500-mL high-density polyethylene wide-mouth containers. Participants labeled these containers according to the date and time of each sample collection and stored them in coolers with blue ice packs (in South Carolina) or in mini-refrigerators (in Minnesota). Field research staff collected the samples daily, monitored compliance, logged each urine sample in a computer database, and created 24-hr composite urine samples with amounts proportional to the volume of each individual urine sample. Three composite samples (one 200-mL sample and two 100-mL samples) were frozen and shipped to a central repos-

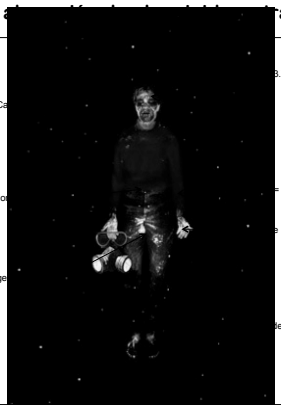
El día de fumigación con glifosato

60% trabajadores residuos en orina

4% de las esposas de los trabajadores

SERTOX

Tasa de a avés de la piel



8.7

Ca

Abdo = 1

s las manos = 1.3

Área ge

del pie / tobillos = 1.6

SERTOX

Dado que este herbicida se utiliza masivamente en la producción mundial de alimentos …

Medizinisches Labor Bremen

Gemeinschaftspraxis für Laboratoriumsmedizin, Mikrobiologie und Infektionsepidemiologie, Biochemie Umweltmedizin

Hafenwende 12 • 28357 Bremen

Document Title	**Determination of Glyphosate residues in human urine samples from 18 European countries**
Test Compound	**Glyphosate and AMPA**

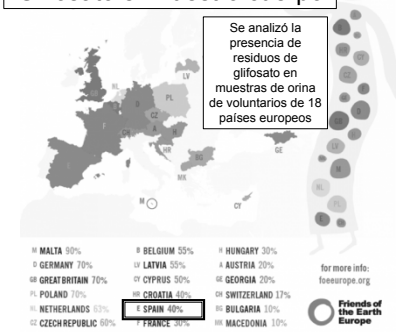
Determinación de residuos de glifosato en muestras de orina de la población general de 18 países de la UE

Marzo 2013

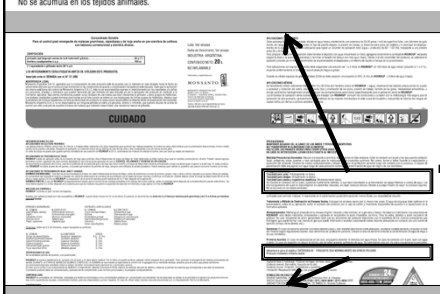
SERTOX

Glifosato en nuestro cuerpo

Se analizó la presencia de residuos de glifosato en muestras de orina de voluntarios de 18 países europeos



Riesgos Ambientales
Toxicidad para aves: Prácticamente no tóxico.
Toxicidad para abejas: Virtualmente no tóxico.
Toxicidad para peces y organismos acuáticos: Moderadamente tóxico.
Se inactiva en contacto con el suelo, quedando fuertemente retenido, lo que hace improbable la contaminación de napas freáticas o cursos de agua. Los microorganismos del suelo lo descomponen en elementos naturales, sin dejar residuos tóxicos. Debido a su baja Presión de vapor no produce vapores. No se acumula en los tejidos animales.



Hasta 1996 MONSANTO publicitaba el glifosato como "Amigo del medioambiente"

Advertencia para el médico: CATEGORIA IV - PRODUCTO QUE NORMALMENTE NO OFRECE PELIGRO
Producto moderado irritante ocular.

SERTOX

Chemosphere, noviembre 2013

Chemosphere. 2013 Nov;93(8):1969-73. doi: 10.1016/j.chemosphere.2013.08.041. Epub 2013 Jul 9.

Environmental fate of glyphosate and aminomethylphosphonic acid in surface waters and soil of agricultural basins.

Aparicio VC, De Gerónimo E, Marino D, Primost J, Carriquiriborde P, Costa JL.

Instituto Nacional de Tecnología Agropecuaria (INTA), Estación Experimental Agropecuaria Balcarce, Route 226 Km 73.5, CP (7620) Balcarce, Buenos Aires, Argentina. Electronic address: vaparicio@balcarce.inta.gov.ar.

Abstract

Argentinian agricultural production is fundamentally based on a technological package that combines no-till and glyphosate in the cultivation of transgenic crops. Transgenic crops (soybean, maize and cotton) occupy 23million hectares. This means that glyphosate is the most employed herbicide in the country, where 180-200million liters are applied every year. The aim of this work is to study the environmental fate of glyphosate and its major degradation product, aminomethylphosphonic acid (AMPA), in surface water and soil of agricultural basins. Sixteen agricultural sites and forty-four streams in the agricultural basins were sampled three times during 2012. The samples were analyzed by UPLC-MS/MS ESI(+). In cultivated soils, glyphosate was detected in concentrations between 35 and 1502(µg/kg(-1), while AMPA concentration ranged from 299 to 2256(µg/kg(-1). In the surface water studied, the presence of glyphosate and AMPA was detected in about 15% and 12% of the samples analyzed, respectively. In suspended particulate matter, glyphosate was found in 67% while AMPA was present in 20% of the samples. In streams sediment glyphosate and AMPA were also detected in 66% and 86.5% of the samples respectively. This study is, to our knowledge, the first dealing with glyphosate fate in agricultural soils in Argentina. In the present study, it was demonstrated that glyphosate and AMPA are present in soils under agricultural activity. It was also found that in stream samples the presence of glyphosate and AMPA is relatively more frequent in suspended particulate matter and sediment than in water.

KEYWORDS: AMPA, Glyphosate, Sediment, Soil, Surface water

El glifosato fue detectado en todas las muestras de suelo agrícola, en mas del 70% de los sedimentos de acuíferos y en el 15% de las aguas superficiales

SERTOX

news > world

Monsanto Calls Glyphosate 'Safe' After AP Report

by THE ASSOCIATED PRESS

October 22, 2013 8:53 PM

BUENOS AIRES, Argentina (AP) — Monsanto Co. is calling for more controls on agrochemicals, including its Roundup line of glyphosate-based weed-killers, in

Attorney General of the State of New York.
Consumer Frauds and Protection Bureau.
Environmental Protection Bureau.
1996.

industrial agriculture and rising rates of cancer and birth defects in rural communities, and they're calling for broader, longer-term studies to rule out agrochemical exposure as a cause of these and other illnesses.

Asked for Monsanto's position on this, company spokesman Thomas Helscher told the AP in an email Tuesday that "the absence of reliable data makes it very difficult to establish trends in disease incidence and even more difficult to establish causal relationships. To our knowledge there are no established causal relationships."

Earlier, Monsanto criticized the AP report as "overbroad in indicting all 'pesticides' when we know that glyphosate is safe."

La fiscalía general del estado de Nueva York consiguió una condena de 250.000 $ a Monsanto por decir que el glifosato es seguro

SERTOX

DEFINICIÓN DE PLAGUICIDA

Sustancia química capaz de acabar con alguna forma de vida

***US EPA*: cualquier sustancia o mezcla de sustancias diseñada para prevenir, destruir o mitigar una peste (plaga)**

TODO PLAGUICIDA ES TÓXICO POR DEFINICIÓN: NO PUEDEN EXISTIR PLAGUICIDAS "INOCUOS"

SERTOX

elEconomista.es | Bolsa, mercados y cotizaciones

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ÚLTIMA HORA: Al menos 44 muertos al estrellarse un avión de pasajeros en la ciudad rusa de Kazán (17:12)

Destacamos: El dilema de Ancelotti: ¿mantener el castigo a Isco o darle la alternativa?

RSC.- La Justicia francesa condena a la compañía Monsanto a pagar 15.000 euros de multa por "publicidad engañosa"

Tweet 0 | Me gusta 0 | g+1 0 | Share | Menéame

12/02/2007 - 10:17

Puntúa la noticia: Nota de los usuarios: 5.0 (1votos)

Monsanto Francia mantiene que el glifosato es biodegradable "ya que se transforma en productos naturales en el suelo en pocas semanas"

MADRID, 12 (EUROPA PRESS)

Un tribunal francés de la ciudad de Lyon ha declarado culpable a la multinacional Monsanto en un delito de "publicidad engañosa", en relación con el herbicida 'Roundup Ready', que la compañía califica como "totalmente biodegradable". Monsanto deberá pagar una

Enlaces relacionados

G.Vasco multa con 96.000 euros a 8 aerolíneas por publicidad engañosa precios (29/01)

Una sentencia declara nulo un préstamo bancario por publicidad engañosa (19/01)

Economía/Finanzas.- Declaran nulo un contrato de préstamo suscrito con una entidad bancaria por publicidad engañosa (19/01)

Audiencia confirma publicidad engañosa Bankinter incurre en "medias verdades" (13/12)

FACUA denuncia a Vodafone por publicidad engañosa tarifa 60 por! (02/11)

El Flash del mercado — Sabadell

Niño Becerra: "El único empleo que aumentará será el contrato temporal a tiempo parcial"

Navarro consigue imponerse al sector crítico del PSC sobre la consulta soberanista

Djokovic bate a Berdych y lleva el desenlace de la Copa Davis hasta el quinto partido

Ver todos | Nuevas fichas empresas

SERTOX

Un tribunal brasileño condena a Monsanto por publicidad engañosa

Publicado: 24 ago 2012 | 15:57 GMT Última actualización: 24 ago 2012 | 16:50 GMT

532 | 127 | 0 | 90 | 90 | 76

AFP/SCOTT OLSON

Un tribunal brasileño condenó a la multinacional estadounidense de agroquímicos Monsanto a pagar 500.000 reales (unos 250.000 dólares) de multa por una publicidad engañosa sobre soja transgénica.

En 2004, la compañía publicó un anuncio de publicidad de semillas modificadas genéticamente, cuando todavía estaban prohibidas en Brasil. En el anuncio se afirmaba que el uso de estas semillas era beneficioso para el medio ambiente, aunque "sus pretendidos beneficios son muy cuestionados para la comunidad científica", señaló el juez instructor del caso, Jorge Antonio Maurique.

El fallo todavía puede ser apelado, pero si es ratificado, la multinacional deberá pagar al Estado brasileño 250.000 dólares de indemnización y difundir información sobre los efectos negativos de los herbicidas que se usan para producir soja con modificaciones genéticas.

SERTOX

¿Por qué condenas por "publicidad engañosa"?

Porque el glifosato es más tóxico de lo declarado …

… Al menos para el medioambiente

Disminución generalizada de las poblaciones de anfibios en las zonas de gran uso de glifosato

Multitud de trabajos recogen la toxicidad sobre los peces (mutaciones, viabilidad de los huevos, alteraciones hepáticas)

Alta toxicidad sobre organismos invertebrados acuáticos y terrestres

SERTOX

Disruptor endocrino

Biomphalaria alexandrina

Toxicol Ind Health. 2013 Nov 8. [Epub ahead of print]

The endocrine disrupter effect of atrazine and glyphosate on Biomphalaria alexandrina snails.

Omran NE, Salama WM.

Zoology Department, Faculty of Science, Tanta University, Tanta, Egypt.

Abstract

Atrazine (AZ) and glyphosate (GL) are herbicides that are widely applied to cereal crops in Egypt. The present study was designed to investigate the response of the snail Biomphalaria alexandrina (Mollusca: Gastropoda) as a bioindicator for endocrine disrupters in terms of steroid levels (testosterone (T) and 17β-estradiol (E)), alteration of microsomal CYP4501B1-like immunoreactivity, total protein (TP) level, and gonadal structure after exposure to sublethal concentrations of AZ or GL for 3 weeks. In order to study the ability of the snails' recuperation, the exposed snails were subjected to a recovery period for 2 weeks. The results showed that the level of T, E, and TP contents were significantly decreased ($p \leq 0.05$) in both AZ- and GL-exposed groups compared with control (unexposed) group. The level of microsomal CYP4501B1-like immunoreactivity increased significantly ($p \leq 0.05$) in GL- and AZ-exposed snails and reach nearly a 50% increase in AZ-exposed group. Histological investigation of the ovotestis showed that AZ and GL caused degenerative changes including azoospermia and oocytes deformation. Interestingly, all the recovered groups did not return back to their normal state. It can be concluded that both herbicides are endocrine disrupters and cause cellular toxicity indicated by the decrease of protein content and the increase in CYP4501B1-like immunoreactivity. This toxicity is irreversible and the snail is not able to recover its normal state. The fluctuation of CYP4501B1 suggests that this vertebrate-like enzyme may be functional also in the snail and may be used as a biomarker for insecticide toxicity.

La exposición a glifosato disminuye significativamente y de forma irreversible los niveles de Estradiol y Testosterona en estos moluscos

SERTOX

Elimina bacterias fijadoras de nitrógeno del suelo

Arch Microbiol (2013) 195:485–495
DOI 10.1007/s00203-013-0919-1

ORIGINAL PAPER

The effects of pesticides on bacterial nitrogen fixers in peanut-growing area

Jorge Angelini · Gilda Silvina · Tania Taurian · Fernando Ibáñez · Maria Laura Tonelli · Lucía Valetti · María Soledad Anzuay · Liliana Ludueña · Vanina Muñoz · Adriana Fabra

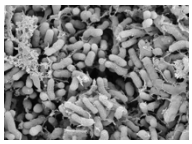
Received: 4 April 2013 / Revised: 1 August 2013 / Accepted: 6 August 2013 / Published online: 21 August 2013

Abstract In the peanut production, the applications of herbicides and fungicides are a common practice. In this work, studies done under field conditions demonstrated that pesticides affected negatively the number and nitrogenase activity of diazotrophic populations of soil. Agrochemical effects were not transient, since these parameters were not recovered to pre-treatment levels even 1 year after pesticides application. Results obtained from greenhouse experiments revealed that the addition of herbicide or fungicides diminished the free-living diazotrophs number reaching levels found in soil amended with the pesticides and that the number of symbiotic diazotrophs was not affected by the insecticide assayed. The soil nitrogenase activity was not affected by fungicides and glyphosate. The effect of pesticides on the nitrogen-fixing bacteria diversity was evaluated both in field and greenhouse experiments. Analysis of clone libraries generated from the amplification of soil nifH gene showed a diminution in the genetic diversity of this bacterial community.

Keywords Peanut · Pesticides · Soil diazotrophs · nifH

Introduction

Many kinds of pesticides, including insecticides, fungicides, herbicides and other pesticides are of fundamental importance in agricultural production. Continual widespread use and release of such synthetic chemicals has become an everyday occurrence, resulting in environmental pollution. It has been estimated that only 0.1 % of applied pesticides reaches the target pests and the remaining 99.9 % accumulates in soils and affects directly or indirectly the microbial density and enzyme activities (Pimentel 1995; Das and Debnath 2006; Singh and Singh 2005; Pal et al. 2006). Microorganisms are fundamental components of soil ecosystem as they degrade soil organic matter and sustain biogeochemical transformations of elements (Lin et al. 2007). As they respond rapidly to any changes in soil composition, soil microbial communities are regarded as bioindicators and used for the assessment of soil quality and for the prediction of soil degradation (Griffiths and Bohlen 1999). Moreover, it has been recently recognized that they play an evolutionary role in maintaining a gene pool from which new genotypes probably emerge in response to selective pressures resulting from changes in soil management (Fuhlbergue et al. 1995). Therefore, if an evolution toward sustainable agriculture is desirable, it is needed to consider the potential harmful side effects



SERTOX

¿Peligroso para las abejas?

Inicio

Un apicultor tinerfeño denuncia que el uso indiscriminado de herbicidas por parte del servicio de mantenimiento de las carreteras del Cabildo tinerfeño ha acabado con miles de sus abejas

viernes, 22 de julio de 2011

Advierte que no hace mucho tiempo encontró a una mujer que estaba recogiendo hinojo para infusiones cuando ese mismo día habían fumigado con herbicida la zona

Audio de la entrevista

SB-Noticias.- José Manuel Gil Marichal, apicultor tinerfeño de El Rosario, analizó en el programa La Trapera de Radio San Borondón la problemática del uso de venenos en Tenerife y las graves consecuencias que conlleva su utilización de forma indiscriminada y explica que ha perdido hasta una docena de colmenas cercanas a la carretera por culpa de la fumigación indiscriminada de herbicidas, motivo por el cual ha denunciado la situación ante las autoridades, las cuales le han indicado que la casa de la miel tiene que constatar que las muertes de las abejas se han producido por culpa del envenenamiento, dicho lo cual asegura que al ser una institución dependiente igualmente del Cabildo este asunto se ha quedado en el olvido.

Riesgos Ambientales
Toxicidad para aves: Relativamente no tóxico.
Toxicidad para abejas: Virtualmente no tóxico.
Toxicidad para peces y organismos acuáticos: Moderadamente tóxico.
Se inactiva en contacto con el suelo, quedando fuertemente retenido, lo que hace improbable la contaminación de napas freáticas o cursos de agua. Los microorganismos del suelo lo descomponen en elementos naturales, sin dejar residuos tóxicos. Debido a su baja Presión de vapor no produce vapores. No se acumula en los tejidos animales.

¿Qué quiere decir "Virtualmente"?

SERTOX

Bacterias, moluscos, peces, ranas, abejas… ¿Sólo?

Andrés E. Carrasco
Laboratorio Embriología Molecular
Universidad de Buenos Aires

Lleva años denunciando la existencia de una tasa extraordinariamente elevada de malformaciones en el norte de Argentina y Brasil

1586 *Chem. Res. Toxicol.* **2010,** *23,* 1586–1595

Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling

Alejandra Paganelli, Victoria Gnazzo, Helena Acosta, Silvia L. López, and Andrés E. Carrasco*

Laboratorio de Embriología Molecular, CONICET-UBA, Facultad de Medicina, Universidad de Buenos Aires, Paraguay 2155, 1° piso (1121), Ciudad Autónoma de Buenos Aires, Argentina

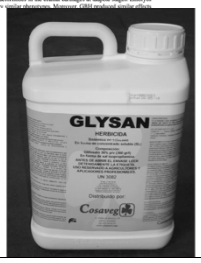
Received May 20, 2010

The broad spectrum herbicide glyphosate is widely used in agriculture worldwide. There has been ongoing controversy regarding the possible adverse effects of glyphosate on the environment and on human health. Reports of neural defects and craniofacial malformations from regions where glyphosate-based herbicides (GBH) are used led us to undertake an embryological approach to explore the effects of low doses of glyphosate in development. *Xenopus laevis* embryos were incubated with 1/5000 dilutions of a commercial GBH. The treated embryos were highly abnormal with marked alterations in cephalic and neural crest development and shortening of the anterior−posterior (A-P) axis. Alterations on neural crest markers were later correlated with deformities in the cranial cartilages at tadpole stages. Embryos injected with pure glyphosate showed very similar alterations. Moreover, GBH produced similar effects in chicken embryos, showing a gradual microcephaly. This suggests that glyp
than a surfactant or other component o
GBH treatment increased endogenous
with a RA antagonist rescued the ter
phenotypes produced by GBH are mai
This is consistent with the decrease of S
with the inhibition of cnr2 expression a
direct effect of glyphosate on early mes
about the clinical findings from humar

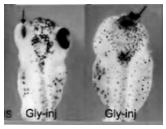
Introduction

The broad-spectrum glyphosate based herbicides (
widely used in agricultural practice, particularly in
with genetically modified organisms (GMO) engin
glyphosate resistant such as soy crops. Considering
use of GBH/GMO agriculture, studies of the possib
of GBH on environmental and human health are
important. Given the intensive use of this technologi
in South America, studies of the possible impacts o
ment and human health are absolutely necessary, req
adequate epidemiological studies. The need for
about the developmental impact of GBH is mind
variety of adverse health effects on people living in a
GBH is extensively used, particularly since there
of data regarding chronic exposure to sublethal do
embryonic development.

It is important to note that the bulk of the data provi
the evaluation stages of GBH/GMO safety were p
the industry. Given the recent history of the endocrin
field with low dose effects observed in numerous
laboratories but not in industry-funded studies (*1, 2*)
that a reasonable corpus of independent studies is n



En 2010 se ha demostrado que el glifosato produce **defectos en el desarrollo de los embriones**



SERTOX

Roundup and birth defects: Carrasco vs Monsanto

1. Letter to journal editor from Monsanto regarding Carrasco's research
2. Response to Monsanto by Carrasco

NOTE: The study that is being discussed here, by a team led by Prof Andres Carrasco, found that glyphosate and Roundup cause birth defects in frog and chicken embryos at extremely low doses. It can be accessed here:
http://www.gmwatch.eu/images/pdf/Carrasco_research_paper.pdf
…
…
1. Letter to the Editor Regarding Paganelli et al. Article
Chem. Res. Toxicol., Article ASAP
Publication Date (Web): March 21, 2011
Copyright © 2011 American Chemical Society
http://pubs.acs.org/doi/abs/10.1021/tr100412x

To the Editor: Regarding the recent article by Paganelli et al. (Chem. Res. Toxicol., 2010, 23, 1586 1595) "Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling", we write to a) confirm the high degree of confidence in the substantial toxicological data base for glyphosate, b) discuss the unsubstantiated basis provided by the authors as rationale for this published research, and c) provide context for the dosing levels evaluated by the authors with respect to human health risk assessment.

a) Multiple high quality toxicological studies and expert review panels consistently agree glyphosate is not a teratogen or reproductive toxicant. The GLP studies that Paganelli et al. infer as untrustworthy "industry-funded studies" have been exhaustively reviewed by multiple government scientific regulators, often comprised of academic expert scientists and all of which have strongly supported the conclusions put forth in those studies. Glyphosate does not cause adverse reproductive effects in adult animals or birth defects in offspring of these adults exposed to glyphosate, even at very high doses. These conclusions are based on multiple studies in laboratory animals that have been conducted to examine the potential for multigenerational and teratogenic effects. These studies have been repeated by different companies at different laboratories across the globe over the last thirty or more years, with consistent results demonstrating that glyphosate does not pose the concerns raised by the authors. Regulatory authorities and independent experts who have documented this position include WHO/FAO (1), U.S. EPA (2), the European Commission (3) and Williams et al. (4).

b) Flawed Premise: The authors provide no valid basis, other than an opinion, of an increase in the rate of birth defects in Argentina. The referenced epidemiology paper (5) implied by the authors as justification for implicating glyphosate as a chemical of concern, does not mention glyphosate or even distinguish between herbicide, insecticide, molluscicide, rodenticide or fungicide potential exposures to pregnant women. This small epidemiological study, conducted in Paraguay, investigated associations between proximity or assumed exposure to pesticide use / storage and congenital malformations in neonates. The association between "living near treated fields" (distance and pesticide types unspecified) and congenital malformations was weak, with an odds ratio about six times lower than the reported association between pesticide storage in the home and congenital malformations. There is nothing unusual about the wide variety of birth defects reported in the Paraguay study and it provides no support for the authors' allegation that they "strikingly resemble the wide spectrum phenotypes resulting from a dysfunctional RA or Shh signaling pathway".

Monsanto

Sin base sólida

Experimentos mal diseñados

Rutas de exposición irrelevantes

Dosis inapropiadamente altas

Pseudociencia …

SERTOX

Más polémica

Food Chem Toxicol. 2012 Nov;50(11):4221-31. doi: 10.1016/j.fct.2012.08.005. Epub 2012 Sep 19.

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

Séralini GE, Clair E, Mesnage R, Gress S, Defarge N, Malatesta M, Hennequin D, de Vendômois JS.

University of Caen, Institute of Biology, CRIIGEN and Risk Pole, MRSH-CNRS, EA 2608, Esplanade de la Paix, Caen Cedex 14032, France. criigen@unicaen.fr

Abstract

The health effects of a Roundup-tolerant genetically modified maize (from 11% in the diet), cultivated with or without Roundup, and Roundup alone (from 0.1 ppb in water), were studied 2 years in rats. In females, all treated groups died 2-3 times more than controls, and more rapidly. This difference was visible in 3 male groups fed GMOs. All results were hormone and sex dependent, and the pathological profiles were comparable. Females developed large mammary tumors almost always more often than and before controls, the pituitary was the second most disabled organ; the sex hormonal balance was modified by GMO and Roundup treatments. In treated males, liver congestions and necrosis were 2.5-6.5 times higher. This pathology was confirmed by optic and transmission electron microscopy. Marked and severe kidney nephropathies were also generally 1.3-2.3 greater. Males presented 4 times more large palpable tumors than controls which occurred up to 600

Gilles-Eric Seralini
Committee of Research and Independent Information on Genetic Engineering (CRIIGEN)

"Tanto el herbicida Roundup® como los organismos genéticamente modificados para tolerarlo producen cáncer"

SERTOX

¿Por qué estudios hechos con Roundup®?

Lleva surfactantes que incrementan mucho su toxicicidad

SERTOX

Toxicidad de Round-up y otros preparados comerciales

Toxicology in Vitro xxx (2012) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Toxicology in Vitro

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

Mixtures of glyphosate and surfactant TN20 accelerate cell death via mitochondrial damage-induced apoptosis and necrosis

Young-hee Kim[a], Jong-rak Hong[b], Hyo-wook Gil[a], Ho-yeon Song[b], Sae-yong Hong[b,*]

[a] Department of Immunology, College of Medicine, Inje University, Busan, Republic of Korea
[b] Department of Internal Medicine, College of Medicine, Inje University, Busan, Republic of Korea

ARTICLE INFO — ABSTRACT

Glyphosate, a common herbicide, is not toxic under normal exposure circumstances. However, this chemical, when combined with a surfactant, is cytotoxic. In this study, the mechanism of the additive

Las mezclas de glifosato y surfactante TN20 aceleran la muerte celular por apoptosis inducida por daño mitocondrial y por necrosis

Toxicology in vitro, 2012

Toxicology xxx (2012) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Toxicology

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

Ethoxylated adjuvants of glyphosate-based herbicides are active principles of human cell toxicity

R. Mesnage[a,b], B. Bernay[c], G.-É. Séralini[a,b,*]

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[b] CRIIGEN, 40 rue de Malte-pas, 75000 Paris, France
[c] Proteogen, SFR 146 IFRB, University of Caen, France

ARTICLE INFO — ABSTRACT

Pesticides are always used in formulations as mixtures of an active principle with adjuvants. Glyphosate, the active ingredient of the major pesticide in the world, is an herbicide supposed to be specific on

Los adyuvantes etoxilados de las formulaciones herbicidas a base de glifosato producen toxicidad en células humanas

Toxicology, 2012

Display Settings: Abstract — Send to:

Food Chem Toxicol. 2012 Nov;50(11):4221-31. doi: 10.1016/j.fct.2012.08.005. Epub 2012 Sep 19.

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

Séralini GE, Clair E, Mesnage R, Gress S, Defarge N, Malatesta M, Hennequin D, de Vendômois JS.

University of Caen, Institute of Biology, CRIIGEN and Risk Pole, MRSH-CNRS, EA 2608, Esplanade de la Paix, Caen Cedex 14032, France. criigen@unicaen.fr

Abstract

The health effects of a Roundup-tolerant genetically modified maize (from 11% in the diet), cultivated with or without Roundup, and Roundup alone (from 0.1 ppb in water), were studied 2 years in rats. In females, all treated groups died 2-3 times more than controls, and more rapidly. This difference was visible in 3 male groups fed GMOs. All results were hormone and sex dependent, and the pathological profiles were comparable. Females developed large mammary tumors almost always more often than and before controls, the pituitary was the second most disabled organ; the sex hormonal balance was modified by GMO and Roundup treatments. In treated males, liver congestions and necrosis were 2.5-6.5 times higher. This pathology was confirmed by optic and transmission electron microscopy. Marked and severe kidney nephropathies were also generally 1.3-2.3 greater. Males presented 4 times more large palpable tumors than controls which occurred up to 600 days earlier. Biochemistry data confirmed very significant kidney chronic deficiencies; for all treatments and both sexes, 76% of the altered parameters were kidney related. These results can be explained by the non linear endocrine-disrupting effects of Roundup, but also by the overexpression of the transgene in the GMO and its metabolic consequences.

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Comment in

We request a serious reconsideration of the recent paper by Seralini et al. alleging tumorigenesis in rats resulting from consumption of corn derived from crops improved through biotechnology (Séralini et al., 2012). [Food Chem Toxicol. 2013]
Comment on "Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize." Séralini et al. [Food Chem Toxicol. 2013]
Problems lie at several levels and bring into serious question the quality and standard of your journal. [Food Chem Toxicol. 2013]
Comments on "Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize." Séralini et al. [Food Chem Toxicol. 2013]
Science requires the dispassionate presentation of information. [Food Chem. Toxicol. 2013]
Re: Séralini, G.-E., et al. Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. Food Chem. Toxicol. 2012). [Food Chem Toxicol. 2013]
A comment on "Séralini, G.-E., et al. Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. Food Chem. Toxicol. 2012). [Food Chem Toxicol. 2013]
Response to Comment on "Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize." Séralini et al. [Food Chem Toxicol. 2013]
The SFPT feels that the paper by Séralini et al. (2012) is not a long term toxicity study. [Food Chem Toxicol. 2013]
Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. [Food Chem Toxicol. 2013]
Food and chemical toxicology should not publish such poor work. [Food Chem Toxicol. 2013]
Letter to the editor: Comment on "Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize." Séralini et al. [Food Chem Toxicol. 2013]
Adverse effects in rats fed a Roundup-tolerant genetically modified maize. [Food Chem Toxicol. 2013]
Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. [Food Chem Toxicol. 2013]
It does not become a scientific study such as Food and Chemical Toxicology to publish such poor work. [Food Chem Toxicol. 2013]
Serious inadequacies in the pathology data presented in the paper by Séralini et al. (2012). [Food Chem Toxicol. 2013]
My comments about the paper do not adequately describe the serious failures that have occurred in the peer review process at FCT. [Food Chem Toxicol. 2013]
Toxicity of Roundup-tolerant genetically modified maize is not supported by statistical tests. [Food Chem Toxicol. 2013]
Answers to critics: Why there is a long term toxicity due to a Roundup-tolerant genetically modified maize and to a Roundup herbicide. [Food Chem Toxicol. 2013]

Mas de 20 contestaciones desde noviembre 2012

Mucha más polémica:

- **"La ciencia requiere una presentación desapasionada de la información"**
- **"La revista debe revisar su proceso de revisión de los artículos"**
- **"Pedimos una seria reconsideración de la publicación de este artículo"**
- **"No soportado por tests estadísticos"**
- **…**

Monsanto

Research | Article

Cancer Incidence among Glyphosate-Exposed Pesticide Applicators in the Agricultural Health Study

Aaron Blair, Jennifer A. Rusiecki, Jane A. Hoppin, Megan Sever, Mustafa Dosemeci, Dale P. Sandler, and Michael C. Alavanja

[1]Program in Epidemiology, Fred Hutchinson Cancer Research Center and the Department of Epidemiology, University of Washington, Seattle, Washington, USA; [2]Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Bethesda, Maryland, USA; [3]Epidemiology Program, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, Research Triangle Park, North Carolina, USA

Glyphosate is a broad-spectrum herbicide that is one of the most frequently applied pesticides in the world. Although there has been little consistent evidence of genotoxicity or carcinogenicity in humans, there has been some concern that it may cause cancer in humans because of its effects of glyphosate. We evaluated associations between glyphosate exposure and cancer incidence in the Agricultural Health Study (AHS), a prospective cohort study of 57,311 licensed pesticide applicators in Iowa and North Carolina. Detailed information on pesticide use and other factors was obtained from a self-administered questionnaire completed at time of enrollment (1993–1997). Among private and commercial applicators, 75.5% reported having ever used glyphosate, of which > 97% were men. In this analysis, glyphosate exposure was defined as at ever use, intensity-weighted lifetime days (IWLD), intensity-weighted lifetime days per year (IWLD/yr), "cumulative exposure days" (years of use × duration), and a intensity-weighted cumulative exposure days (years of use × duration × estimated intensity level). Poisson regression was used to estimate exposure–response relations between glyphosate and incidence of all cancers combined and 12 relatively common cancer subtypes. Glyphosate exposure was not associated with cancer incidence overall or with most of the cancer subtypes we studied. There was a suggested association with multiple myeloma incidence that should be followed up as more cases accrue in the AHS. Although glyphosate is widely used in agriculture, there is little evidence to suggest an association of long-term health effects, including how common cancers. Key words: cancer, cohort study, farming, glyphosate, pesticide. *Environ Health Perspect* 113:49–54 (2005); doi:10.1289/ehp.7540 available via *http://dx.doi.org/*[Online 8 November 2004]

Glyphosate [N-(phosphonomethyl)glycine], herbicide, is the most frequently applied pesticide in the United States and the world, ranging in use from 1 million to 10 million pounds per year (Durkin et al. 2001; El Demerdash et al. 2001; Hietanen et al. 1983; Lee et al. 1998a, 1998b; Okuzumugo et al. 1975; Tokes et al. 1998; Walsh et al. 2000; Yousef et al. 1995). Results from genotoxicity studies of glyphosate have been conflicting. Glyphosate did not show any genotoxic activity in a battery of assays (Garry et al. 1999; Grisola et al. 1997; Kier et al. 1995; Lioy et al. 1996; Mensah et al. 1997; Peluso et al. 1998; Sina et al. 1983; Vigfusdottir et al. 1997). The U.S. Environmental Protection Agency (U.S. EPA 1993) and the World Health Organization (WHO 1994) reviewed the toxicology data on glyphosate and concluded that glyphosate is not mutagenic or carcinogenic. The U.S. EPA classified glyphosate as category E, indicating "evidence of noncarcinogenicity for humans" (U.S. EPA 1993). Despite this conclusion, three recent case–control studies suggested an association between glyphosate exposure and the risk of non-Hodgkin lymphoma (NHL) (De Roos et al. 2003b; Hardell and Eriksson 1999; Hardell et al. 2002; McDuffie et al. 2001). Considering the widespread and frequent use of glyphosate in both the United States and the rest of the world, ongoing risk assessment, and the lack of long-term, site-specific cancer incidence associated with glyphosate use among pesticide applicators in the Agricultural Health Study (AHS) cohort.

Materials and Methods

Cohort enrollment and follow-up. The AHS is a prospective cohort study of farmers in Iowa and Carolina, which includes 57,311 private and commercial applicators who were licensed to apply restricted-use pesticides at the time of enrollment. Recruitment of the applicators occurred between 1993 and 1997 (Alavanja et al. 1996). Cohort members were matched to the National Death Index (NDI) to ascertain cancer incidence and mortality through 2001 (Lubin et al. 2004). NDI is a database that includes death records from all 50 states and the District of Columbia. The U.S. Environmental Protection Agency (U.S. EPA 1993) and the World Health Organization (WHO 1994) reviewed the toxicology data on glyphosate and concluded that glyphosate is not mutagenic or carcinogenic. The U.S. EPA classified glyphosate as category E, indicating "evidence

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The authors declare they have no competing financial interests.

Received 21 June 2004; accepted 3 November 2004.

Incidencia de cáncer entre los aplicadores expuestos al glifosato (Agricultural Health Study)

Environmental Health Perspectives, 2005

57.311 participantes

Aumenta la incidencia de mieloma múltiple en aplicadores

Indica que es necesario hacer más estudios de carcinogenicidad del producto

Arch Toxicol (2012) 86:803–813
DOI 10.1007/s00204-012-0804-0

GENOTOXICITY AND CARCINOGENICITY

Cytotoxic and DNA-damaging properties of glyphosate and Roundup in human-derived buccal epithelial cells

Verena J. Koller · Maria Fürhacker · Armen Nersesyan · Miroslav Mišík · Maria Eisenbauer · Siegfried Knasmueller

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© Springer-Verlag 2012

Abstract Glyphosate (G) is the largest selling herbicide worldwide; the most common formulations (Roundup, R) contain polyoxyethylenamine as main surfactant. Recent findings indicate that G exposure may cause DNA damage and cancer in humans. Aim of this investigation was to study the cytotoxic and genotoxic properties of G and R (Ultra[Max] in a buccal epithelial cell line (TR146), as workers are exposed via inhalation to the herbicide. R induced acute cytotoxic effects at concentrations >40 mg/l after 20 min, which were due to membrane damage and impairment of mitochondrial functions. With G, increased release of extracellular lactate dehydrogenase indicative for membrane damage was observed at doses >80 mg/l. Both G and R induced DNA migration in single-cell gel electrophoresis assays at doses >20 mg/l. Furthermore, an increase of nuclear aberrations that reflect DNA damage was observed. The frequencies of micronuclei and nuclear buds were elevated after 20-min exposure to 10–20 mg/l, while nucleoplasmatic bridges were only enhanced by R at the highest dose (20 mg/l). R was under all conditions more active than its active principle (G). Comparisons with results of earlier studies with lymphocytes and cells from internal organs indicate that epithelial cells are more susceptible to the cytotoxic and DNA-damaging properties of the herbicide and its formulation. Since we found genotoxic effects after short exposure to concentrations that correspond to a 450-fold dilution of spraying used in agriculture, our findings indicate that inhalation may cause DNA damage in exposed individuals.

Keywords Glyphosate · Roundup · Cytotoxic · Comet assay · Micronuclei · Buccal cells

Abbreviations

BN-MN	Binucleated cells with micronuclei
G	Glyphosate
LDHe	Extracellular lactate dehydrogenase
MN	Micronuclei
NB	Nuclear buds
NDI	Nuclear division index
NPB	Nucleoplasmatic bridge
NR	Neutral red
R	Roundup Ultramax
SRB	Sulforhodamine B
XTT	2,3-bis(2-methoxy-4-nitro-5-sulfophenyl)-5-[(phenyl-amino)carbonyl]-2H-tetrazolium hydroxide

Introduction

Glyphosate (G) is one of the most widely used herbicides worldwide; in 2007, its annual global use exceeded 907,000 tons (REUTERS 2011).

Since its solubility and ionic nature retard the penetration into plant tissues, the native compound is mixed with surfactants; one of the most widely used is polyethoxylated tallow amine (POEA), the common trade name of these formulations being Roundup (R) (Williams et al. 2000).

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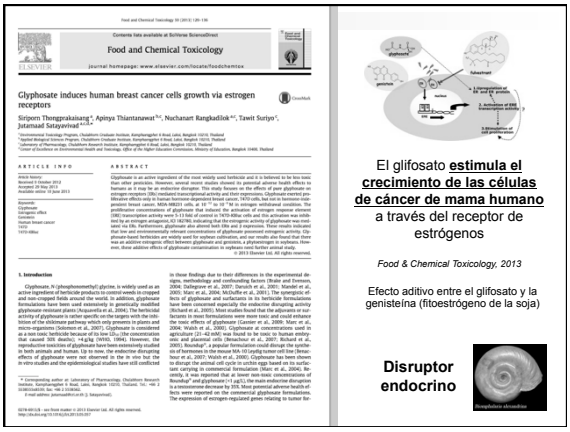
Propiedades citotóxicas y de daño al ADN del glifosato y Roundup en células del **epitelio bucal humano**

Archives of Toxicology, 2012

Encontraron efectos genotóxicos a dosis 450 veces más bajas de las que se usan en las fumigaciones

Concluyen que la inhalación del producto puede producir daño al ADN en los individuos expuestos


Food and Chemical Toxicology 50 (2012) 1201–1206

Contents lists available at SciVerse ScienceDirect

Food and Chemical Toxicology

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

Glyphosate induces human breast cancer cells growth via estrogen receptors

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ARTICLE INFO

ABSTRACT

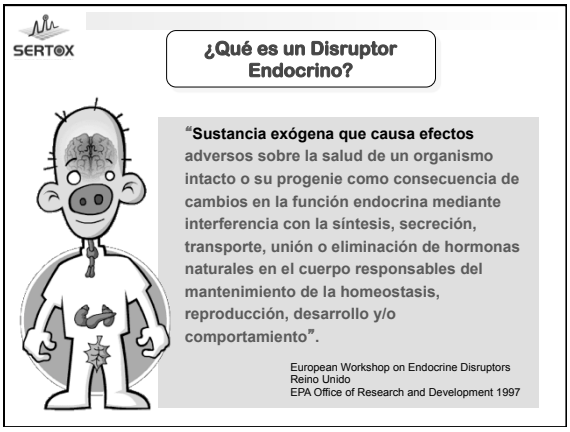
1. Introduction

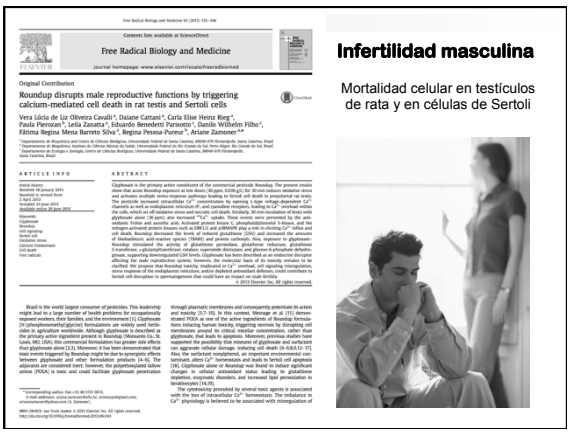
El glifosato **estimula el crecimiento de las células de cáncer de mama humano** a través del receptor de estrógenos

Food & Chemical Toxicology, 2013

Efecto aditivo entre el glifosato y la genisteína (fitoestrógeno de la soja)

Disruptor endocrino




Free Radical Biology and Medicine 66 (2013) 335–346

Contents lists available at SciVerse ScienceDirect

Free Radical Biology and Medicine

Original Contribution

Roundup disrupts male reproductive functions by triggering calcium-mediated cell death in rat testis and Sertoli cells

Vera Lúcia de Liz Oliveira Cavalli[a], Daiane Cattani[a], Carla Elise Heinz Rieg[a], Paula Pierozan[a], Leila Zanatta[a], Eduardo Benedetti Parisotto[a], Danilo Wilhelm Filho[a], Fátima Regina Mena Barreto Silva[b], Regina Pessoa-Pureur[c], Ariane Zamoner[a,*]

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[c] Departamento de Bioquímica e Biologia Celular, Centro de Ciências Biológicas, Universidade Federal de Santa Catarina, 88040-970 Florianópolis, Santa Catarina, Brazil

ARTICLE INFO

ABSTRACT

Infertilidad masculina

Mortalidad celular en testículos de rata y en células de Sertoli


Environmental Health Perspectives, 2007

CHILDREN'S HEALTH Articles

An Exploratory Analysis of the Effect of Pesticide Exposure on the Risk of Spontaneous Abortion in an Ontario Farm Population

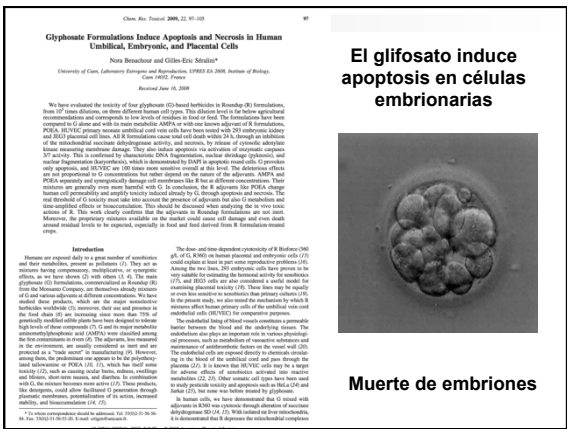
Tye E. Arbuckle, Zhiqiu Lin, and Leslie S. Mery

Aumentan el riesgo de **aborto espontáneo**:

- Tiocarbamatos
- Triazinas
- Herbicidas fenoxiacéticos
- **Glifosato***
- ….

Exposición antes de la concepción

* Autorizado en la platanera


Chem. Res. Toxicol. 2009, 22, 97–105

Glyphosate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells

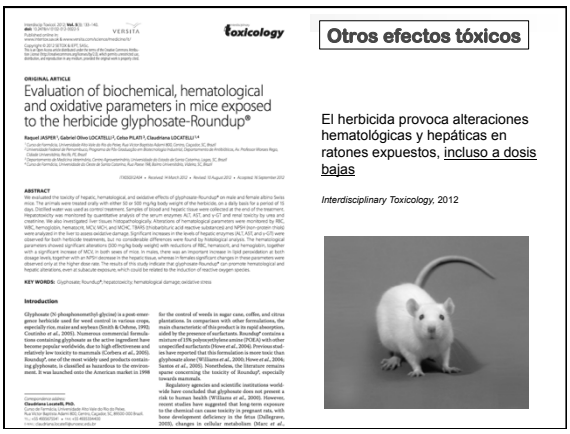
Nora Benachour and Gilles-Eric Séralini*

University of Caen, Laboratory Estrogens and Reproduction, UPRES EA 2608, Institute of Biology, Caen 14032, France

Received June 16, 2008

El glifosato induce apoptosis en células embrionarias

Muerte de embriones


toxicology

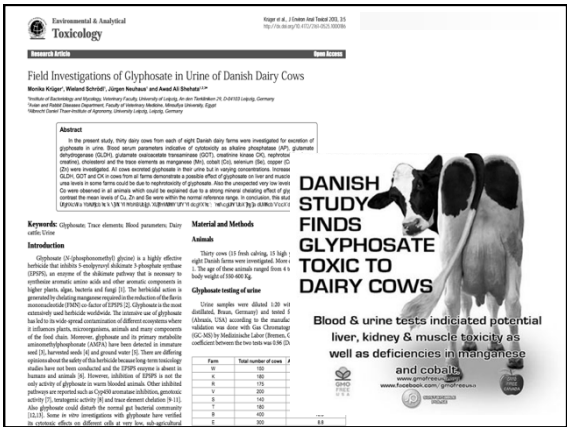
ORIGINAL ARTICLE

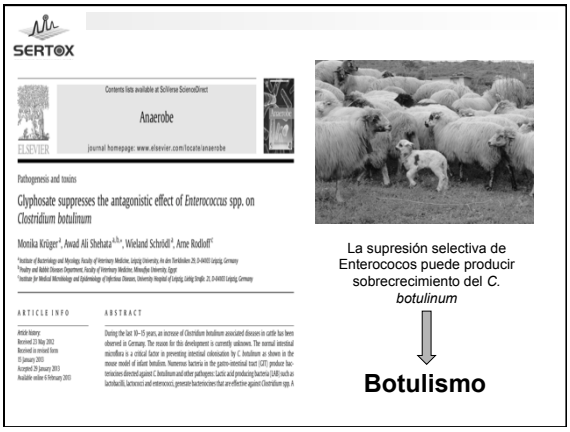
Evaluation of biochemical, hematological and oxidative parameters in mice exposed to the herbicide glyphosate-Roundup®

Otros efectos tóxicos

El herbicida provoca alteraciones hematológicas y hepáticas en ratones expuestos, incluso a dosis bajas

Interdisciplinary Toxicology, 2012





La supresión selectiva de Enterococos puede producir sobrecrecimiento del *C. botulinum*

Botulismo

Clasificación toxicológica del glifosato

SERTOX

U.S. ENVIRONMENTAL PROTECTION AGENCY

Integrated Risk Information System

Glyphosate (CASRN 1071-83-6)

- **Toxicidad general → Tipo IV:**
  - **Producto que normalmente no ofrece peligro**
- **Carcinogenicidad → Tipo D:**
  - **No evidencias de carcinogenicidad**
- **Mutagenicidad → No mutágeno**

El compuesto no se está reevaluando

_VI. Bibliography

Substance Name -- Glyphosate
CASRN -- 1071-83-6
Last Revised -- 09/01/1990

_VI.A. Oral RfD References

Monsanto Company. 1981a. RfD No. 0081674, 00103995. Available from EPA. Write to FOI, EPA, Washington, DC 20460.

Monsanto Company. 1981b. RfD No. 00093879. Available from EPA. Write to FOI, EPA, Washington, DC 20460.

Monsanto Company. 1985. RfD No. 00153374. Available from EPA. Write to FOI, EPA, Washington, DC 20460.

Monsanto Company. 1980a. RfD No. 00046362. Available from EPA. Write to FOI, EPA, Washington, DC 20460.

Monsanto Company. 1980b. RfD No. 00046363. Available from EPA. Write to FOI, EPA, Washington, DC 20460.

_VI.I. Revision History

¿La información de la compañía Monsanto es de fiar?

SERTOX

PCBs

Década de los 30

Multitud de cánceres

Memorandos internos de Monsanto documentaron los efectos tóxicos de los PCB y al mismo tiempo reiteraban la preocupación obsesiva de la compañía para "no dañar nuestra posición de ventas"

2,4,5-T

Década de los 70

Multitud de cánceres y mutaciones (dioxinas)

La toxicidad fue sistemáticamente negada por la compañía.

Existen pruebas de que la conocían

Presentaron multitud de documentos científicos falsificados

BGH

Década de los 50 (prohibida en Europa y Canadá)

22 efectos adversos conocidos (incluye cáncer)

Como muchos consumidores no quieren beber la leche en EE.UU., Monsanto recurrió a todas las estrategias legales para conseguir que se prohibiera etiquetar la leche que no usaba la hormona como libre de BGH

SERTOX

"PRINCIPIO DE PRECAUCIÓN"

"Cuando una actividad es potencialmente amenazadora para la salud humana o el medio ambiente, las medidas de precaución deberán tomarse incluso si alguna relación causa-efecto no estuviera totalmente demostrada científicamente"

SERTOX

Probablemente muchos científicos independientes seguirán trabajando en todo el mundo para aportar más evidencias científicas de la toxicidad del glifosato

¿Reevaluación?

Un lobo con piel de cordero

Muchas hierbas se han vuelto resistentes al glifosato

Glifosato → Glufosinato de sodio

¡¡Mucho más tóxico!!