GMOs and Roundup: A Marriage Made in Hell

Stephanie Seneff

Wise Traditions Workshop, London

February 8, 2014

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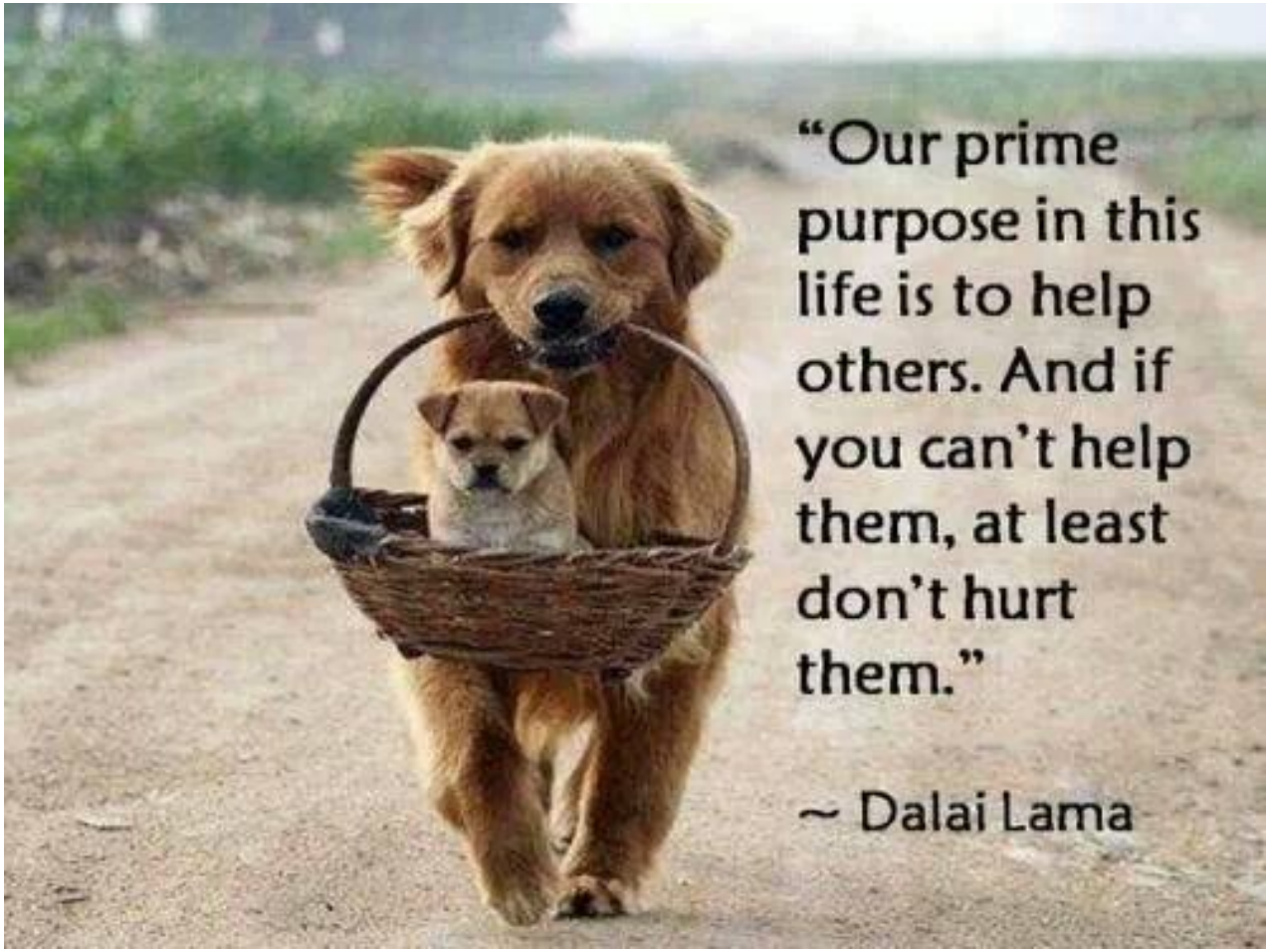
http://people.csail.mit.edu/seneff/London2014/SeneffGlyphosate2014.pptx

Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.

-- Margaret Mead

US anthropologist (1901 - 1978)


"Our prime purpose in this life is to help others. And if you can't help them, at least don't hurt them."
~ Dalai Lama

Outline

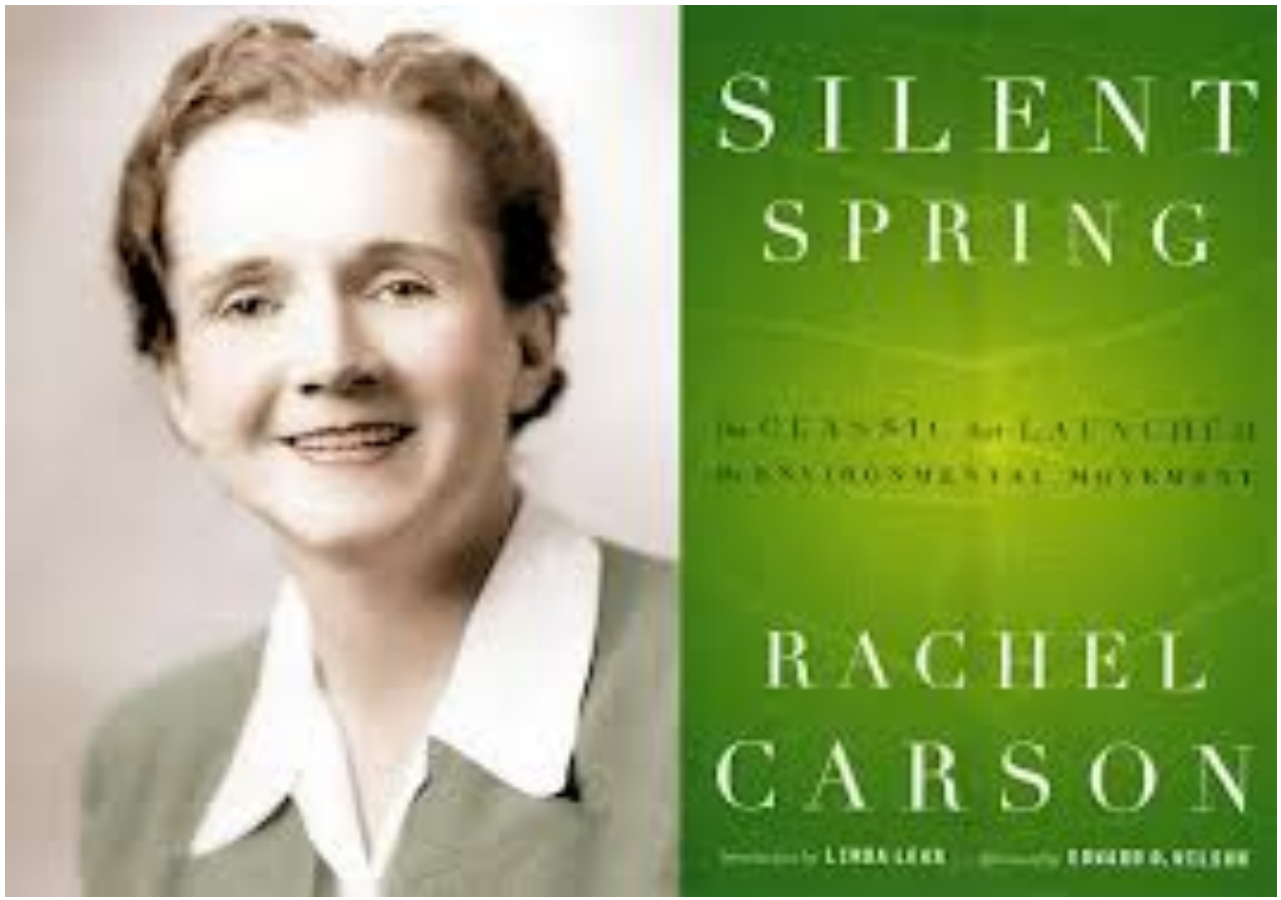
- Introduction
- Autism
- Obesity and Digestive Disorders
- GMO Crops and Dying Species
- Endocrine Disruption and Cancer
- Nutrient Deficiencies and Climate Change
- Summary

*"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

Silent Spring (1962)

Argued that uncontrolled and unexamined pesticide use was harming and even killing not only animals and birds, but also humans.



Industry Attacks on Dissent: From Rachel Carson to Oprah*

"Monsanto manufactured ***DDT*** and polychlorinated biphenyls (***PCBs***) before they were banned by the U.S. Environmental Protection Agency in the 1970s. It still makes a long list of synthetic chemicals and aggressively markets genetically engineered products like ***bovine growth hormone*** … and genetically modified seeds. A billion-dollar company when "Silent Spring" first appeared, Monsanto published a parody of Carson's work, called "The Desolate Year," in the October 1962 issue of Monsanto Magazine. Since then, Monsanto has become a ***corporate role model in sugar-coating unpalatable facts and silencing dissent.***"

*Laura Orlando
http://www.dollarsandsense.org/archives/2002/0302orlando.html

Autism

"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

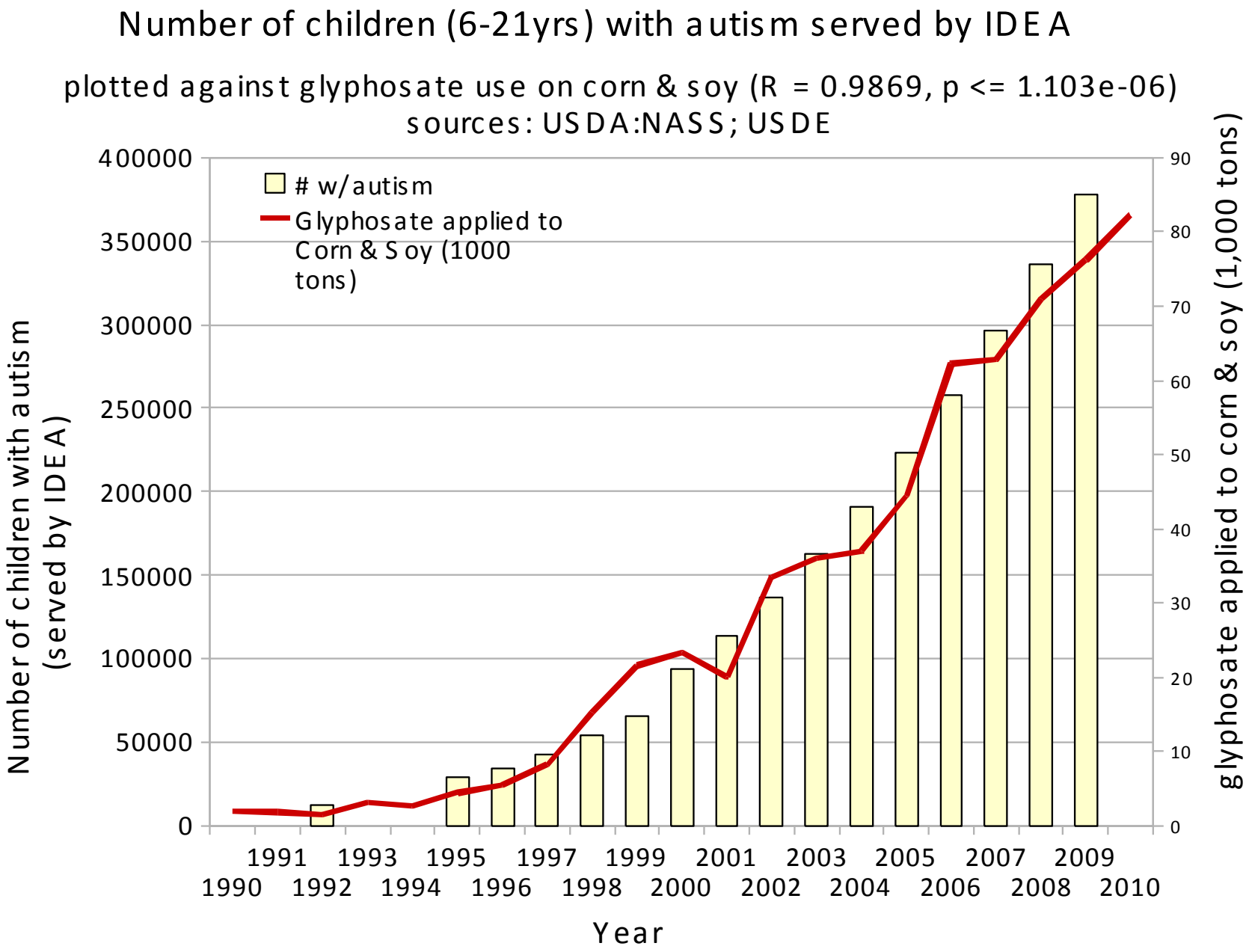
Is there a toxic environmental substance that has been on the rise since 1980 and that could account for these comorbidities?


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.

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



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

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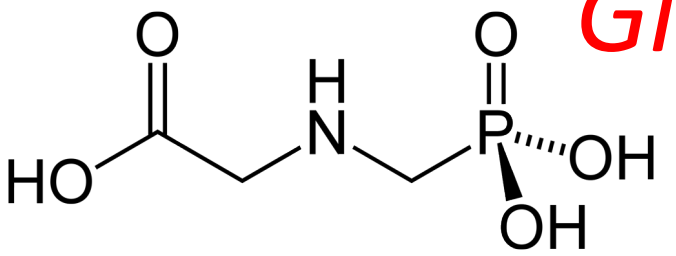
Received: 15 January 2013; in revised form: 10 April 2013 / Accepted: 10 April 2013 / Published:

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



Glyphosate!!

- Glyphosate is now the #1 herbicide in use in the U.S. and is increasingly used around the world
  - Developed and patented by Monsanto in the 1970's
  - Introduced into the US food chain in 1974
  - Came out from under patent in 2000
  - Inhibits an enzyme in the *shikimate pathway* involved in synthesis of tyrosine, tryptophan and phenylalanine (the three *aromatic amino acids*)
- Huge expansion of GMO corn, soy, cotton and canola crops has led to sharp increases in the last decade

Is Glyphosate Nontoxic?

- Monsanto has argued that glyphosate is harmless to humans because we don't have the shikimate pathway
- 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

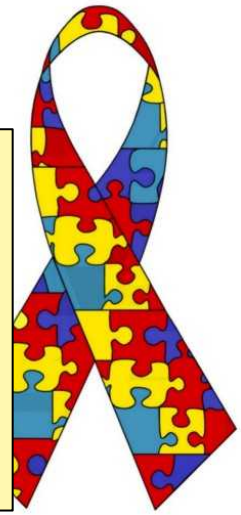
Some Biomarkers for Autism

- 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

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
- Interferes with synthesis of aromatic amino acids and methionine
- Disrupts sulfate synthesis and sulfate transport

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

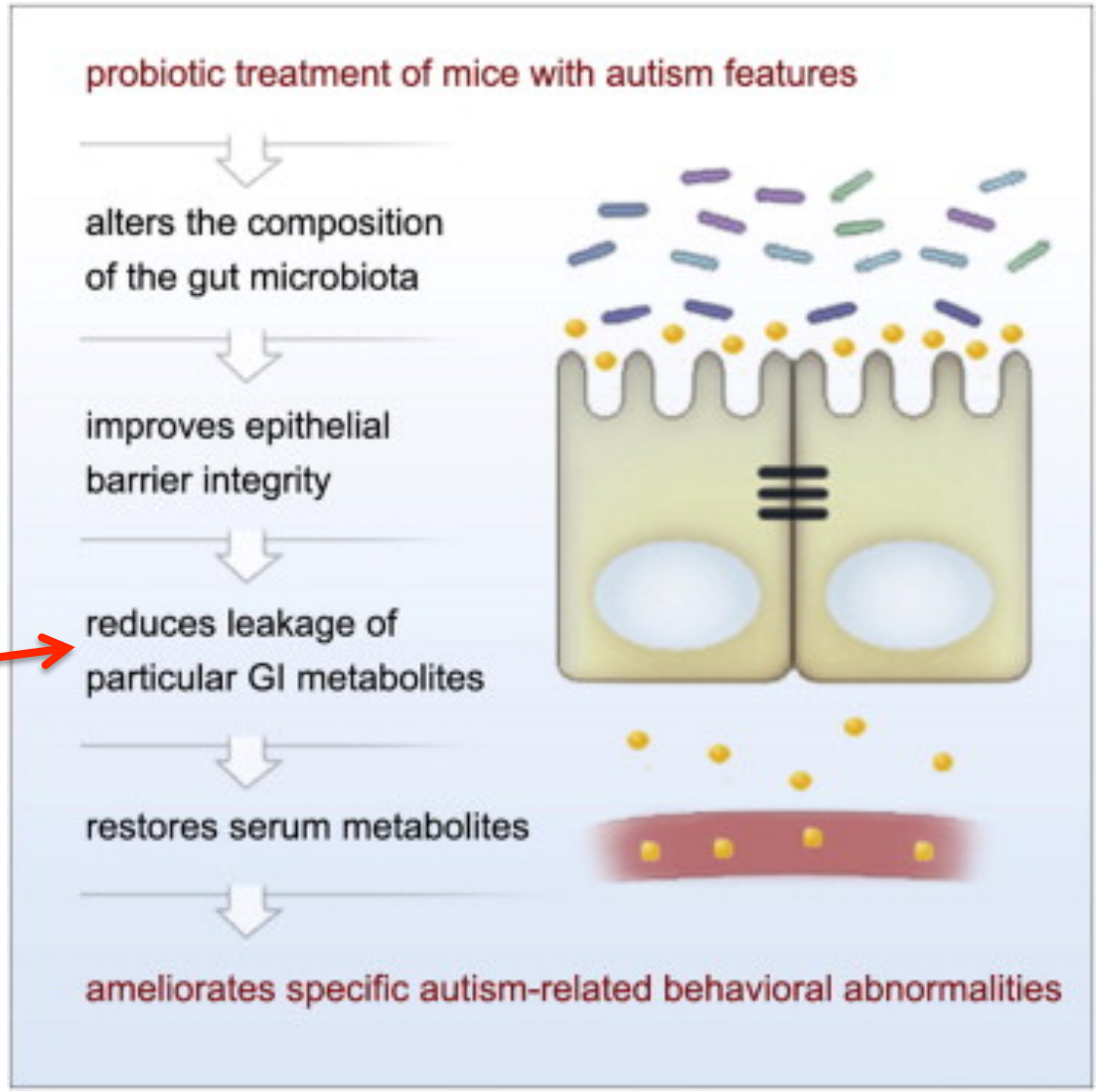
Aromatase

"Aromatase protein is significantly reduced in the frontal cortex of autistic subjects relative to sex- and age-matched controls"*

- Aromatase is a *CYP enzyme* that converts testosterone to estrogen
- Its association with autism explains the fact that boys are four to five times as susceptible as girls to autism.

*T. Sarachana et al., PLoSONE, Feb. 2011, 6(2):e17116

Probiotics Treat Mouse Autism*



P-cresol

*Graphical Abstract from E.Y. Hsiao et al., Cell, Dec. 5, 2013

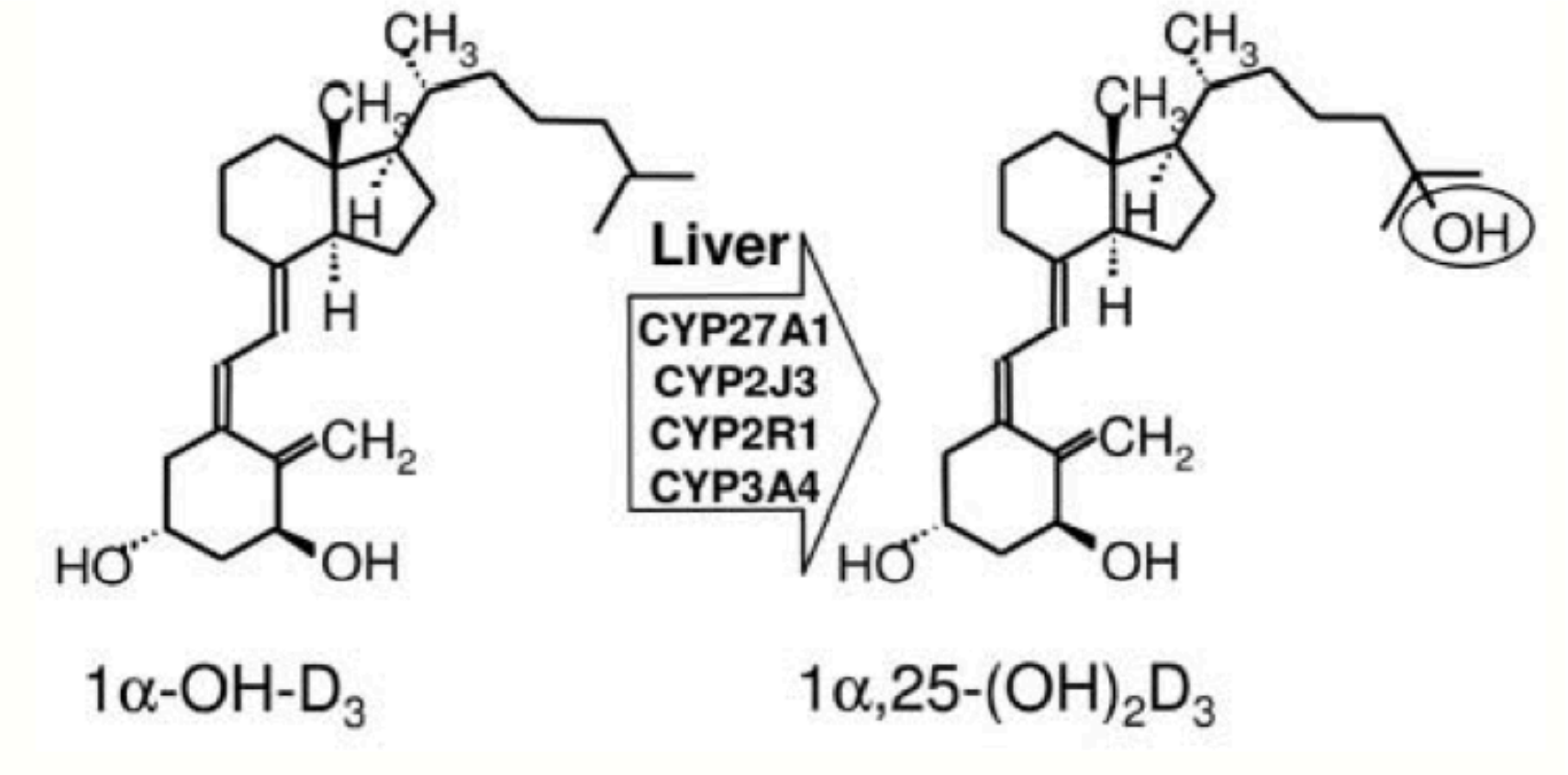
P-Cresol is Key*

- Studied mice engineered to be autistic
  - They suffered from a leaky gut
  - Reduced levels of *Bacteroides fragilis in gut*
  - Level of 4-ethylphenylsulphate (4EPS) was *46x* higher than that of the control group
  - 4EPS is closely related to p-Cresol (a toxic phenol)
  - p-Cresol is produced by Clostridium *difficile*
  - Glyphosate induces Clostridium *difficile* overgrowth
- Exposing normal mice to 4EPS induces autistic behaviors

*E.Y. Hsiao et al., Cell, Dec. 5, 2013

CYP Enzymes Activate Vitamin D3*

This takes place in the liver, and the same enzymes detoxify a number of pharmaceutical drugs



* Figure 1 in Glenville Jones et al., Anticancer Research 26: 2589-2596 (2006)

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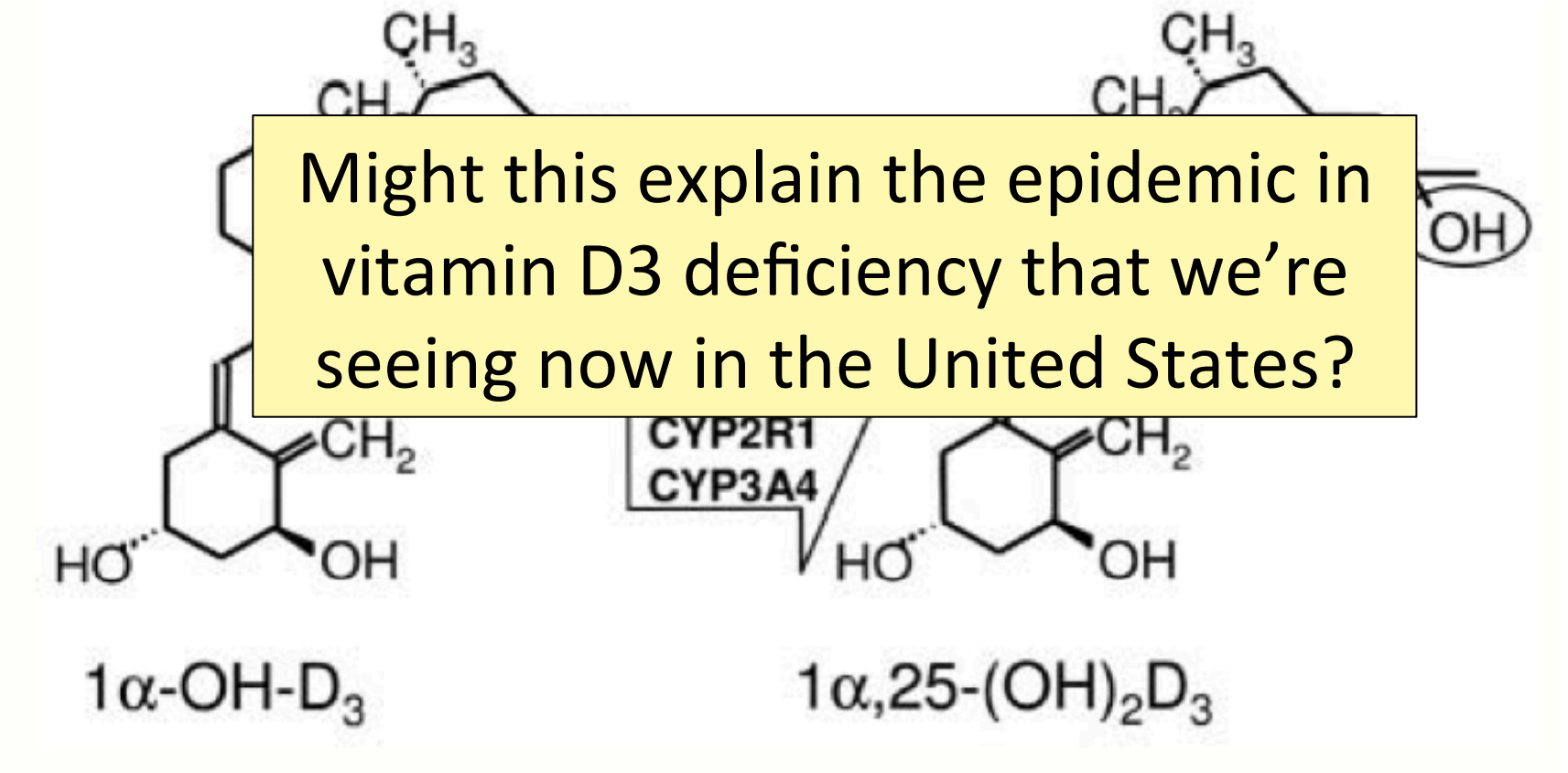

Might this explain the epidemic in vitamin D3 deficiency that we're seeing now in the United States?

* Figure 1 in Glenville Jones et al., Anticancer Research 26: 2589-2596 (2006)

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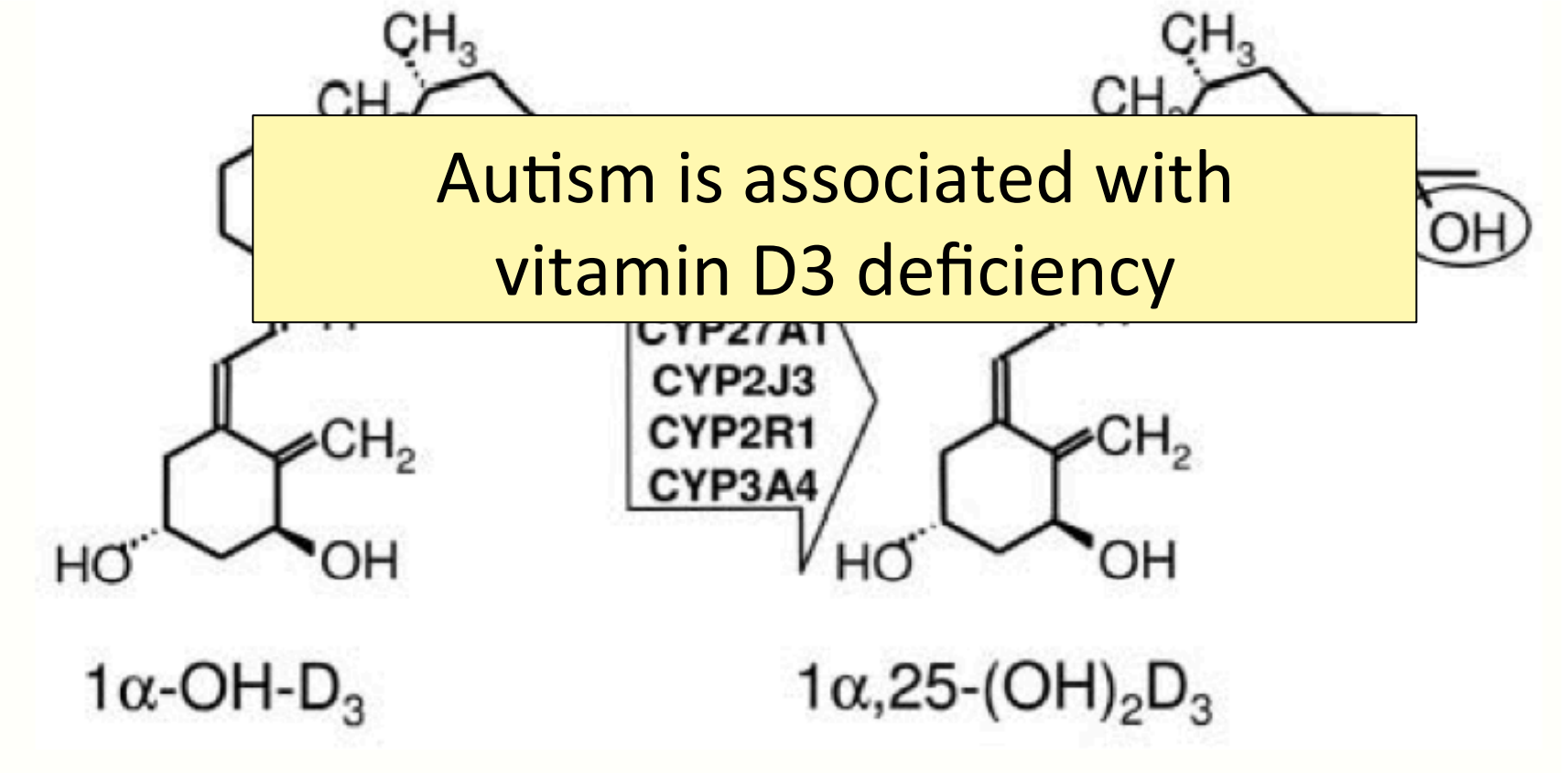
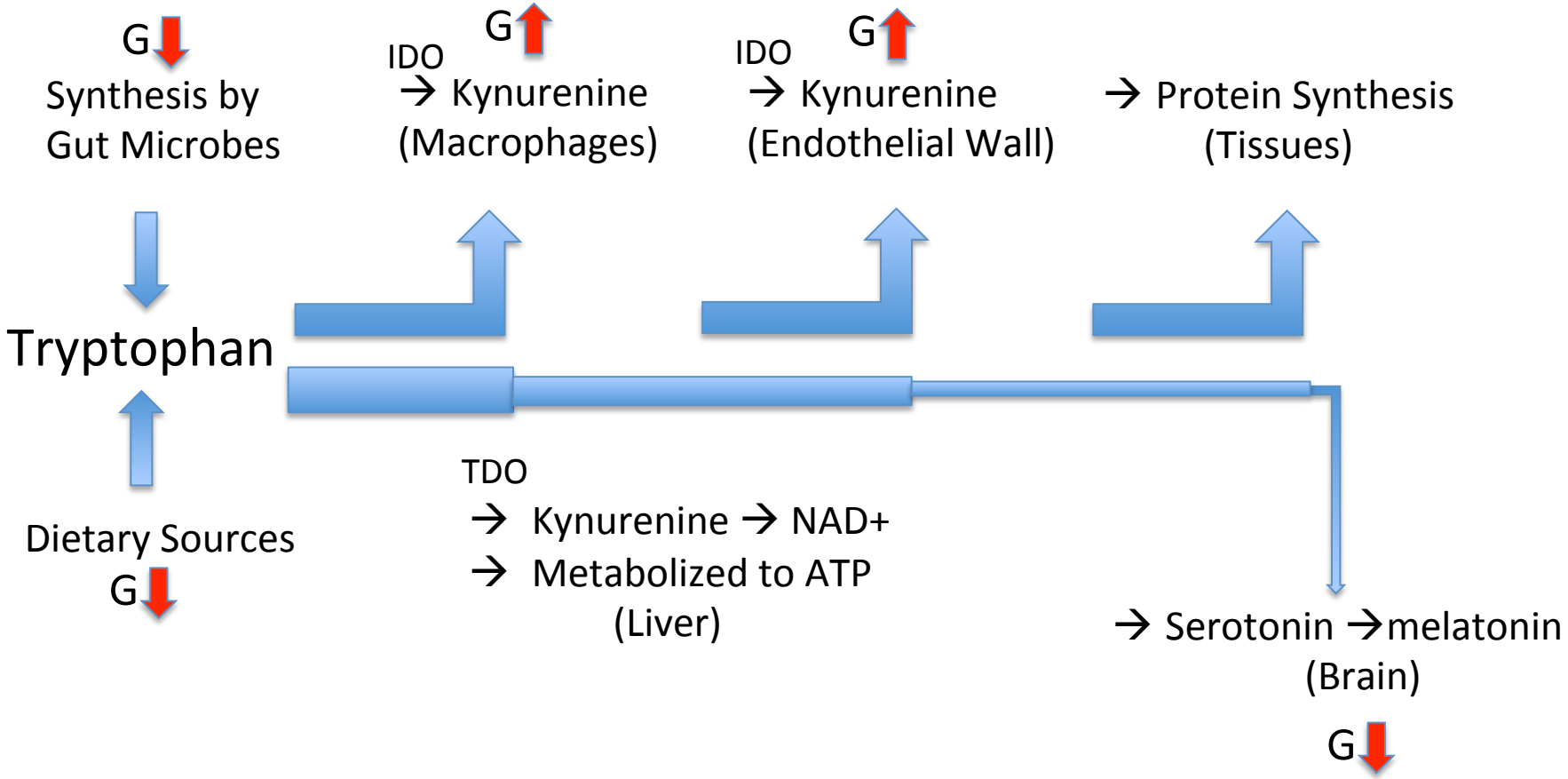


* Figure 1 in Glenville Jones et al., Anticancer Research 26: 2589-2596 (2006)

How Glyphosate Depletes Serotonin and Melatonin

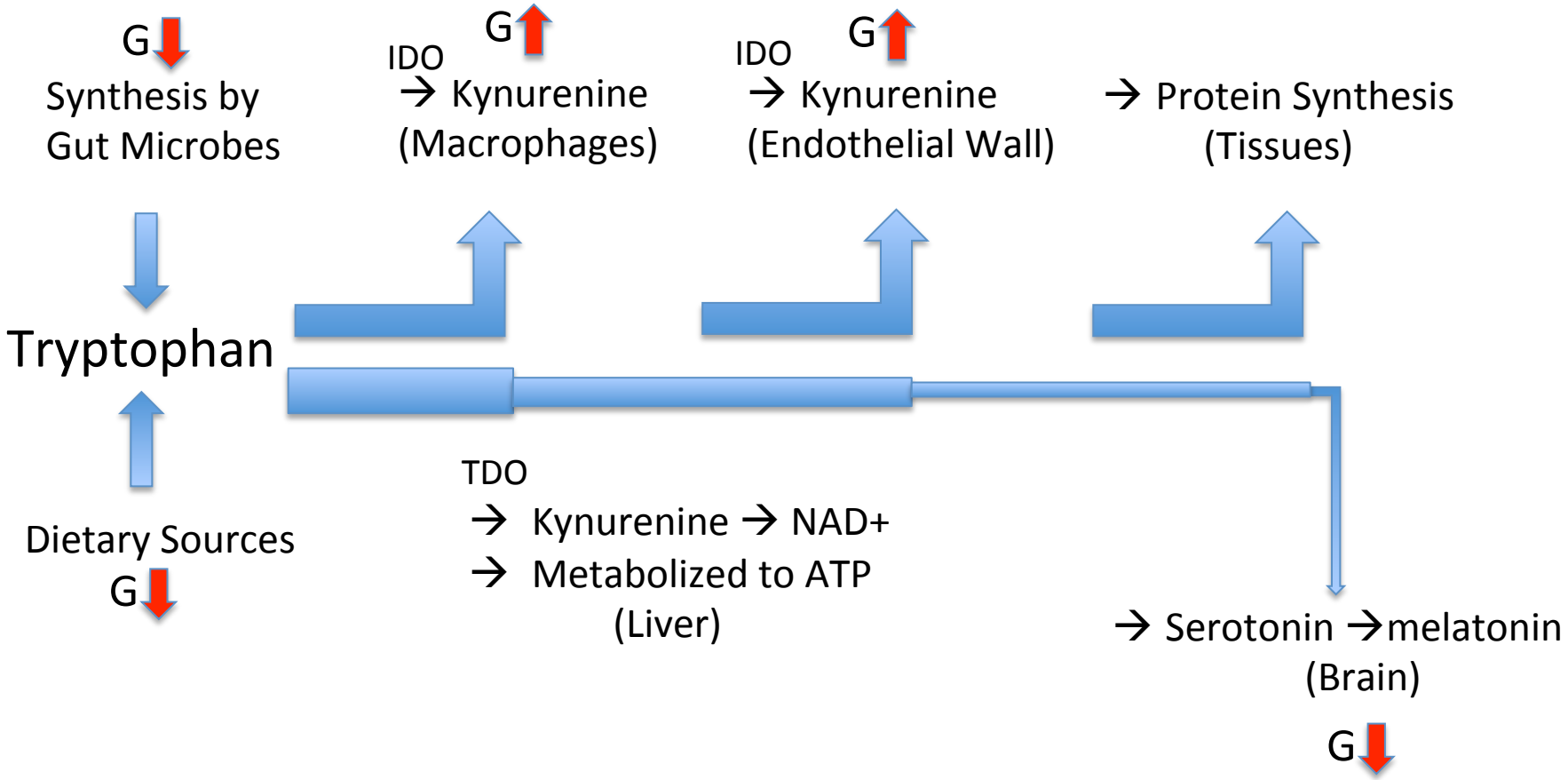
Plasma serotonin levels in autism mothers were significantly lower than in mothers of normal children ($P = 0.002$)*



*S.L. Connors et al., Plasma Serotonin in Autism. Pediatric Neurology 35(3), Sep 2006, 182-186.

How Glyphosate Depletes Serotonin and Melatonin

Serotonin deficiency is linked to not only autism but also obesity, depression, Alzheimer's disease and violent behavior



*S.L. Connors et al., Plasma Serotonin in Autism. Pediatric Neurology 35(3), Sep 2006, 182-186.

Recapitulation

- Autism rates have been increasing at an alarming rate in recent years, in step with increases in glyphosate application to GMO crops
- Autism is associated with disrupted gut bacteria, overproduction of p-cresol, and deficiencies in serotonin, zinc, iron, vitamin D3, and aromatase
- Most of the biomarkers associated with autism can be explained by known biological effects of glyphosate

Obesity and Digestive Disorders

Dr. Roy Dittman*

"If the microbial world is the substrate for life, why are we waging war on it?"

"The same chemicals we use to sterilize our environment sterilize us."

*Talk at AutismOne Conference, May 25, 2013 Chicago, Illinois

Is Glyphosate Making Us Obese?

Obesity in US over Time*

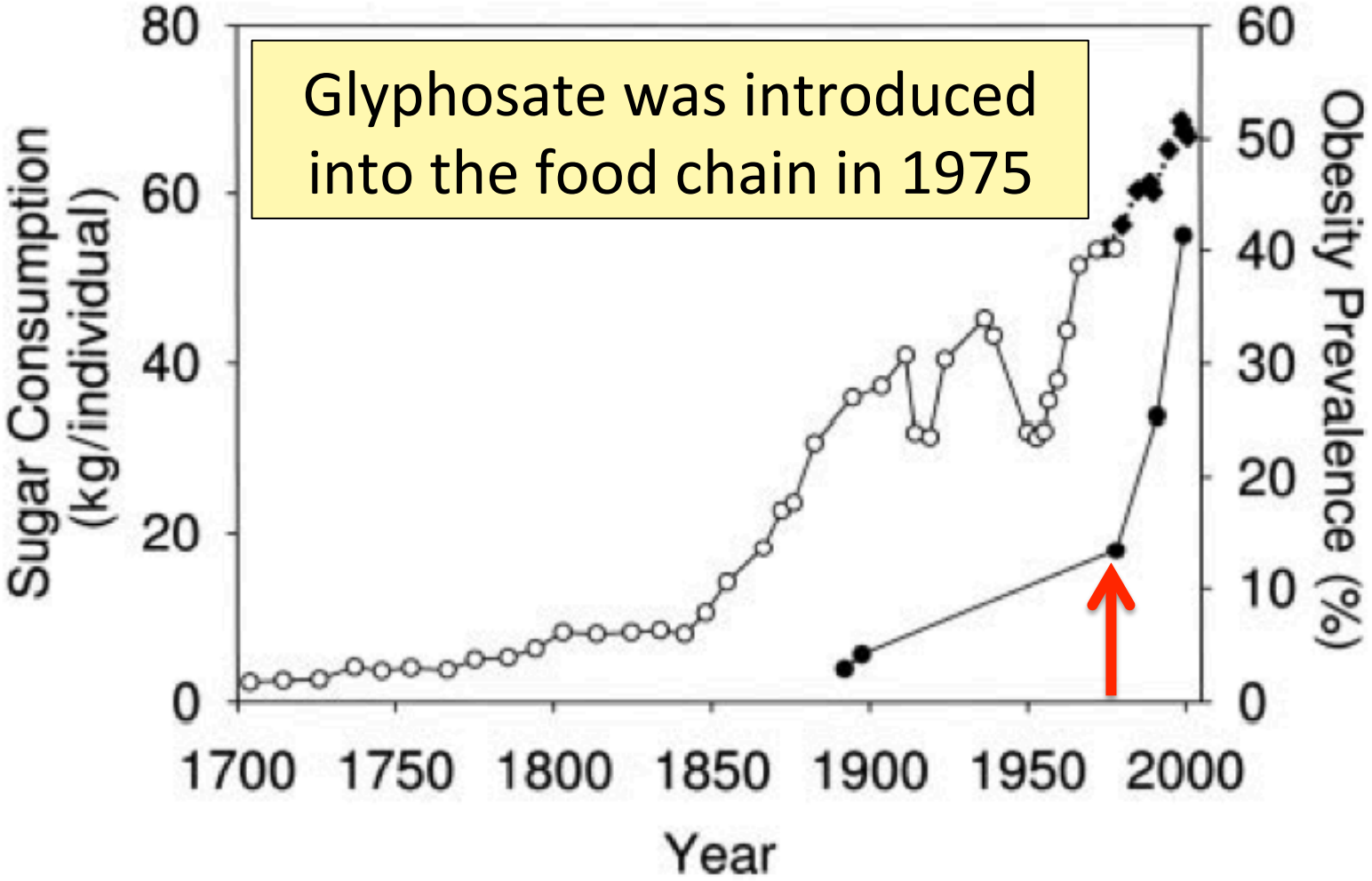
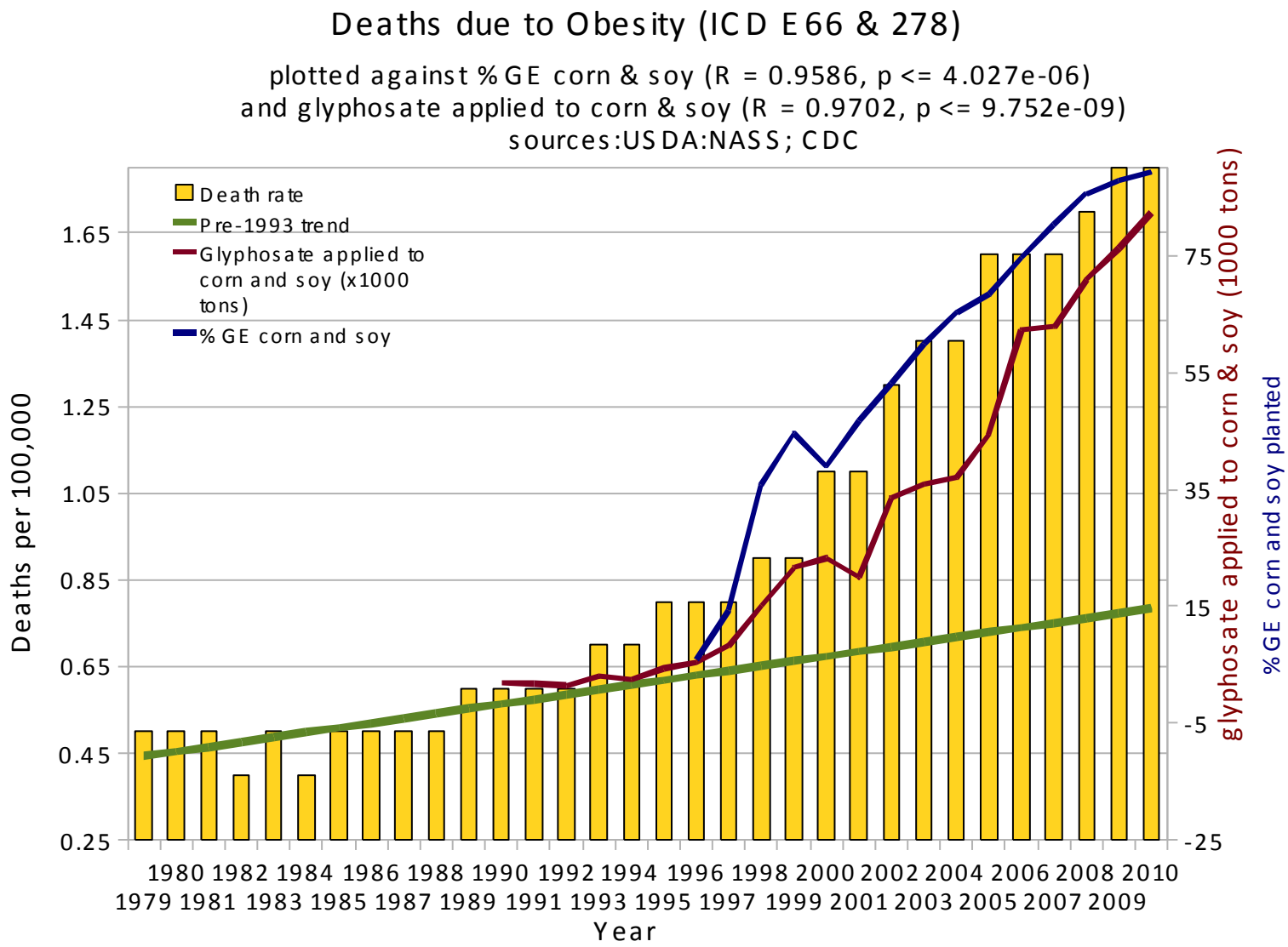


*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.



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

Obesity Switch*

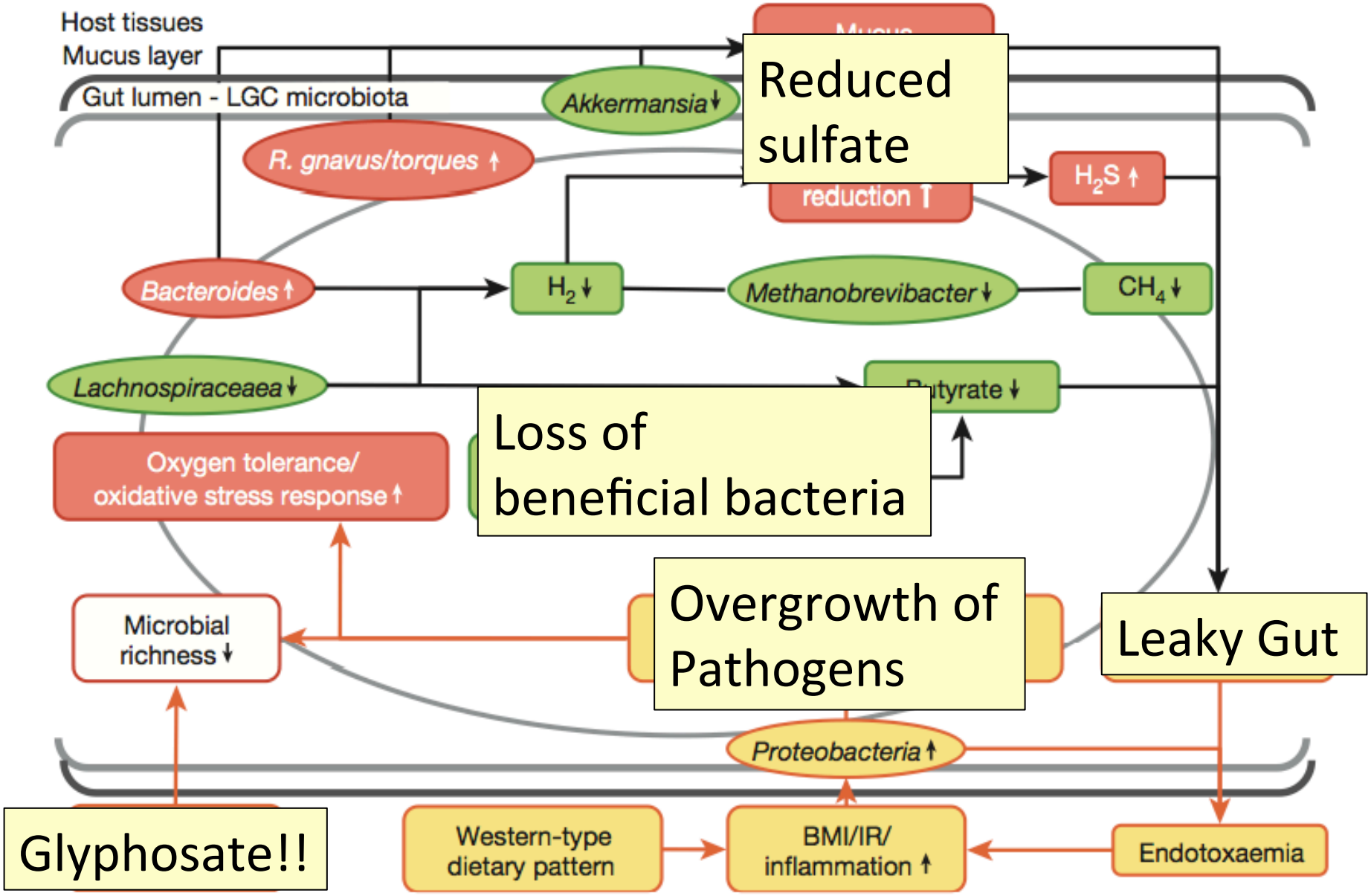


*Figure 3, Le Chatelier et al., Nature 500, Aug 29, 2013, 541-548.

America's Two-Headed Pig*

Treating Nutritional Deficiencies and Disease in a Genetically Modified, Antibiotic Resistant and Pesticide Dependent World

*book by Leah Dunham, www.americastwoheadedpig.com, 2013

Some Observations from Leah Dunham's Book

- Calves are born too weak to walk, with enlarged joints and limb deformities.
- As many as 20% of piglets experience a "failure to thrive" following weaning
- Cows on a diet of GMO corn and soy develop twisted gut, ulcers and other digestive disorders
- She suspects glyphosate as a major player

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

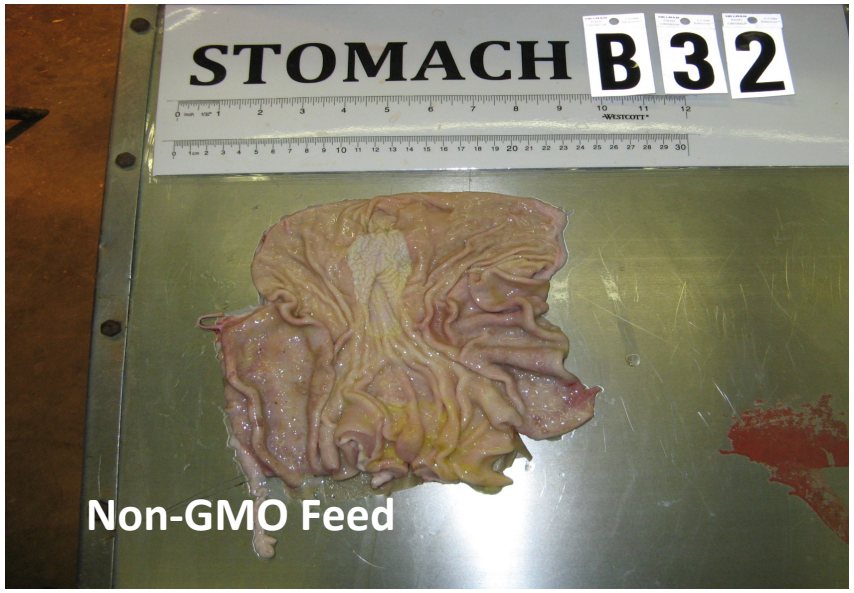
Follow-on Experiment:

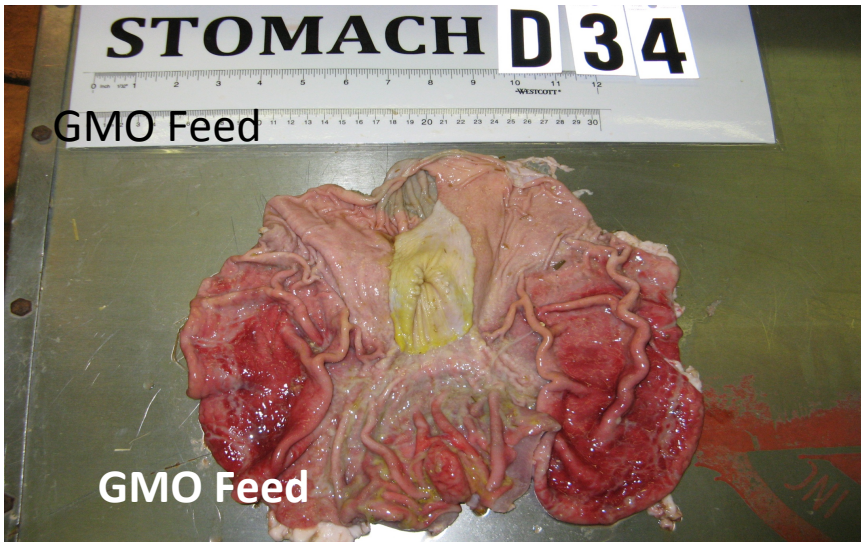
- 168 just-weaned pigs fed "typical diet," soy and corn, until slaughtered
  - Half fed GMO versions, half organic.

*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.

“Deformities, sickness and livestock deaths: the real cost of GM animal feed?”*

"When using GM feed I saw symptoms of bloat, stomach ulcers, high rates of diarrhoea, pigs born with the deformities ... but when I switched [to non GM feed] these problems went away, some within a matter of days.”

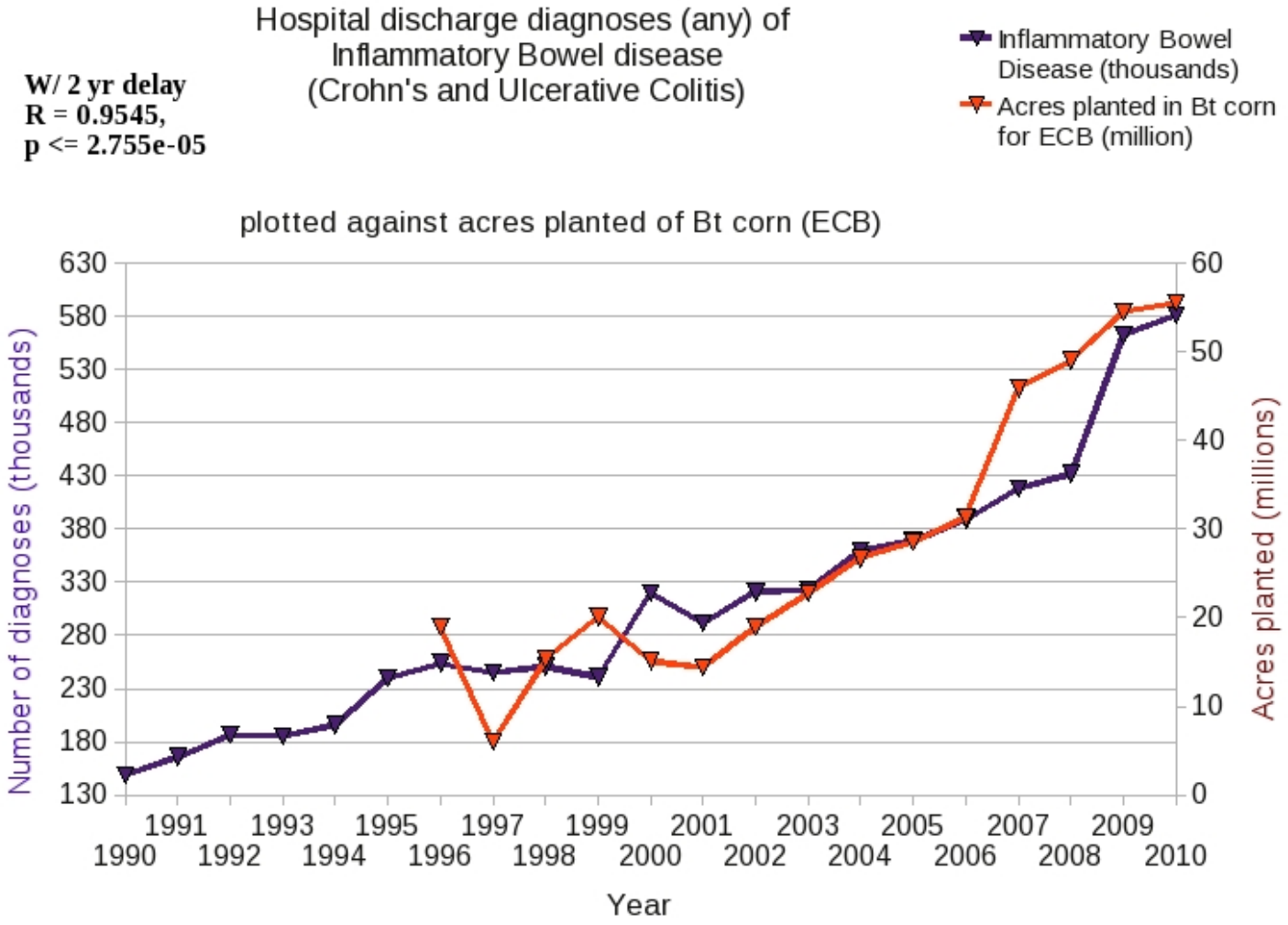
Quote from Ib Pedersen, producer of 13,000 pigs a year supplying Europe's largest pork company, Danish Crown

*Andrew Wasley, Nov. 28, 2013, The Ecologist., theecologist.org/News/news_analysis/2176082/deformities_sickness_and_livestock_deaths_the_real_cost_of_gm_animal_feed.html

Human Digestive System Disorders

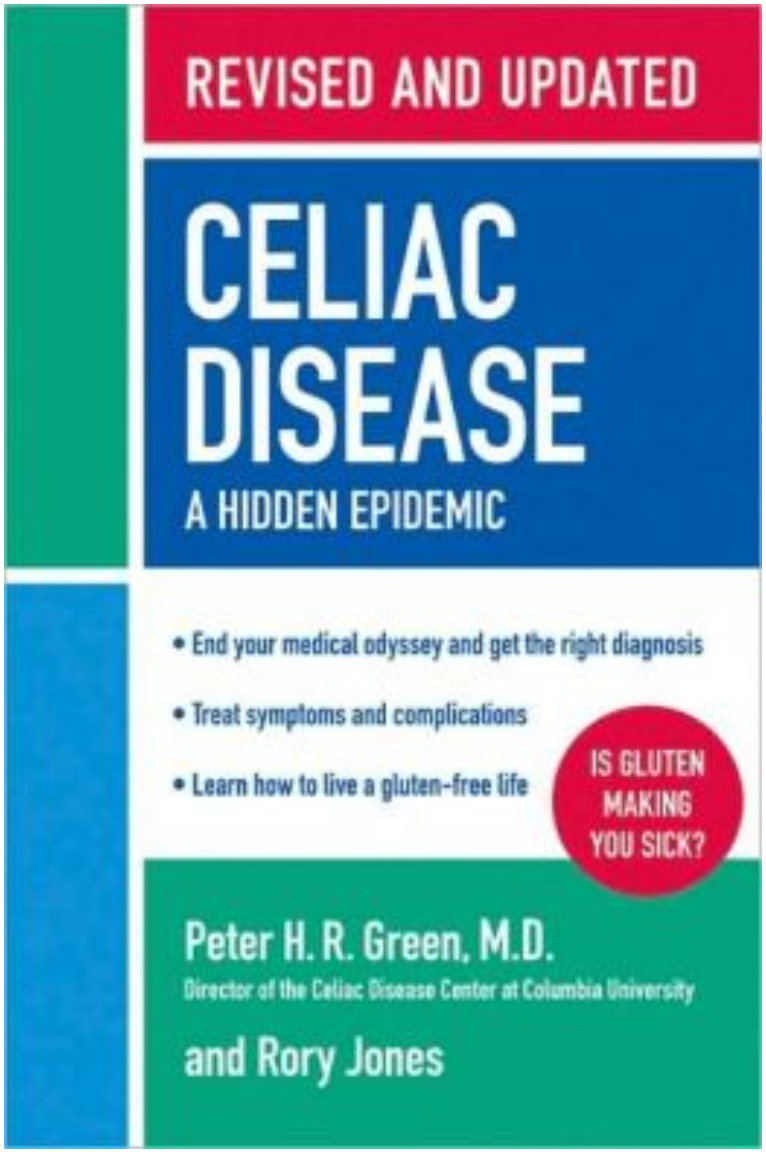
- We are seeing an alarming increase in the US in many diseases related to the gut
  - Crohn's disease, inflammatory bowel disease, colitis, acid reflux disease, gluten and casein intolerance, celiac disease, leaky gut
- The gut-brain axis links neurological disorders with gut disorders
- I believe that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

Inflammatory Bowel Disease and Bt Corn*



*http://sustainablepulse.com/wp-content/uploads/GMO-health.pdf


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

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.

"Herbicide Resistant Ryegrass Troubling for Wheat Growers"*

"If you see ryegrass at harvest following an Axial XL application, it may be resistant. And you can scatter seed all over the field with the combine."

"A reduced-tillage approach, using a burndown herbicide ahead of planting in a stale seedbed, also holds promise for improved control."

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

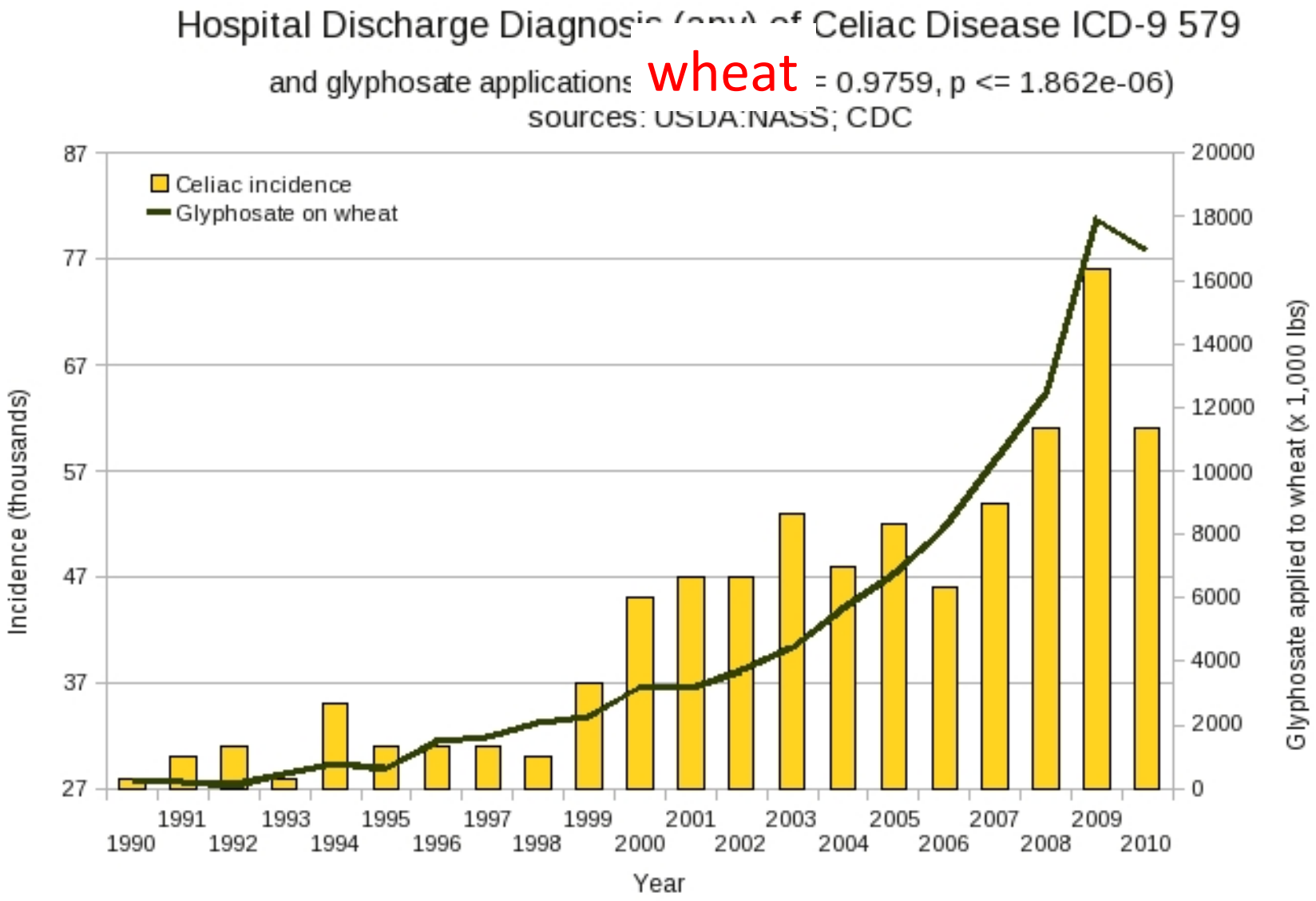
-- Jim Swart, integrated pest management specialist

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

Desiccation: It's Not Just Wheat

- 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



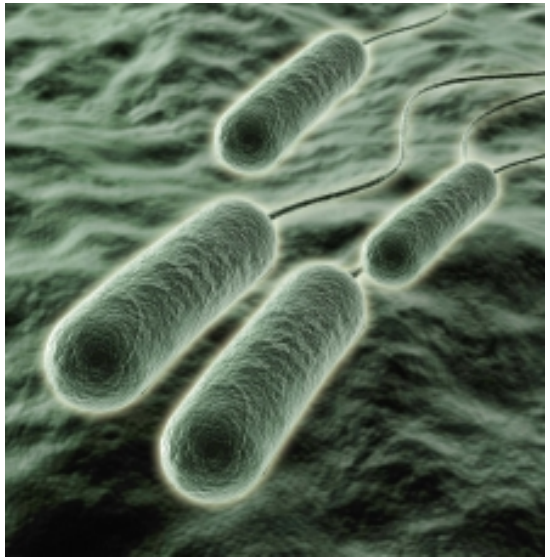
Graph provided by Nancy Swanson, with permission

"Dramatic Increase in Hospitalization of US Children With Inflammatory Bowel Disease"*

- Study conducted at Case Western Reserve University School of Medicine
- > 11 Million hospitalization records examined
- Patients < 20 years old
  - 49% increase from 2000 to 2009 in Crohn's disease discharges
  - 71% increase in ulcerative colitis discharges

* Science Daily, June 25, 2013

Pseudomonas and Formaldehyde



- There are only a few bacteria that can break down glyphosate completely: Pseudomonas aeruginosa, Pseudomonas sp, and Alcaligenes sp.
- Pseudomonas aeruginosa, a gram negative bacterium, is a major problem today in hospitals due to its resistance to multiple antibiotics*
  - It produces formaldehyde (a well established neurotoxin) as a by-product of glyphosate breakdown
  - It requires (and depletes) thiamine

*S. de Betnzmann and P. Plésiat Environ Microbiol. 2011 Jul;13(7):1655-65.

Kidney Failure in Agricultural Workers*

- Workers in sugarcane fields in Central America and in India are dying at a young age in record numbers from kidney failure
- Arsenic exposure from drinking water?
- Excess use of tylenol?

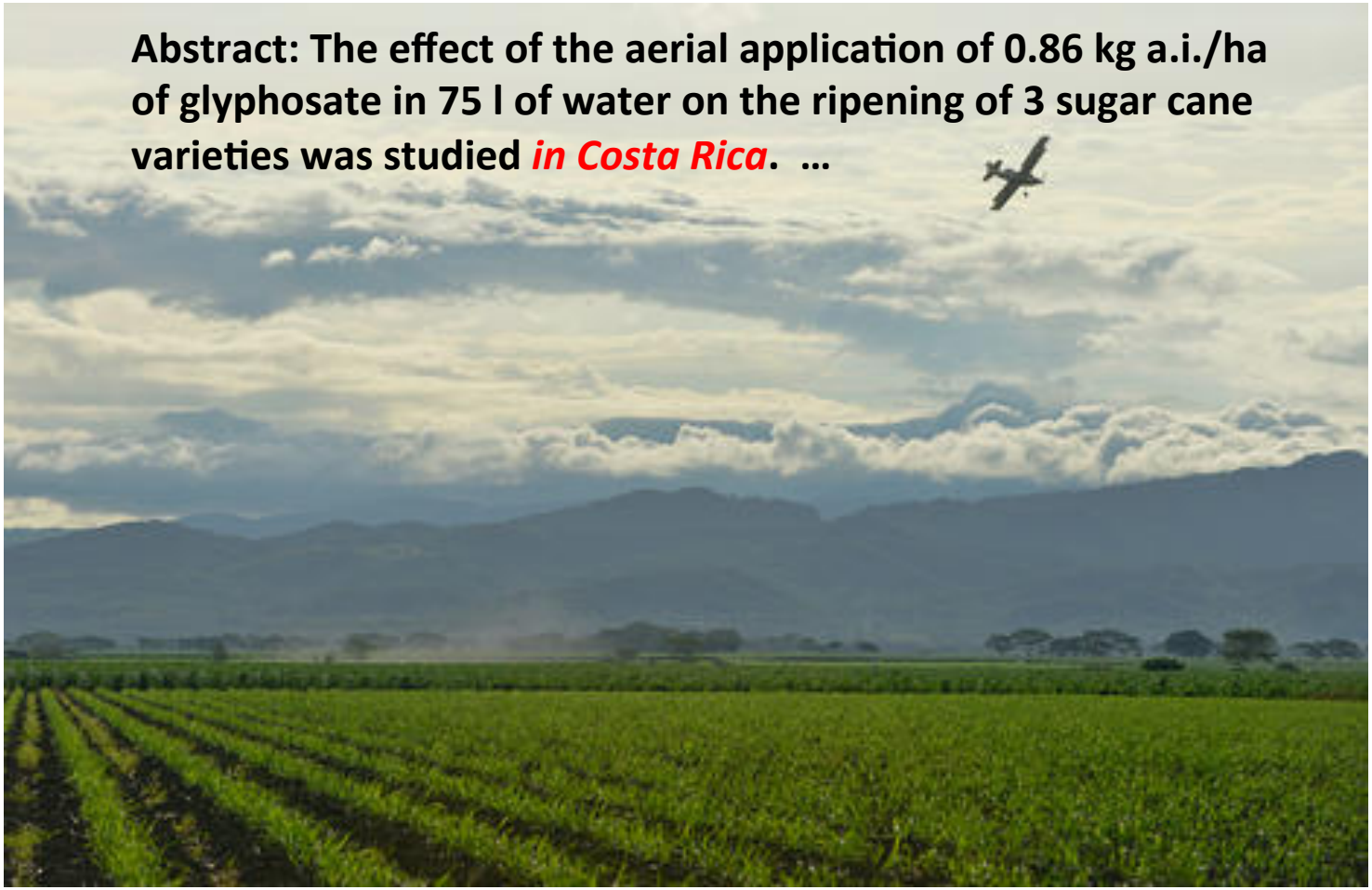
Glyphosate disrupts the CYP enzyme that breaks down tylenol, leading to tylenol toxicity

*ticotimes.net, San Jose, Costa Rica, August 8, 2013.

“What is killing the young men of Cañas?”*

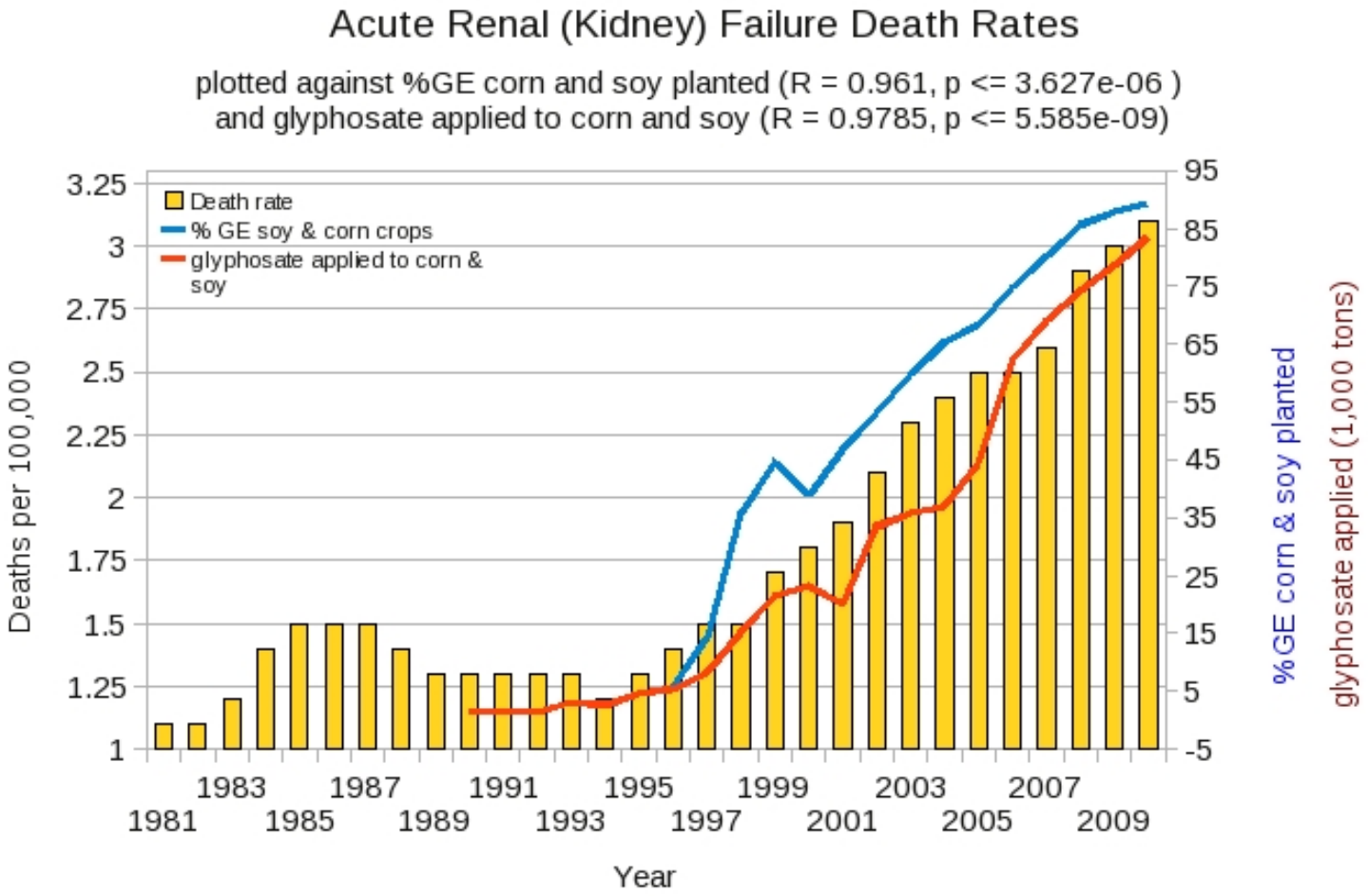
*ticotimes.net, San Jose, *Costa Rica*, August 8, 2013.

“What is killing the young men of Cañas?”*



*J.F. Subiros, The effect of applying glyphosate as ripener in three sugar cane varieties, Turrialba *1990*, 40(4), 527-534.

Acute Kidney Disease Death Rate Plotted Against Glyphosate and GMOs*



*Plot prepared by Nancy Swanson from available data online

Recapitulation

- Glyphosate disrupts gut bacteria, favoring pathogen overgrowth
  - Obesity can be encoded in gut microbe distributions
- Pigs fed a GMO diet develop inflammatory gut
  - Piglets fed GMOs fail to thrive
- Inflammatory bowel diseases are on the rise in America's youth
- Kidneys are failing in agricultural workers exposed to glyphosate
  - Glyphosate application over time correlates with deaths from kidney disease

GMO Crops and Dying Species

https://www.commondreams.org/view/2013/05/29-4

From WIKILeaks*

- "The United States is *threatening nations who oppose Monsanto's* genetically modified (GM) crops with military-style trade wars."
- "Nations like France, which have moved to ban one of Monsanto's GM corn varieties, were requested to be '*penalized*' by the United States for opposing Monsanto and genetically modified foods."
- "The information reveals just how deep Monsanto's roots have penetrated key positions within the United States government, with the cables reporting that many *U.S. diplomats work directly for Monsanto*."

*http://www.bibliotecapleyades.net/ciencia/ciencia_monsanto81.htm
*http://www.youtube.com/watch?v=eiK_RF3ioRw&feature=youtu.be

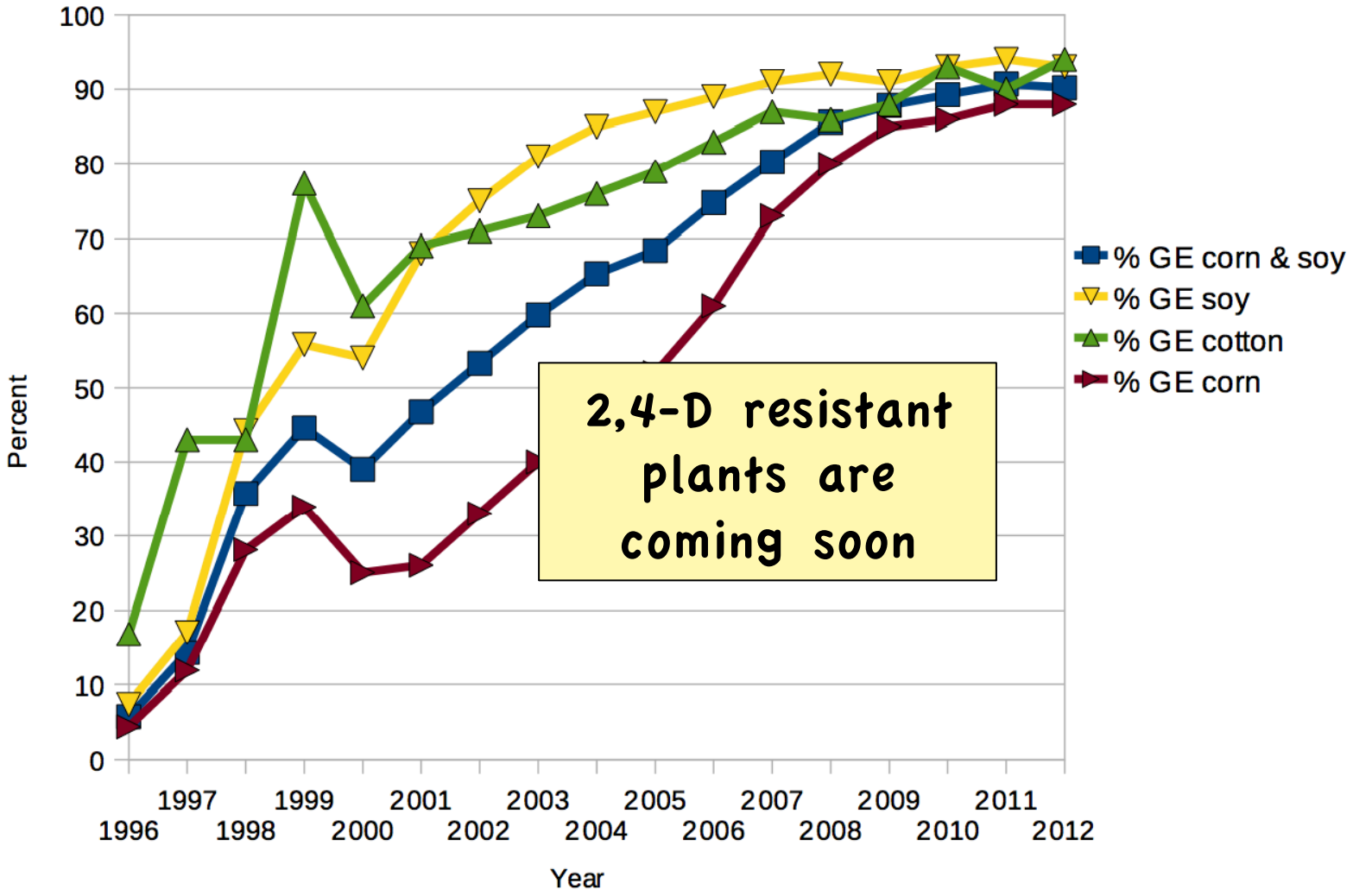
Have GMOs Worked?*

"Exactly *none* of the supposed benefits of GM crops - increased yields, more food production, controlled pests and weeds, reductions in chemical use in agriculture or drought-tolerant seeds - have actually materialized. … GMOs have resulted in *greater pesticide use* and the predictable emergence of *herbicide resistant super weeds*. In fact, 130 types of weeds in 40 states are now herbicide-resistant, increasing costs, cutting yields and leading to the use of *more powerful and increasingly toxic chemical herbicides*."

Dr. Brian Moench, Truthout, **Mankind: Death by Corporation**

*http://truth-out.org/opinion/item/17178-mankind-death-by-corporation

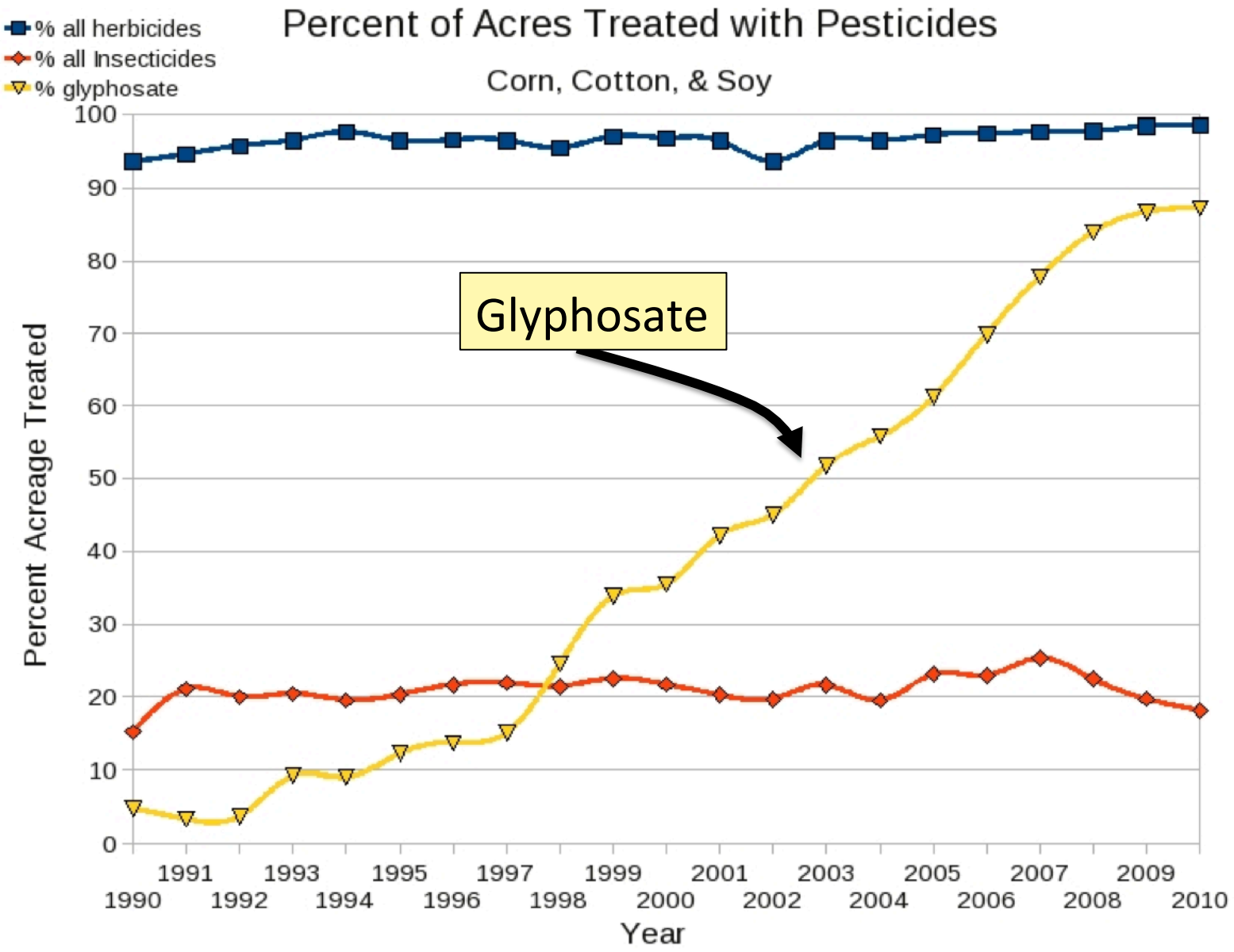
Tremendous Growth in GE Crops in Last 15 Years (U.S.)



Plots provided by Nancy Swanson, with permission

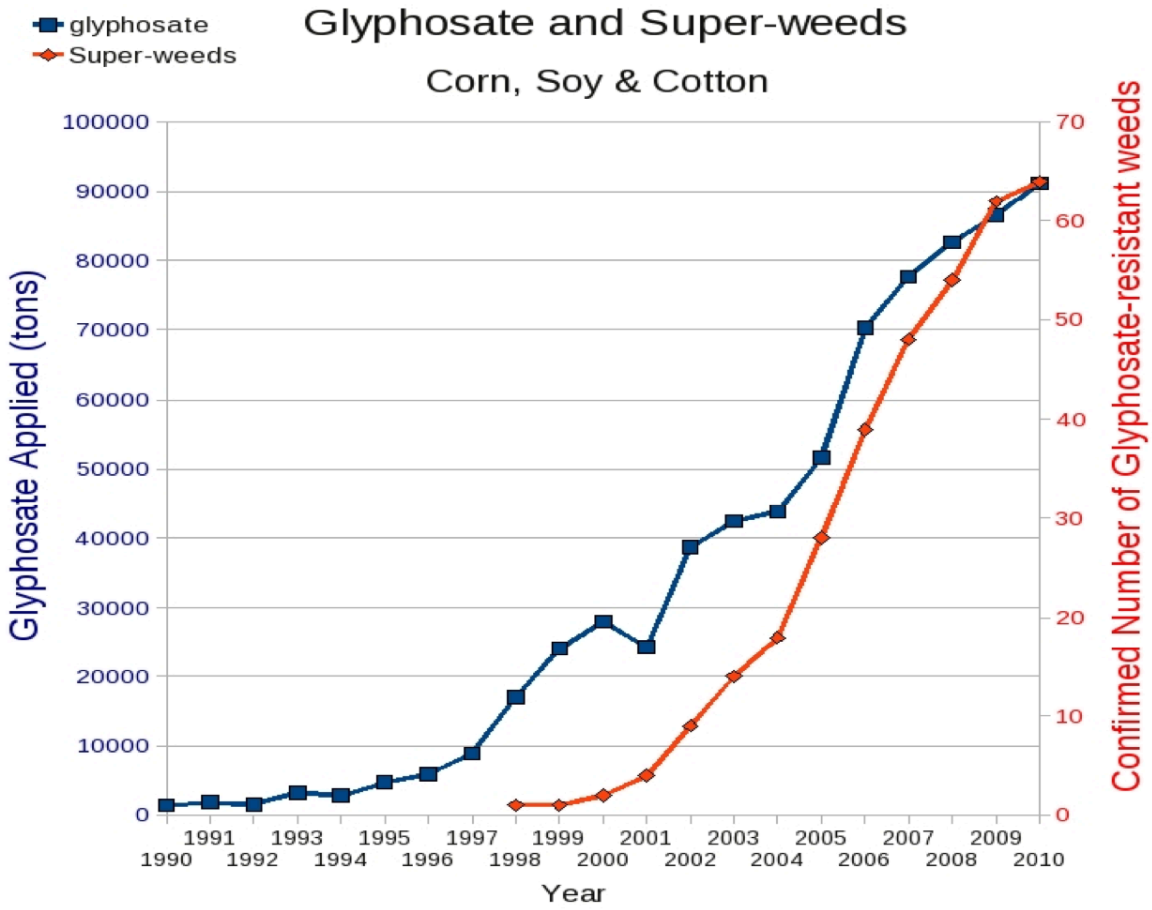
1996-1999 data: USDA Agricultural Economic Report No. (AER-810) 67 pp, May 2002
2000-2012 data: USDA:NASS National Agricultural Statistics Service

Glyphosate vs. Other Pesticides*



*http://sustainablepulse.com/wp-content/uploads/GMO-health.pdf

Glyphosate and Superweeds: U.S.*



*http://sustainablepulse.com/wp-content/uploads/GMO-health.pdf

Glyphosate and AMPA in GMO Soy*

"we were able to discriminate GM, conventional and organic soybeans without exception, demonstrating '*substantial non-equivalence*' in compositional characteristics for 'ready-to-market' soybeans.

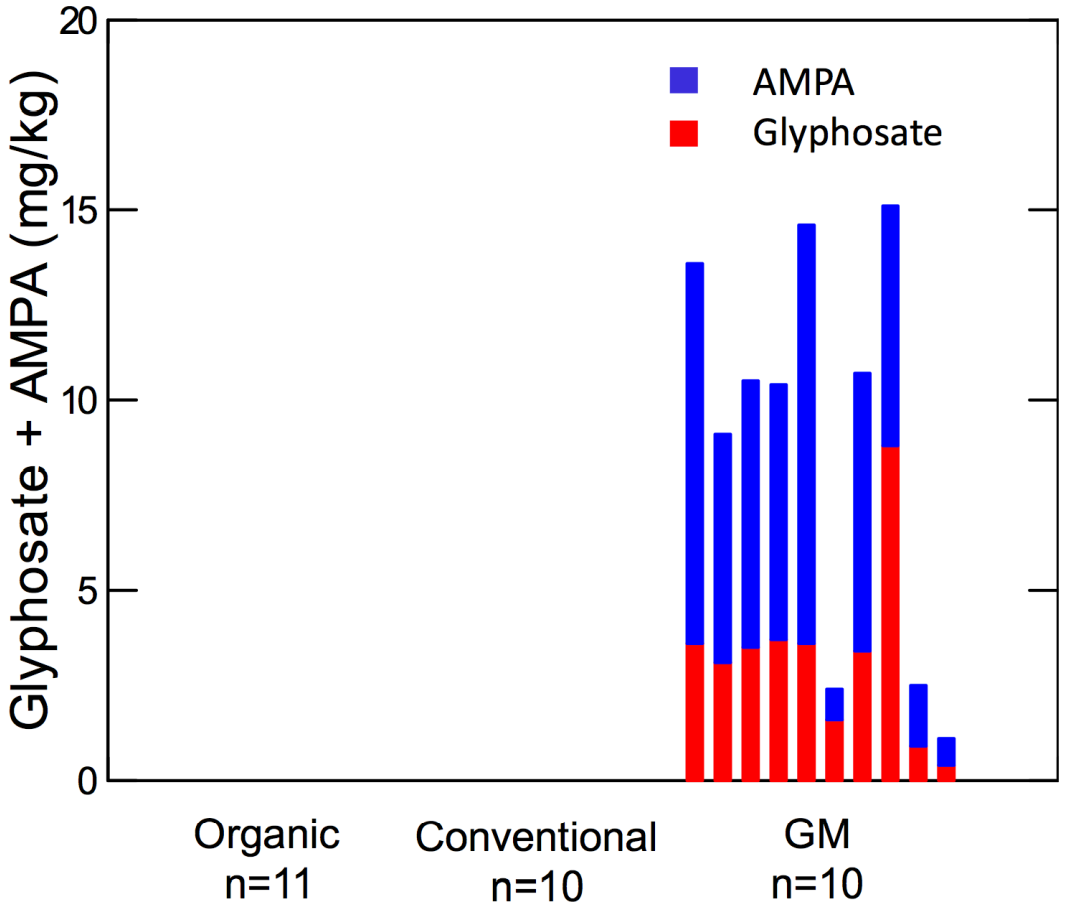


*Figure 1, T. Bøhn et al., Compositional differences in soybeans on the market: glyphosate accumulates in Roundup Ready GM soybeans. Food Chemistry (2013) Epub ahead of print.

U.S. Approves Genetically Modified Alfalfa*

- Alfalfa is the major source of hay for cattle and horses
- Nation's fourth-largest crop by acreage, behind corn, soybeans and wheat
- GMO alfalfa is "Roundup Ready"

*http://www.nytimes.com/2011/01/28/business/28alfalfa.html?_r=0
Andrew Pollack, NY Times, January 27, 2011.

Prof. Don Huber on Alfalfa*

- Roundup-Ready alfalfa compared to traditional plants
- Manganese levels reduced by 31%, sulfur by 52%, amino acids by 15%
- EPA says *400 ppm* glyphosate residue is okay in alfalfa
  - 80% stays in plant and 20% moves into soil in root exudates
  - Rhizobia/Bradyrhizobia, Pseudomonads, Bacillus, Mycorrhizae, etc. etc. are harmed
- It takes only *0.1 ppm* to produce dysbiosis of the GI tract for chronic botulism, leaky gut, etc.

*Personal communication

One Square Foot

Public park near Cape Town, South Africa

*Robert Krulwich, http://www.npr.org/blogs/krulwich/2012/11/29/166156242/cornstalks-everywhere-but-nothing-else-not-even-a-bee

GMO Corn: Cornstalks Everywhere But Nothing Else, Not Even A Bee*

*Robert Krulwich, http://www.npr.org/blogs/krulwich/2012/11/29/166156242/cornstalks-everywhere-but-nothing-else-not-even-a-bee

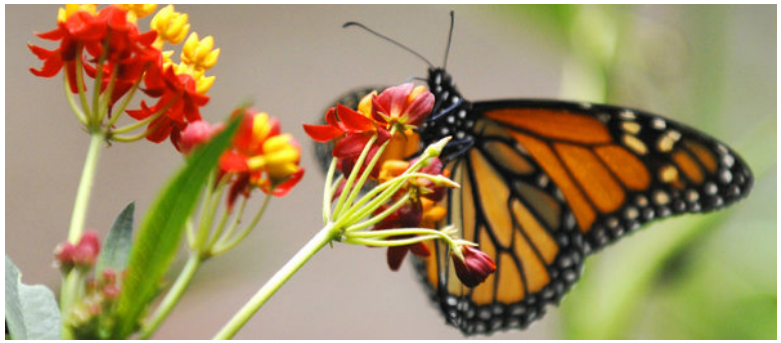
Where Have all the Insects Gone?

"The nine-spotted beetle commonly made her home on *farmlands* for the rich source of insects these regions provided."

"Until the *mid-1970s*, the nine-spotted beetle was one of the most common ladybug beetles"

*http://animals.pawnation.com/causes-decline-ninespotted-beetle-6492.html

Monarch Butterfly Collapse*



".. farmers have switched in droves to new varieties of crops that are genetically engineered to tolerate *the most widely used weed killer in the United States*. The resulting use of weed killers has wiped out much of the milkweed that once grew between crop rows and on buffer strips separating fields and roads."

Glyphosate

*M. Wines, New York Times, Dec. 20, 2013.
nytimes.com/2013/12/21/us/setting-the-table-for-a-fluttering-comeback-with-milkweed.html

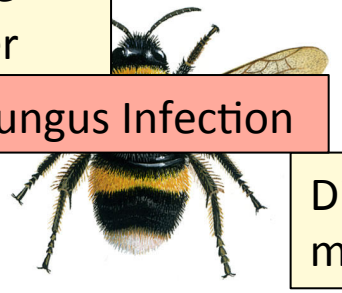
Bee Colony Collapse Syndrome (Explained in Mercola Interview with Don Huber)

- Factors associated with bee colony collapse
  - Bees are mineral deficient for micronutrients
  - Plenty of food present, but they can't utilize it
  - They're devoid of the lactobacillus and bifidobacterium
  - They become disoriented (endocrine hormone disruption)
- Glyphosate explains all of these features
  - Chelation of micronutrients and disruption of gut bacteria
  - 30% mortality in bees drinking water containing glyphosate at levels found commonly in our drinking water
- The other canary in the coal mine are frogs and amphibians: they're disappearing just like the bees

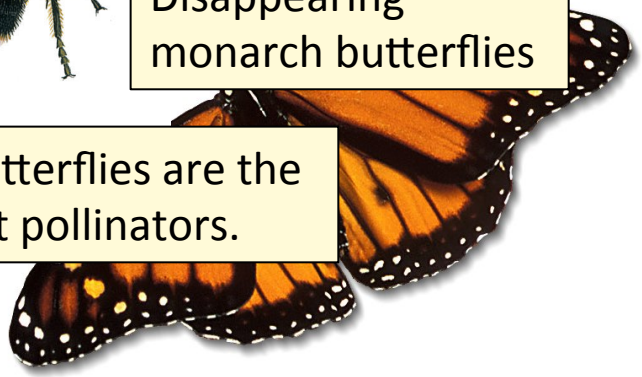
We Should be Alarmed!*

Bee Colony Collapse Disorder

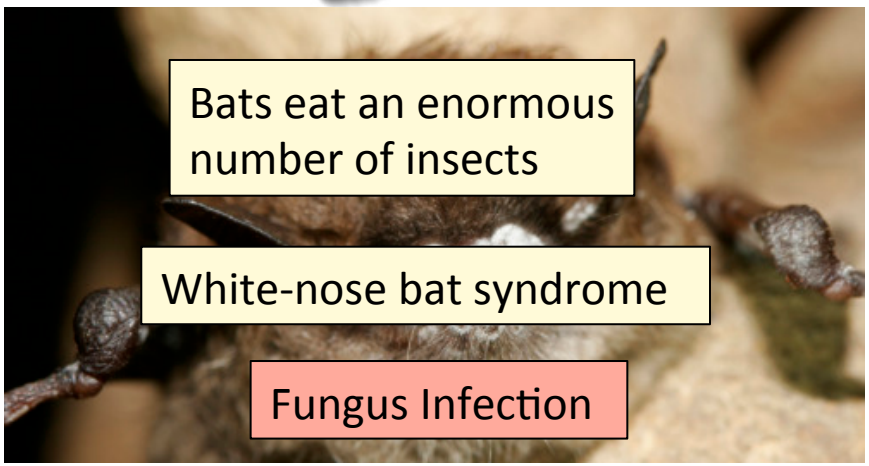
Fungus Infection



Disappearing monarch butterflies



After bees, butterflies are the second largest pollinators.



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

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

- Fungus is a growing threat in GMO Roundup-Ready corn
- Research consistent with studies on other fungal strains such as Fusarium, Rust fungi and Blight fungi

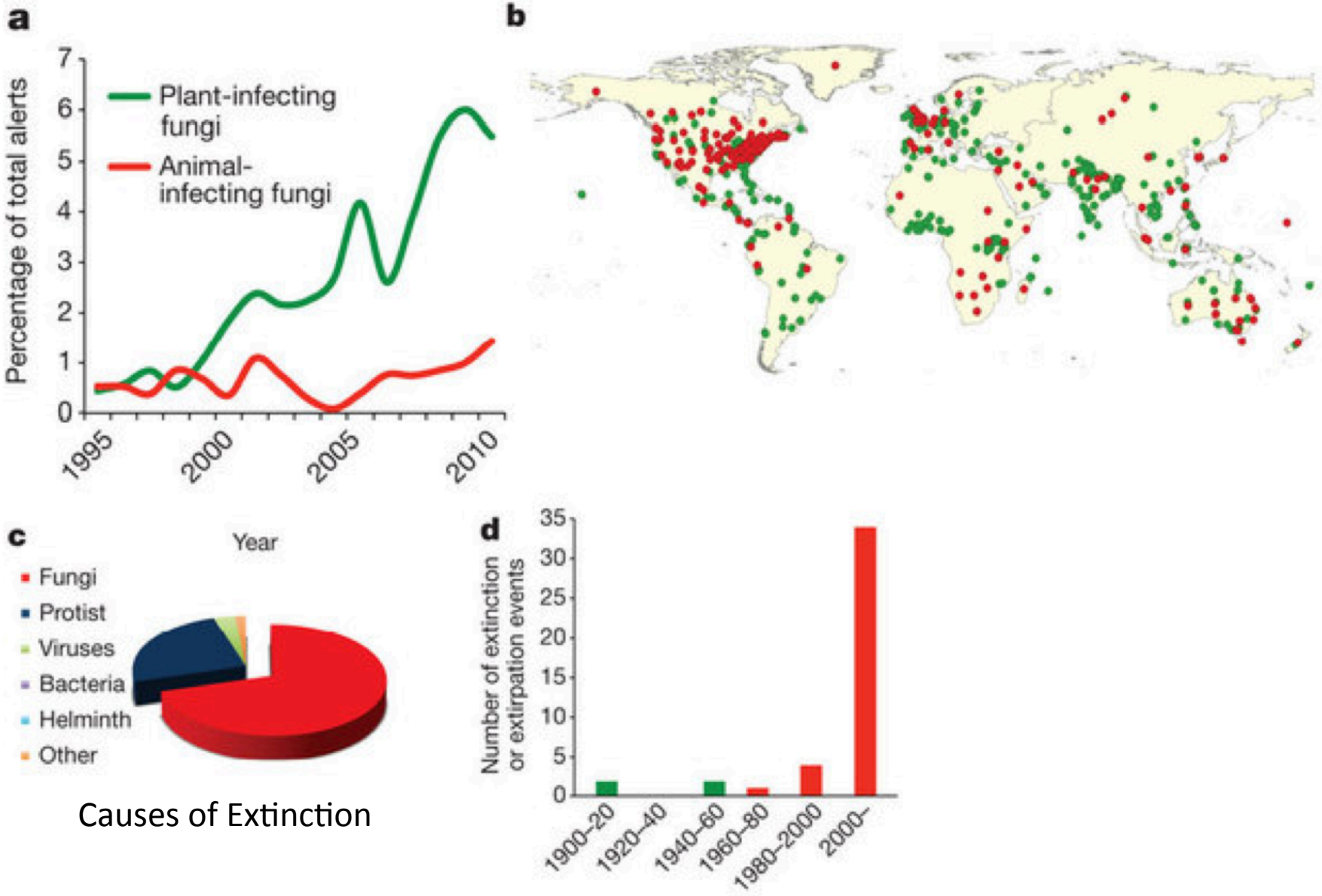
*Barberis et al., Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2013, 48(12), 1070-1079.

“Emerging fungal threats to animal, plant and ecosystem health”*

“The past two decades have seen an increasing number of virulent infectious diseases in natural populations and managed landscapes. In both animals and plants, an unprecedented number of fungal and fungal-like diseases have recently caused some of the most severe die-offs and extinctions ever witnessed in wild species, and are jeopardizing food security.”

*M.C. Fisher et al., Nature Reviews 484(7393), 186-194.

Figure 1, Nature Reviews Paper*



Causes of Extinction

*M.C. Fisher et al., Nature Reviews 484(7393), 186-194.

Bee Colony Collapse Syndrome

- Bees are exposed to many insecticides from pollen
- Their resistance to neonicotinoids depends on CYP enzymes
- These enzymes are disrupted by glyphosate

Disruption of CYP enzymes in the liver would impair humans' ability to detoxify many environmental toxicants: synergistic effect

Honey Bees Have Fewer CYP Genes than other Insects*

"It is also a parsimonious interpretation that the deficit of detoxification genes in the honeybee will translate to *less pesticide detoxification capability*, which would then explain the species' unusual sensitivity to pesticides."

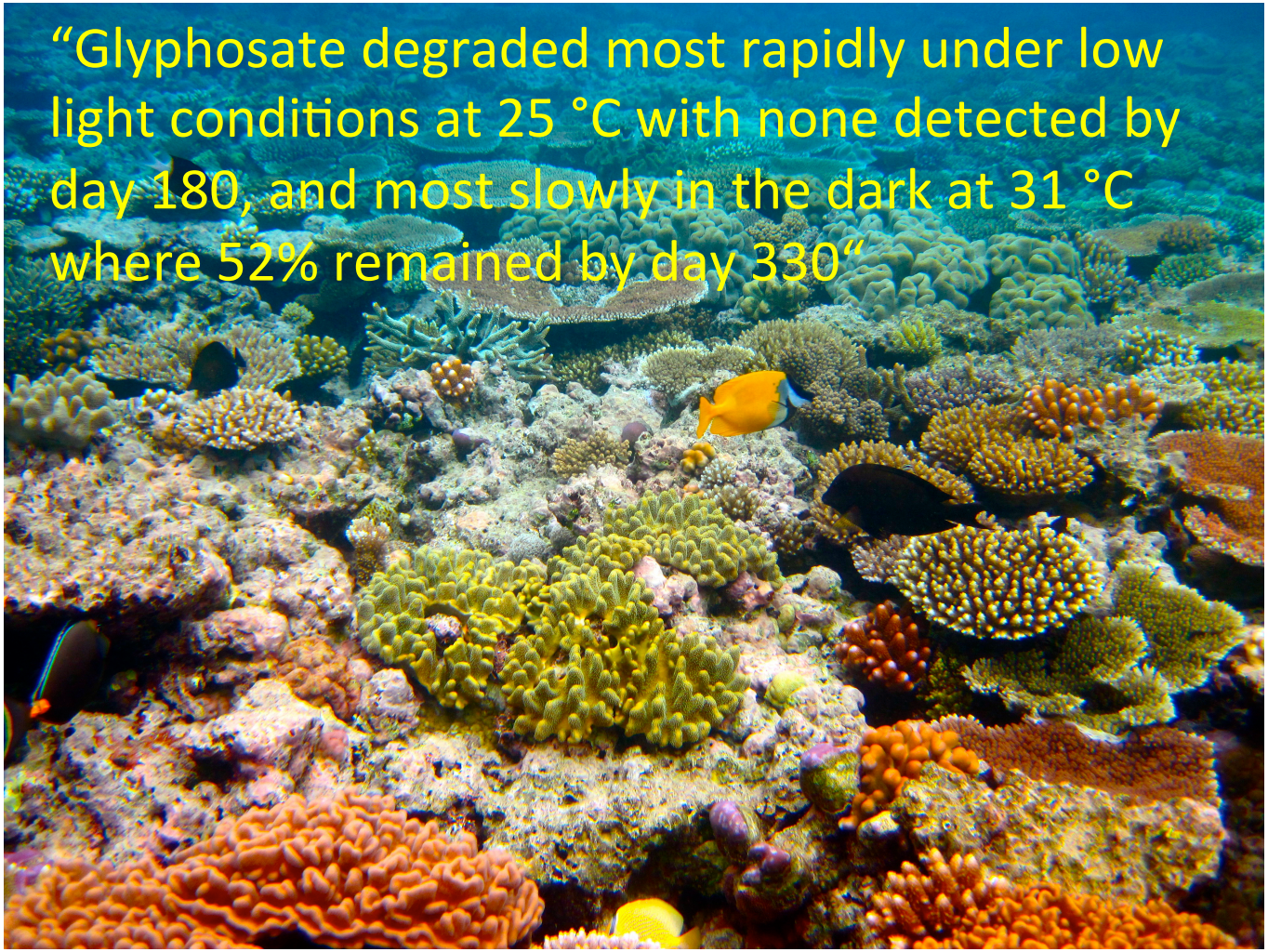
*Claudianos et al., Insect Molecular Biology (2006) 15(5), 615–636.

White Nose Syndrome: Bats

- Has reached epidemic proportions in US Northeast since 2006
- Corresponds to increases in glyphosate application
- At least one million bats have died since 2006.
  - Gravest threat to bats ever seen
- Bats wake up repeatedly during hibernation
  - Suggests melatonin deficiency

*W. Quarles, The IPM Practiioner, 33(9-10), June, 2013, 1-5.

“Glyphosate persistence in seawater”*



P. Mercurio et al., Marine Pollution Bulletin, 2014, In press*

Recapitulation

- According to WIKILeaks, the US is launching military style trade wars against other nations on GMO issues
- Tremendous growth in GMO crops corresponds to tremendous growth in glyphosate usage
- Bees, bats, frogs, lady bugs, starfish, monarch butterflies, and coral, among many other species, are suffering an unexplained collapse in recent years
  - Fungus infection is a major factor
  - Glyphosate induces fungus infection in plants
  - Fungus disease rates are growing alarmingly in both plants and animals

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*
- Estrogenic activity mediated by estrogen receptors
- Additive effect from genistein, a phytoestrogen in soybeans

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

Glyphosate and Anencephaly*

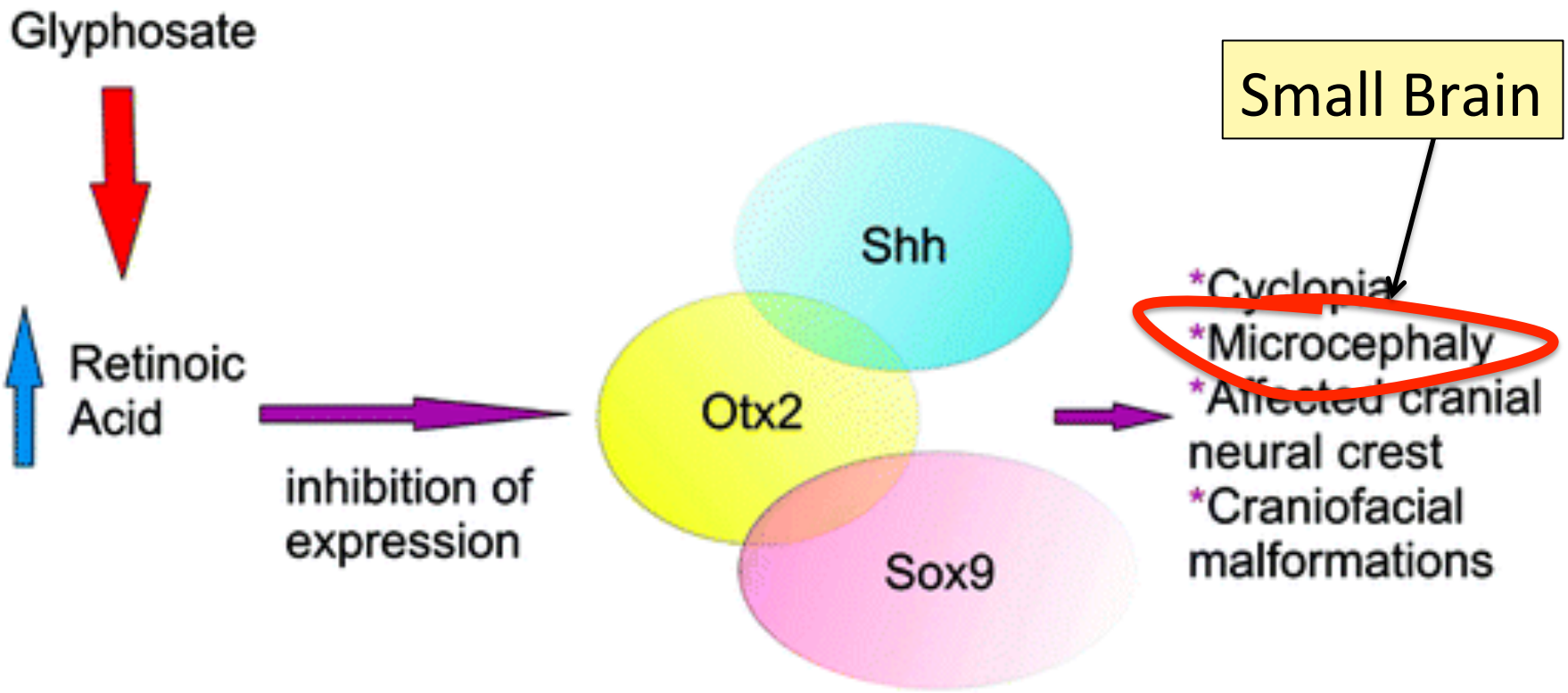
- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by the birth defect, anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
  - 47 (63%) of these were detected
  - Glyphosate was applied in large 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.

Fertility Rates are Dropping Worldwide*

- Fertility rates are falling rapidly in countries around the world, often to below 2.0.
  - Cultural changes play a role
  - But glyphosate is likely contributing as well
- Sperm depend on cholesterol sulfate for decapitation and fertilization
- Cholesterol sulfate synthesis depends on cytochrome P450 (CYP) enzymes
- Glyphosate disrupts CYP enzyme function

*A. Samsel and S. Seneff, Entropy 2013, 15, 1416-1463.

"Male fertility under threat as average sperm counts drop"*

- Study of 26,600 men in France found sperm concentration had decreased by 32% since the 1990s.
- Numbers steadily dropped by 2% per year from 1989 to 2005.
- Proportion of normally formed sperm also declined by about 1/3.

* M. Rolland et al., Hum Reprod. 2013 Feb;28(2):462-70.

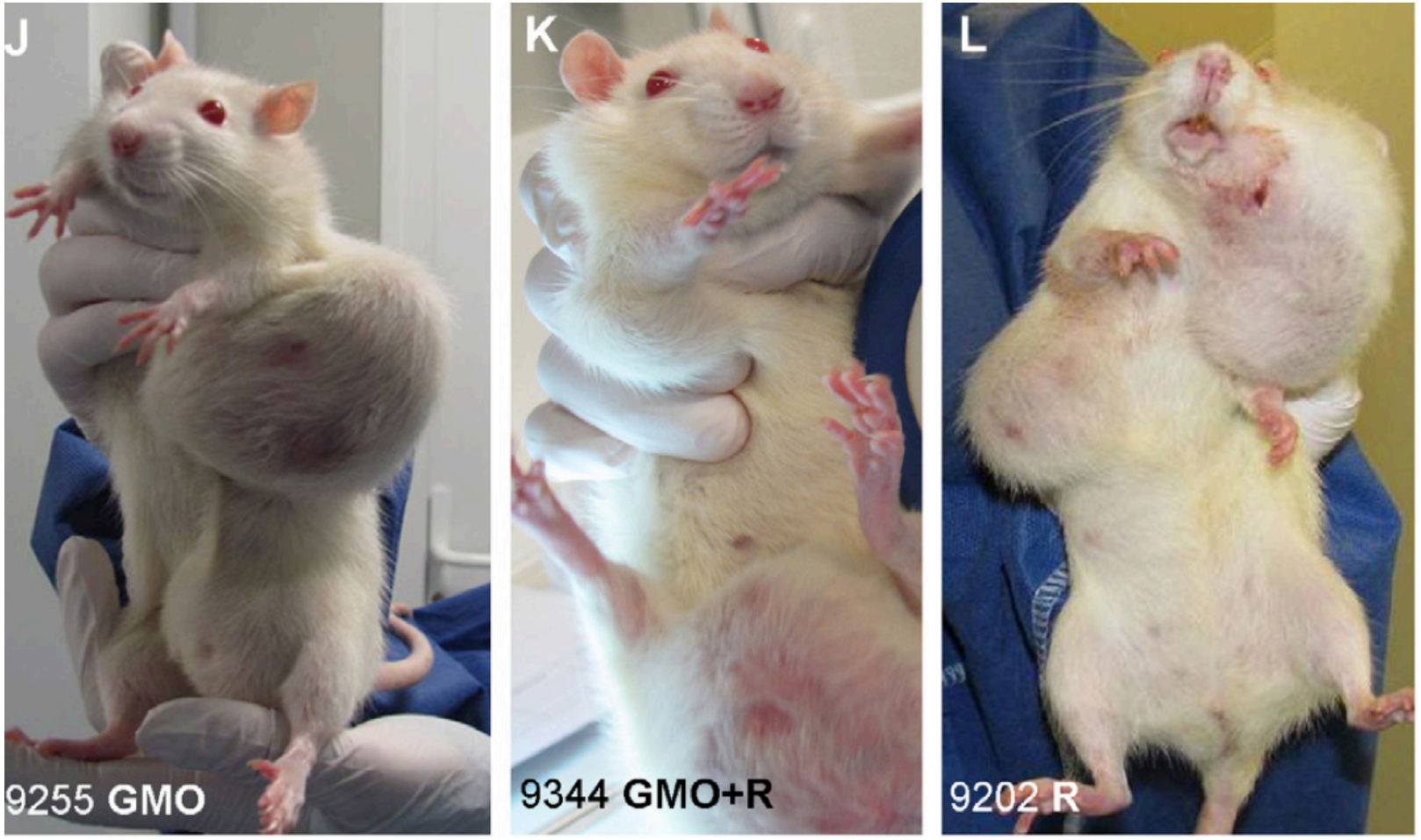
This Defect Likely Transfers to Subsequent Generations*

- Designer mice (obesity gene) fed a diet mimicking fast food diet
- This initiated subfertility in both male and female offspring lasting over two generations
- Suggest altering of epigenome of sperm, leading to developmental programming of subfertility outcome

*T. Fullston et al., Human Reproduction 27(5), 1391-1400, 2012.

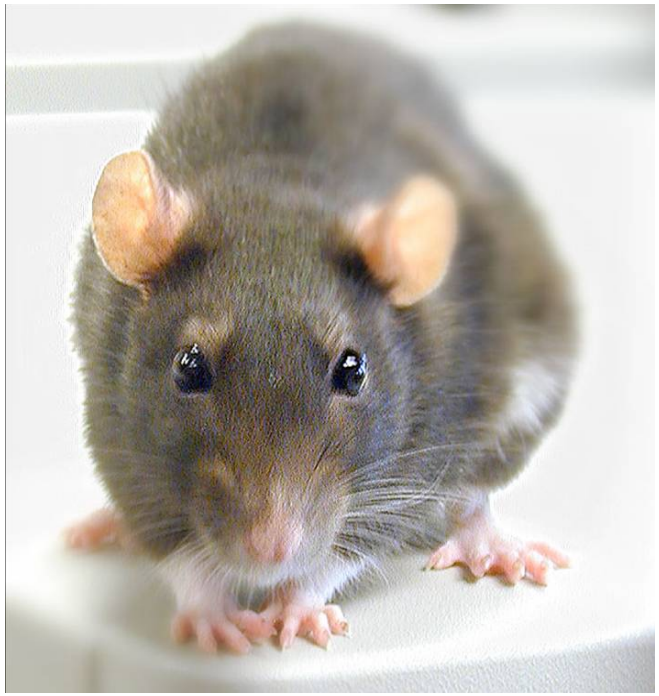
Mammary Tumors in Rats*

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



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

Conclusions from Rat Study *



- Female rats had greatly increased risk of mammary tumors
- Males had significantly increased risk of tumors of the liver and kidney
- Sex hormone disruption for both males and females
- Enhanced oxidative stress
- Very significant kidney dysfunction
- *Effects didn't become apparent until after 4 months*

*G.-E. Séralini et al., Food and Chemical Toxicology, 2012, *in press*

Conclusions from Rat Study *

- Female rats had greatly increased risk of br
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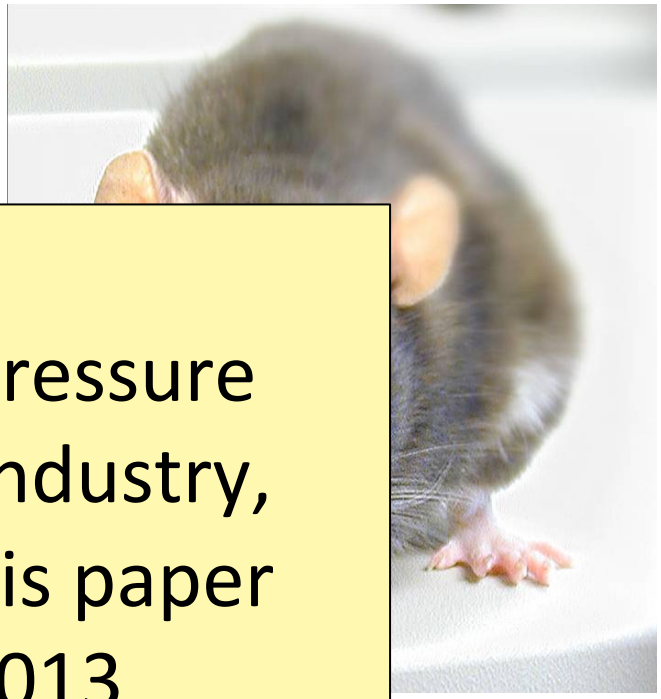


Under a great deal of pressure from the agrichemical industry, the journal retracted this paper on Thanksigiving, 2013

*G.-E. Séralini et al., Food and Chemical Toxicology, 2012, *in press*

Dr. Mercola on Glyphosate in Soybean Oil*

- "Glyphosate is easily one of the world's most overlooked poisons"
- Birth defects in frog and chicken embryos occurred at 2 mg/kg
  - This is 10 times lower than the residue limit set by the European Union
- Glyphosate causes endocrine disruption, DNA damage, developmental toxicity, neurotoxicity, reproductive toxicity, and cancer.
- GMO crops soak up glyphosate so it can't be washed off

*Soybean Oil: One of the Most Harmful Ingredients in Processed Foods. January 27, 2013

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.

Photos from Argentina, where GMO Soy has replaced Grass-fed Cattle Farms

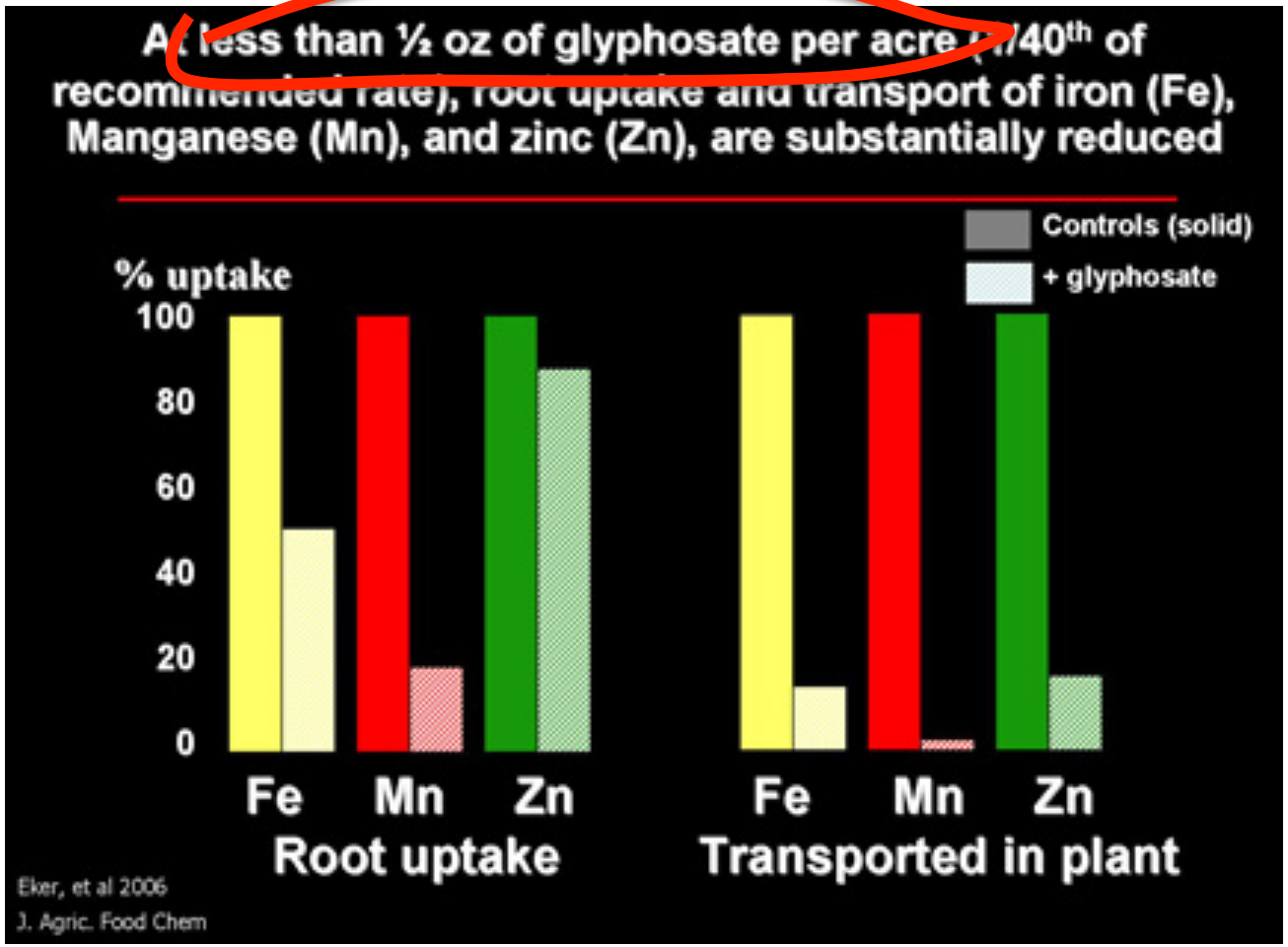
Boston Globe, October 30, 2013

Recapitulation

- Glyphosate has carcinogenic and endocrine disrupting properties → microcephaly
- Low concentrations of glyphosate induce estrogenic activity
  - At parts per *trillion*, it can induce tumor growth in vitro
- Female rats fed glyphosate contaminated food developed massive mammary tumors
  - Male rats had liver and kidney dysfunction
- Glyphosate kills liver cells at low doses in vitro
- Glyphosate in minute amounts causes birth defects in frog and chicken embryos
- Exposed children and agricultural workers are getting sick

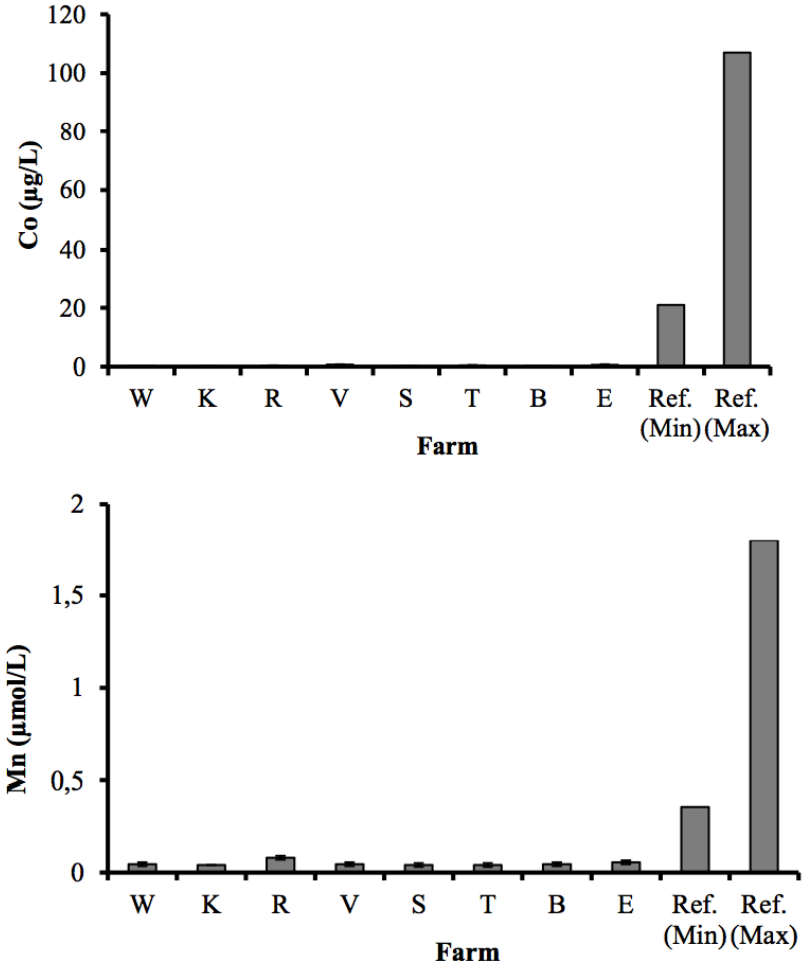
Nutrient Deficiencies & Climate Change

Glyphosate Depletes Nutrients*



*Jeffrey M. Smith, Jan 16, 2011
http://www.naturalnews.com/031138_Monsanto_Roundup.html

Severe Deficiency in Manganese and Cobalt in Cows*



*M. Krüger et al., J Environ Anal Toxicol 2013, 3:5

GMO Corn: Nutrient Deficient*

Nutrient	GMO	Non-GMO
sulfur	3	42
zinc	2.3	14
manganese	2	14
iron	2	14
copper	2.6	16
molybdenum	0.2	1.5
Toxin	**GMO**	**Non-GMO**
formaldehyde	200	0
glyphosate	13	0

Units are parts per million

*http://www.momsacrossamerica.com/stunning_corn_comparison_gmo_versus_non_gmo

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*http://www.momsacrossamerica.com/stunning_corn_comparison_gmo_versus_non_gmo

"Sulfur is deficient in 90(+)% of the soil samples I review, no matter where they come from."*

- Rainfall leaches sulfur out of the root zone in low humus soils
- Humus levels have dropped considerably following industrial farming practices
  - Humus levels have fallen from as high as 20% to 3% or less.
- Many commercial fertilizers used to be sulfated but this is changing.
- Adequate amounts of sulfur are needed for nitrogen fixing soil bacteria

* Jerry Brunetti, soil expert, personal communication

Glyphosate and Climate Change*

"The metabolic quotient obviously signaled unfavorable soil maintenance with higher efflux of CO_2 to the atmosphere."

"Dying plants upon desiccation leads to the highest average values … in the course of the experiment."

"organic practices rapidly improve soil microbial characteristics and slowly increase soil organic C (Carbon)."

*M. Růžková et al., Plant Soil Environ 57(2), 2011, 88-94.

"Plants Warn One Another of Pest Attack through Mycorrhizal Fungal Network"*

- Form symbiotic relationships with plants
  - Increase mineral uptake
  - Redistribute water during drought stress
  - Increase tolerance to root and shoot pathogens
- When one plant is infected by aphids, chemical signals are transmitted through fungus network in ground to neighboring plants
  - Neighbors release chemicals to repel aphids and attract predatory wasps
- *Glyphosate disrupted growth of five species of ectomycorrhizal fungi tested in vitro***

*ISIS Report 28/10/13, http://www.i-sis.org.uk/mycorrhizae_and_plant_communication.php

** P. Chakravarty and S.S. Sidhu, European Journal of Forest Pathology 17(4-5), 204-210, 1987.

"Predators Help Plants Put Away Carbon"*

- Yale University study
- Plants with three conditions in enclosed environment:
  - No predators
  - Grasshoppers only
  - Grasshoppers and spiders

- Surprisingly, the condition with spiders resulted in 20% more carbon storage in the plants compared to the isolated plants

*A Duhaime-Ross, Scientific American, September 2013, p. 16

"Predators Help Plants Put Away Carbon"*

- [illegible]
- [illegible]
  - No predators
  - Grasshoppers only
  - Grasshoppers and spiders

This has a direct effect on global warming!!

- Surprisingly, the condition with spiders resulted in 20% more carbon storage in the plants compared to the isolated plants

*A Duhaime-Ross, Scientific American, September 2013, p. 16

Corn (Maize) Monocrop in US*

"Maize production in the United States, the world's largest producer, is *heavily subsidised*, coming to some $84 billion between 1995 and 2010.[15] In 2012 subsidies to US maize farmers were *greater than South Africa's entire agricultural budget*.[16] Additionally, a range of tax incentives (worth $45 billion from 1980 to 2011)[17] mean that now over 40% of annual maize production is used to produce *ethanol*, a prodigious waste of resources.[18]

*GM Maize: lessons for Africa - Cartels collusion and control of South Africa's staple food. Nov. 5, 2013.
acbio.org.za/index.php/publications/rest-of-africa/449-gm-maize-lessons-for-africa

Biofuel? Maybe not!*

- Inflammatory response was higher for the biofuel than for the standard diesel
  - Biofuel = 20/80 blend of soy biodiesel and standard diesel
  - Measured in bronchoalveolar lavage fluid of exposed mice
  - Levels were 20-30% higher for biodiesel fuel
- Reduces particulate emissions but may be more damaging to health

Is this Due to Glyphosate Contamination?

*Environ. Sci. Technol. 2013, DOI: 10.1021/es403146c

Recapitulation

- GMO corn is depleted in many nutrients, including sulfur, zinc, manganese, iron, and copper
- Glyphosate may be playing a direct role in climate change by interfering with CO_2 fixation in plants and soil.
  - Destroying ectomycorrhizal fungi
  - Desiccation
  - Destroying predators
- Soy and corn as biofuels may not be such a good idea due to toxicity of burning pesticides

"Determination of Glyphosate residues in human urine samples from 18 European countries"*

- 182 urine samples from 18 European countries analyzed for glyphosate
  - city-dwellers who had never handled roundup or any herbicides.
- 44% of the samples contained quantifiable amounts of glyphosate
- 7% of the participants exceed 0.8 micrograms/ Liter, the reference cutoff for "safety"
- Diet seems to be the main source of exposure
- These numbers would be much worse if they were measured in the U.S.

*https://www.foeeurope.org/sites/default/files/glyphosate_studyresults_june12.pdf

"Determination of Glyphosate residues in human urin

- 18
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- 44
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- 7
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  - were measured in the U.S.

"Our testing highlights a serious lack of action by public authorities across Europe and indicates that this weed killer is being widely overused. Governments need to step-up their monitoring and bring in urgent measures to reduce its use. This includes rejecting any *genetically modified crops* that would increase the use of glyphosate."

*https://www.foeeurope.org/sites/default/files/glyphosate_studyresults_june12.pdf

One Final Message:
Go Organic!

Prof. Don Huber on Glyphosate*

"When future historians write about our time, they're not going to write about the tons of chemicals that we did or didn't apply. When it comes to glyphosate, they're going to write about our willingness to sacrifice our children and jeopardize our existence, while threatening and jeopardizing the very basis of our existence; the sustainability of our agriculture."

*Retired professor from Purdue University; Expert in plant pathology
articles.mercola.com/sites/articles/archive/2012/01/15/dr-don-huber-interview-part-2.aspx

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, celiac disease, kidney failure, infertility, etc.