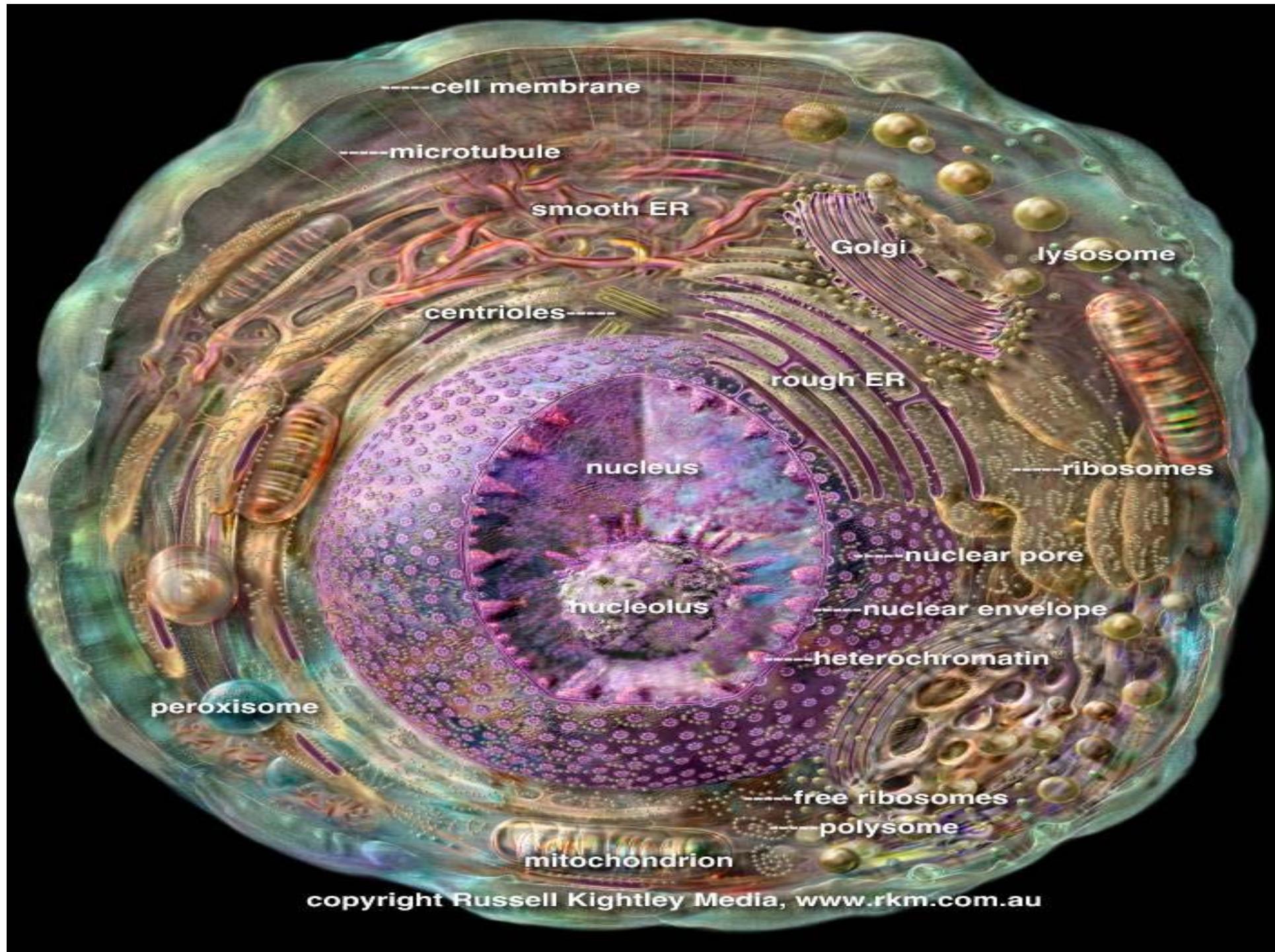




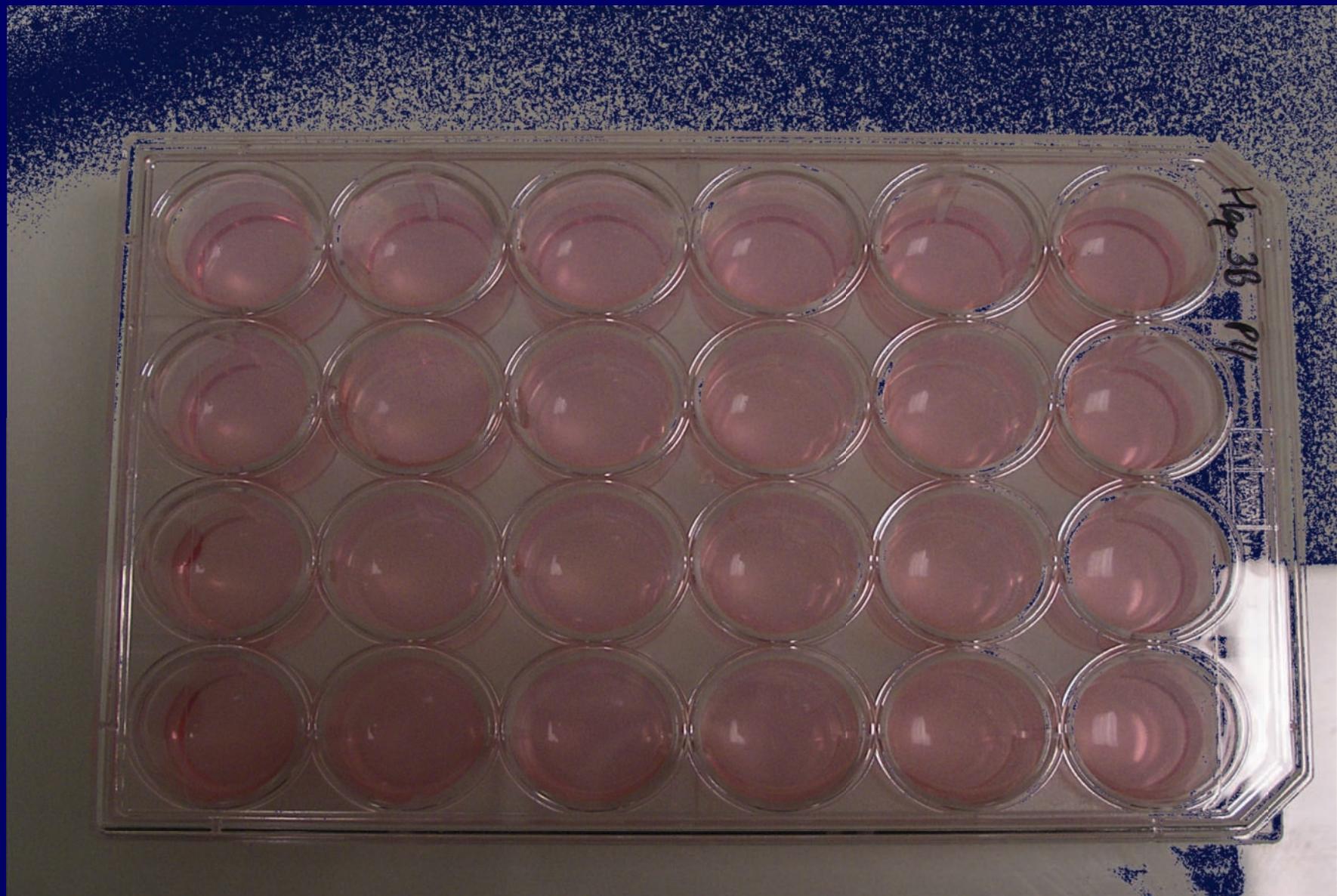
# Toxicity of Roundup on human cells

Pr Gilles-Eric SERALINI  
[www.criigen.org](http://www.criigen.org)

2010



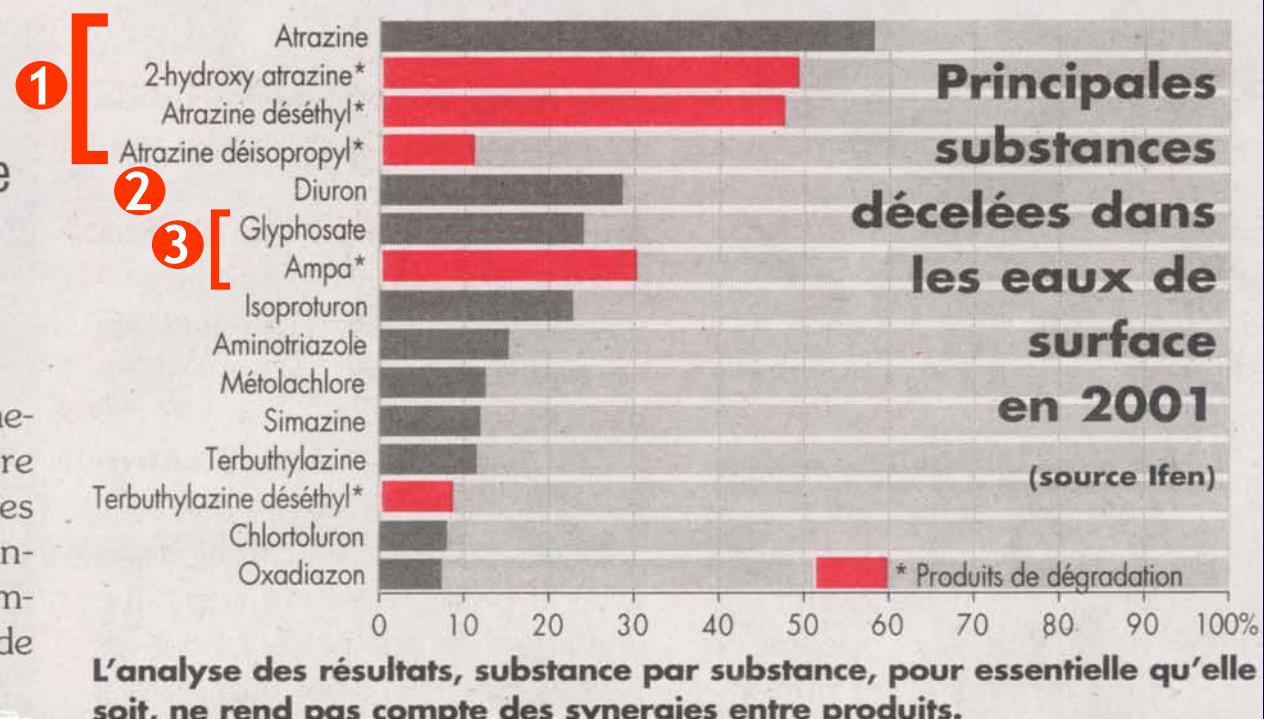
Les cellules sont transférées dans des cupules pour les traitements



# Les pesticides sont présents dans trois points de prélèvement sur quatre

Les pesticides sont plus souvent présents dans les eaux de surface (73 %) que dans les eaux souterraines (57 %).

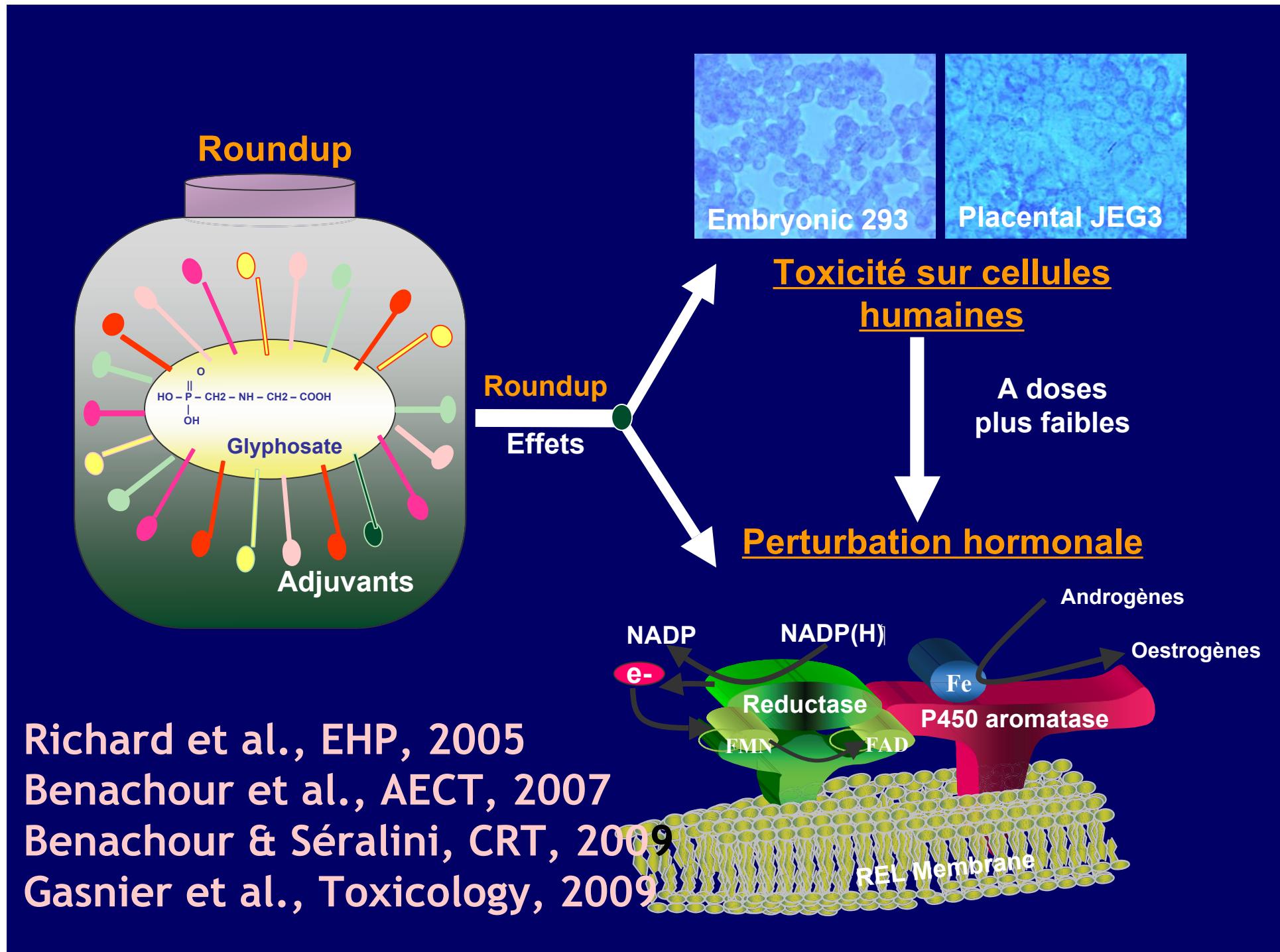
L'Institut français de l'environnement (Ifen) vient de rendre public son rapport annuel sur les pesticides dans les eaux. Le cinquième bilan, publié le 30 septembre, synthétise les informations de l'année 2001.



L'analyse des résultats, substance par substance, pour essentielle qu'elle soit, ne rend pas compte des synergies entre produits.

*Le Paysan d'Auvergne, 10 octobre 2003*

→ 2006 : Glyphosate et AMPA, 1er et 3ème polluants les plus communs



## Differential Effects of Glyphosate and Roundup on Human Placental Cells and Aromatase

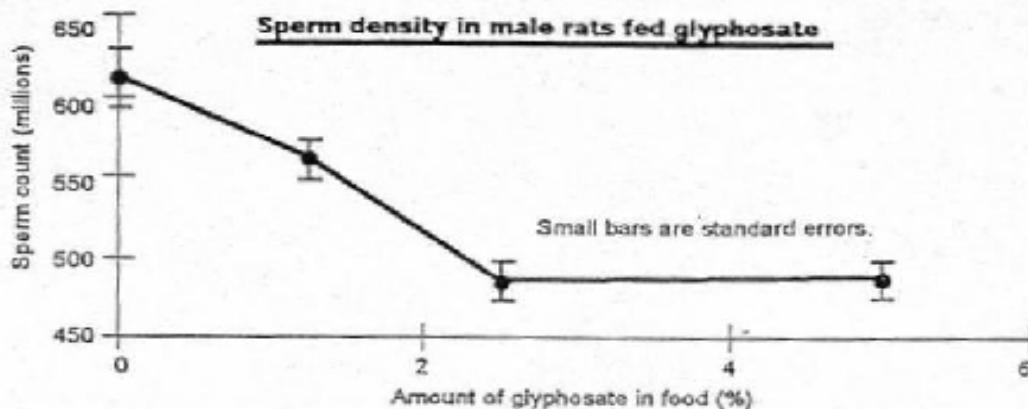
Sophie Richard, Safa Moslemi, Herbert Sipahutar, Nora Benachour, and Gilles-Eric Séralini

Laboratoire de Biochimie et Biologie Moléculaire, USC-INRA, Université de Caen, Caen, France

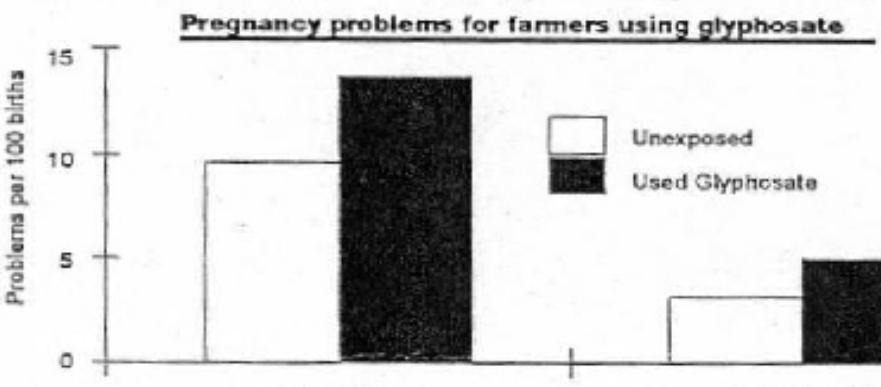
Roundup is a glyphosate-based herbicide used worldwide, including on most genetically modified plants that have been designed to tolerate it. Its residues may thus enter the food chain, and glyphosate is found as a contaminant in rivers. Some agricultural workers using glyphosate have pregnancy problems, but its mechanism of action in mammals is questioned. Here we show that glyphosate is toxic to human placental JEG3 cells within 18 hr with concentrations lower than those found with agricultural use, and this effect increases with concentration and time or in the presence of Roundup adjuvants. Surprisingly, Roundup is always more toxic than its active ingredient. We tested the effects of glyphosate and Roundup at lower nontoxic concentrations on aromatase, the enzyme responsible for estrogen synthesis. The glyphosate-based herbicide disrupts aromatase activity and mRNA levels and interacts with the active site of the purified enzyme, but the effects of glyphosate are facilitated by the Roundup formulation in microsomes or in cell cultures. We conclude that endocrine and toxic effects of Roundup, not just glyphosate, can be observed in mammals. We suspect that the mixture of Roundup adjuvants enhances glyphosate

(Saint Quentin Fallavier, France), and the pesticide Roundup (containing 360 g/L acid glyphosate; Monsanto, Herent, Belgium) was from a commercial source. A 2% solution of Roundup and an equivalent solution of glyphosate were prepared in Eagle's modified minimum essential medium (EMEM; Abey, Paris, France), and the pH of glyphosate solution was adjusted to the pH of the 2% Roundup solution (- pH 5.8). Successive dilutions were then obtained with serum-free EMEM. 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) was obtained from Sigma (St. Louis, MO, USA).

**Figure 5**  
**Effects of Glyphosate on Male Reproductive Success**



U.S. Dept. of Health and Human Services, Public Health Serv, National Inst. Health. 1992, NTP technical report on toxicity studies of glyphosate (CAS No. 1071-63-6) administered in dosed feed to F344/N rats and B6C3F1 mice. Research Triangle Park, NC: National Toxicology Program.



Savitz, D.A. et al. 1997. Male pesticide exposure and pregnancy outcome. *Am. J. Epidemiol.* 146:1025-1036.

Glyphosate exposure is associated with reproductive problems in both laboratory animals and farmers.

## Time- and Dose-Dependent Effects of Roundup on Human Embryonic and Placental Cells

N. Benachour,<sup>1</sup> H. Sipahutar,<sup>2</sup> S. Modemi,<sup>3</sup> C. Gasnier,<sup>1</sup> C. Travert,<sup>1</sup> G. E. Séralini<sup>1</sup>

<sup>1</sup> Laboratoire Estrogènes et Reproduction, USC-INRA, IBFA, Université de Caen, Caen, France

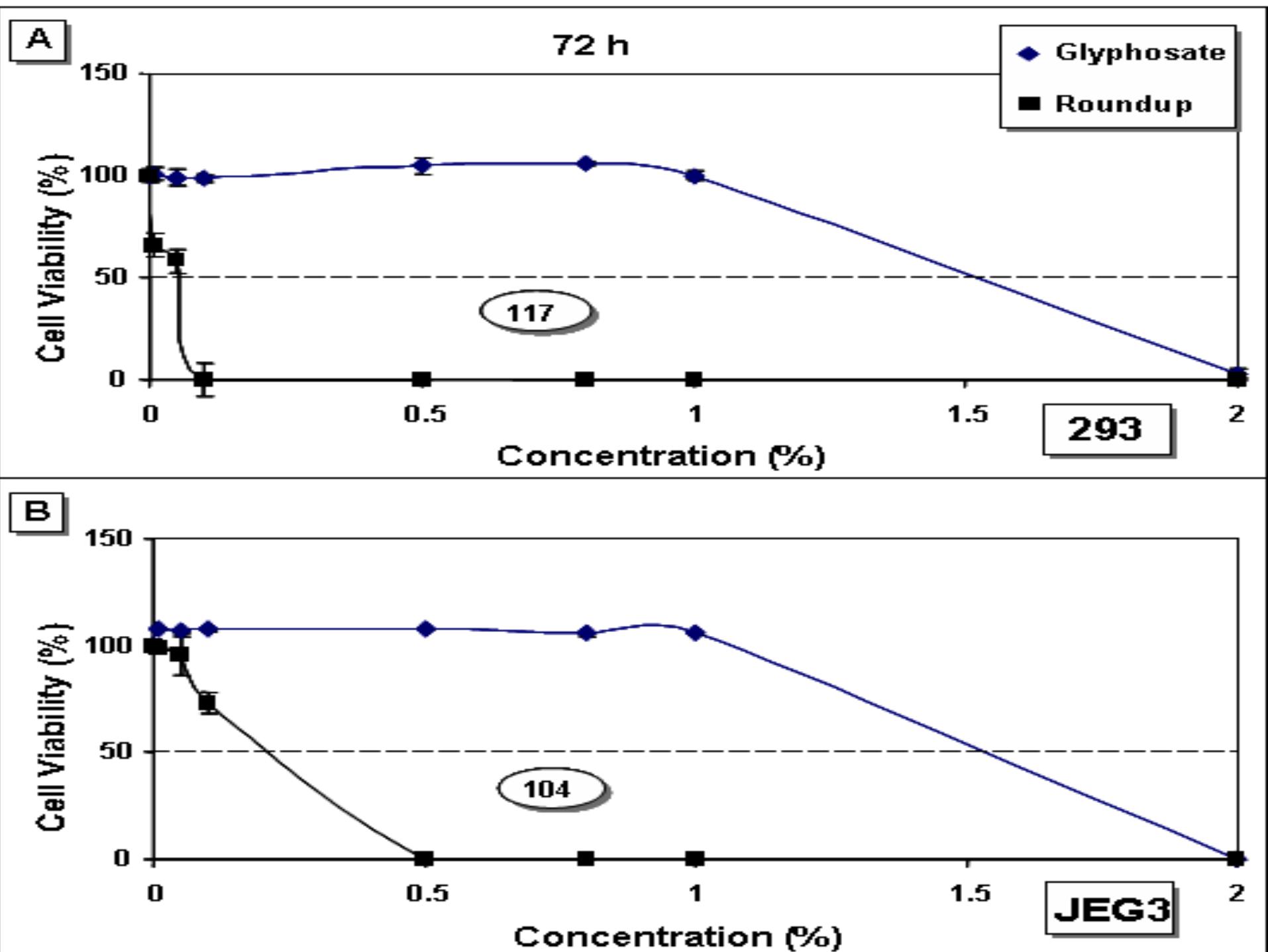
<sup>2</sup> Department of Biology, State University of Medan, Medan, Indonesia

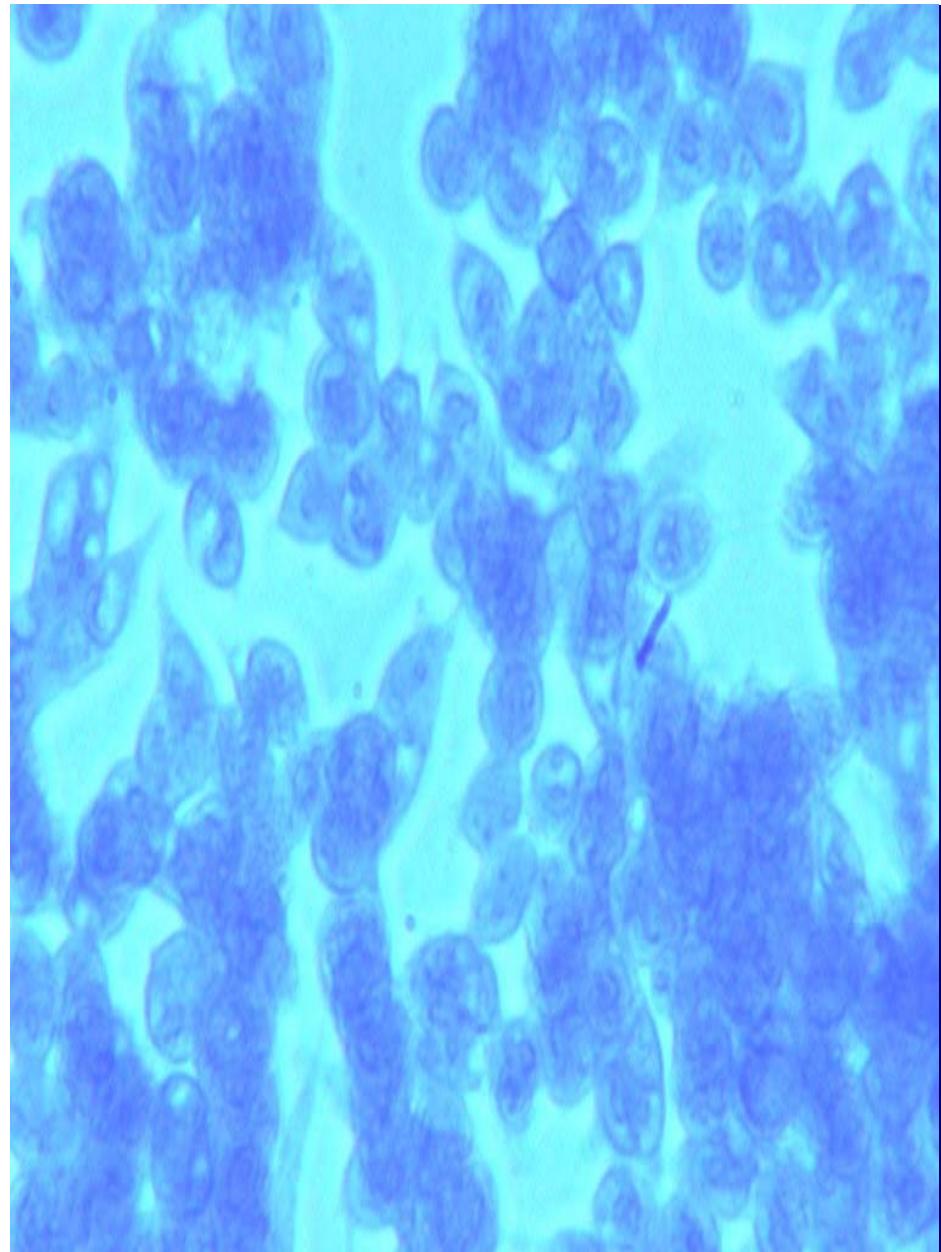
<sup>3</sup> Laboratoire de Biochimie du Tissu Conjonctif, EA3214, CHU Côte de Nacre, Caen, France

Received: 25 July 2006/Accepted: 20 November 2006

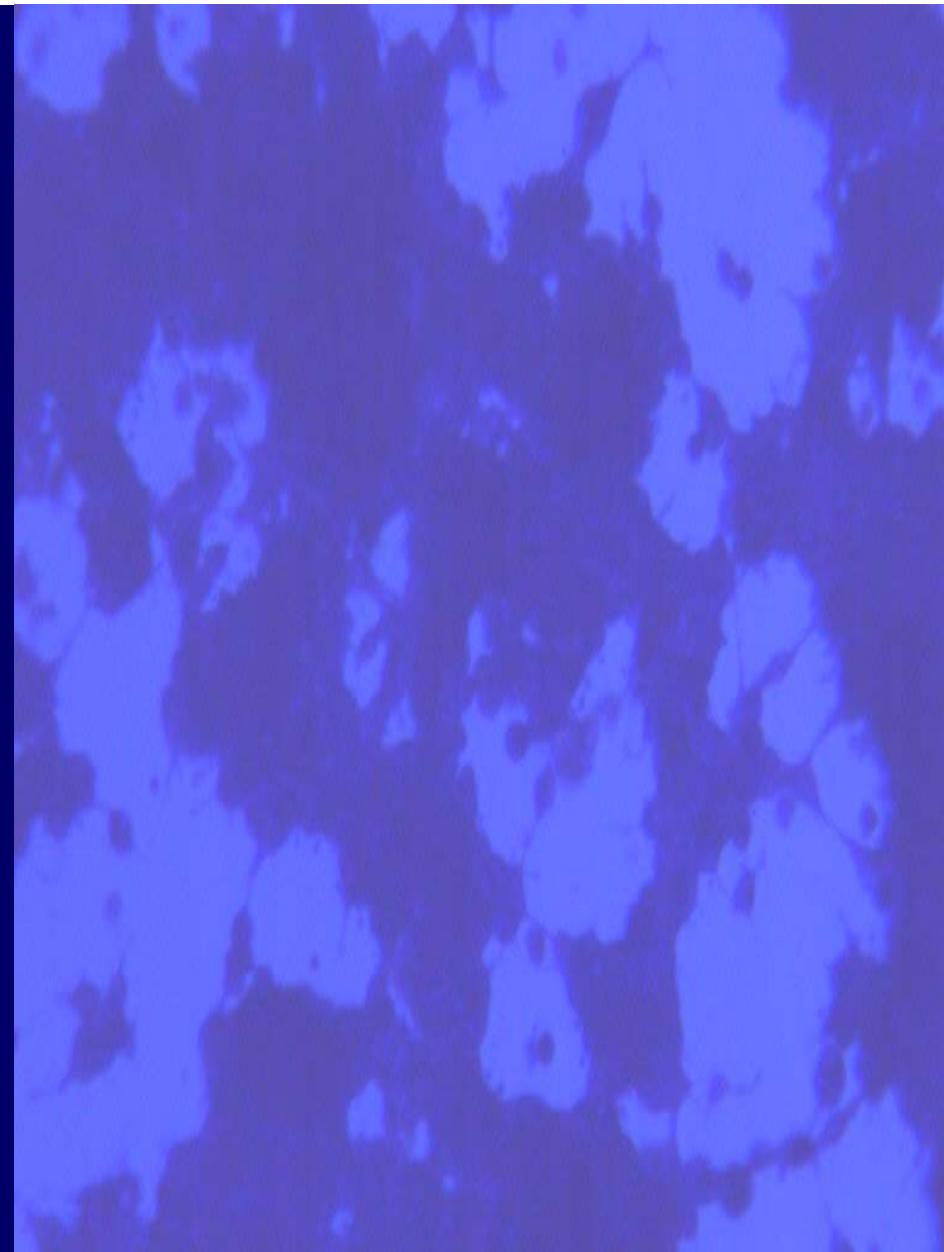
**Abstract.** Roundup® is the major herbicide used worldwide, in particular on genetically modified plants that have been designed to tolerate it. We have tested the toxicity and

Mammals and humans may be exposed to Roundup herbicide residues by agricultural practices (Acquavella *et al.* 2004) or when the residues enter the food chain (Takahashi *et al.* 2001);





**Cellules embryonnaires humaines 293 normales**



**Cellules embryonnaires humaines 293 traitées au Roundup (0,05%) 24h**

*Soja transgénique tolérant un herbicide  
d'après 'Ces OGM qui changent le monde' de G.E. Séralini,  
Ed. Flammarion, coll. «Champs»*

## Aux champs :

- **herbicide total (+)**
  - **autres (-)**
- à court terme**

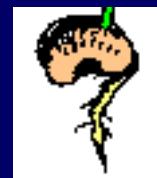
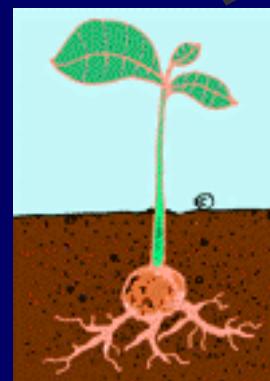


## Dans la plante

ou la graine :

**herbicide total**

**et ses dérivés (+)(+)**

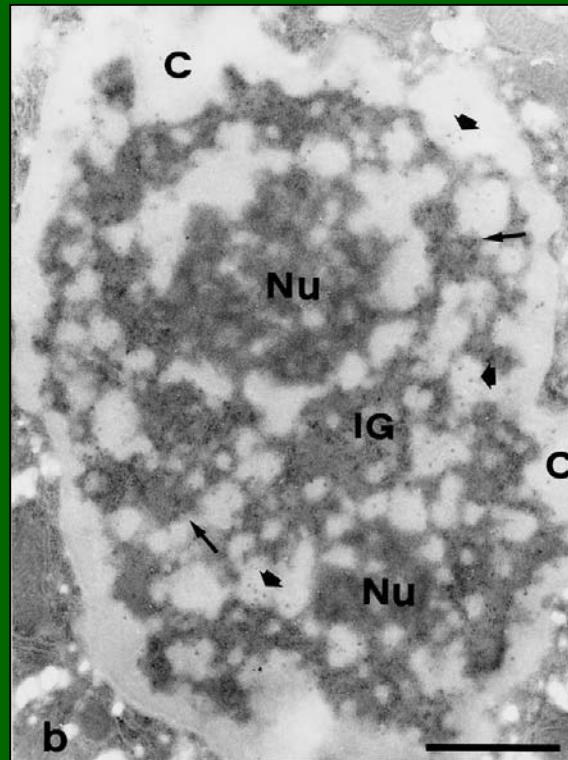
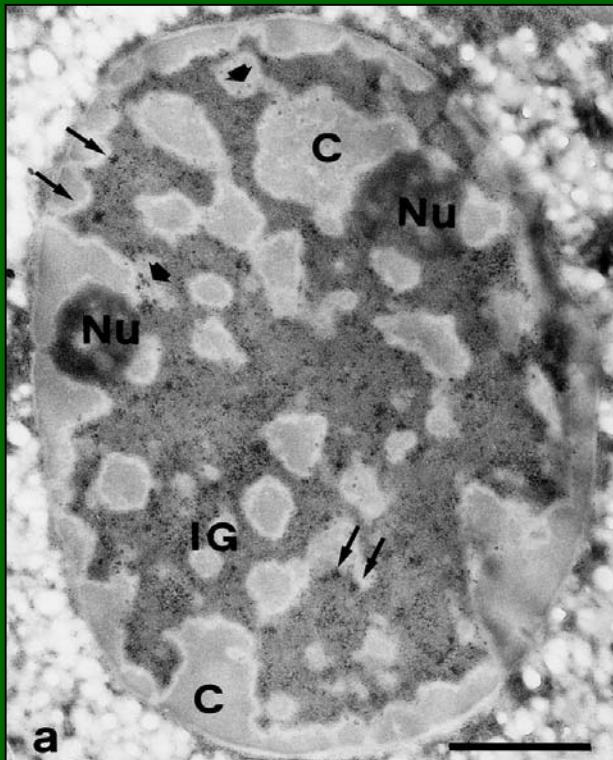


**graine**

► **Possibilité d'accumulation des dérivés de l'herbicide total par tolérance** ◀

# les OGM sont-ils sans risque pour la santé ?

- constat : ils ne sont pas sans effet sur les cellules...

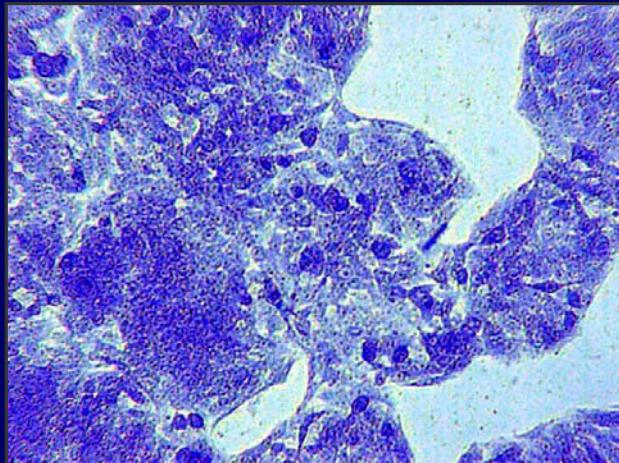


les noyaux des hépatocytes des souris nourries avec soja GM (b)  
montrent une forme plus irrégulière par rapport à celle des souris alimentées avec soja naturel (a)

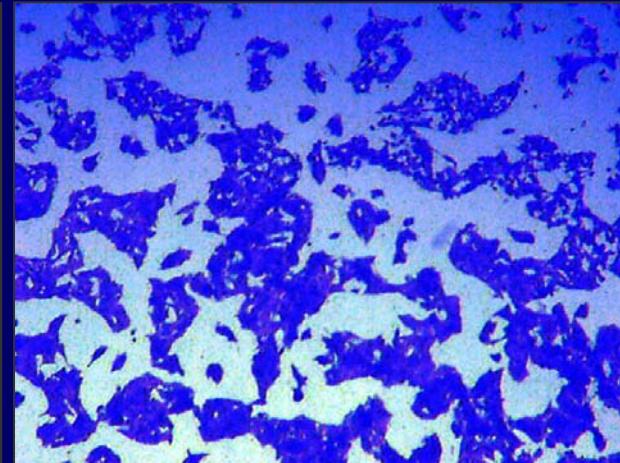
Echelle 1 µm - Malatesta et al., *Cell Struct. Funct.*, 2002

### Human hepatocytes HepG2

Before Roundup



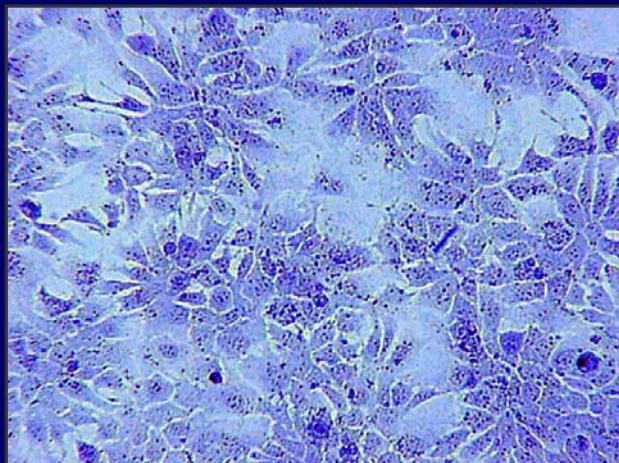
After 0.8% Roundup during 24H



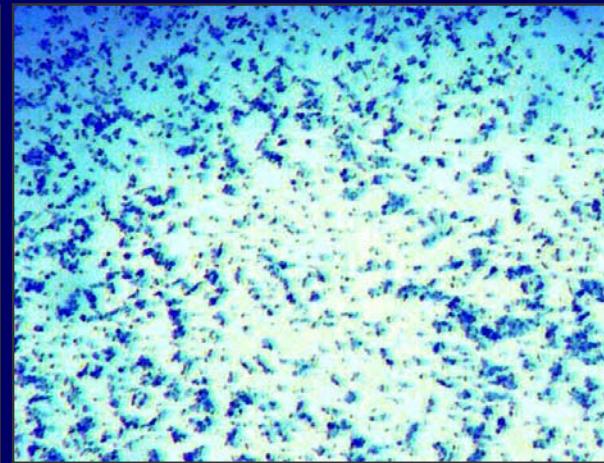
x320

### Human hepatocytes Hep3B

Before Roundup

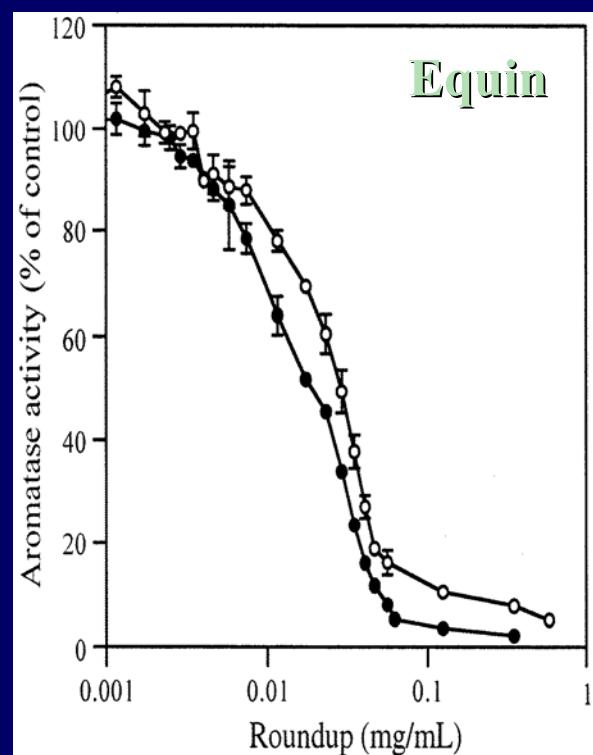
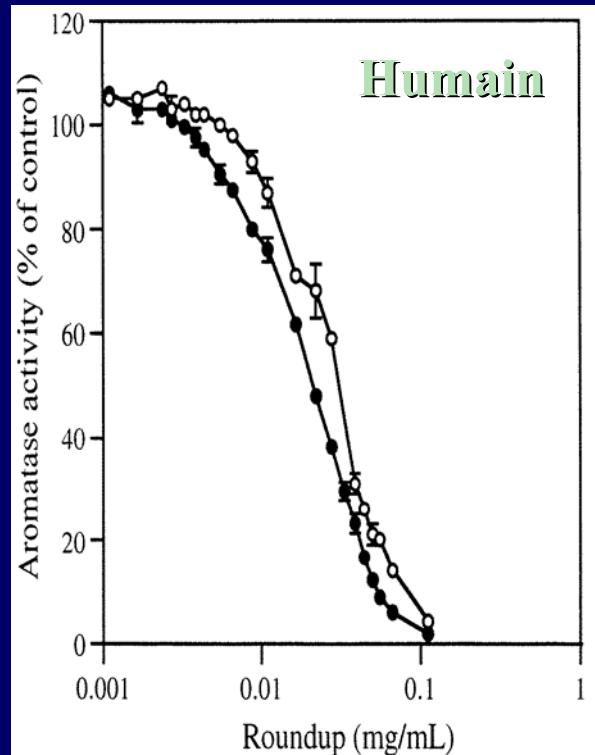


After 0.8% Roundup during 24h



x320

# Effets du Roundup sur l 'aromatase



IC<sub>50</sub>= 21 mg/mL (1,8%)

IC<sub>50</sub>= 17 mg/mL (1,5%)

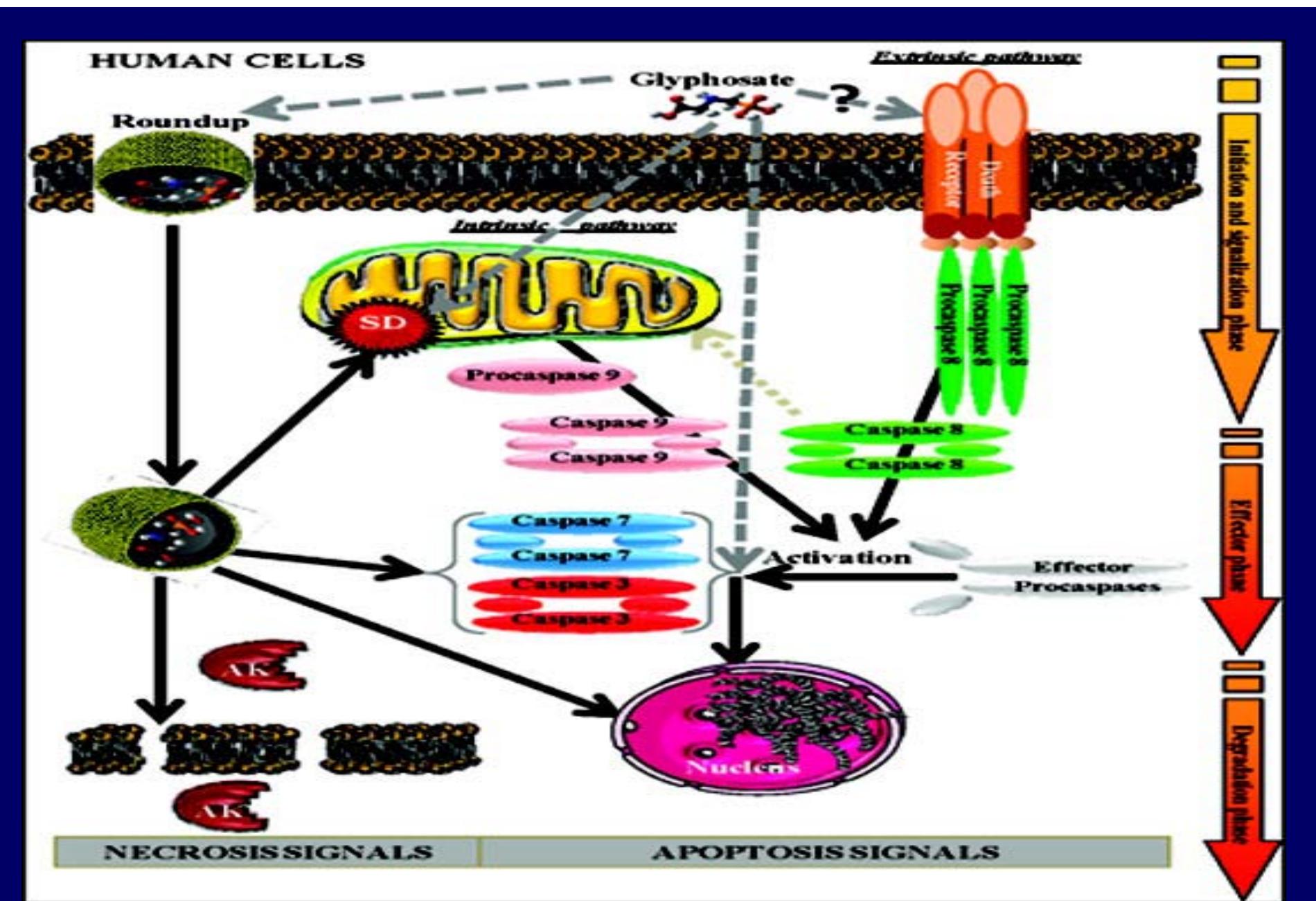
# Glyphosate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells

Nora Benachour and Gilles-Eric Séralini\*

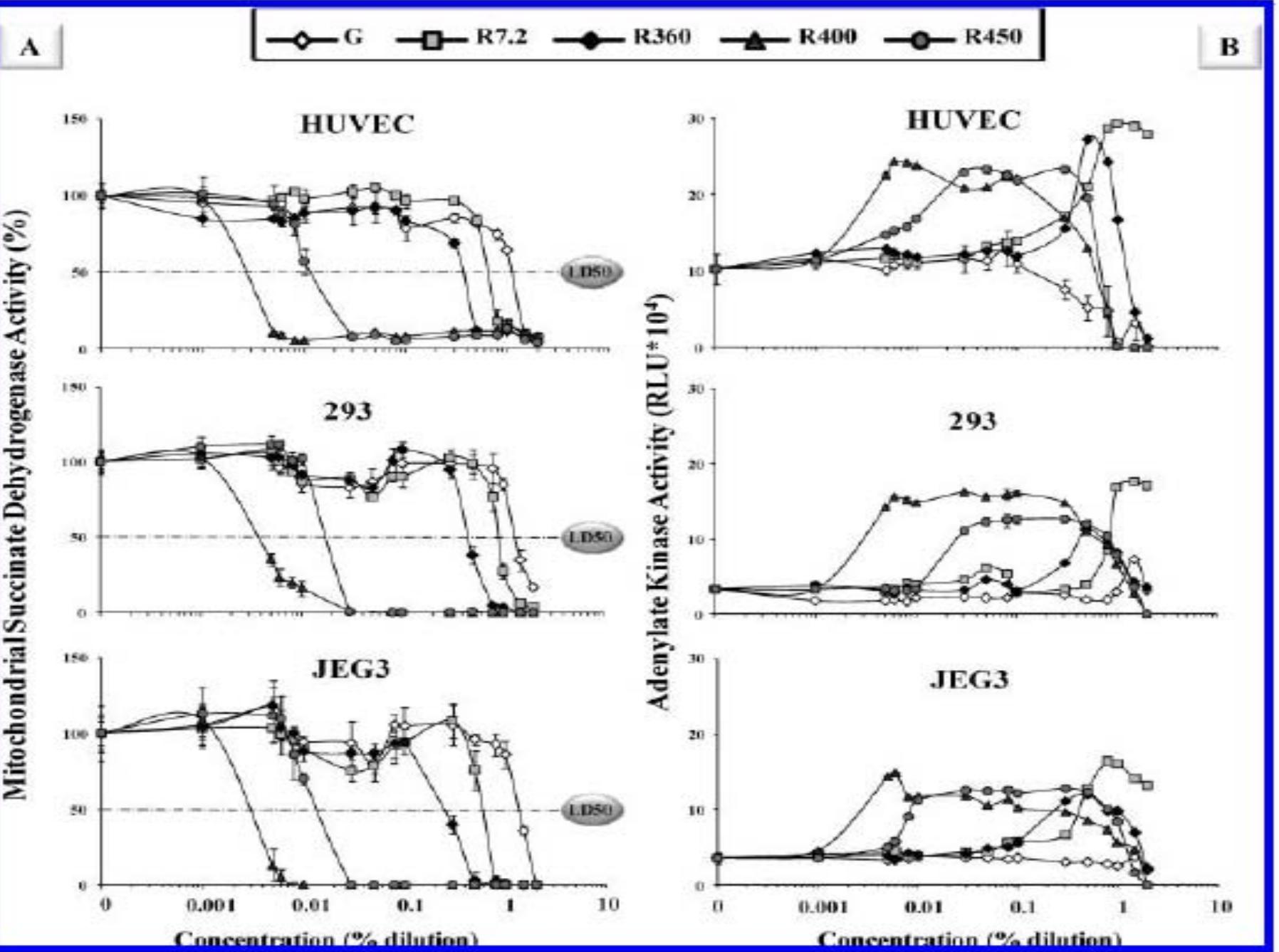
*University of Caen, Laboratory Estrogens and Reproduction, UPRES EA 2608, Institute of Biology,  
Caen 14032, France*

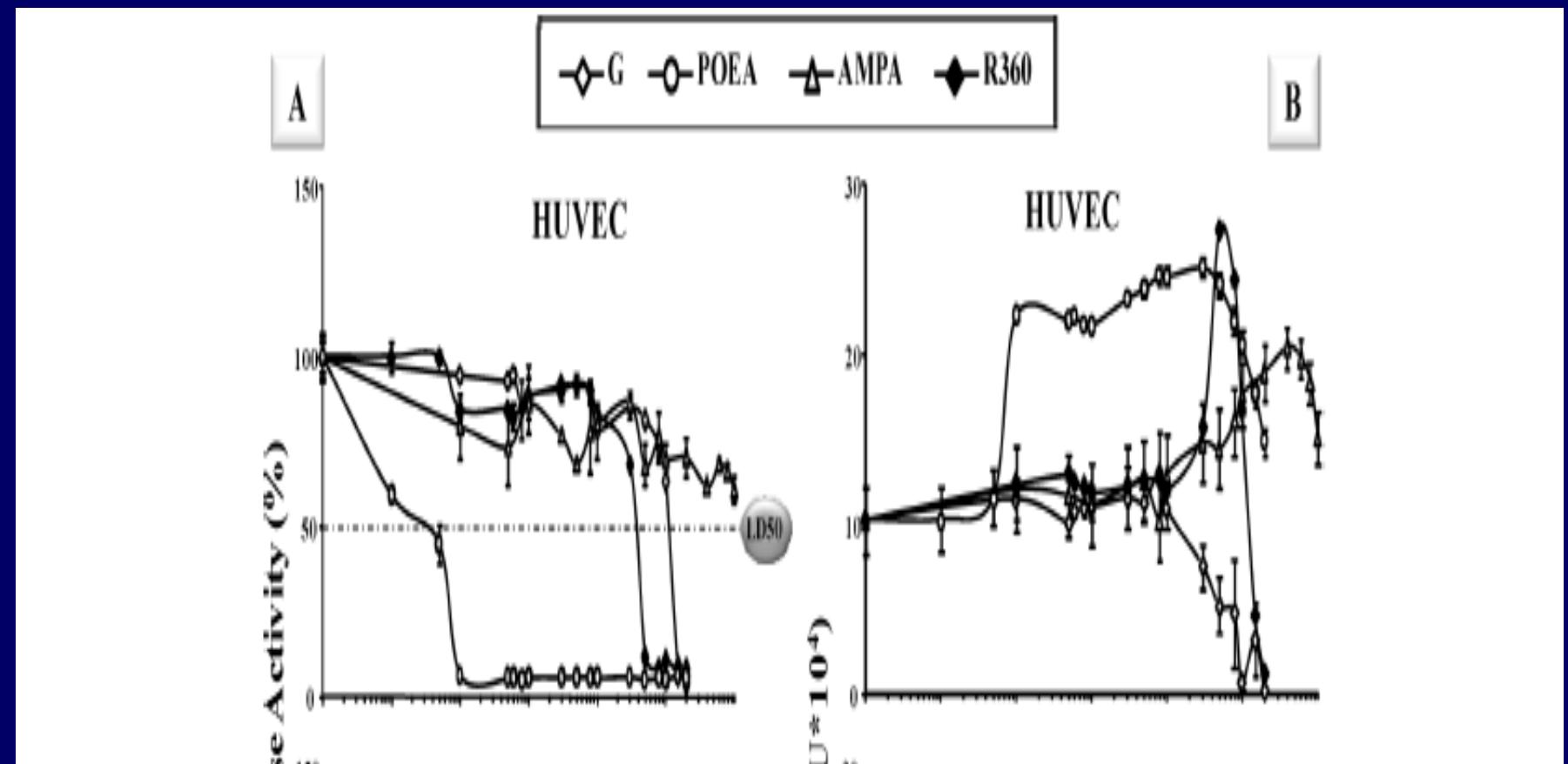
*Received June 16, 2008*

We have evaluated the toxicity of four glyphosate (G)-based herbicides in Roundup (R) formulations, from  $10^5$  times dilutions, on three different human cell types. This dilution level is far below agricultural recommendations and corresponds to low levels of residues in food or feed. The formulations have been compared to G alone and with its main metabolite AMPA or with one known adjuvant of R formulations, POEA. HUVEC primary neonate umbilical cord vein cells have been tested with 293 embryonic kidney and JEG3 placental cell lines. All R formulations cause total cell death within 24 h, through an inhibition of the mitochondrial succinate dehydrogenase activity, and necrosis, by release of cytosolic adenylate



*Benachour & Séralini, Chem. Res. Toxicol., 2009*

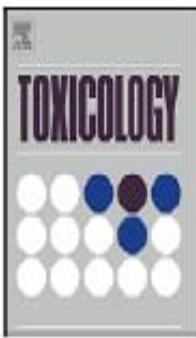




*Benachour & Séralini, Chem. Res. Toxicol., 2009*



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## Toxicology

journal homepage: [www.elsevier.com/locate/toxicol](http://www.elsevier.com/locate/toxicol)

# Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines

Céline Gasnier<sup>a</sup>, Coralie Dumont<sup>b</sup>, Nora Benachour<sup>a</sup>, Emilie Clair<sup>a</sup>, Marie-Christine Chagnon<sup>b</sup>, Gilles-Eric Séralini<sup>a,\*</sup>

<sup>a</sup> University of Caen, Institute of Biology, Lab. Biochemistry EA2608, Esplanade de la Paix, 14032 Caen cedex, France

<sup>b</sup> University of Burgundy, Lab. Food Toxicology UMR1129, 1 Esplanade Erasme, 21000 Dijon, France

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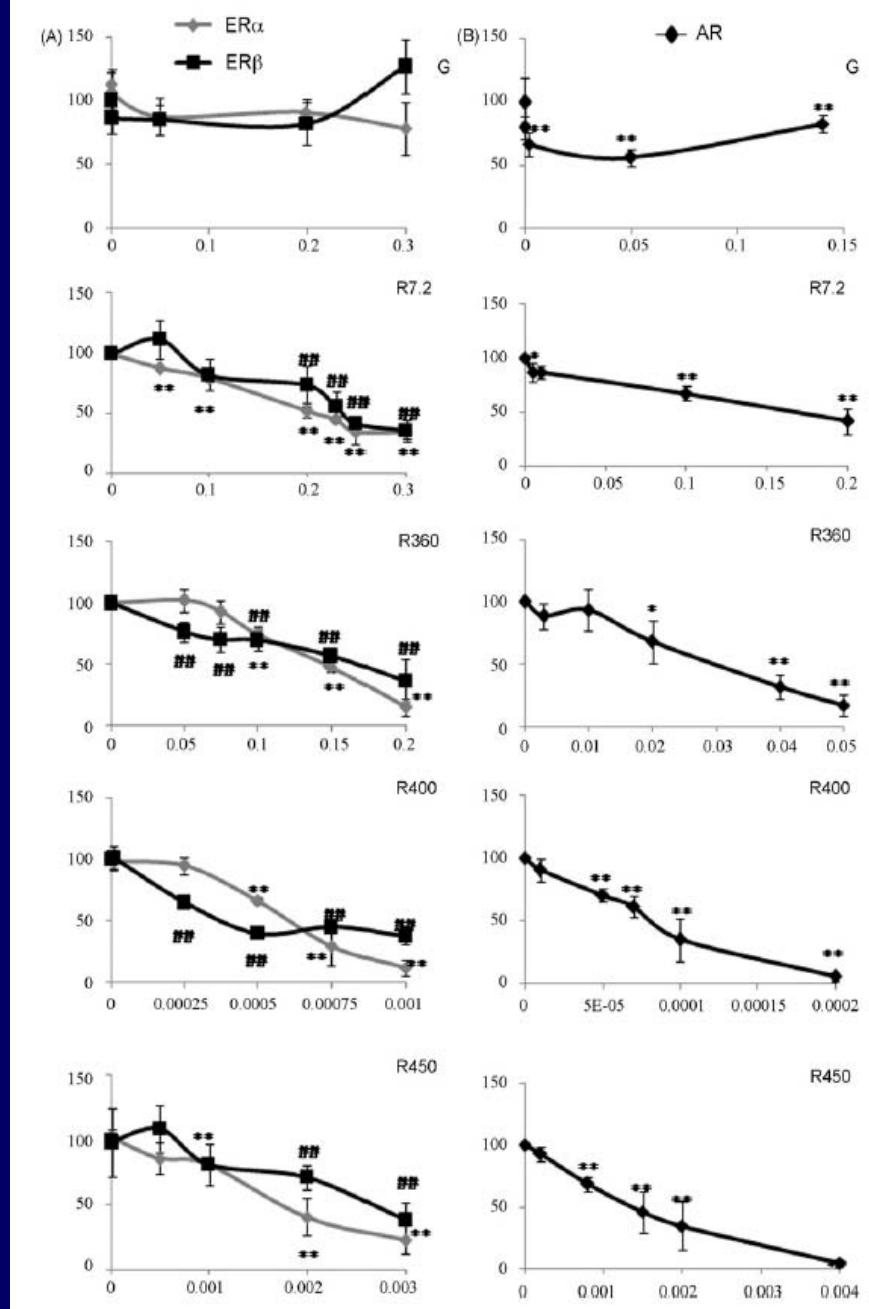
Received in revised form 4 June 2009

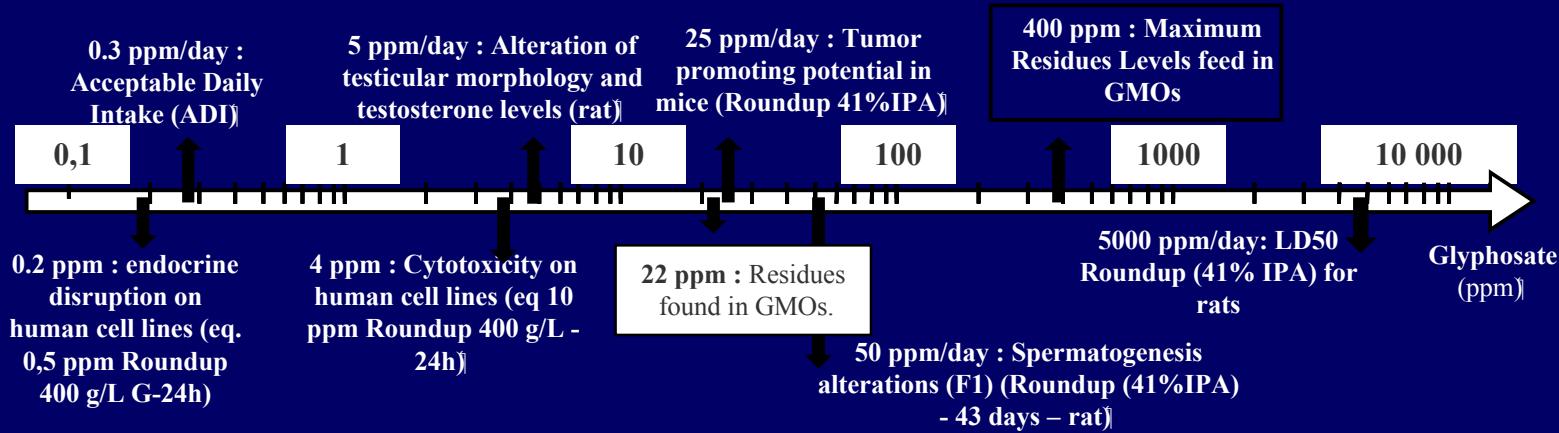
Accepted 8 June 2009

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### ABSTRACT

Glyphosate-based herbicides are the most widely used across the world; they are commercialized in different formulations. Their residues are frequent pollutants in the environment. In addition, these herbicides are spread on most eaten transgenic plants, modified to tolerate high levels of these compounds





**CRIIGEN** [www.criigen.org](http://www.criigen.org)  
**is in favour of well controlled pesticides**

- Today their evaluation is a major scientific shame in history - because of avoiding to test formulations in long term
- The scientific negationism could be criminal, some persons are responsible for this lack of consideration of health risks
- We dream about transparency...

