Pesticide applications **by** and **with** genetically modified (GM) crops: misregulated pesticide issues

NARIC AERI

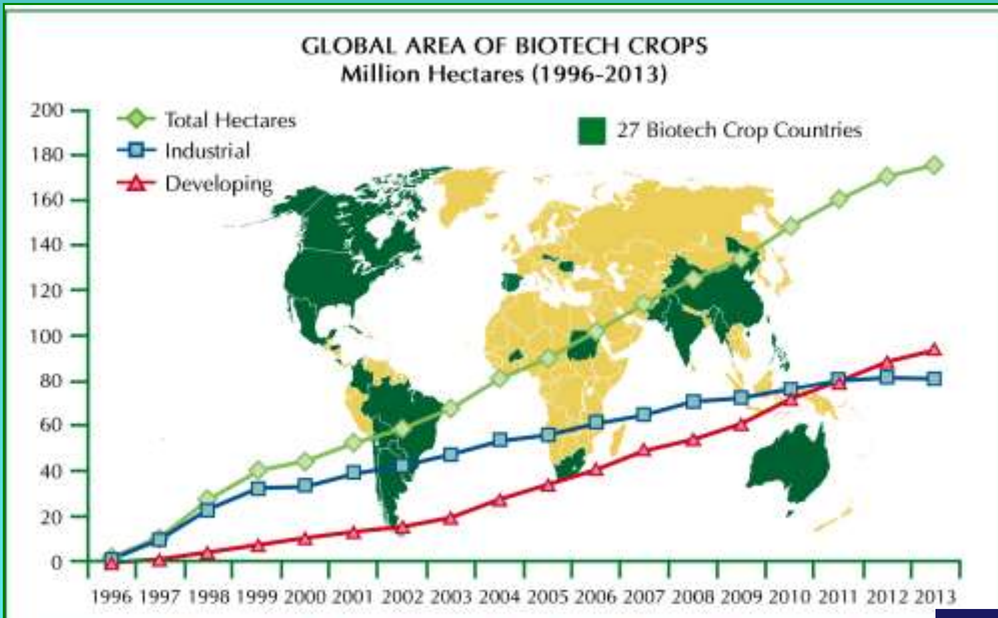
CRIIGEN
Comité de Recherche et d'Information Indépendantes sur le génie Génétique

Eszter Takács, Nicolas Defarge, Gilles-Éric Séralini,
Béla Darvas and András Székács

ENSSER Meeting, Berlin 2014

European Network of Scientists for Social and Environmental Responsibility

Global GMO status



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

Source: Clive James, 2013.

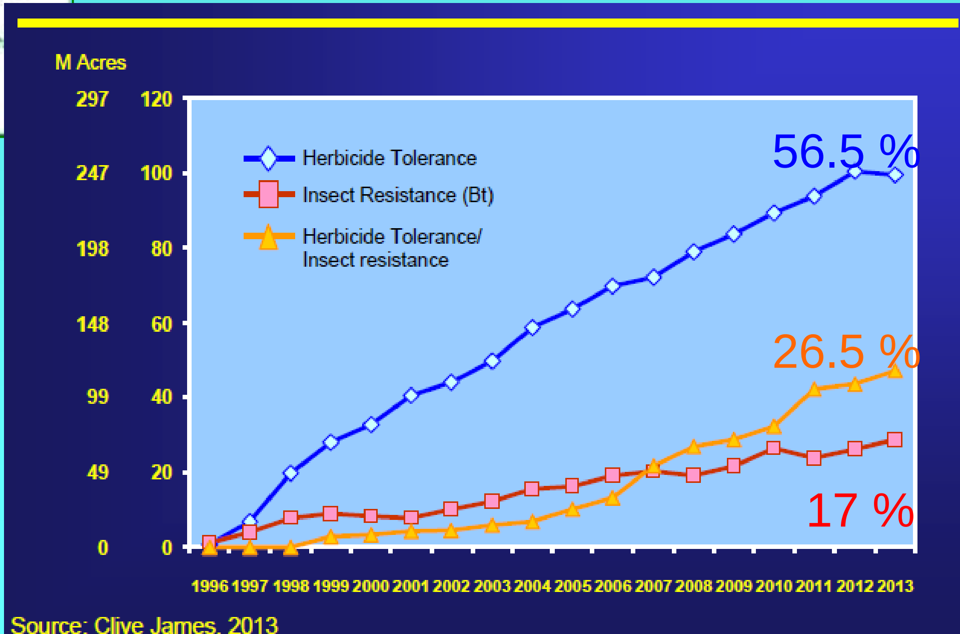
175.2 million hectares

soybean (84.5 M ha)
maize (57.4 M ha)
cotton (23.9 M ha)
canola (8.2 M ha)

The vast majority of GM plants worldwide is represented by first generation GM crops

> plant protection strategies

Serious concerns of environmental safety and legal registration status!



„Insect resistant” plants

Insecticide producing plants (*Bt* plants), considered as “bioformulated” pesticides

_Bt_-based bioinsecticide

_Bt_ crop

<u>application</u>

singular

environmantal dosage
< 625–1.930-fold

continuous

<u>composition of the active ingredients</u>

Cry1Ab (and several related) toxin (protoxin form)

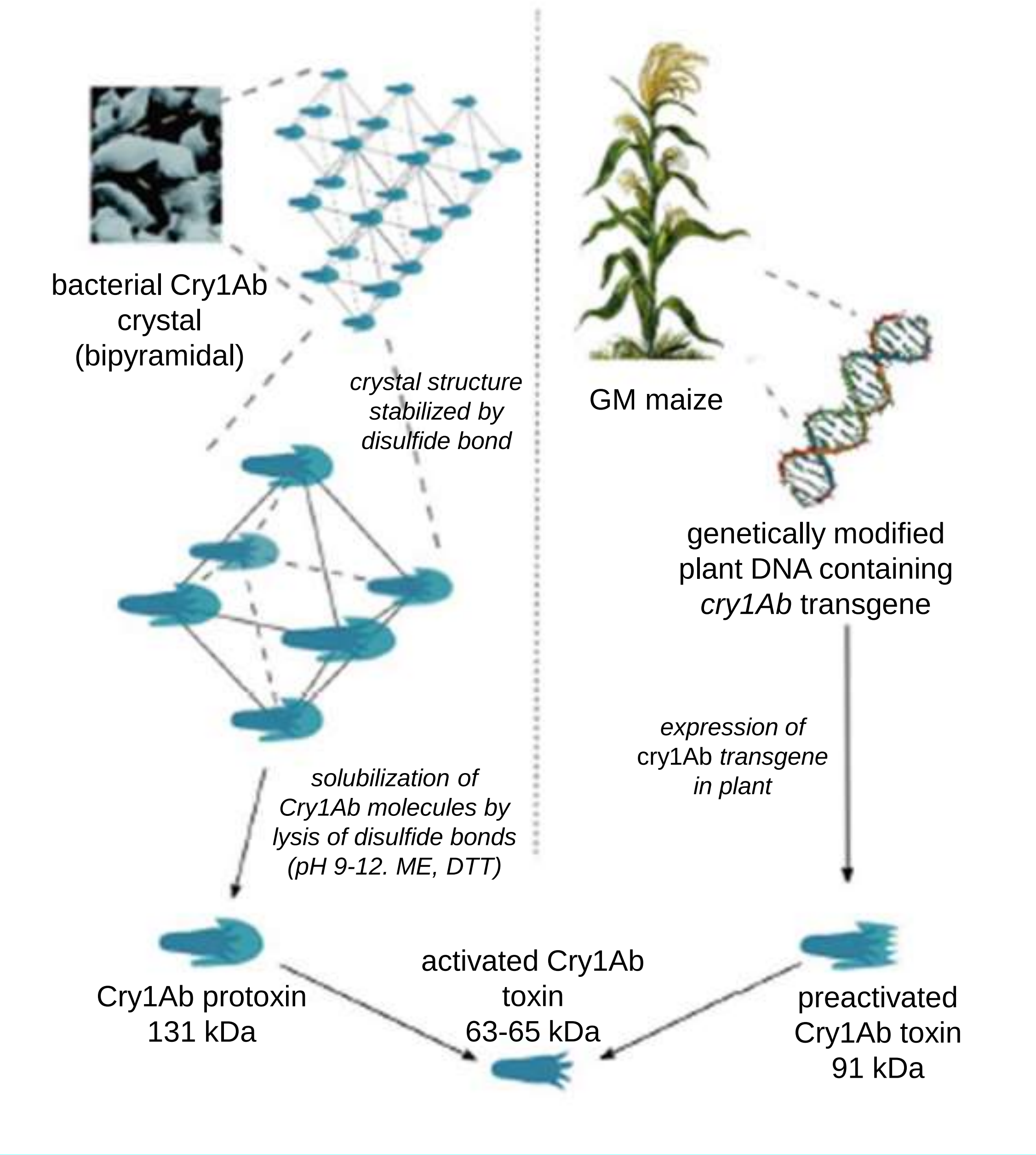
single modified Cry1Ab toxin (preactivated form)

Cannot be considered as equivalent technologies!

Biopesticide vs. GM plant

Bacillus thuringiensis

MON 810 maize



Difficulties

Anal Bioanal Chem (2010) 396:2203–2211
DOI 10.1007/s00216-009-3384-6

ANALYTICAL & BIOANALYTICAL CHEMISTRY

ORIGINAL PAPER

Detection of Cry1Ab toxin in the leaves of *MON 810* transgenic maize

András Székács · Éva Lauber · Eszter Takács · Béla Darvas

SETAC PRESS

ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY

CRY1AB TOXIN PRODUCTION OF *MON 810* TRANSGENIC MAIZE

ANDRÁS SZÉKÁCS,* ÉVA LAUBER, JUDIT JURACSEK, and BÉLA DARVAS
Department of Ecotoxicology and Environmental Chemistry, Plant Protection Institute, Hungarian Academy of Sciences, H-1022, Budapest, Herman Ottó u. 15, Hungary

(*Submitted 4 April 2009; Returned for Revision 16 June 2009; Accepted 26 July 2009*)

Acta Phytopathologica et Entomologica Hungarica 47 (2), pp. 293
DOI: 10.1556/APhyt.

Analytical Difficulties and Certain Biological Aspects of Cry1Ab Toxin Determination in *MON 810* Genetically Modified Maize

Inter-laboratory comparison of Cry toxin quantification in *MON 810* maize by enzyme-immunoassay

András Székács [a], Gabriele Weiss [b], David Quist [c], Eszter Takács [a], Béla Darvas [a], Matthias Meier [b], Trilochan Swain [c] & Angelika Hilbeck [b d]

Food and Agricultural Immunology

Springer

Advanced Technologies for Managing Insect Pests

(Isaac Ishaaya, Suba Reddy Palli, Rami Horowitz, Eds.)

Springer Verlag, 2012

Comparative aspects of Cry toxin usage in insect control

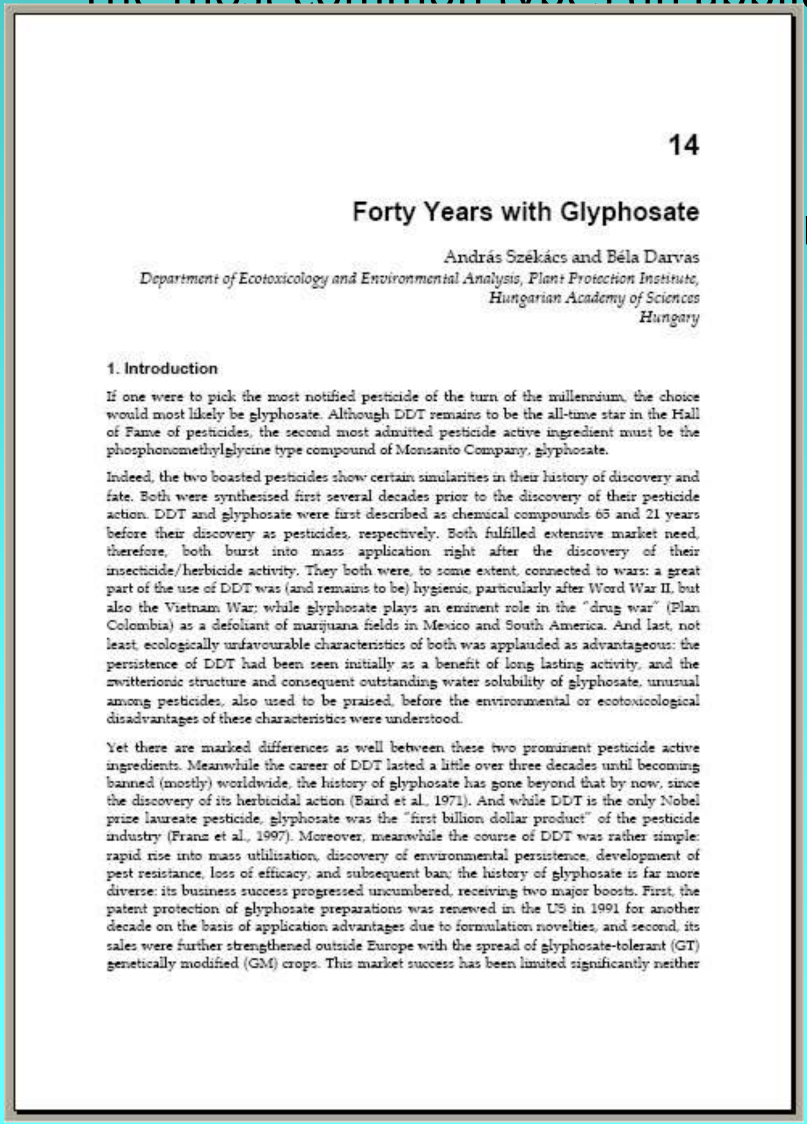
András Székács and Béla Darvas

Department of Ecotoxicology and Environmental Analysis, Plant Protection Institute, Hungarian Academy of Sciences, Budapest, Hungary
Central Food Research Institute, Budapest, Hungary

- integrated pest management
- registration
- analytical methods
- ecotoxicology studies

„Herbicide tolerant” plants

The most common types (in application) are glyphosate tolerant GM crops



14

Forty Years with Glyphosate

András Székács and Béla Darvas
Department of Ecotoxicology and Environmental Analysis, Plant Protection Institute, Hungarian Academy of Sciences
Hungary

1. Introduction

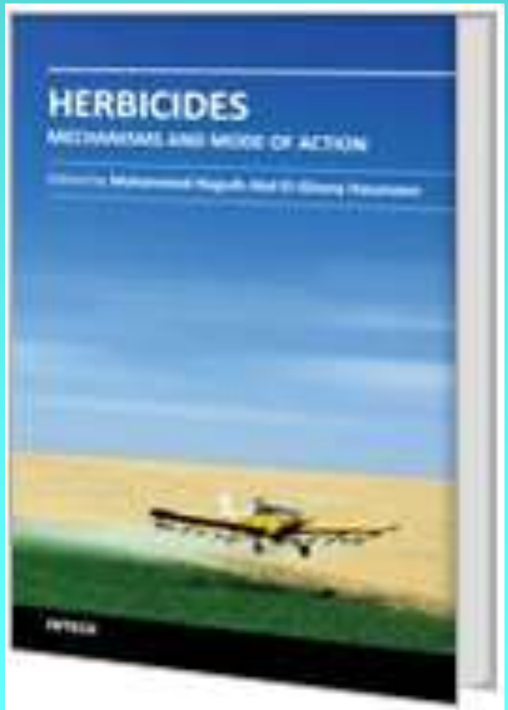
If one were to pick the most notified pesticide of the turn of the millennium, the choice would most likely be glyphosate. Although DDT remains to be the all-time star in the Hall of Fame of pesticides, the second most admitted pesticide active ingredient must be the phosphonomethylglycine type compound of Monsanto Company, glyphosate.

Indeed, the two boasted pesticides show certain similarities in their history of discovery and fate. Both were synthesised first several decades prior to the discovery of their pesticide action. DDT and glyphosate were first described as chemical compounds 65 and 21 years before their discovery as pesticides, respectively. Both fulfilled extensive market need, therefore, both burst into mass application right after the discovery of their insecticide/herbicide activity. They both were, to some extent, connected to wars: a great part of the use of DDT was (and remains to be) hygienic, particularly after Word War II, but also the Vietnam War; while glyphosate plays an eminent role in the "drug war" (Plan Colombia) as a defoliant of marijuana fields in Mexico and South America. And last, not least, ecologically unfavourable characteristics of both was applauded as advantageous: the persistence of DDT had been seen initially as a benefit of long lasting activity, and the zwitterionic structure and consequent outstanding water solubility of glyphosate, unusual among pesticides, also used to be praised, before the environmental or ecotoxicological disadvantages of these characteristics were understood.

Yet there are marked differences as well between these two prominent pesticide active ingredients. Meanwhile the career of DDT lasted a little over three decades until becoming banned (mostly) worldwide, the history of glyphosate has gone beyond that by now, since the discovery of its herbicidal action (Baird et al., 1971). And while DDT is the only Nobel prize laureate pesticide, glyphosate was the "first billion dollar product" of the pesticide industry (Franz et al., 1997). Moreover, meanwhile the course of DDT was rather simple: rapid rise into mass utilisation, discovery of environmental persistence, development of pest resistance, loss of efficacy, and subsequent ban; the history of glyphosate is far more diverse: its business success progressed unencumbered, receiving two major boosts. First, the patent protection of glyphosate preparations was renewed in the US in 1991 for another decade on the basis of application advantages due to formulation novelties, and second, its sales were further strengthened outside Europe with the spread of glyphosate-tolerant (GT) genetically modified (GM) crops. This market success has been limited significantly neither

n, increased environmental load

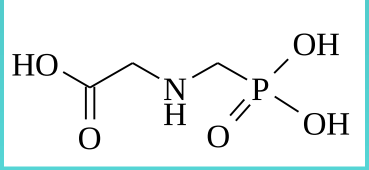
us risk assessment



Székács, A. and Darvas B. (2012) Forty years with glyphosate.
In: Herbicides – Properties, Synthesis and Control of Weeds
(Hasaneen, M. N. A. E.-G., Ed.), InTech, Rijeka, Croatia, pp. 247-284.

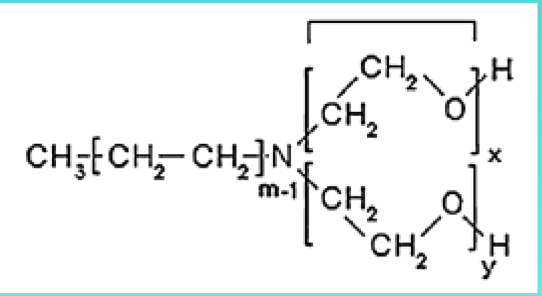
„Herbicide tolerant” plants

glyphosate *herbicide active ingredient*



formulating agents *„inert”*

e.g., polyethoxylated tallow amine (POEA)

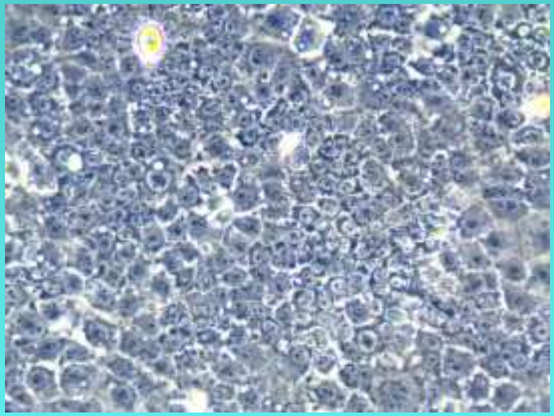


controversy in pesticide registration: surfactants, adjuvants are assumed to be inert

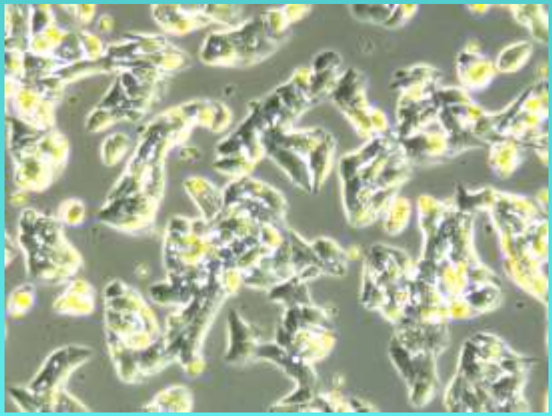
- Tsui and Chu (2003): POEA, assumed to be biologically inactive, is strongly toxic to species of bacteria, microalgae, protozoa and crustacean
- Marc *et al.* (2005): POEA is toxic to sea urchin
- Relyea and Jones (2009): POEA has endocrine disruptor effect of glyphosate is synergized by POEA
- Székács *et al.* (2014): POEA is toxic to *Daphnia magna* and have cytotoxic effect
- Mesnage *et al.* (2013, 2014): POEA has cytotoxic effect

Cell lines, cytotoxicity tests, test substances

JEG 3



HEPG2



HEK293

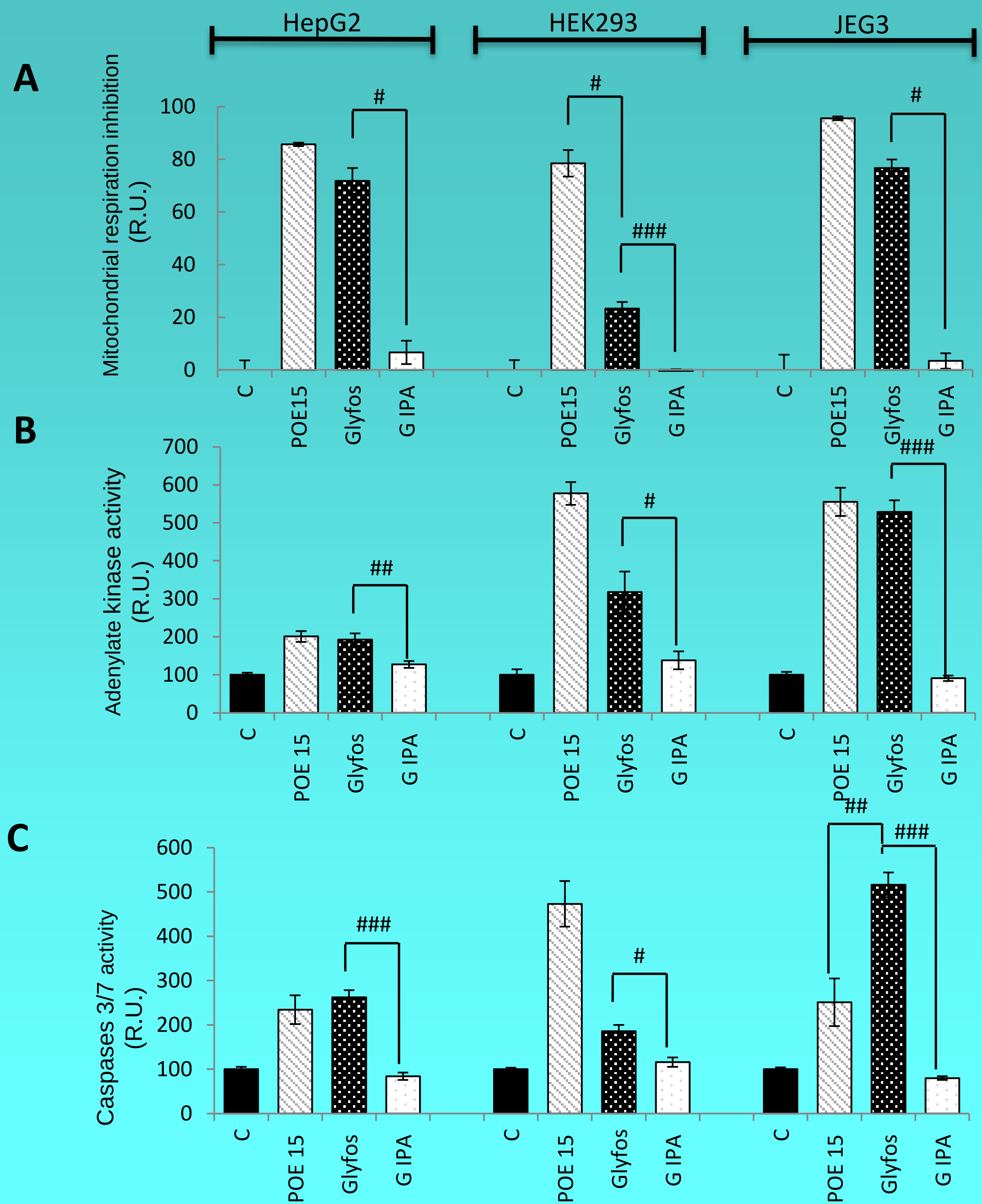
MTT (cell proliferaiton assay)

ToxiLight test (necrosis)

Caspase-Glo 3/7 test (apoptosis)

- **Glyfos (Cheminova)**
  42% glyphosate IPA salt
  9% polyethoxylated tallow amine (POEA)
- **Medallon Premium (Syngenta)**
  34% glyphosate DA salt
  10-20% alkyl polyglucoside
- **POEA, APG**
- **glyphosate IPA salt (97%)**

Results, Glyfos

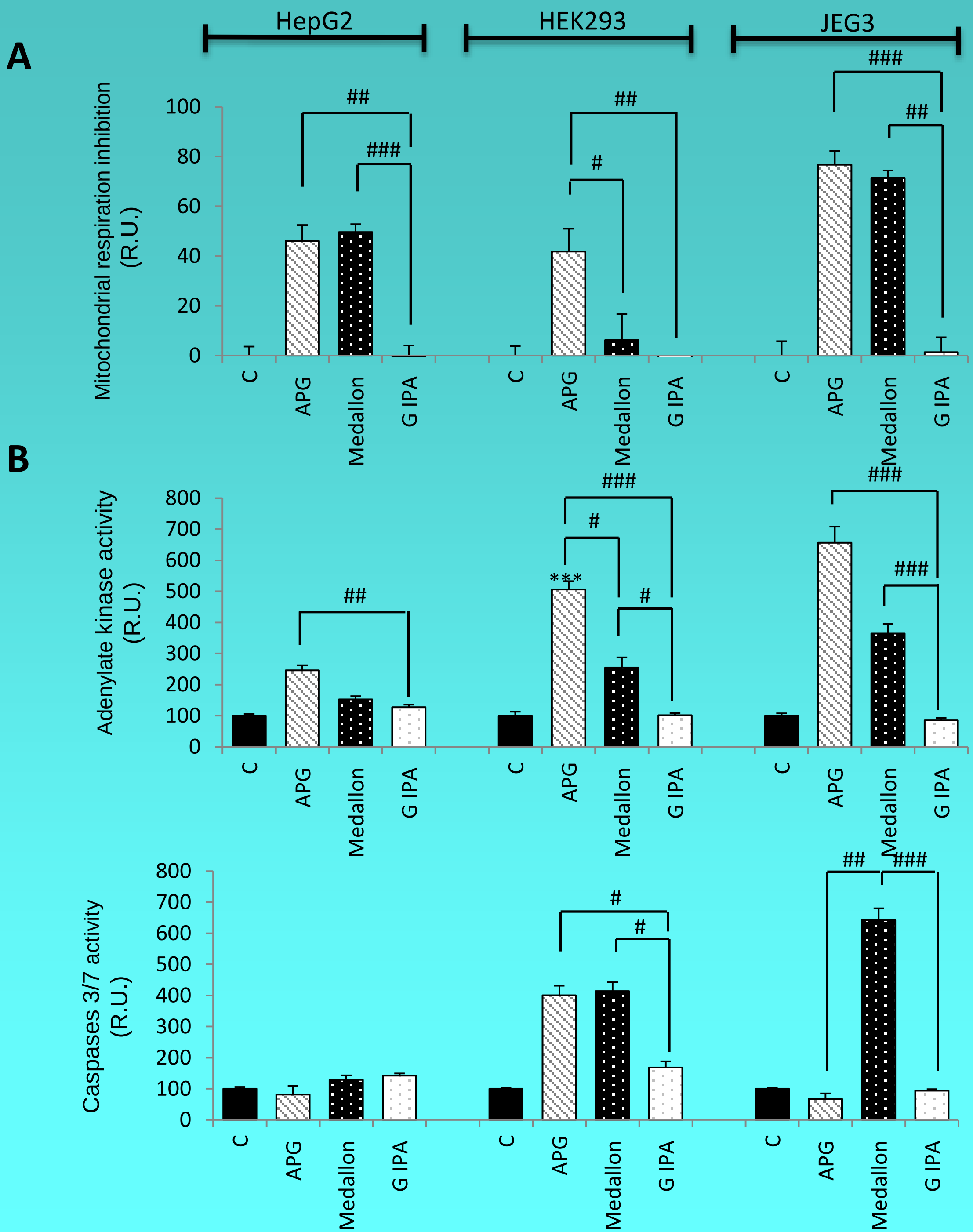


POEA > Glyfos > glyphosate

POEA > Glyfos > glyphosate

POEA > Glyfos > glyphosate
not in every case!

Results, Medallon



APG > Medallon > glyphosate

APG > Medallon > glyphosate

APG ? Medallon ? glyphosate

Conclusion

• regulation of *Bt* crops and glyphosate-based herbicide are not adequate

• not only POEA, but other adjuvants also exert higher toxic effects than glyphosate

• authorization should require risk assessment of adjuvants

• *Bt* bioinsecticides do not equal to *Bt* crops

• decrease in mitochondrial respiratory indicated the same trend for the three human cell lines: **glyphosate > Glyfos > POEA**

glyphosate > Medallon > APG

• different sensitivity was detected among cell lines: **glyphosate** caused **lower toxicity than POEA**

• difference in cytotoxicity between the two glyphosate-based herbicides