

Glyphosate: The “Safe” Herbicide that’s Making us all Sick!



Stephanie Seneff, MIT CSAIL
Institute of Sustainable Nutrition
Saturday, March 24, 2018

New York Times: “Another View” July 13, 2015

“The GMO experiment, carried out in real time and with our entire food and ecological system as its laboratory, is perhaps the greatest case of human hubris ever. It creates yet another systemic, ‘too big too fail’ enterprise — but one for which no bailouts will be possible when it fails.”

Mark Spitznagel and Nassim Nicholas Taleb

nytimes.com/2015/07/14/business/dealbook/another-too-big-to-fail-system-in-gmos.html

Outline

- Introduction
- Glyphosate as a glycine analogue
- Food allergies and autoimmune disease
- Collagen and gelatin
- Animals in distress
- How to protect yourself
- Summary

US Health Status

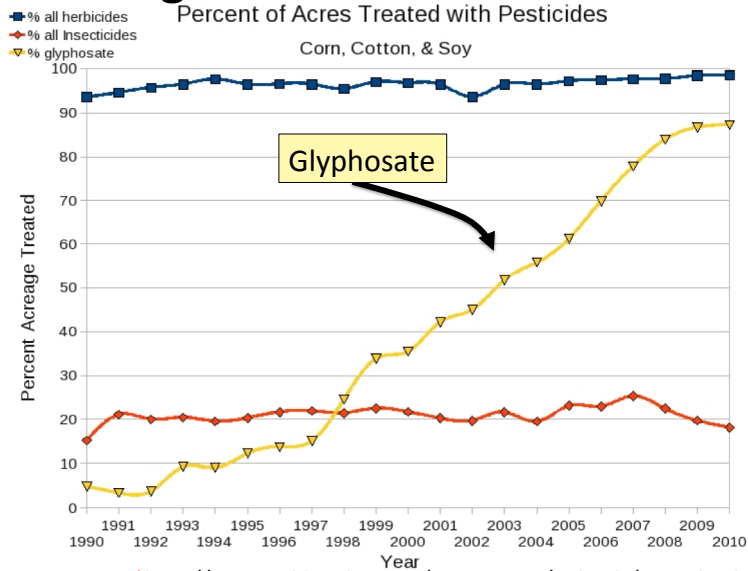
- US makes up 5% of the world's population but consumes more than 50% of the world's pharmaceutical drugs
- We spend more on health care than Japan, France, China, UK, Italy, Canada, Brazil, Spain, and Australia, *combined*
- US ranks last or near last among developed nations on infant mortality and life expectancy
- We also suffer from more chronic illnesses
- *We consume 20% of the world supply of glyphosate*

Roundup and GMO Crops

GMO Roundup-Ready corn, soy, canola, sugar beets
cotton, tobacco and alfalfa



Glyphosate vs. Other Pesticides: Usage in the United States*



Glyphosate and AMPA (Breakdown Product) Far Exceed Other Chemicals*

Table 7 Pesticides and transformation products^a detected in precipitation in each sample type in the Lower Fraser Valley and Okanagan Basin, British Columbia, sampling from 2003-2005

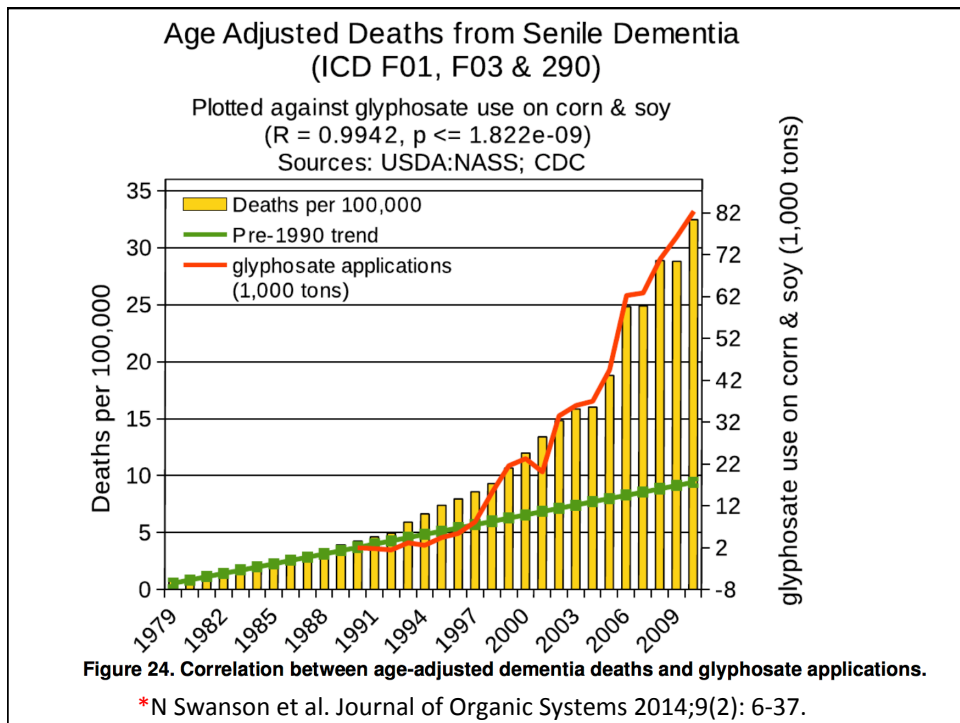
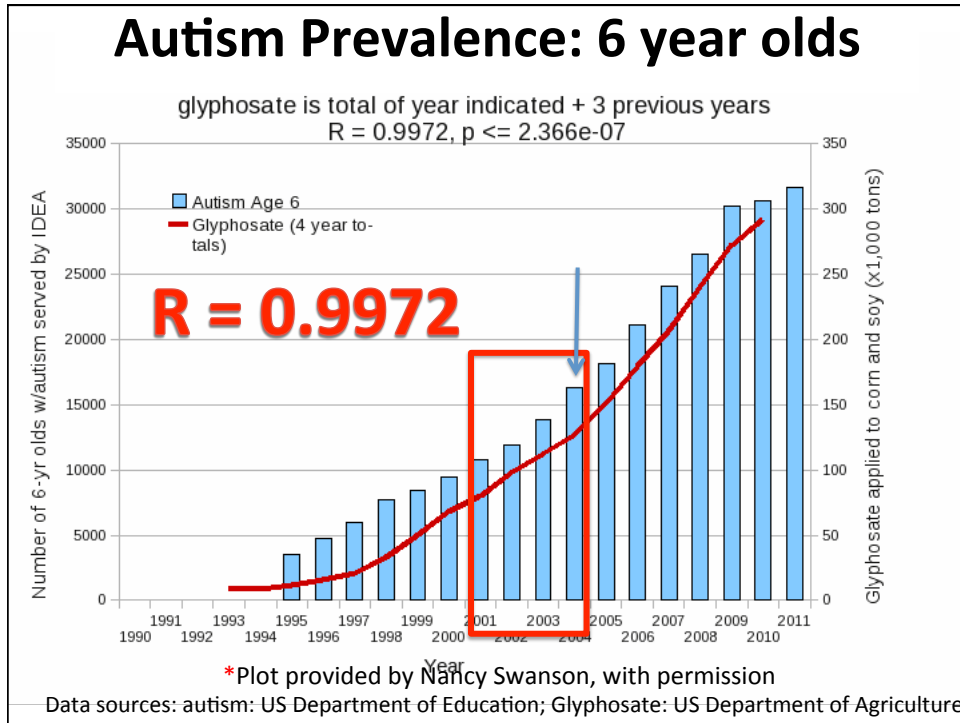
Lower Fraser Valley							
Precipitation		Runoff		Surface water		Groundwater	
Pesticide	Range (ng/L)	Pesticide	Range (ng/L)	Pesticide	Range (ng/L)	Pesticide	Range (ng/L)
Diazinon	0.46-106	Glyphosate	2 000-9 000	Diazinon	0.04-12 500	Simazine	0.05-90
Chlorothalonil	1.27-52.1	AMPA	3 000-6 000	2,4-D	0.62-1 230	MCPPP	0.07-14.5
Diazinon-oxon	0.13-33.6	Metalaxyl	250-5 500	Linuron	0.41-1 050	Atrazine	0.009-10.7
Malathion	0.15-29.8	Dimethoate	200-3 000	MCPPP	0.11-917	b-Endosulphan	0.001-5.11
Azinphos-methyl	0.32-22.9	Diazinon	100-2 710	Simazine	0.57-896	2,4-D	5.01
Atrazine	0.11-19.1	Metolachlor	20-1 350	MCPA	0.08-789	Desethylatrazine	0.001-4.93
Chlorpyrifos-oxon	1.79-10.8	Chlorpyrifos	100-750	Dimethoate	1.4-604	a-Endosulphan	0.001-3.17
Simazine	0.18-9.96	Atrazine	100-600	Diazinon-oxon	0.02-233	Dieldrin	0.001-2.23
Linuron	1.51-8.16	Desethylatrazine	10-510	Dicamba	0.08-179	Linuron	0.21-2.08
Metolachlor	0.02-6.34	Methoprene	500	Metolachlor	0.006-123	Endosulphan-sulphate	0.001-1.7

*Table from PRESENCE AND LEVELS OF PRIORITY PESTICIDES IN SELECTED CANADIAN AQUATIC ECOSYSTEMS. published in 2011 by the Canadian Government

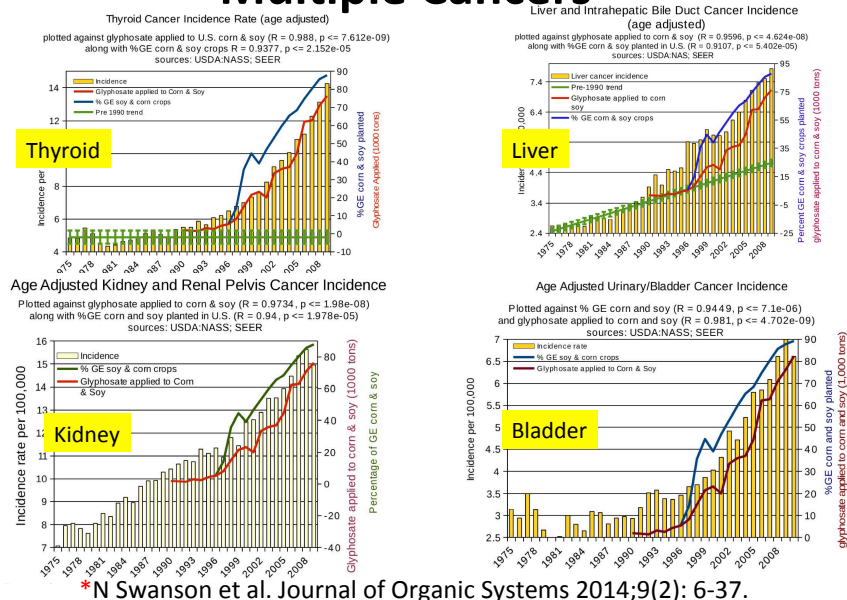
Main Toxic Effects of Glyphosate*

- Interferes with function of cytochrome P450 (CYP) enzymes
- Chelates important minerals (iron, cobalt, manganese, etc.)
- Interferes with synthesis of aromatic amino acids and methionine
 - Leads to shortages in critical neurotransmitters and folate
- Disrupts sulfate synthesis and sulfate transport

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



Correlations between Glyphosate and Multiple Cancers*



COMMENTARY

WILEY AMERICAN JOURNAL OF INDUSTRIAL MEDICINE

Commentary: IARC Monographs Program and public health under siege by corporate interests*

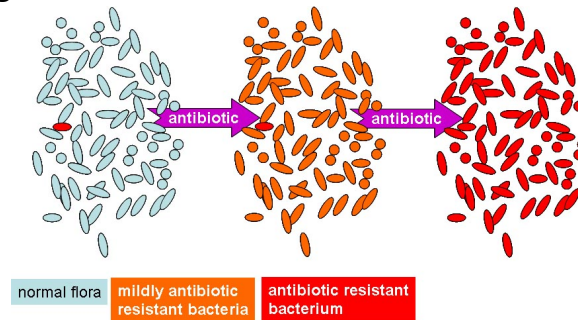
Peter F. Infante DrPH¹ | Ronald Melnick PhD² | James Huff PhD³ | Harri Vainio MD⁴

- IARC declared glyphosate a “probable carcinogen” in 2015
 - Monsanto sent a threatening letter of intimidation to IARC staff
 - Ominously, EPA staff has been accused of collusion with Monsanto to downgrade the health hazards of glyphosate
- “The interferences by economic interests in cancer evaluations conducted by public health institutions do not bode well for the free flow of scientific information that informs and *protects the public and workers from clear risks of cancer.*”

*Am J Ind Med. 2018;61:277–281.

Glyphosate and Antibiotic Resistance*

- Huge and growing problem with antibiotic resistant microbes in hospitals worldwide
- Glyphosate is a patented antimicrobial agent
- Chronic low-level exposure to one antibiotic empowers pathogens to become resistant to other antibiotics



*B Kurenbach et al., mBio March/April 2015; 6(2):e00009-15.

Glyphosate-Resistant Weeds

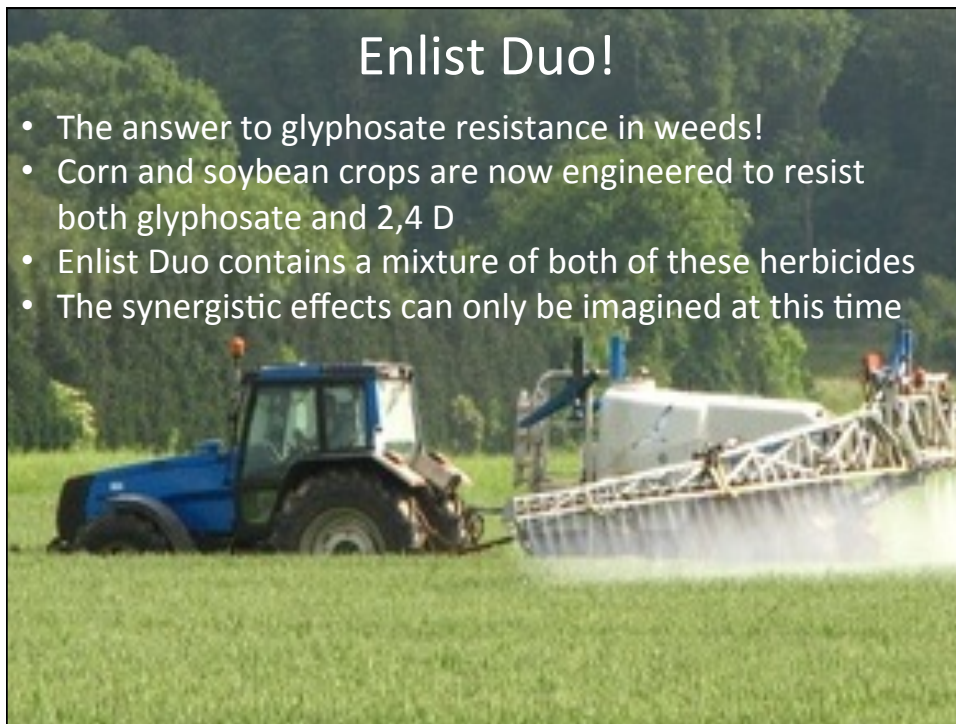


A maize field in Georgia, USA, in 2010, over-run with glyphosate-resistant palmer amaranth.

From GMO Myths and Truths, EarthOpenSource

Enlist Duo!

- The answer to glyphosate resistance in weeds!
- Corn and soybean crops are now engineered to resist both glyphosate and 2,4 D
- Enlist Duo contains a mixture of both of these herbicides
- The synergistic effects can only be imagined at this time



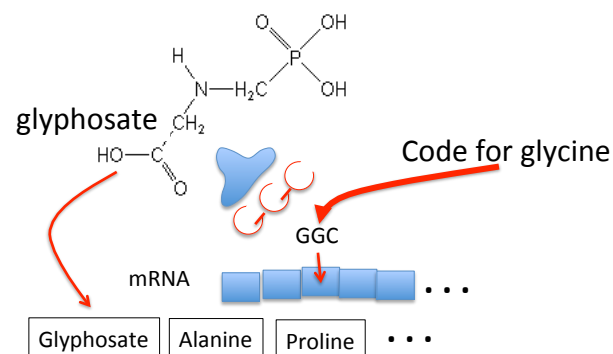
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“Monsanto's new Roundup Ready Xtend cotton and soybeans are engineered to be resistant to a combination of *glyphosate and dicamba*, while Dow AgroSciences' new breed of Enlist Duo corn and soybeans are resistant to a combination of *glyphosate and 2,4-D.*”*

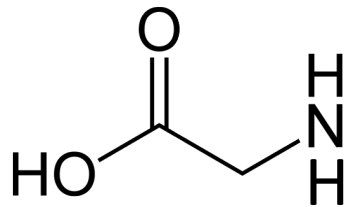
Glyphosate as a Glycine Analogue

What If Glyphosate Could Insert Itself Into Protein Synthesis by mistake???



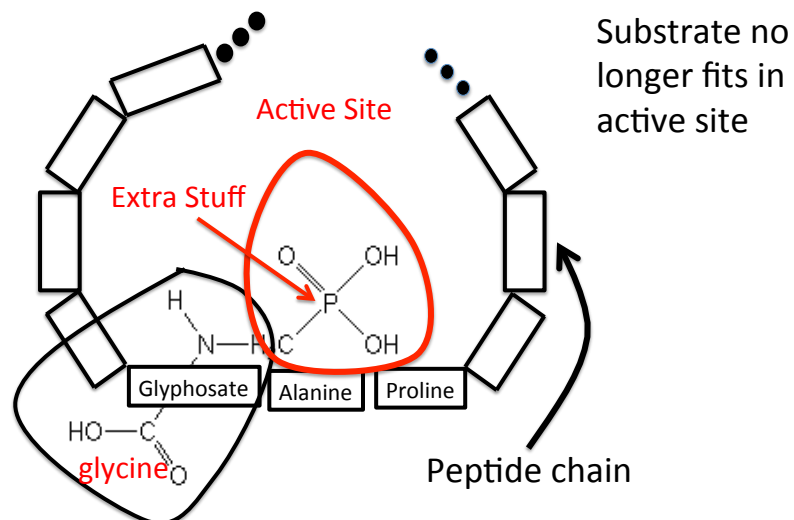
Any proteins with conserved glycine residues are likely to be affected in a major way

Glyphosate is a non-coding amino acid analogue of glycine



Glycine

Extra Piece Sticks Out at Active Site



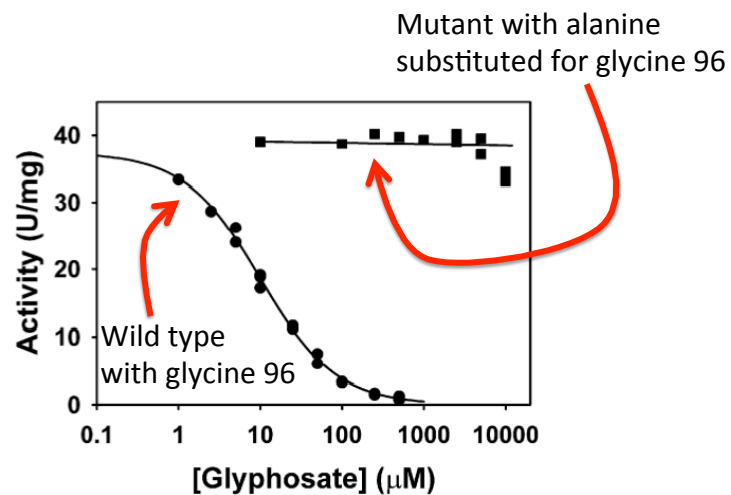
Extra Piece Sticks Out at Active Site

This explains how glyphosate disrupts EPSPs in the shikimate pathway:
Multiple bacteria and weeds have developed resistance by replacing active site glycine with alanine and this is the basis for GMO Roundup Ready crops*

Substrate no
fits in
site

*T Funke et al., Molecular basis for the herbicide resistance of Roundup Ready crops. PNAS 2006;103(35):13010-13015.

Inhibition of EPSPs by glyphosate: Resistant E coli mutant*



*Figure 3, S Eschenburg et al. Planta 2002;216:129-135.

Quote from Monsanto Study (1989)*

- Study exposed bluegill sunfish to carbon-14 radiolabelled glyphosate
- Measured radiolabel in tissues greatly exceeded measured glyphosate levels
- Proteolysis recovered more glyphosate



20% → 70%

"Proteinase K hydrolyses proteins to amino acids and small oligopeptides, suggesting that a significant portion of the 14C activity residing in the bluegill sunfish tissue was tightly associated with or *incorporated into* protein."

*WP Ridley and KA Chott. Monsanto unpublished study. August, 1989.

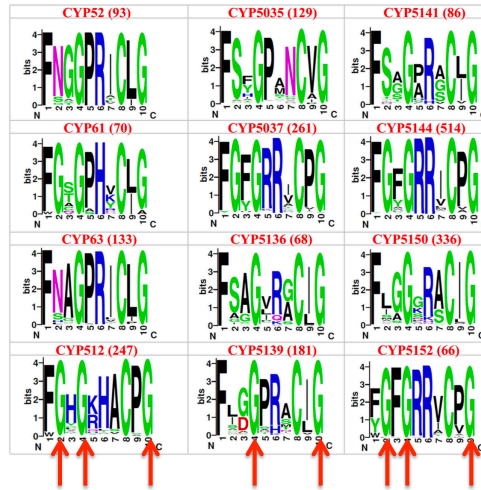
Some Predicted Consequences*

- Impaired CYP enzymes → low bile acids, low vitamin D, impaired detox capabilities
- Neurological diseases (autism, Alzheimer's, ...)
- Autoimmune diseases (Celiac disease, MS, ...)
- Chronic fatigue syndrome (myosin impairment)
- Impaired collagen → osteoarthritis
- Fatty liver disease
- Obesity and adrenal insufficiency
- Impaired iron homeostasis and kidney failure
- Insulin resistance and diabetes
- Cancer

*Samsel A and Seneff S. Journal of Biological Physics and Chemistry 2016;16:9-46.

Glyphosate Disrupts Cytochrome P450 (CYP) Enzymes*

- Glyphosate has been shown to severely suppress CYP enzymes in rat liver
- CYP enzymes have a unique FXX**G**XRXCX**G** motif with two and sometimes three critical glycine residues**

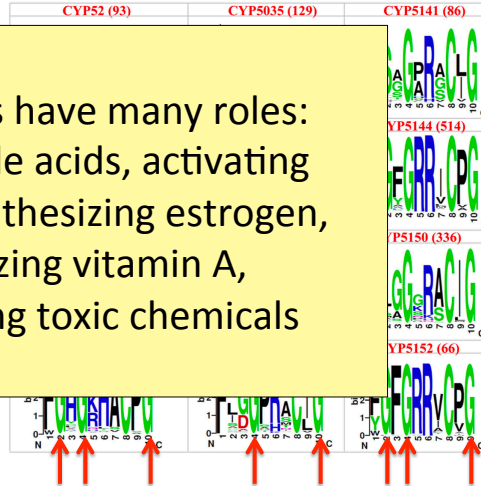


*A Samsel and S Seneff. Entropy 2013; 15: 1416-1463.
 **K Syed and SS Mashele. PLOS ONE 2014; 9(4):| e95616.

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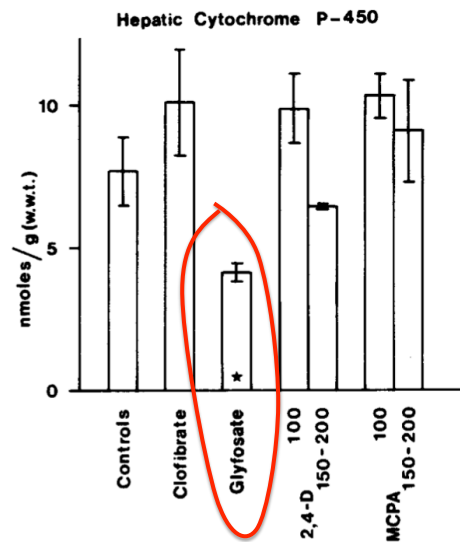
- Glyph...
- show...
- suppress...
- CYP e...
- unique...
- motif...
- some...
- critical glycine residues**

CYP enzymes have many roles:
 producing bile acids, activating
 vitamin D, synthesizing estrogen,
 metabolizing vitamin A,
 detoxifying toxic chemicals



*A Samsel and S Seneff. Entropy 2013; 15: 1416-1463.
 **K Syed and SS Mashele. PLOS ONE 2014; 9(4):| e95616.

Inhibition of Cytochrome P450 Enzymes (CYPs) by Various Pesticides*



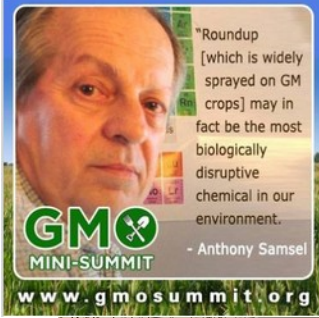
Study in rats on
2,4-D, clofibrate,
MCPA, and
glyphosate

*E Hetanen et al., *Acta Pharmacol. Et Toxicol.* 1983, **53**, 103-1 12.

Glyphosate Exposure During Pregnancy Leads to Shortened Gestation Length*

- Population study in Indiana
 - Measured glyphosate levels in urine
 - 93% of 71 women had detectable urinary glyphosate
 - Higher levels associated with rural areas
- Higher urinary glyphosate correlated with shorter gestation ($p = 0.02$)
- Hypothesized hormonal disruptions:
 - Aromatase suppression (CYP enzyme) causes estrogen deficiency
 - Defective CYPs prevent retinoic acid clearance

*S Parvez et al. *Environmental Health* 2018; **17**:23





"Roundup [which is widely sprayed on GM crops] may in fact be the most biologically disruptive chemical in our environment."
- Anthony Samsel

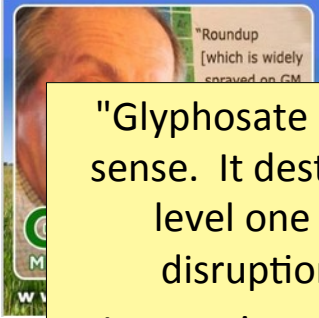
GMO
MINI-SUMMIT
www.gmosummit.org

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Previous Anthony Samsel, Scientist/Consultant, Arthur D. Little



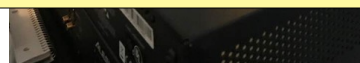

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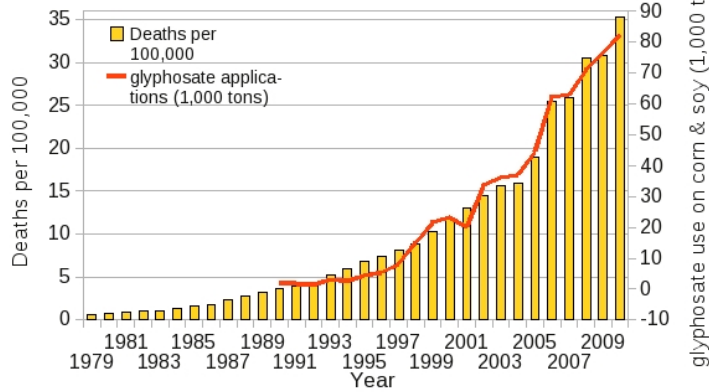
"Glyphosate is not toxic in the conventional sense. It destroys our biology at the cellular level one molecule at a time through disruption of proteins and signaling. Integration of glyphosate with globular and structural proteins is how it can be the cause of an endless array of unrelated diseases, and unleash a cascade of ill health effects that kill us like a slow cumulative poison."

-- Anthony Samsel

Dementia and Glyphosate*

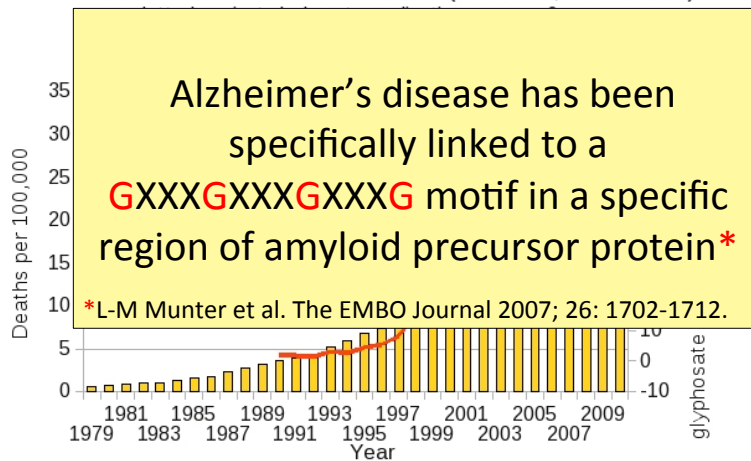
Deaths from Senile Dementia (ICD F01, F03 & 290)
 plotted against glyphosate applications on corn & soy
 (R = 0.9933, p <= 1.947e-09) sources: USDA:NASS; CDC



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

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“Glyphosate Substitution for Glycine During Protein Synthesis as a Causal Factor in Mesoamerican Nephropathy”*

- Young men who work in the sugar cane fields in Central America are dying in record numbers from an unusual form of kidney failure
- Heavy labor in hot climate leads to dehydration



- *Glyphosate incorporation into multiple proteins can fully explain observed symptoms*

*S Seneff and L Orlando. J Environ Anal Toxicol 2018; 8:1.

“Glyphosate Substitution for Glycine During Protein Synthesis as a Causal Factor in Mesoamerican Nephropathy”*

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fully explain observed symptoms

“Specifically, glycine substitution in aquaporin, chloride channels, cytochrome C oxidase and collagen, among others, could contribute to dehydration, increased urinary acidification, renal fibrosis, rhabdomyolysis and mitochondrial dysfunction.”



*S Seneff and L Orlando. J Environ Anal Toxicol 2018; 8:1.

Glyphosate and Anencephaly*

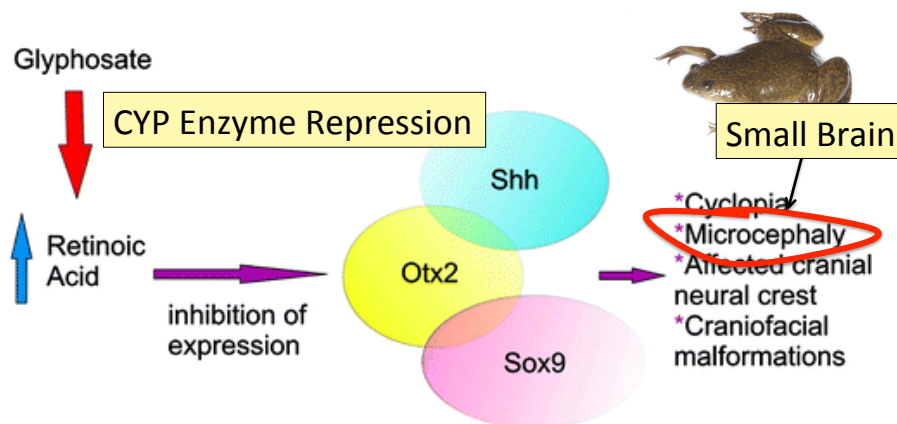
- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by the birth defect, anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
 - 47 (63%) of these were detected
 - Glyphosate was applied in large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

Glyphosate and Anencephaly: Death by A Thousand Cuts

Stephanie Seneff^{1*} and Gregory L Nigh²

Received date: 12 Jun 2017; Accepted date: 11 Jul 2017; Published date: 18 Jul 2017.

Citation: Seneff S, Nigh GL (2017) Glyphosate and Anencephaly: Death by A Thousand Cuts. J Neurol Neurobiol 3(2); doi <http://dx.doi.org/10.16966/2379-7150.140>

Protein	Conserved G
Insulin receptor	G-centered motif
Folate receptor	G137
LDL receptor	G34
CDK1	GEGTYG motif
Kinases	GxGxxG
Tyrosine phosphatase	G127
ACTH	Terminal glycine
Metallothionein	MSCCGGNCGCS motif
Serine protease	G193
Myosin	G699

Food Allergies and Autoimmune Disease

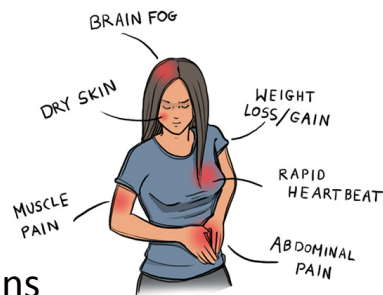
Autoimmune Disease: An Invisible Epidemic*

“Taken together, the number of people suffering from autoimmune diseases is 24–50 million Americans, 16% of the US population. To put it in perspective, autoimmune disease prevalence equals heart disease and cancer combined.”

*Feldman B, Martin EM, Simms T. An Invisible Epidemic — When your body attacks itself — Autoimmune Disease; How Reframing the Data Unveils a Public Health Crisis Bigger than Cancer and Heart Disease Combined. www.tincture.io.

Autoimmune Disease Statistics*

- Annual direct health care costs for AD in US estimated to be ~\$100 billion
- At least 23.5 million Americans suffer from one or more autoimmune diseases
- Among the top-10 causes of death in females under 64 years old
- Immunosuppressant treatments have devastating side effects



*<https://www.aarda.org/autoimmune-information/autoimmune-statistics/>

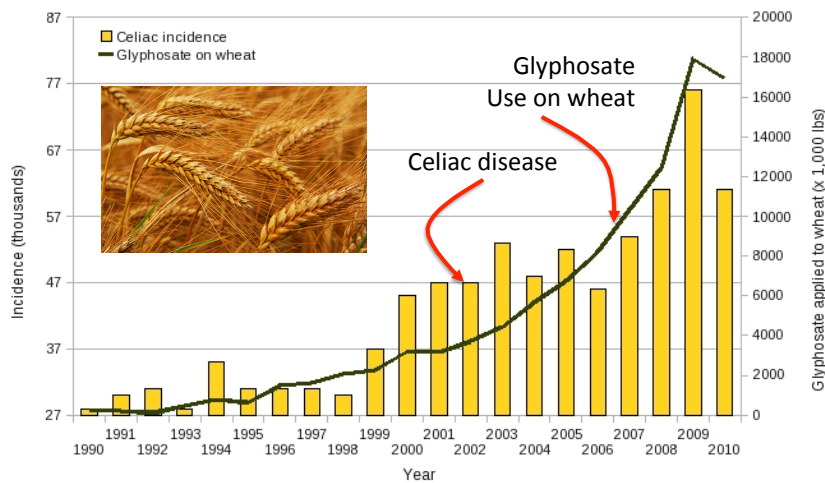
Why do we have an epidemic in autoimmune disease in America today?

Hypothesis

- Glyphosate exposure sets up a weakened immune system, a leaky gut barrier and a leaky brain barrier
- Glyphosate contamination in proteins makes them hard to break down
- Glyphosate disrupts the pancreatic enzymes that metabolize proteins
- Person develops overactive antibody response to foreign protein contaminated with glyphosate and, through molecular mimicry, this leads to autoimmune disease
- This easily explains gluten intolerance and other food allergies



Glyphosate and Celiac Disease*



*Samsel and Seneff, Interdiscip Toxicol. 2013;6(4): 159–184.

Celiac disease: Impaired gluten digestion

- Gluten intolerance results from inability to break down gluten, which is enriched in proline*
- The enzyme that breaks down proline depends on *manganese* as a catalyst (depleted by glyphosate)
- It also contains three regions with highly conserved glycines**
- Malabsorption can lead to nutritional deficiencies and symptoms of autism***

*G. Janssen et al., PLoS One 2015; 10(6): e0128065

**F Morel et al., Biochimica et Biophysica Acta 1999;1429: 501-505

***SJ Genuis and TP Bouchard, J Child Neurol. 2010;25(1):114-9

Celiac disease: Impaired gluten digestion

- Gluten intolerance results from inability to break

Wheat is routinely sprayed right before harvest
with glyphosate as a desiccant

Other treated plants include
Sugar cane, barley, peanuts, maize and legumes

deficiencies and symptoms of autism

*G. Janssen et al., PLoS One 2015; 10(6): e0128065

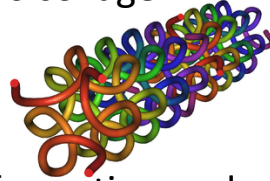
**F Morel et al., Biochimica et Biophysica Acta 1999;1429: 501-505

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Collagen and Gelatin

Collagen and Gelatin

- 25% of the protein in our body is collagen
- 25% of the amino acids in collagen are glycines
- Glyphosate substitution for glycine will disrupt triple-helix formation and lead to diseases of the vasculature, joints and bones
- Gelatin is derived from collagen in bones and ligaments sourced from cows and pigs fed glyphosate-contaminated GMO Roundup-Ready feed



Products Containing Gelatin !!



Glyphosate Contamination in Vaccines (Parts Per Billion)*

Merck	ZOSTAVAX	0.62	Shingles
Merck	MMR-II	3.74	Measles, Mumps and Rubella
Merck	VARIVAX	0.56	Varicella, Chicken Pox
MERCK	PNEUMOVAX	ND	Pneumococcal 18
MERCK	PROQUAD	0.66	Measles, Mumps, Rubella, Varicella
GSK	ENERGIX-B	0.34	Heptatitis B

*A Samsel and S Seneff, Journal of Biological Physics and Chemistry 2017;17:8-32.

Glyphosate Contamination in Vaccines (Parts Per Billion)*

The suspected link between MMR and autism can be explained through an autoimmune attack on the myelin sheath following exposure to glyphosate-contaminated antigen in the vaccine

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Rheumatoid Arthritis

- Inflammation in the joints causes pain and limits movement
 - Small joints of the hands, feet and cervical spine most affected
- Can lead to lung fibrosis
- Increases risk to atherosclerosis, heart attack and stroke.
- Poor iron absorption leads to "anemia of chronic disease"
- Fatigue, low grade fever, malaise, morning stiffness, loss of appetite and loss of weight



US Department of Health and Human Services Data on Pain-Killer Drug Abuse*

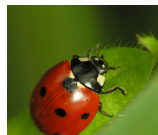
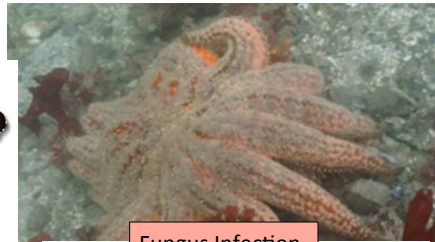
- Drug overdose is the leading cause of injury death in the United States
 - Heroin, morphine, and prescription pain relievers
- More people died from drug overdoses in 2014 than in any previous year on record
- More than 6 out of 10 involved an opioid drug
- More than 650,000 opioid prescriptions are dispensed every day



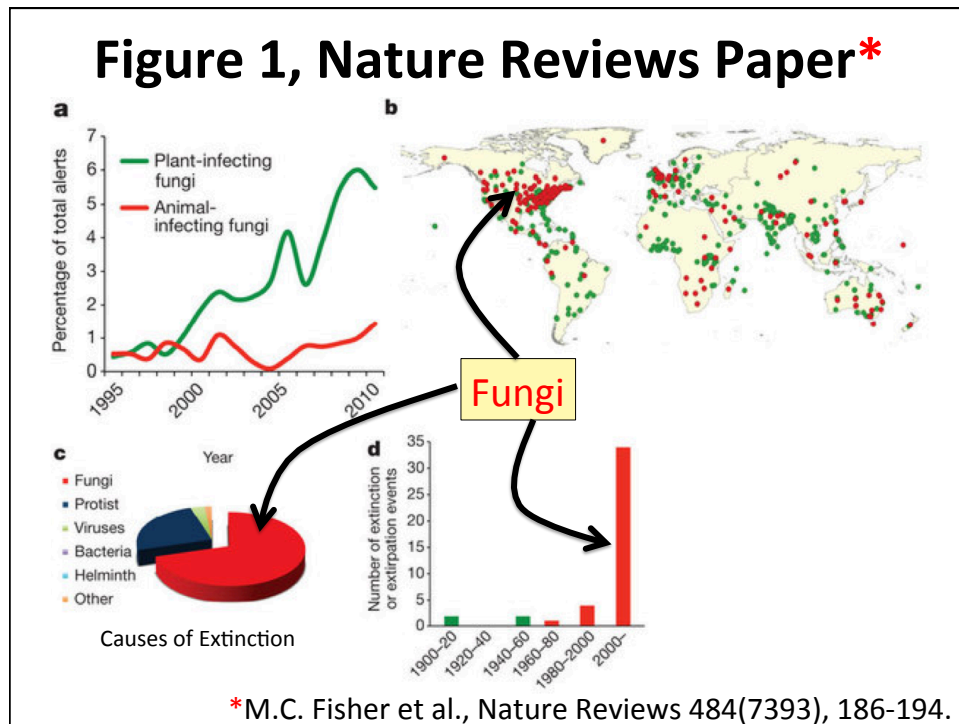
*<http://www.hhs.gov/opioids/about-the-epidemic/>

Animals in Distress

Species in Stress



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



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

“ 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.

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.



The High Cost of Pesticides: Human and Animal Diseases

Judy Hoy¹, Nancy Swanson² and Stephanie Seneff^{3*}

¹Independent Researcher, Stevensville, MT, USA

²Abacus Enterprises, Lummi Island, WA, USA

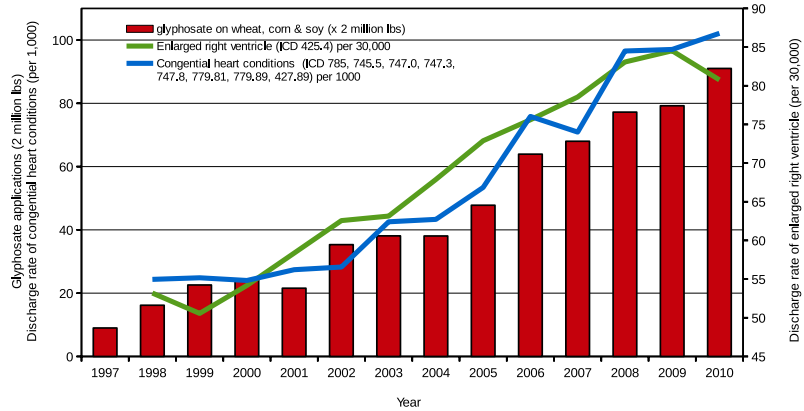
³Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, USA



Congenital Heart Defects*

Congenital heart defect, newborns (R = 0.9833, p <= 9.224e-06)
 Enlarged right ventricle (all ages except newborn) (R = 0.9551, p <= 2.695e-05)

& glyphosate applications to wheat, corn & soy crops



*Figure 22, Hoy et al., Poultry, Fisheries and Wildlife Sciences, 3:1, 2015

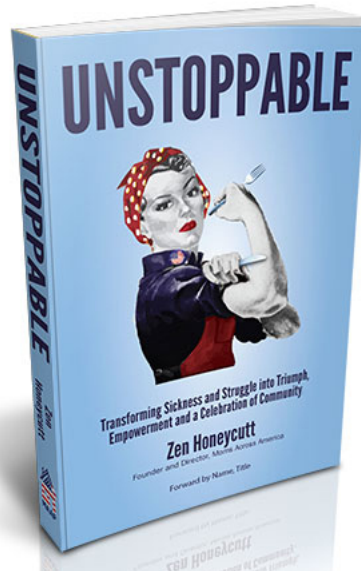
What You Can Do



- Sauerkraut and apple cider vinegar contain acetobacter, one of the very few microbes that can metabolize glyphosate
- Yogurt and kimchi probably do, too



New Book by Zen Honeycutt Founder of Moms Across America

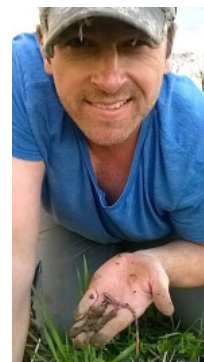




WHAT YOU NEED TO KNOW...
MONSANTO/ROUNDUP®/IARC/PROP65/CANCER
DR. STEPHEN FRANTZ, RESEARCH PATHOBIOLOGIST

Fixing the Soil*

- Dirt is inert; soil is alive
- Missouri farmer JR Bollinger grew corn and soy on a former coal mine
- “We tried ... all kinds of goodies: humates, ... sea minerals, microbes, fish meal and biochar powder.”
 - Earthworms till the soil
 - Soil microbes are crucial for soil health
- Greatly reduce fertilizer needs and improve yield



JR Bollinger

*ecofarmingdaily.com/wormhole-customizing-biological-methods-large-scale-farming/
 David Yarrow
 Down the Wormhole: Customizing Biological Methods for Large Scale Farming
 Belize Ag Report 2017;34:5-17.

Small Organic Farms are the Answer



Bluebird Hill Organic Farm, North Carolina

A Hopeful Quote*

“It’s interesting that in 2016, for the first time in almost 20 years, what we saw is a decrease in the amount of acreage where genetically engineered crops are growing around the world. This represents the fact that this technology is failing, in the sense of superweeds and superpests are popping up all over the world.”

*Ronnie Cummins, founder of the
Organic Consumers Association*

*articles.mercola.com/sites/articles/archive/2017/03/26/market-rejection-of-gmos-grows.aspx

Summary

- Glyphosate is pervasive in our food supply today
 - Contrary to popular belief, it is insidiously cumulatively toxic to all life forms, including humans
- Time trends in glyphosate usage on core crops are correlated with alarming rises in a large number of debilitating diseases, including autism, Alzheimer's and cancer.
- Glyphosate's insidious toxicity is likely mediated through substitution for glycine during protein synthesis by mistake
 - Explains causal relationship with multiple diseases, particularly autoimmune diseases and neurological diseases
- Glyphosate is likely a major factor in antibiotic resistance
- Glyphosate in collagen leads to opioid drug epidemic
- Glyphosate explains the epidemic in kidney failure among sugarcane workers
- Glyphosate urgently needs to be banned, worldwide