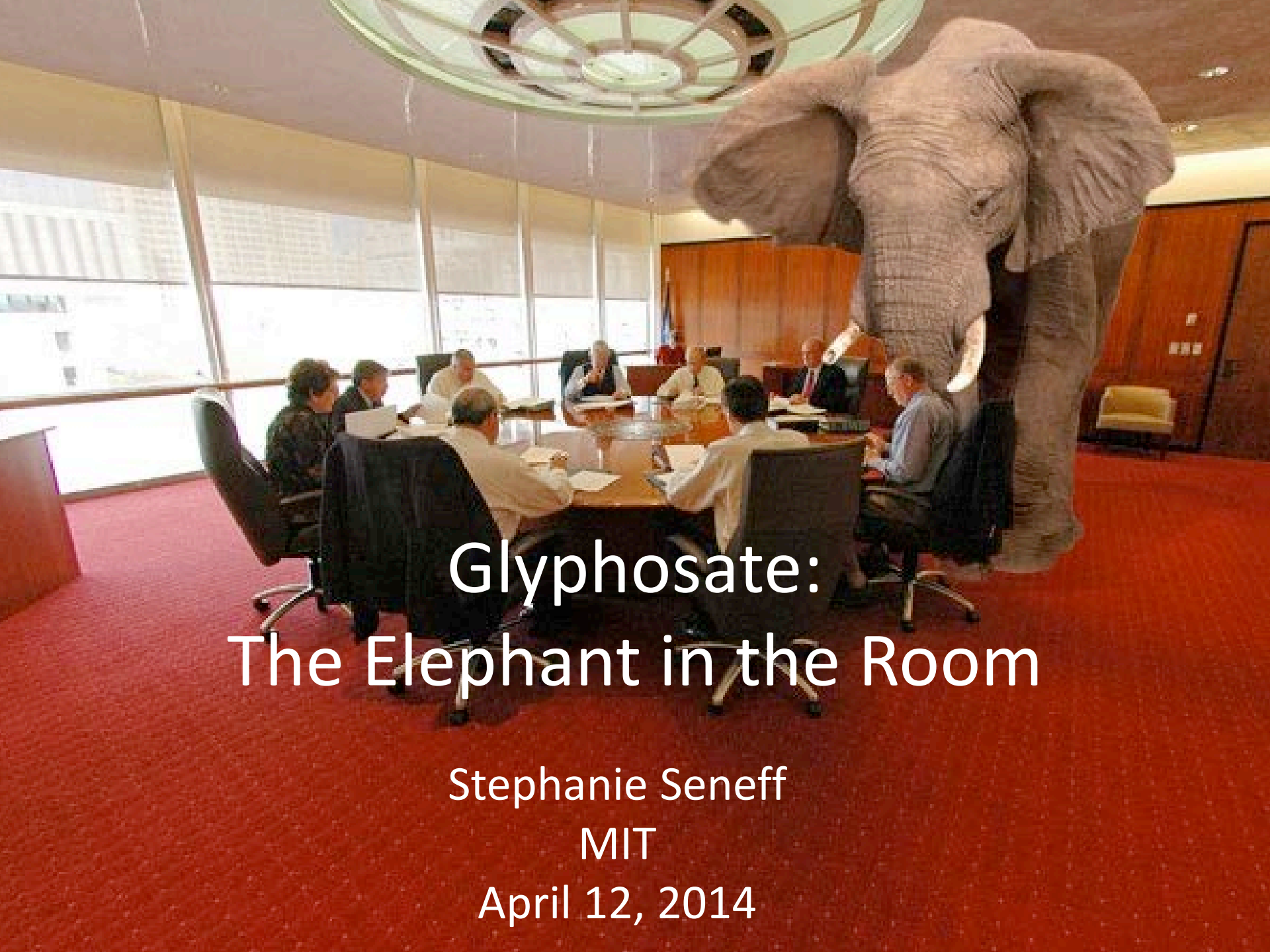


Glyphosate: The Elephant in the Room

Stephanie Seneff
MIT
April 12, 2014

"If we do not save the environment then whatever we do in civil rights will be of no meaning because then we will have the equality of extinction."

-- Martin Luther King

Download These Slides

http://people.csail.mit.edu/seneff/SeneffGlyphosateYale.pptx (or .pdf)

Outline

- Introduction
- Autism and Dementia
- Obesity and Digestive Disorders
- Endocrine Disruption and Cancer
- Species in Stress (two slides)
- Summary

Autism and Dementia

*"Children today are sicker than they were a generation ago. From childhood cancers to autism, birth defects and asthma, a wide range of childhood diseases and disorders are on the rise. Our assessment of the latest science leaves little room for doubt: pesticides are one key driver of this sobering trend."**

*http://www.emagazine.com/earth-talk/pesticides-and-childrens-health

"One of the puzzling aspects of autism is the marked increase in the incidence of autism that began in the United States in the early 1980s and has appeared to increase continuously since then."

-William Shaw, Journal of Restorative Medicine 2013; 2: First line of Introduction.

The rate was one in fifty in the most recent estimate last year

Conditions Associated with Autism

- Disrupted gut bacteria
- Deficiencies in serotonin and melatonin
- Impaired sulfur metabolism

Is there a toxic environmental substance that has been on the rise since 1980 and that could account for these comorbidities?


GLYPHOSATE
PUMP 'n GO
REFILL
Roundup

Glyphosate use rose 1500% from 1994 to 2005.*

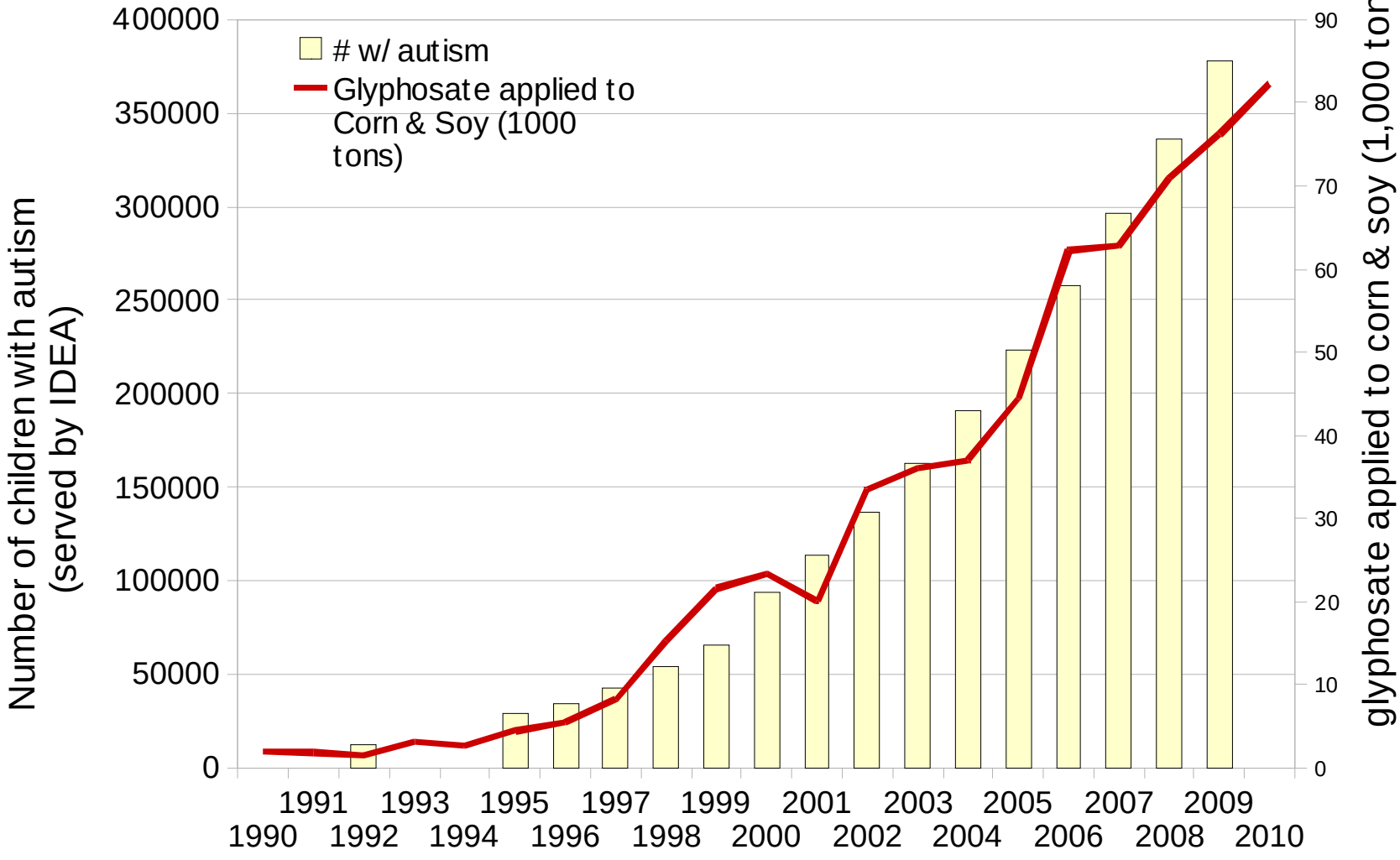
100 million pounds of glyphosate is used every year on more than a billion acres.

Huge expansion of GMO “Roundup-Ready” corn, soy, cotton and canola crops has led to sharp increases in the last decade

*Cherry B. GM crops increase herbicide use in the United States. Science in Society 45, 44-46, 2010

Number of children (6-21yrs) with autism served by IDEA

plotted against glyphosate use on corn & soy (R = 0.9869, p <= 1.103e-06)
sources: USDA:NASS; USDE



Nancy Swanson, http://www.examiner.com/article/
data-show-correlations-between-increase-neurological-diseases-and-gmos

Recent Publication

entropy

ISSN 1099-4300

www.mdpi.com/journal/entropy

Review

Glyphosate's Suppression of Cytochrome P450 Enzymes and Amino Acid Biosynthesis by the Gut Microbiome: Pathways to Modern Diseases

Anthony Samsel [1] and Stephanie Seneff [2,*]

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E-Mail: anthonysamsel@acoustictracks.net

[2] Computer Science and Artificial Intelligence Laboratory, MIT, Cambridge, MA 02139, USA

* Author to whom correspondence should be addressed; E-Mail: Seneff@csail.mit.edu;
Tel.: +1-617-253-0451; Fax: +1-617-258-8642.

Received: 15 January 2013; in revised form: 10 April 2013 / Accepted: 10 April 2013 / Published:

Abstract: Glyphosate, the active ingredient in Roundup®, is the most popular herbicide used worldwide. The industry asserts it is minimally toxic to humans, but here we argue otherwise. Residues are found in the main foods of the Western diet, comprised primarily

Is Glyphosate Nontoxic?

- Monsanto has argued that glyphosate is harmless to humans because our cells don't have the shikimate pathway, which it inhibits
- However, our gut bacteria DO have this pathway
  - We depend upon them to supply us with essential amino acids (among many other things)
- Other ingredients in Roundup greatly increase glyphosate's toxic effects
- Insidious effects of glyphosate accumulate over time
  - Most studies are too short to detect damage

Main Toxic Effects of Glyphosate*

- Kills beneficial gut bacteria and allows pathogens to overgrow
- Interferes with function of cytochrome P450 (CYP) enzymes
- Chelates important minerals (iron, zinc, manganese, etc.)
- Interferes with synthesis of aromatic amino acids and methionine
  - Leads to shortages in critical neurotransmitters
- Disrupts sulfate synthesis and sulfate transport

Samsel and Seneff, Entropy **2013**, *15*, 1416-1463

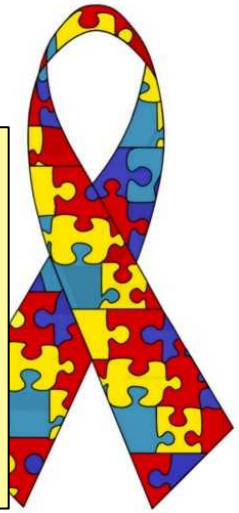
Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate
- Methionine deficiency
- Serotonin and melatonin deficiency
- Defective aromatase
- Zinc, iron and vitamin D deficiency
- Urinary p-cresol
- High serum nitrate and ammonia
- Impaired immune function
- Chronic low-grade inflammation in the brain

Some Biomarkers for Autism

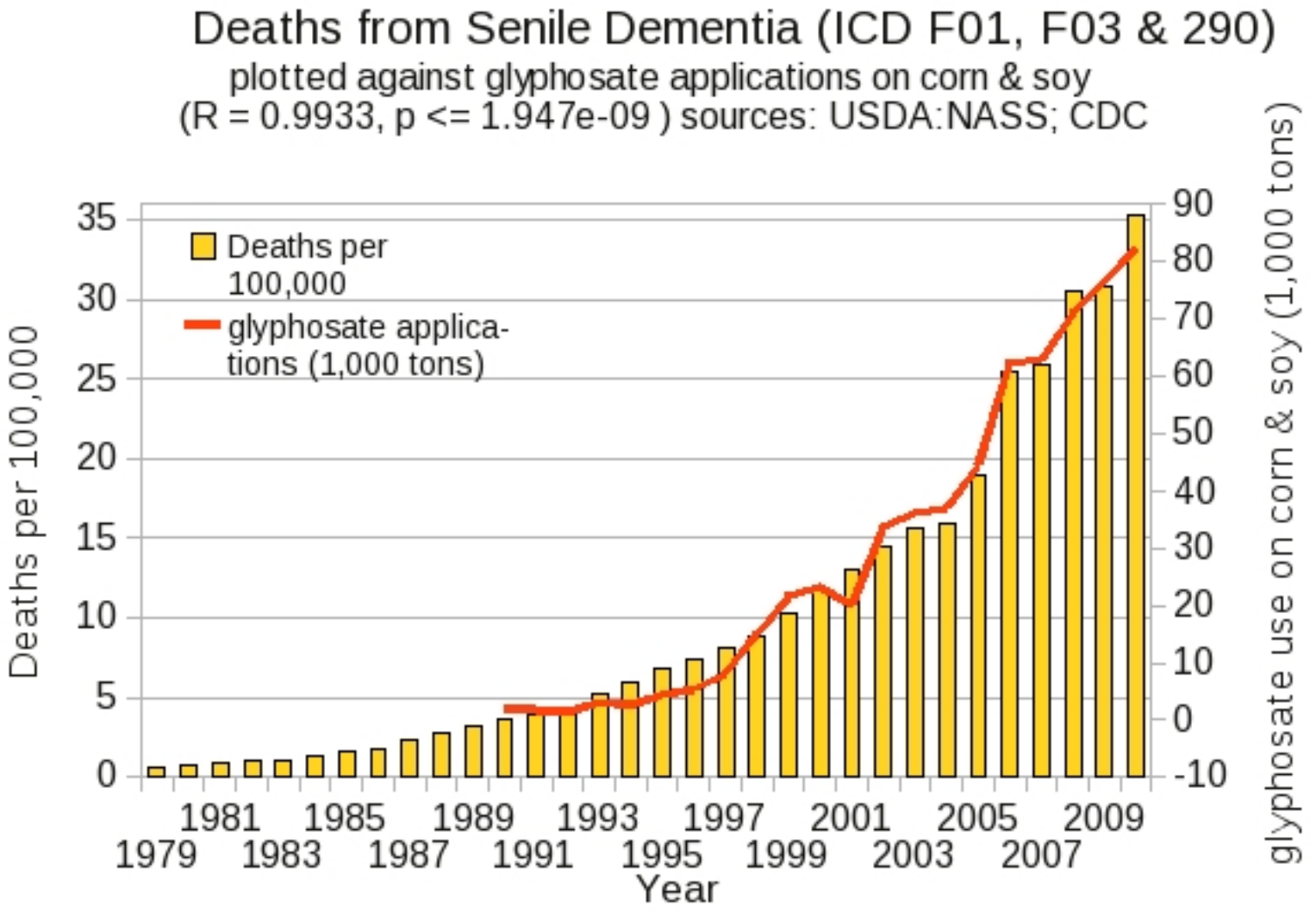
- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate

These can all be explained as potential effects of glyphosate on biological systems



- Urinary p-cresol
- High serum nitrate and ammonia
- Impaired immune function
- Chronic low-grade inflammation in the brain

Dementia and Autism Have Much in Common



Plot kindly provided by Nancy Swanson

Obesity and Digestive Disorders

Is Glyphosate Making Us Obese?

Obesity in US over Time*

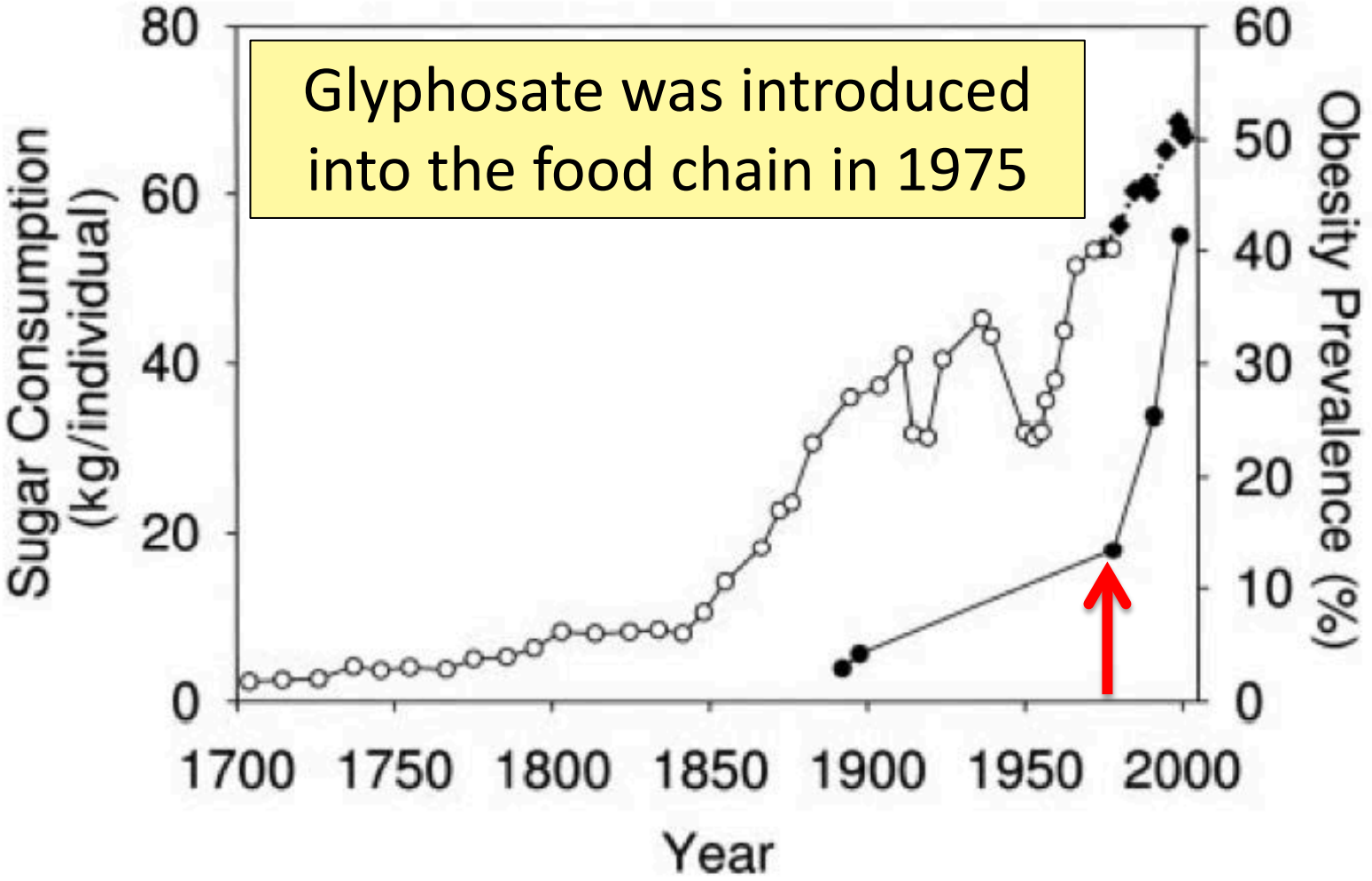
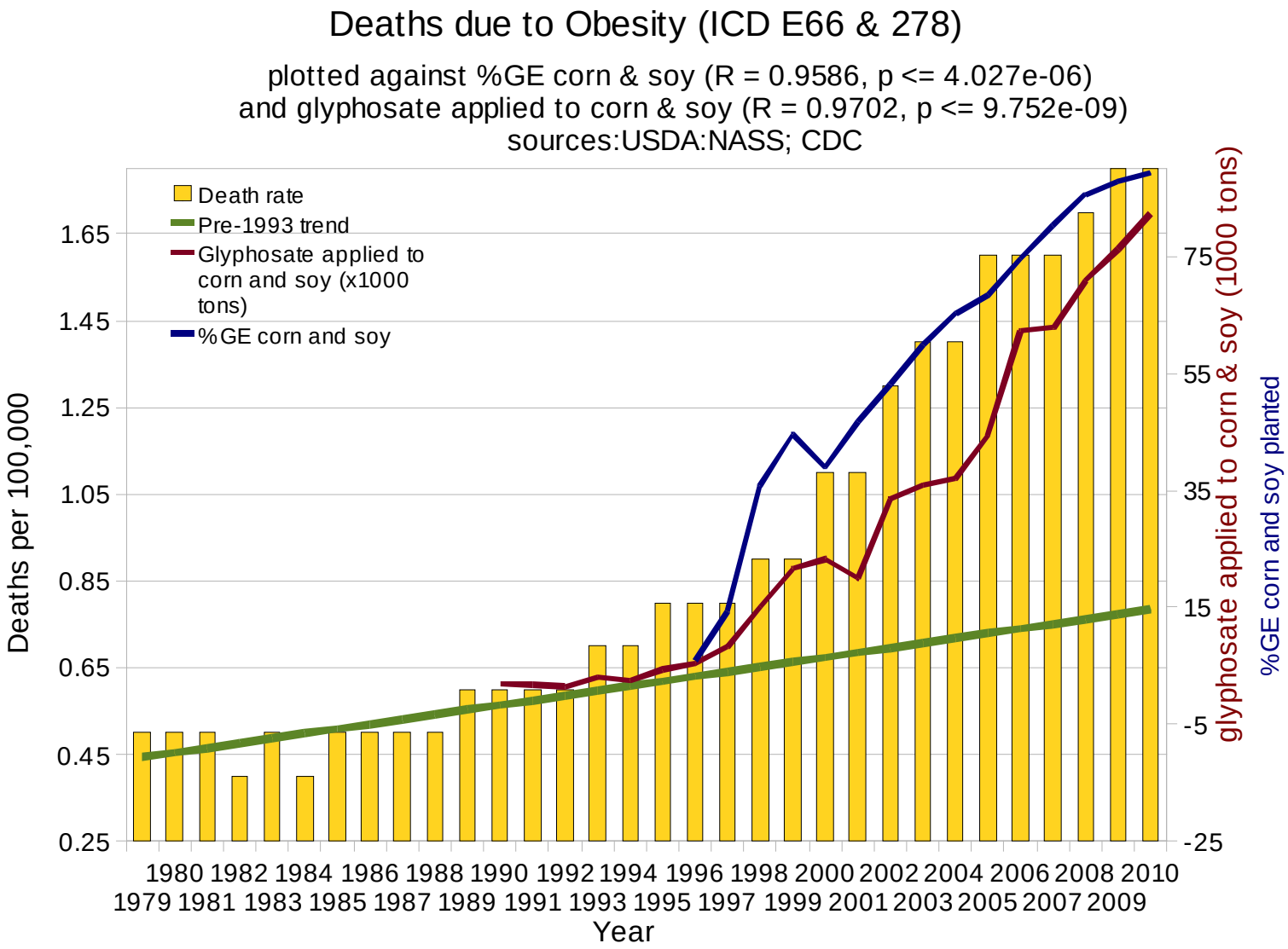


*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.



Nancy Swanson, http://www.examiner.com/article/data-show-correlations-between-increase-neurological-diseases-and-gmos

Gut Microbes and Obesity

- Our microbes outnumber our own cells 10 to 1
- There are between 200 and 300 different species in a typical person.
- Environmental toxins like glyphosate can cause an overgrowth of pathogens in the gut
  - They release toxic phenols
  - This can lead to inflammatory bowel disease
    - And a direct path to obesity!
- Gut microbes from an obese person induced obesity in mice*

*N. Fei and L. Zhao, The ISME Journal, Online Publication Dec. 2012

Pigs Fed GMOs Develop Inflamed Gut*

- Pigs have a similar digestive system to humans
- Digestive problems observed anecdotally in GMO-fed pigs
  - inflammation in stomach and intestine, stomach ulcers, thinning of intestinal walls, increase in haemorrhagic bowel disease

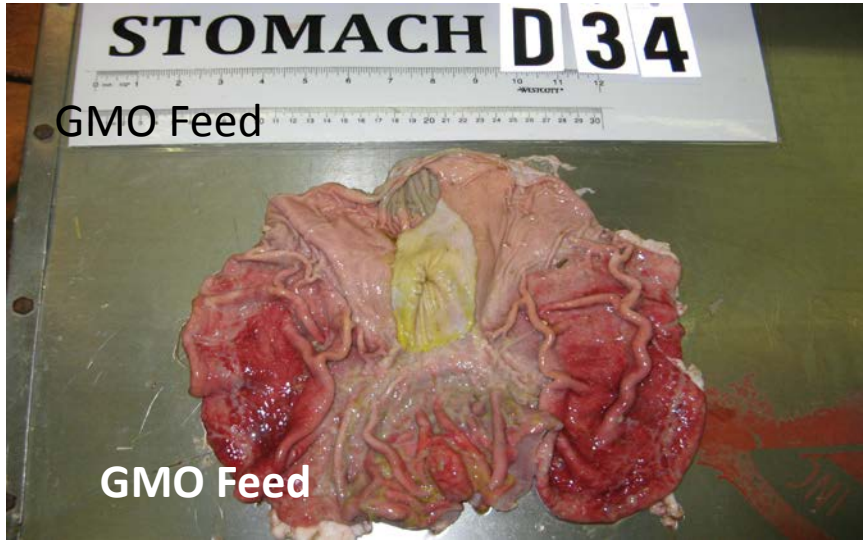
Follow-on Experiment:

- 168 just-weaned pigs fed "typical diet," soy and corn, until slaughtered
  - Half fed GMO versions, half organic.

*J.A. Carman et al., Journal of Organic Systems, 8(1), 2013.

Pigs Fed GMOs Develop Inflamed Gut*

- Blind autopsies conducted
  - Female pigs' uterus 25% larger in GMO-fed pigs
  - Female pigs 2.2x more likely to get severe stomach inflammation on GMO diet
  - Males were 4x more likely



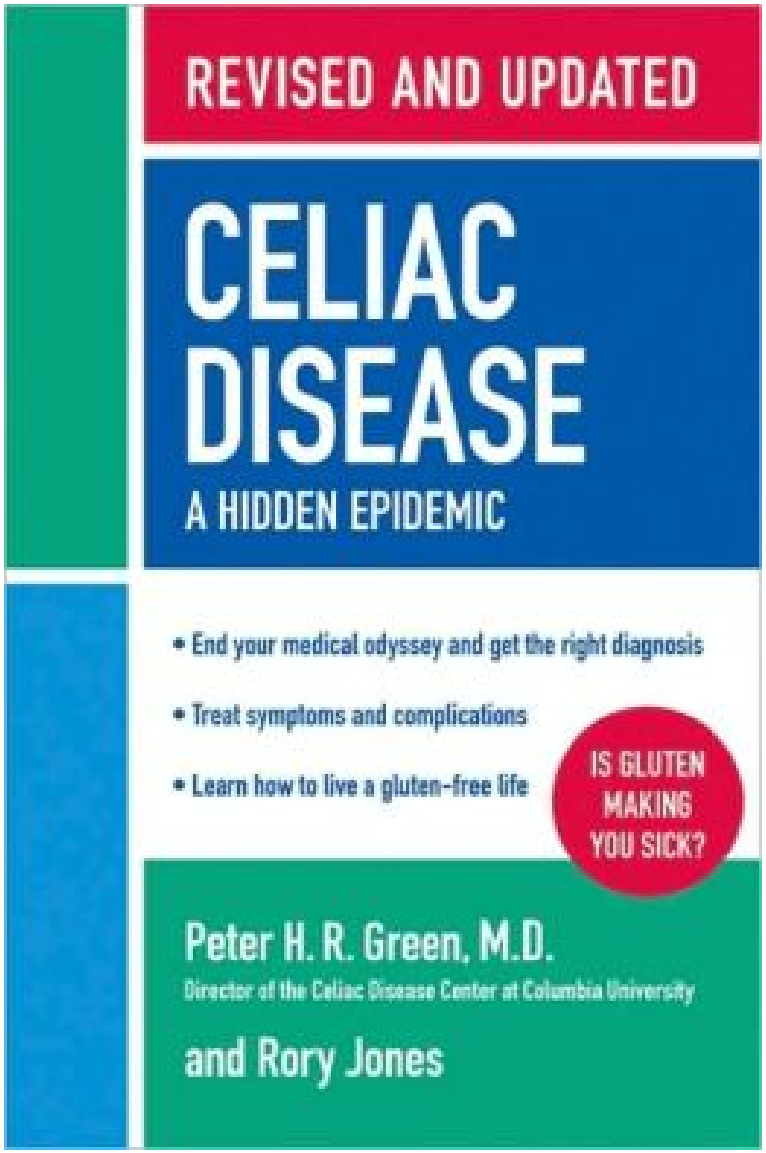
Photos kindly provided by Howard Vlieger

*J.A. Carman et al., *Journal of Organic Systems*, 8(1), 2013.

Human Digestive System Disorders

- We are seeing an alarming increase in the US in many diseases related to the gut
  - Crohn's disease, inflammatory bowel disease, colitis, acid reflux disease, gluten and casein intolerance, celiac disease, leaky gut
- The gut-brain axis links neurological disorders with gut disorders
- I believe that glyphosate is a major cause


CHECK OUT
OUR NEW
GLUTEN
FREE
AISLE!


REVISED AND UPDATED
CELIAC DISEASE
A HIDDEN EPIDEMIC
• End your medical odyssey and get the right diagnosis
• Treat symptoms and complications
• Learn how to live a gluten-free life
IS GLUTEN MAKING YOU SICK?
Peter H. R. Green, M.D.
Director of the Celiac Disease Center at Columbia University
and Rory Jones

Recent Publication (Dec. 2013)

Interdiscip Toxicol. 2013; **Vol. 6**(4): 159–184.
doi: 10.2478/intox-2013-0026
Published online in:
www.intertox.sav.sk & www.versita.com/it

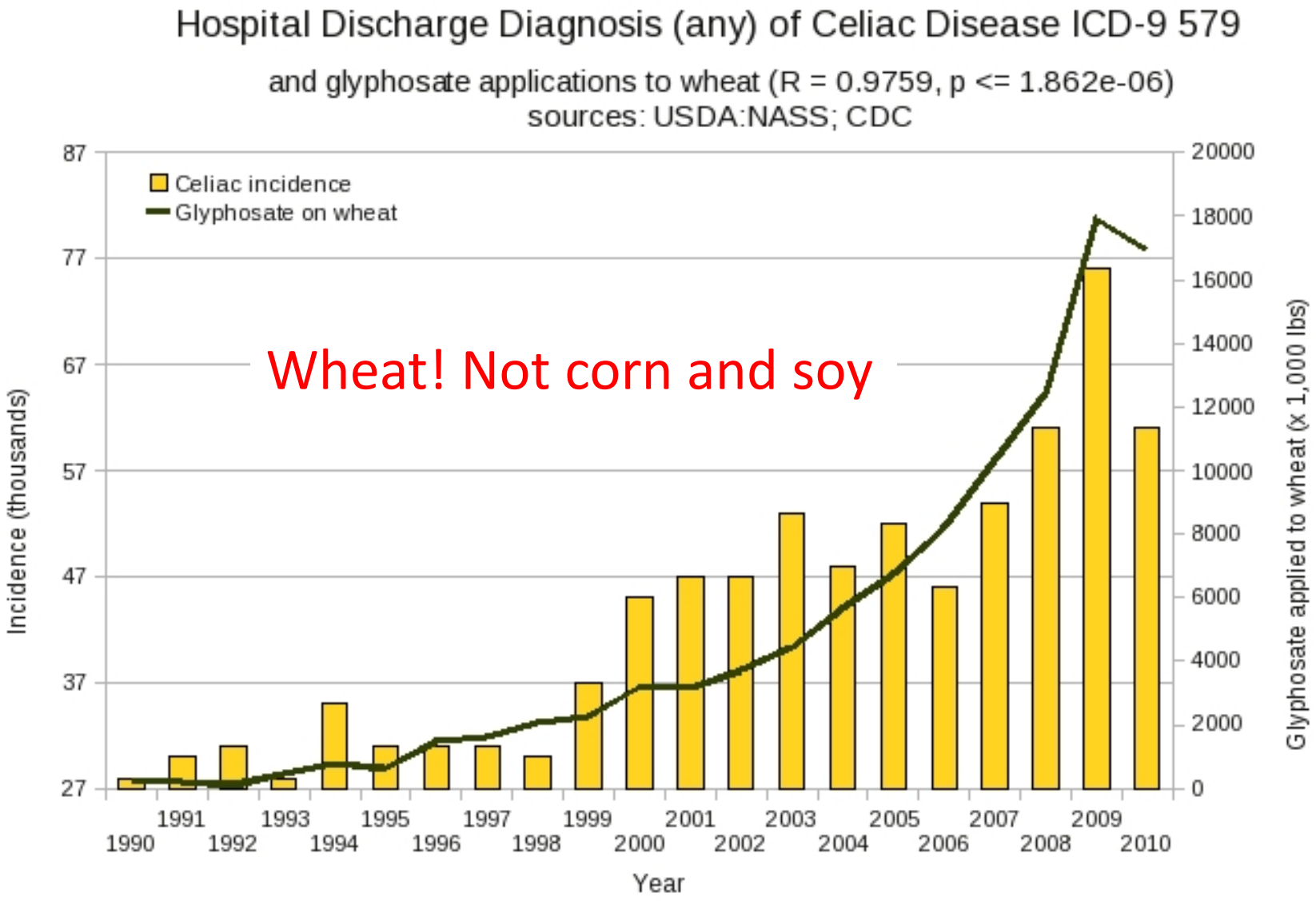
VERSITA

interdisciplinary toxicology

REVIEW ARTICLE

Glyphosate, pathways to modern diseases II: Celiac sprue and gluten intolerance

Anthony SAMSEL [1] and Stephanie SENEFF [2]



Graph provided by Nancy Swanson, with permission

Desiccation with Glyphosate*

- Advantages:
  - Hastens maturity to harvest
  - Weed control for next year's crop
  - Reduces green material and therefore strain on harvesting machinery

- Disadvantages
  - Herbicide cannot be washed out prior to human use.
  - Animals fed herbicide-treated crops --> contamination in animal products
- Crops include wheat, barley, legumes, corn, sunflower, kiwi, grapes (wine), raspberries, apples, soybeans, alfalfa, sugar cane

"We may be able to knock out 80% to 90% of the resistant ryegrass with glyphosate."

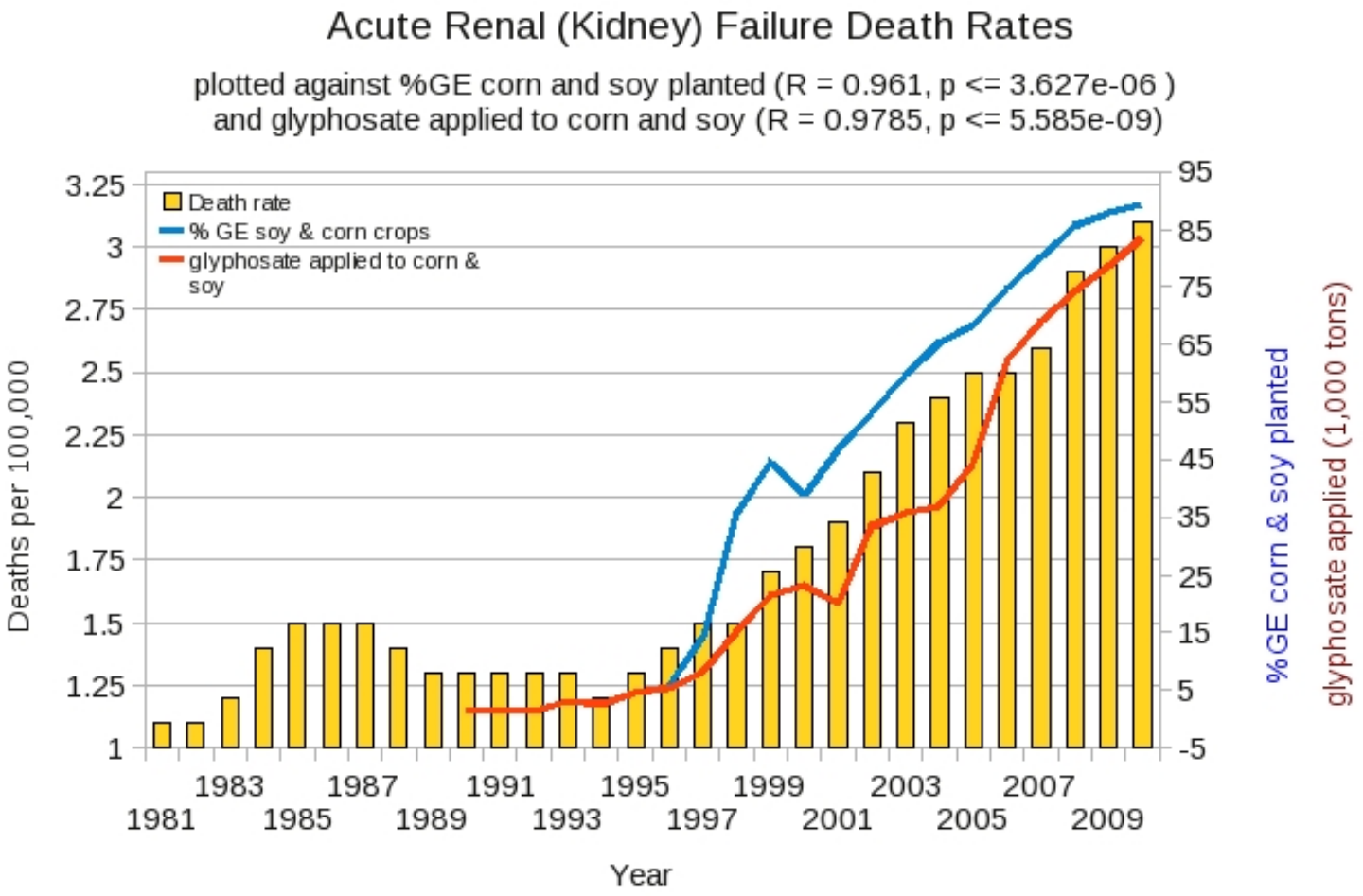
*Ron Smith, Western Farm Press, Mar. 23, 2013

Celiac Disease, Glyphosate and Non Hodgkin's Lymphoma

- Glyphosate preferentially kills bifidobacteria*
- Bifidobacteria are depleted in celiac disease**
- Celiac disease is associated with increased risk to non Hodgkin's lymphoma***
- Glyphosate itself is also linked directly to non Hodgkin's lymphoma****

*A.A. Shehata et al., Curr Microbiol. 2013 Apr;66(4):350-8.
** M. Velasquez-Manoff, NY Times Sunday Review, Feb. 23, 2013.
*** C. Catassi et all, JAMA. 2002 Mar 20;287(11):1413-9.
****M. Eriksson et al., Int J Cancer. 2008 Oct 1;123(7):1657-63.

Acute Kidney Disease Death Rate Plotted Against Glyphosate and GMOs*



*Plot prepared by Nancy Swanson from available data online

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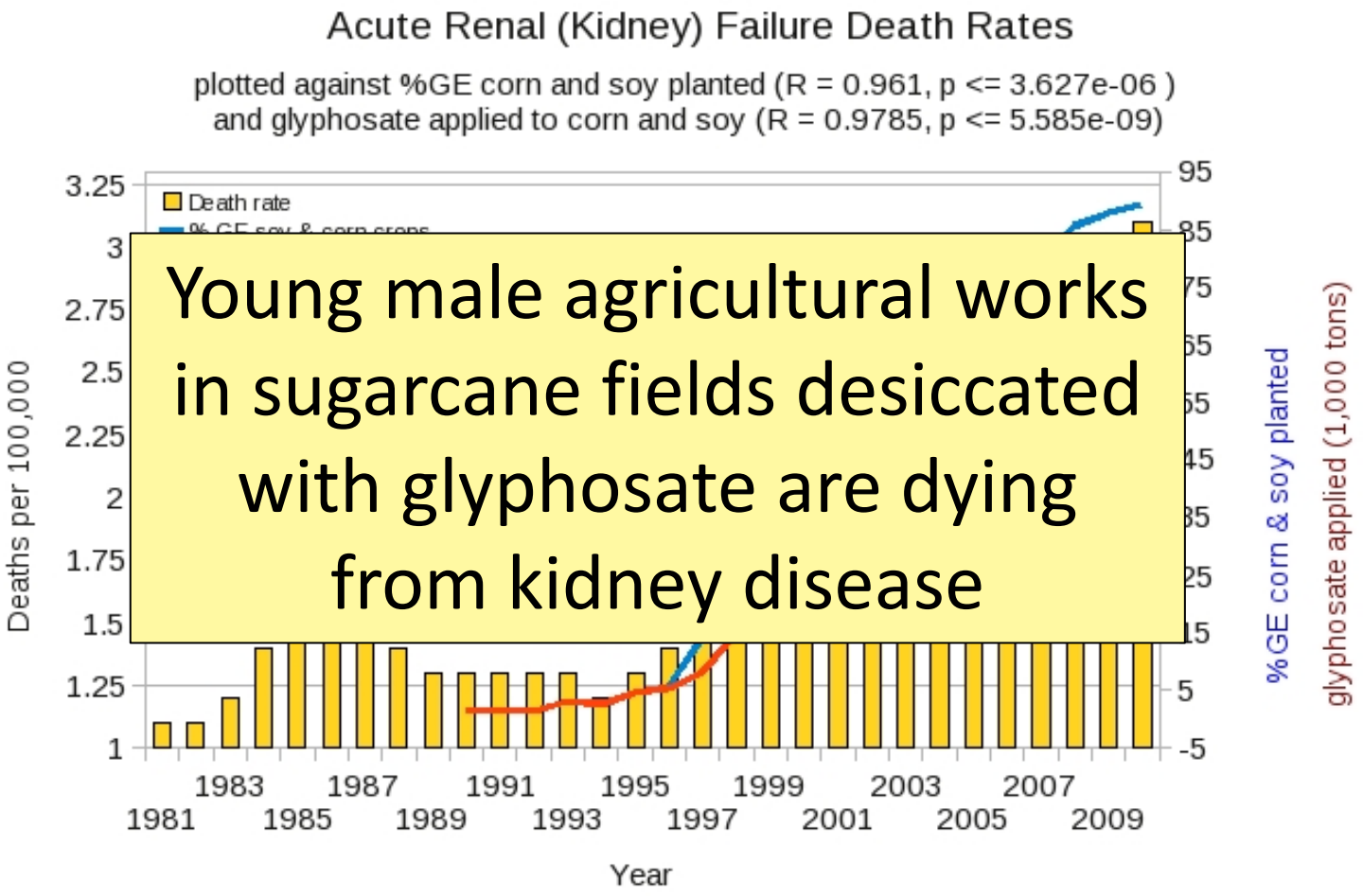

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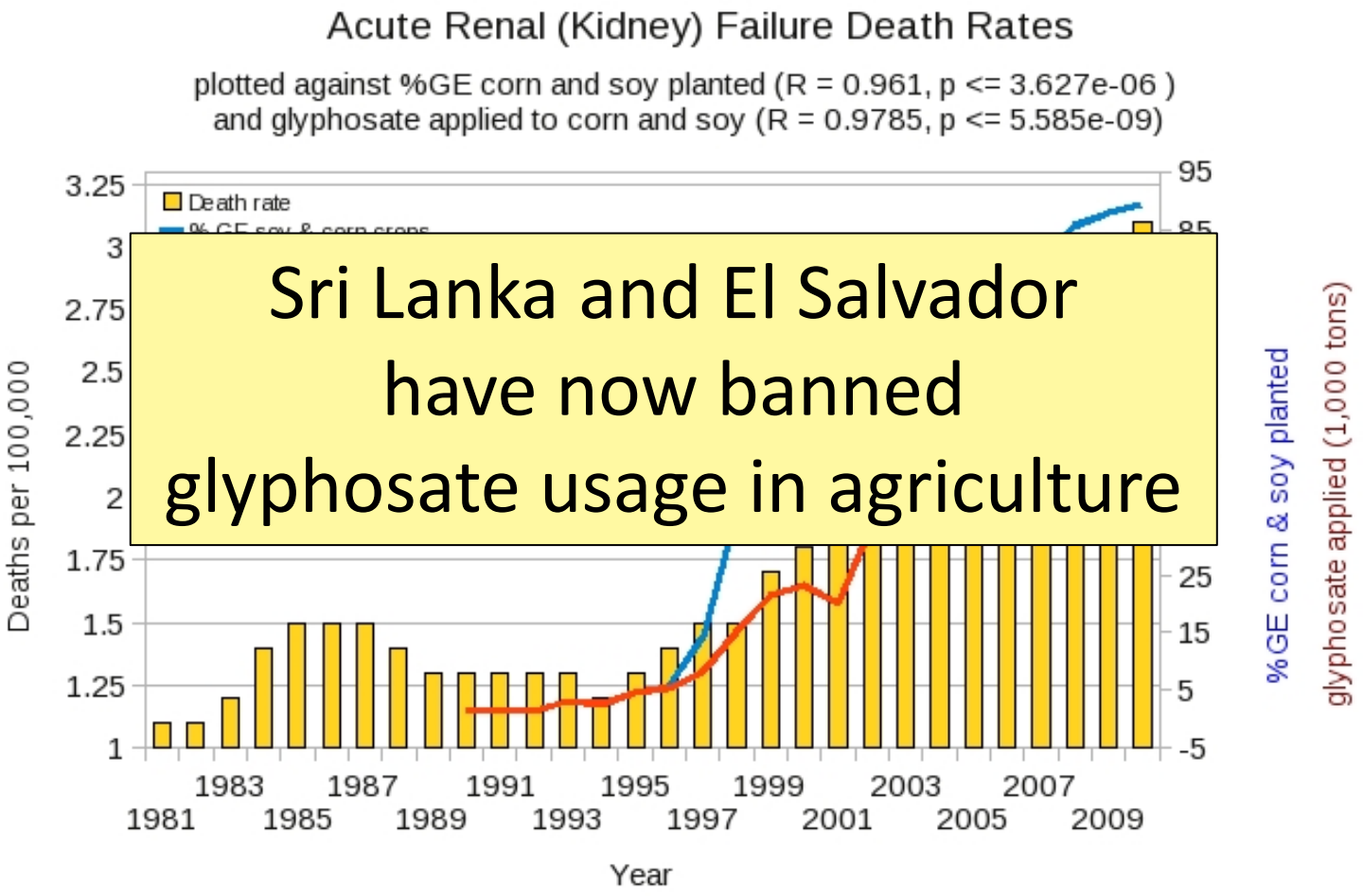


*Plot prepared by Nancy Swanson from available data online

Endocrine Disruption and Cancer

Roundup Safety Claims Disputed*

"It is commonly believed that Roundup is among the safest pesticides. … Despite its reputation, Roundup was by far the most toxic among the herbicides and insecticides tested. This inconsistency between scientific fact and industrial claim may be attributed to huge economic interests, which have been found to falsify health risk assessments and delay health policy decisions."

*R. Mesnage et al., Biomed Research International, 2014 *In Press*

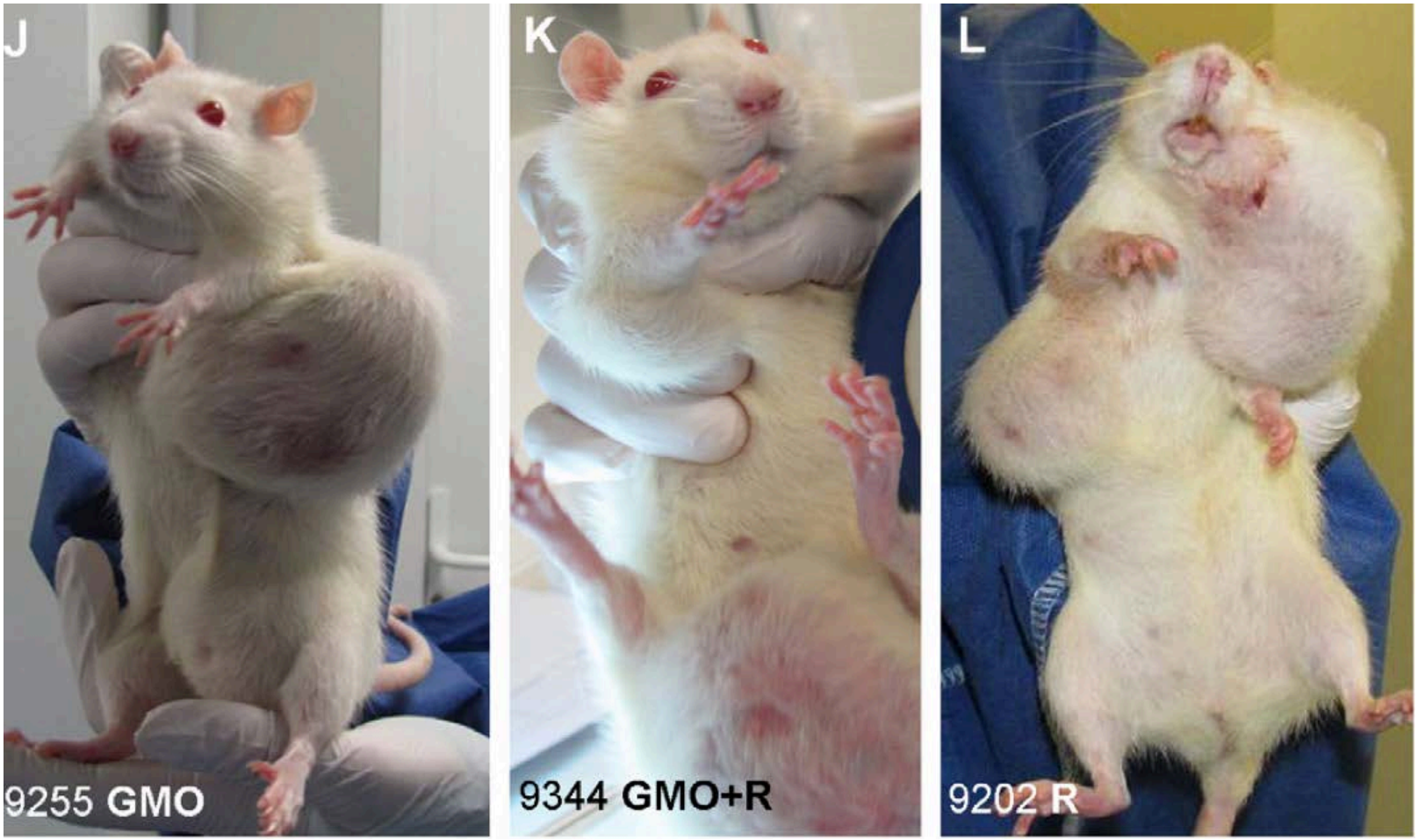
Glyphosate is an endocrine disruptor that promotes breast cancer*

- Low and environmentally relevant concentrations of glyphosate possess estrogenic activity
- Glyphosate caused human hormone-dependent breast cancer cells to proliferate at concentrations of *parts per trillion*

* S. Thongprakaisang et al., Food Chem Toxicol. 2013 Jun 8. S0278-6915(13)00363-3.

Mammary Tumors in Rats*

Rats through their entire lifespan exposed to Roundup at levels well below established safety limits



*G.-E. Séralini et al., Food Chem. Toxicol. (2012) [retracted]
http://dx.doi.org/10.1016/j.fct.2012.08.005

Glyphosate and Anencephaly*

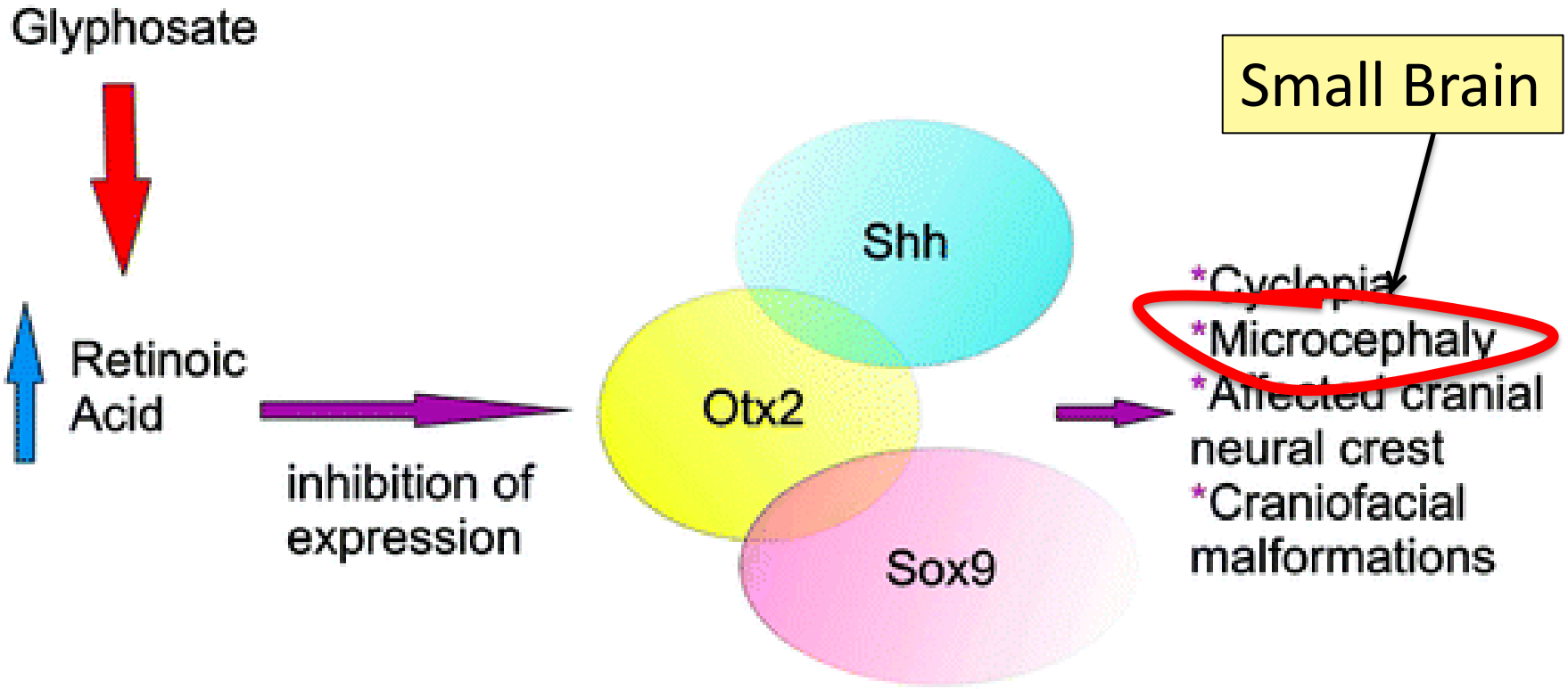
- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by the birth defect, anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
  - 47 (63%) of these were detected
  - Glyphosate was applied in large amounts, but was not studied

- 5% solution of glyphosate was also used heavily around irrigation ditches to control weeds
  - Main herbicide recommended due to its "low toxicity"

Glyphosate has been linked to anencephaly due to its effect on retinoic acid

*__Barbara H. Peterson__. __Farm Wars__, http://farmwars.info/?p=11137

Glyphosate Upregulates Retinoic Acid*



*A. Carrasco, Teratogenesis by glyphosate based herbicides and other pesticides. Relationship with the retinoic acid pathway. In Breckling, B. & Verhoeven, R. (2013) GM-Crop Cultivation – Ecological Effects on a Landscape Scale. Theorie in der Ökologie 17. Frankfurt, Peter Lang.

An Important Paper (2012)

Environmental & Analytical
Toxicology

Antoniou et al., J Environ Anal Toxicol 2012, S:4
http://dx.doi.org/10.4172/2161-0525.S4-006

Review Article Open Access

Teratogenic Effects of Glyphosate-Based Herbicides: Divergence of Regulatory Decisions from Scientific Evidence

M Antoniou[1], MEM Habib[2], CV Howard[3], RC Jennings[4], C Leifert[5], RO Nodari[6], CJ Robinson[7]* and J Fagan[8]*

"A substantial body of evidence demonstrates that glyphosate and Roundup cause *teratogenic* effects and other toxic effects on reproduction, as well as *genotoxic* effects. From an objective scientific standpoint, attempts by industry and government regulatory bodies to dismiss this research are unconvincing and work against the principle that it is *the responsibility of industry to prove that its products are safe* and not the responsibility of the public to prove that they are unsafe."

Glyphosate Kills Liver Cells*

- Doses far below those used in agriculture kill liver cells in vitro
- Downregulated synthesis of glutathione, critical for detox of environmental chemicals
- Upregulated synthesis of CYP enzymes
  - Likely due to interference with their function

*C. Gasnier et al., Journal of Occupational Medicine and Toxicology 2010, 5:29.

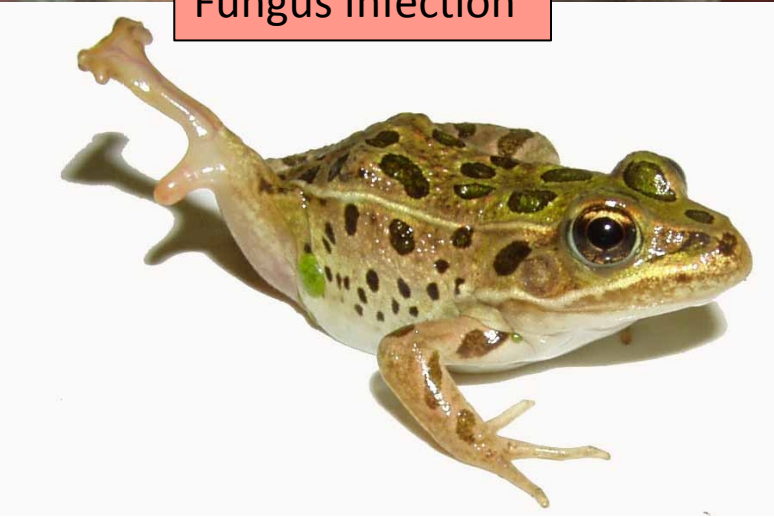
Species in Stress

Species in Stress

Fungus Infection

Fungus Infection

Fungus Infection



Fungus Infection

*R. Mason et al., Journal of Environmental Immunology and Toxicology 1:1, 3-12; 2013

*Roundup herbicide enhances the growth of aflatoxin-producing fungi**

*Barberis et al., Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2013, 48(12), 1070-1079.

"Aflatoxins are mutagenic, carcinogenic, teratogenic, hepatotoxic, immunosuppressive, and they also inhibit several metabolic systems"*

*Barberis et al., Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2013, 48(12), 1070-1079.

Summary

- I believe we need to be very worried about glyphosate in the food and water supplies
- Glyphosate's disruption of gut bacteria, depletion of essential amino acids and minerals, and interference with cytochrome P450 enzymes have widespread consequences
- Glyphosate may be the most important factor in the recent die-off of many species
- Glyphosate may be the most important factor in the U.S. health crisis related to obesity, autism, dementia, celiac disease, kidney failure, etc.