Why Glyphosate Should be Banned, Globally

Stephanie Seneff

MIT CSAIL

April, 2017

Professor Don Huber wrote…

"The irresponsible application of this massive experiment with glyphosate and GMO crops appears to be more of a *generalized ecocide* than a benefit to society as commercially promoted.

Future historians may well look back upon our time and write ... about how willing we are to sacrifice our children and *jeopardize future generations* for this massive experiment we call genetic engineering that is based on failed promises and flawed science."

Outline

- Overview
- Gut Dysbiosis and Autism
- Lab Animals and Farm Animals
- Diabetes, Obesity & Glyphosate
- Autoimmune Disease
- Endocrine Disruption and Developmental Disorders
- Kidney Failure
- Species in Distress
- Fusarium and Root Rot
- Massive Die-off of Marine Life
- Solutions
- Summary

Overview

The Big Picture

Background

- Weeds => Roundup => Glyphosate
- Mega farms => GMOs (Roundup-Ready Crops)

The Problem

- We were told Glyphosate is safe, since it disrupts the Shikimate pathway that humans do not have
- But our gut bacteria have it, and they provide essential services to us

Consequences

- Incidents of many diseases have sky-rocketed
- Many creatures are affected; the earth is suffering

What to do

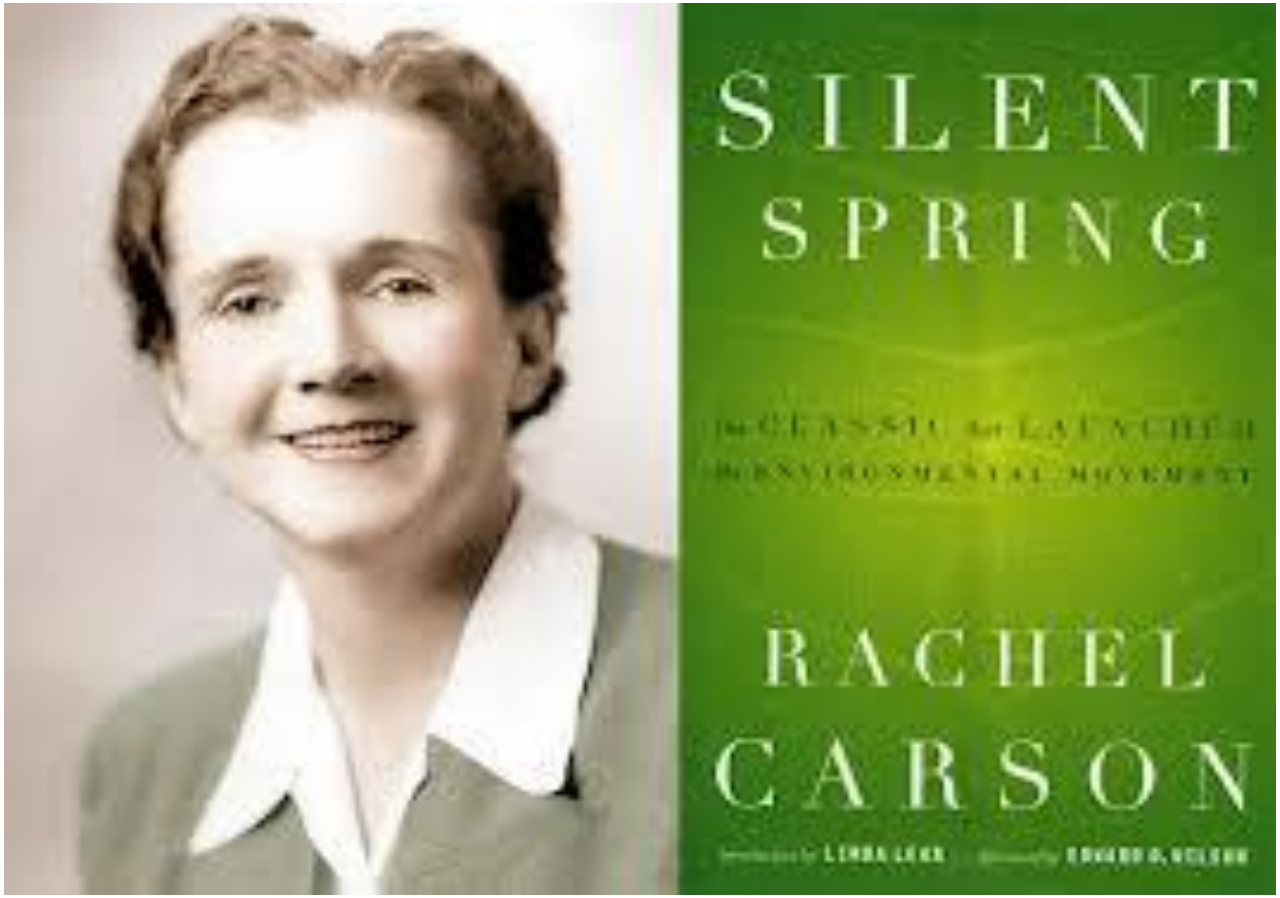
- Educate
- Advocate => legislate, litigate
- Change the way we grow and consume food
- Extend our time horizon => for our grandchildren's' grandchildren

It's everyone's responsibility, but why Belize?

- Small countries have advantages
- New opportunities, eco-tourism, teaching organic farming, etc
- Become a world leader

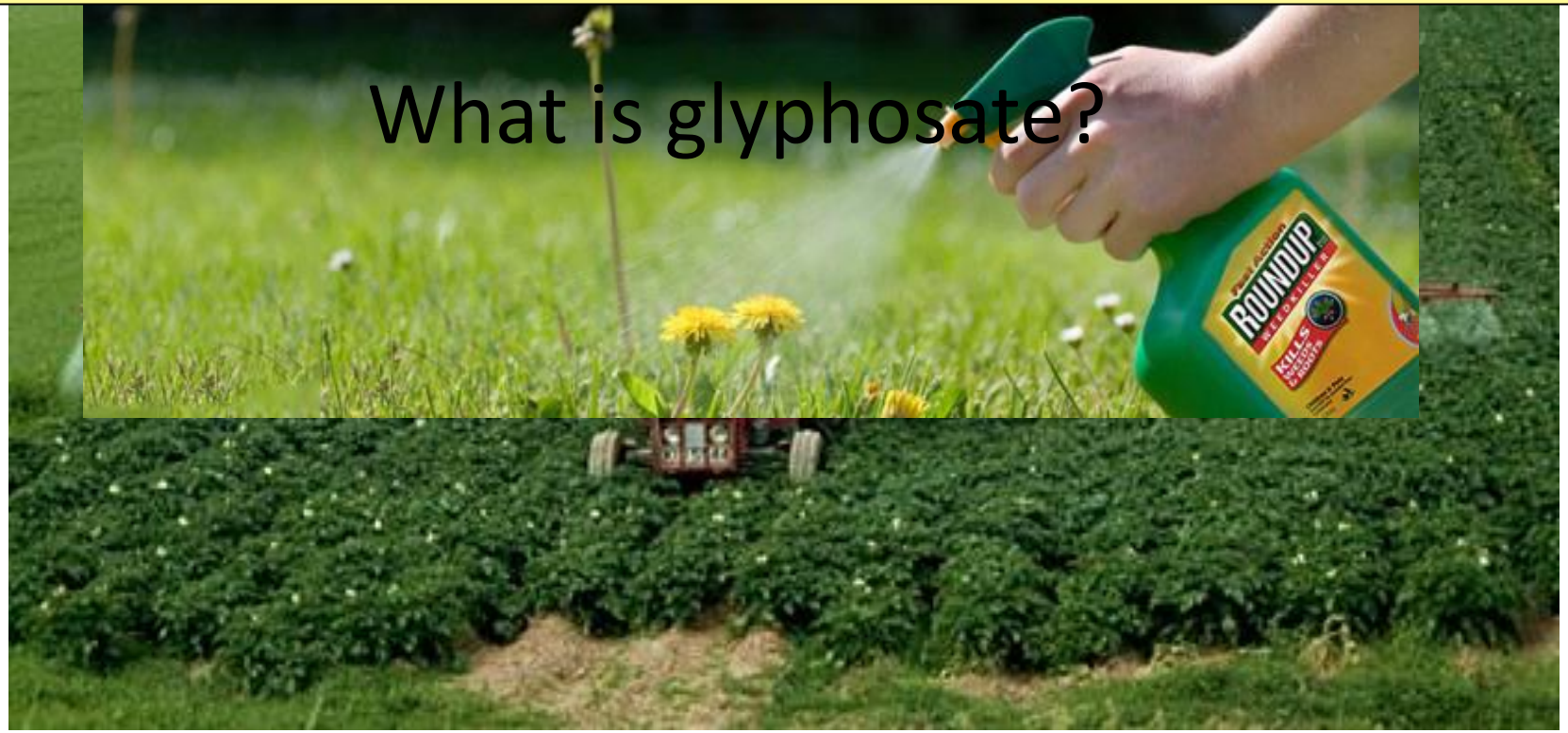
Silent Spring (1962)

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

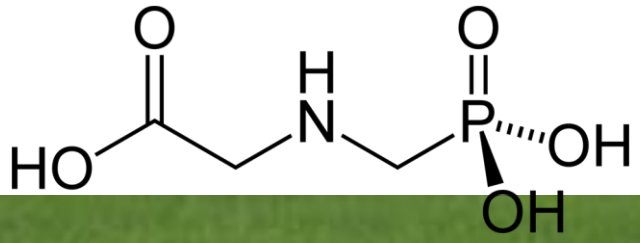


Roundup and GMO Crops

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



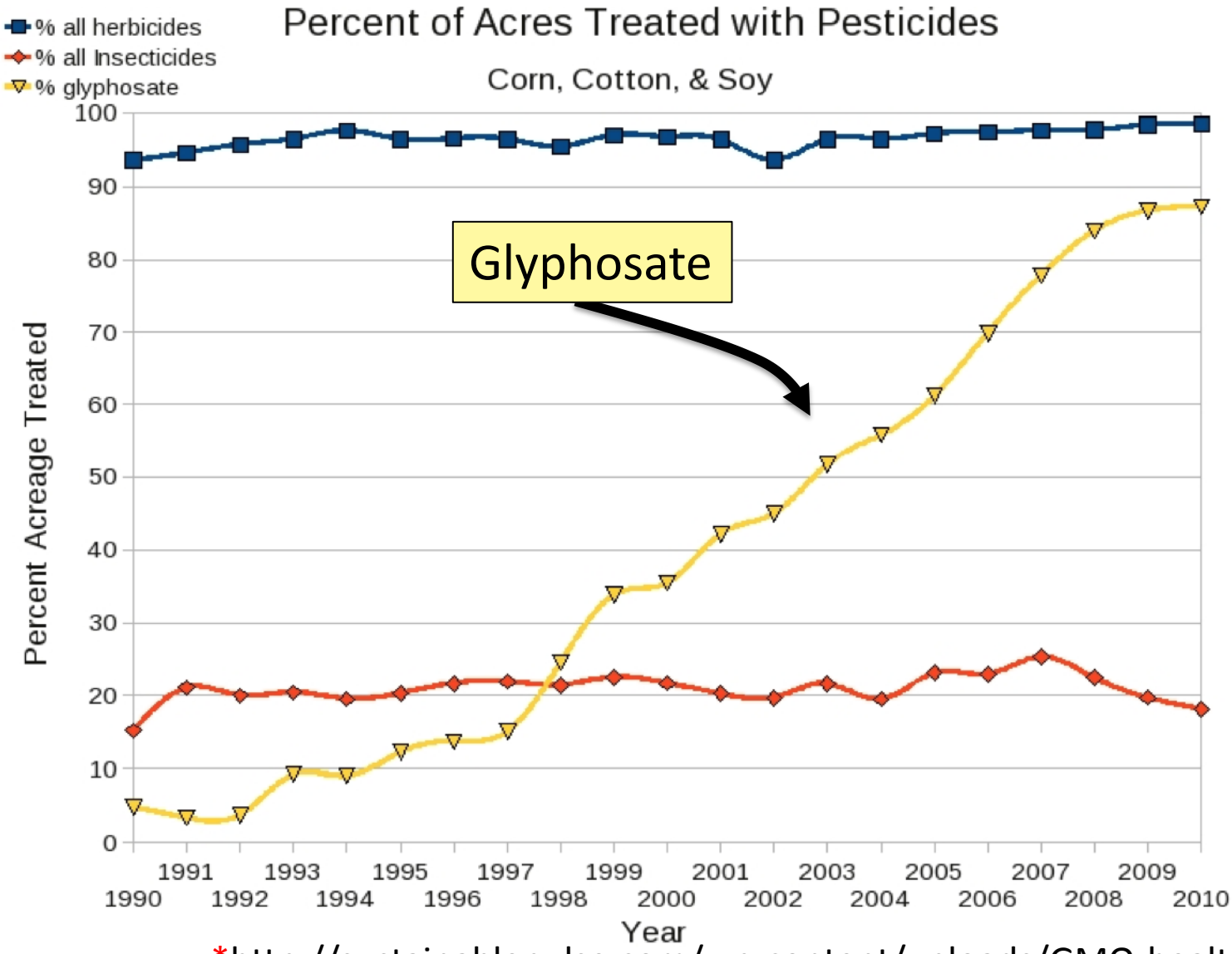
Roundup as a Desiccant/Ripener just before Harvest



Glyphosate!!

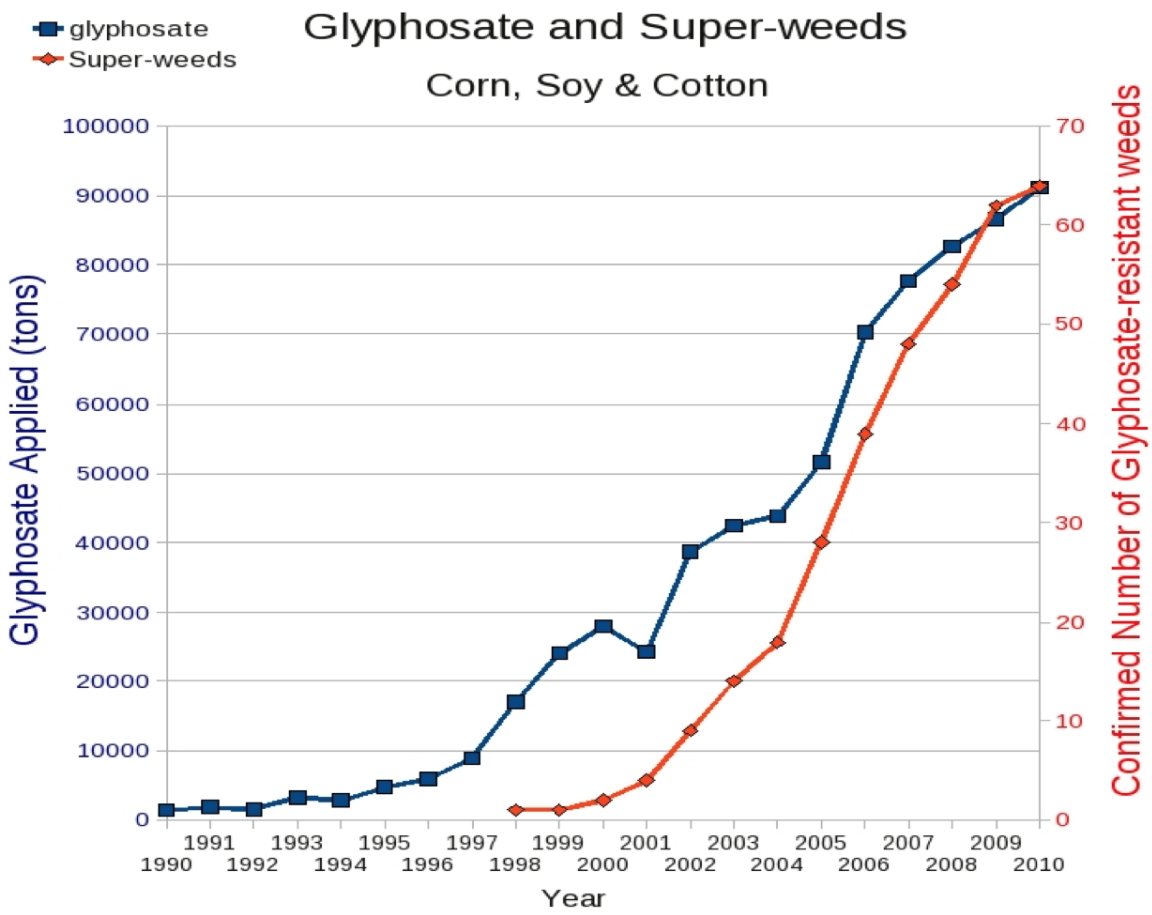
- Glyphosate is now the #1 herbicide in use in the U.S. and is increasingly used around the world
  - Developed and patented by Monsanto in the 1970's
  - Introduced into the US food chain in 1974
  - Came out from under patent in 2000
- Inhibits an enzyme in the *shikimate* pathway involved in the synthesis 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 two decades

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



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

Glyphosate and Superweeds: U.S.*



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

Glyphosate Acronym*

G **Glycine** mimicry, **Gut** bacteria disruption

L **Lymphoma** - the cancer most often linked to G

Liver, one of the key organs damaged by G

YP **CYP-450** enzyme impairment by G

H **Hemoglobin** activity reduced due to chelation of iron and suppressed synthesis of the pyrrole ring

O **Osteoarthritis** due to collagen disruption

S **Shikimate** pathway suppression - 'good' gut bacteria disrupted

Sulfur pathways disrupted

A **Acinar Cells** damaged in pancreas: leads to pancreatitis

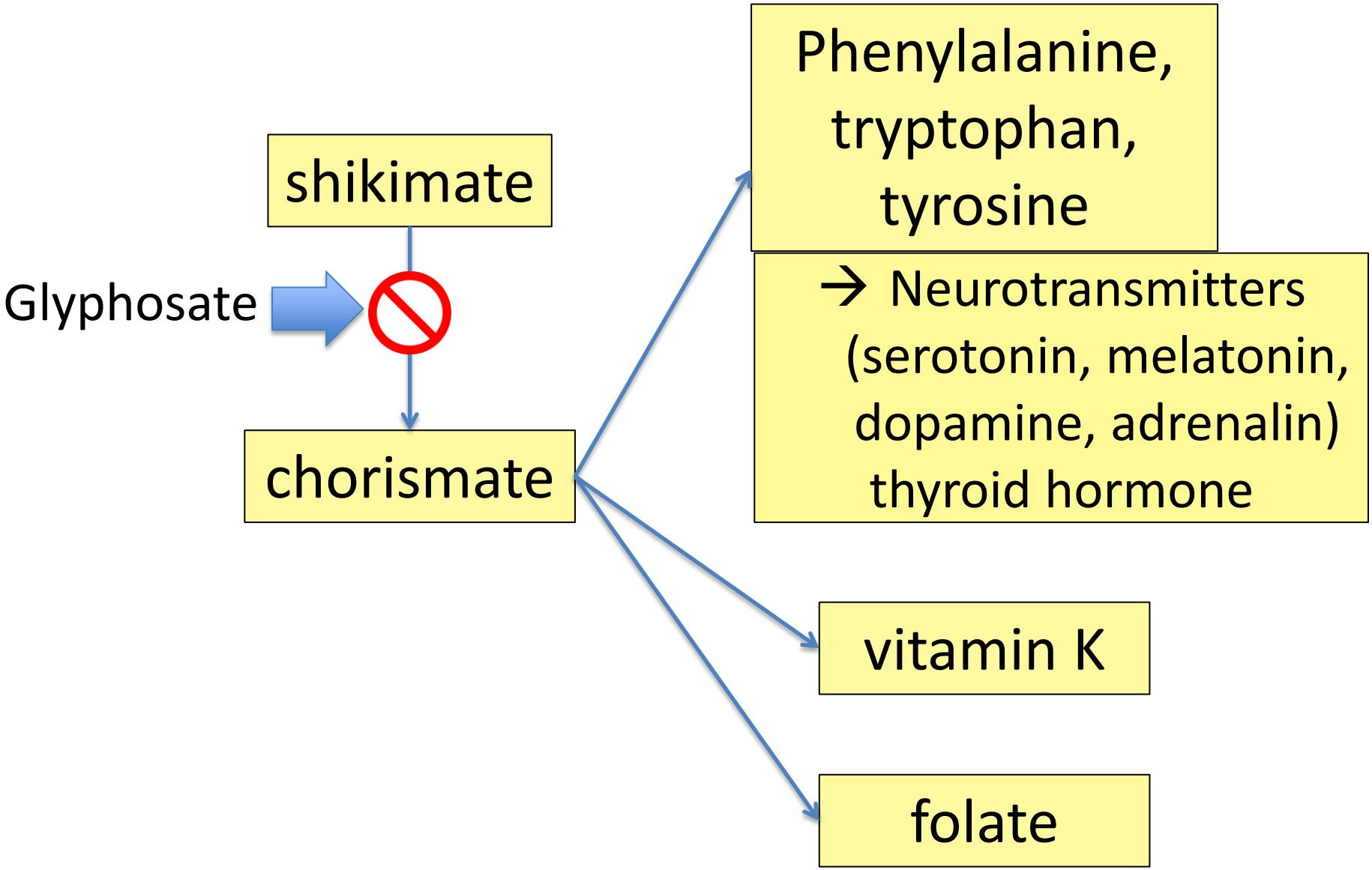
T **Tubule** damage in kidneys: kidney failure

Transition metal chelation, **Tryptophan** deficiency

E **Enzyme** disruption through metal chelation and glycine substitution during protein synthesis

*Thanks to David Fichtenberg

Shikimate Pathway Disruption



Paper Showing Strong Correlations between Glyphosate Usage and Chronic Disease

Journal of Organic Systems, 9(2), 2014

ORIGINAL PAPER

Genetically engineered crops, glyphosate and the deterioration of health in the United States of America

Nancy L. Swanson[1], Andre Leu[2]*, Jon Abrahamson[3] and Bradley Wallet[4]

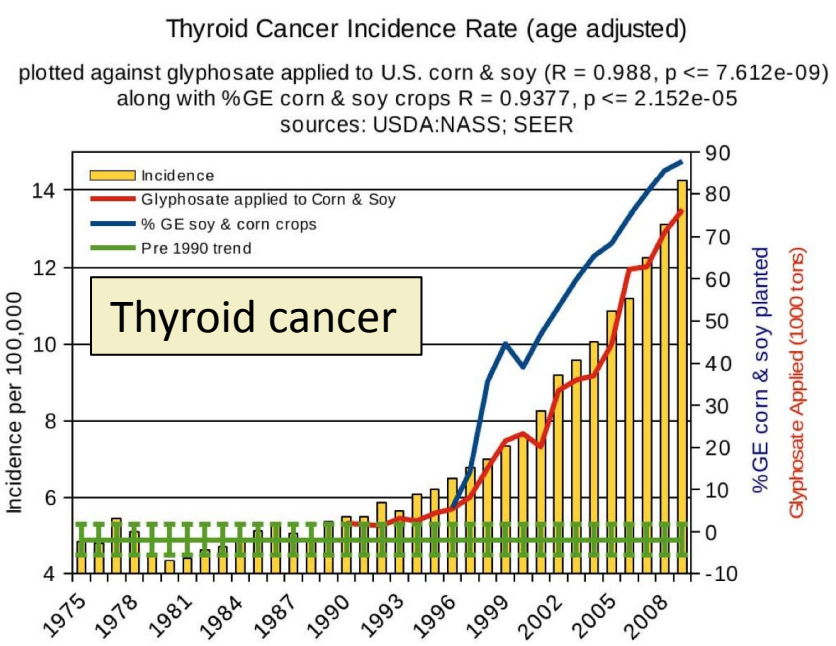
[1] *Abacus Enterprises, Lummi Island, WA, USA*

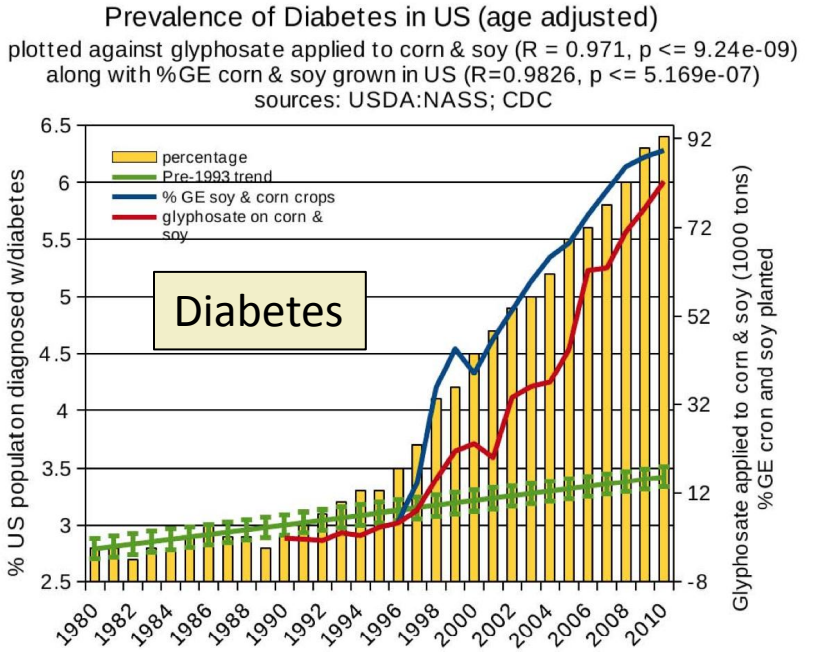
[2] *International Federation of Organic Agricultural Movements, Bonn, Germany*

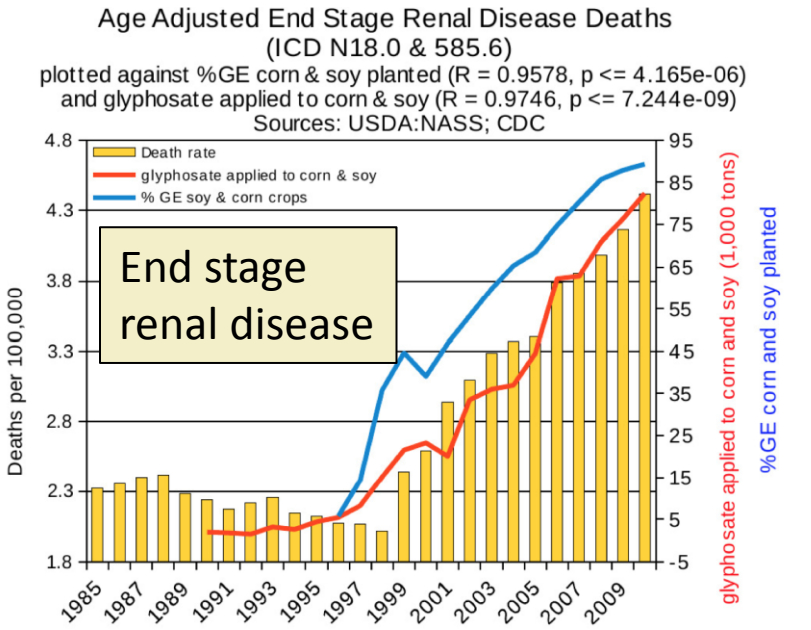
[3] *Abacus Enterprises, Lummi Island, WA, USA*

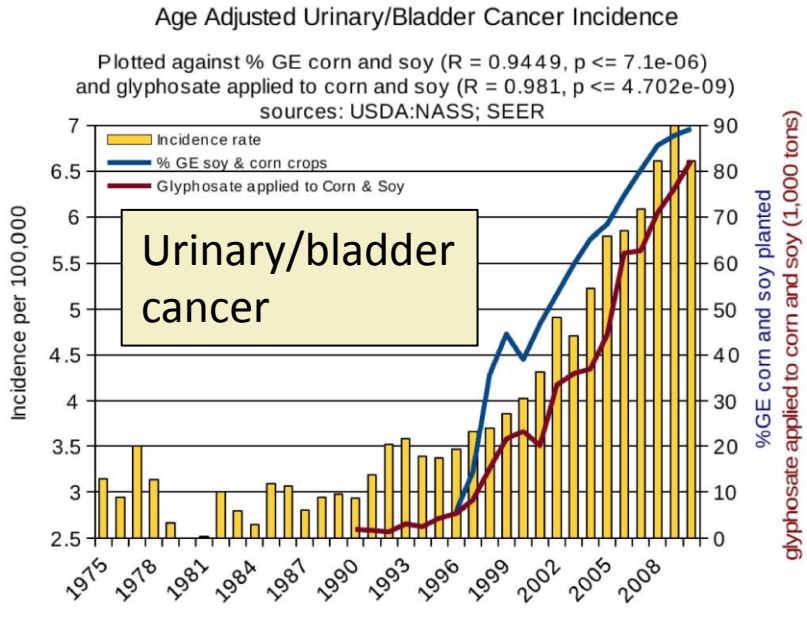
[4] *Crustal Imaging Facility, Conoco Phillips School of Geology and Geophysics, University of Oklahoma, USA*

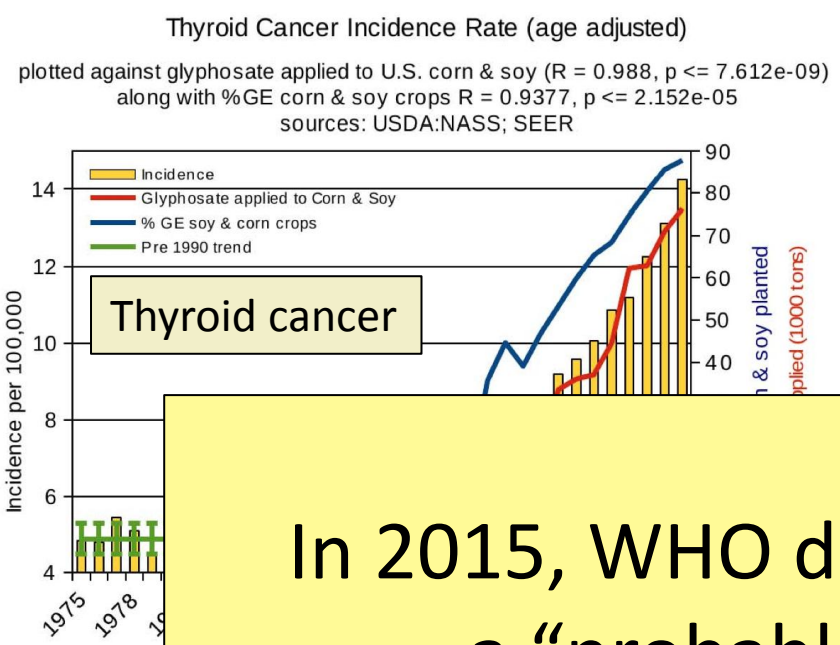
* *Corresponding author: andreleu.al@gmail.com*

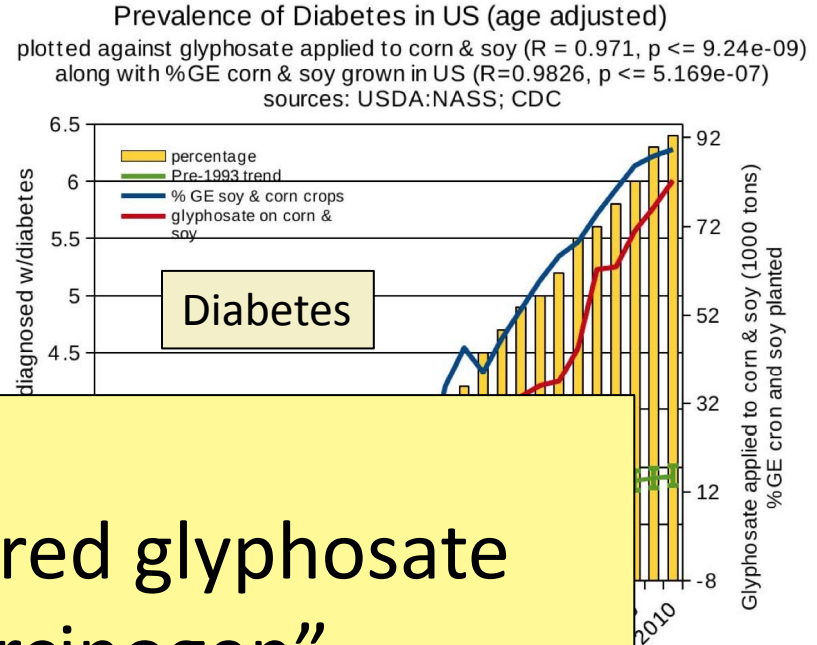

Thyroid Cancer Incidence Rate (age adjusted)
plotted against glyphosate applied to U.S. corn & soy (R = 0.988, p <= 7.612e-09)
along with %GE corn & soy crops R = 0.9377, p <= 2.152e-05
sources: USDA:NASS; SEER
Incidence
Glyphosate applied to Corn & Soy
% GE soy & corn crops
Pre 1990 trend
Thyroid cancer
Incidence per 100,000
%GE corn & soy planted
Glyphosate Applied (1000 tons)


Prevalence of Diabetes in US (age adjusted)
plotted against glyphosate applied to corn & soy (R = 0.971, p <= 9.24e-09)
along with %GE corn & soy grown in US (R=0.9826, p <= 5.169e-07)
sources: USDA:NASS; CDC
percentage
Pre-1993 trend
% GE soy & corn crops
glyphosate on corn & soy
Diabetes
% US populaton diagnosed w/diabetes
Glyphosate applied to corn & soy (1000 tons)
%GE cron and soy planted

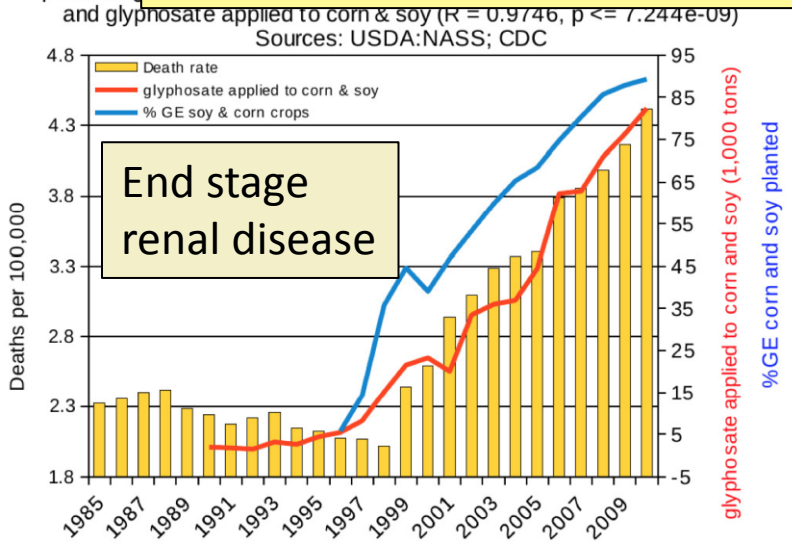

Age Adjusted End Stage Renal Disease Deaths
(ICD N18.0 & 585.6)
plotted against %GE corn & soy planted (R = 0.9578, p <= 4.165e-06)
and glyphosate applied to corn & soy (R = 0.9746, p <= 7.244e-09)
Sources: USDA:NASS; CDC
Death rate
glyphosate applied to corn & soy
% GE soy & corn crops
End stage
renal disease
Deaths per 100,000
glyphosate applied to corn and soy (1,000 tons)
%GE corn and soy planted

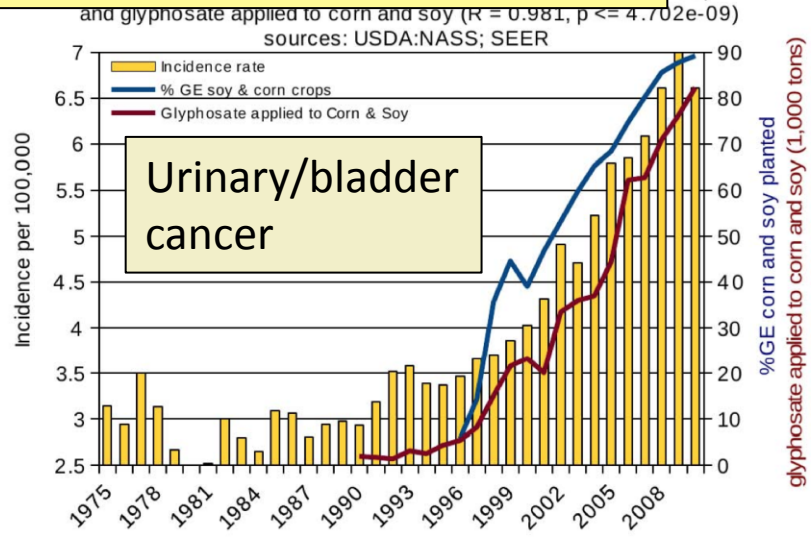

Age Adjusted Urinary/Bladder Cancer Incidence
Plotted against % GE corn and soy (R = 0.9449, p <= 7.1e-06)
and glyphosate applied to corn and soy (R = 0.981, p <= 4.702e-09)
sources: USDA:NASS; SEER
Incidence rate
% GE soy & corn crops
Glyphosate applied to Corn & Soy
Urinary/bladder
cancer
Incidence per 100,000
%GE corn and soy planted
glyphosate applied to corn and soy (1,000 tons)





In 2015, WHO declared glyphosate a "probable carcinogen"





Quote from the Conclusion*

"Although correlation does not necessarily mean causation, when correlation coefficients of over 0.95 (with *p*-value significance levels less than 0.00001) are calculated for a list of diseases that can be directly linked to glyphosate, via its known biological effects, it would be imprudent not to consider causation as a plausible explanation."

*NL Swanson et al. Journal of Organic Systems 9(2), 2014, p. 32,

Wales: Excessive Roundup Use and Multiple Debilitating Diseases*

- Rosemary Mason says that in Wales there are cancer/disease hotspots in the surrounding villages where Roundup has been sprayed
  - Brain tumors, cancers of the breast, ovary, prostate, lung ,oesophagus, colon, pancreas, rectum, and kidney as well as non-Hodgkin's lymphoma, uterine carcinoma and multiple myeloma
  - Parkinson's disease, multiple sclerosis, motor-neurone disease and Alzheimer's/dementia
- Many of the cancers are aggressive and unusual
  - Resemble the cancers that were seen in factory workers in the pesticides industry in the 1960s.

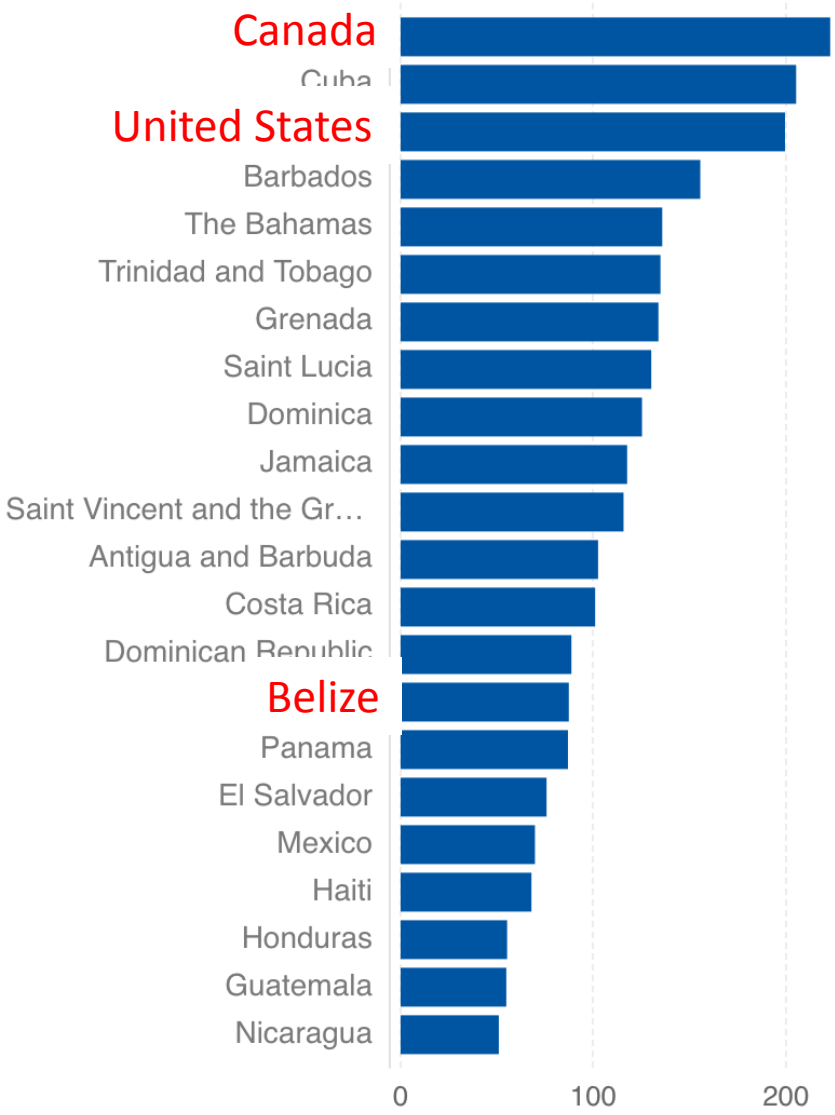
*www.countercurrents.org/2017/01/27/the-british-government-has-colluded-with-monsanto-and-should-be-held-accountable-in-the-international-criminal-court/

Cancer Statistics in Belize*

Cancer Type	Mortality Rate	Change since 1990
All cancer	87.3	48%
Pancreatic cancer	7.3	540%
Ovarian cancer	4.7	539%
Liver cancer	6.3	429%
Testicular cancer	0.1	193%
Prostate cancer	30.4	93%
Lung cancer	19.8	64%
Breast cancer	15.0	62%
Colon cancer	19.4	58%

*global-disease-burden.healthgrove.com

Cancer Rates in North America



http://global-disease-burden.healthgrove.com/l/29531/Cancer-in-Belize

Carey Gillam on Monsanto Corruption*

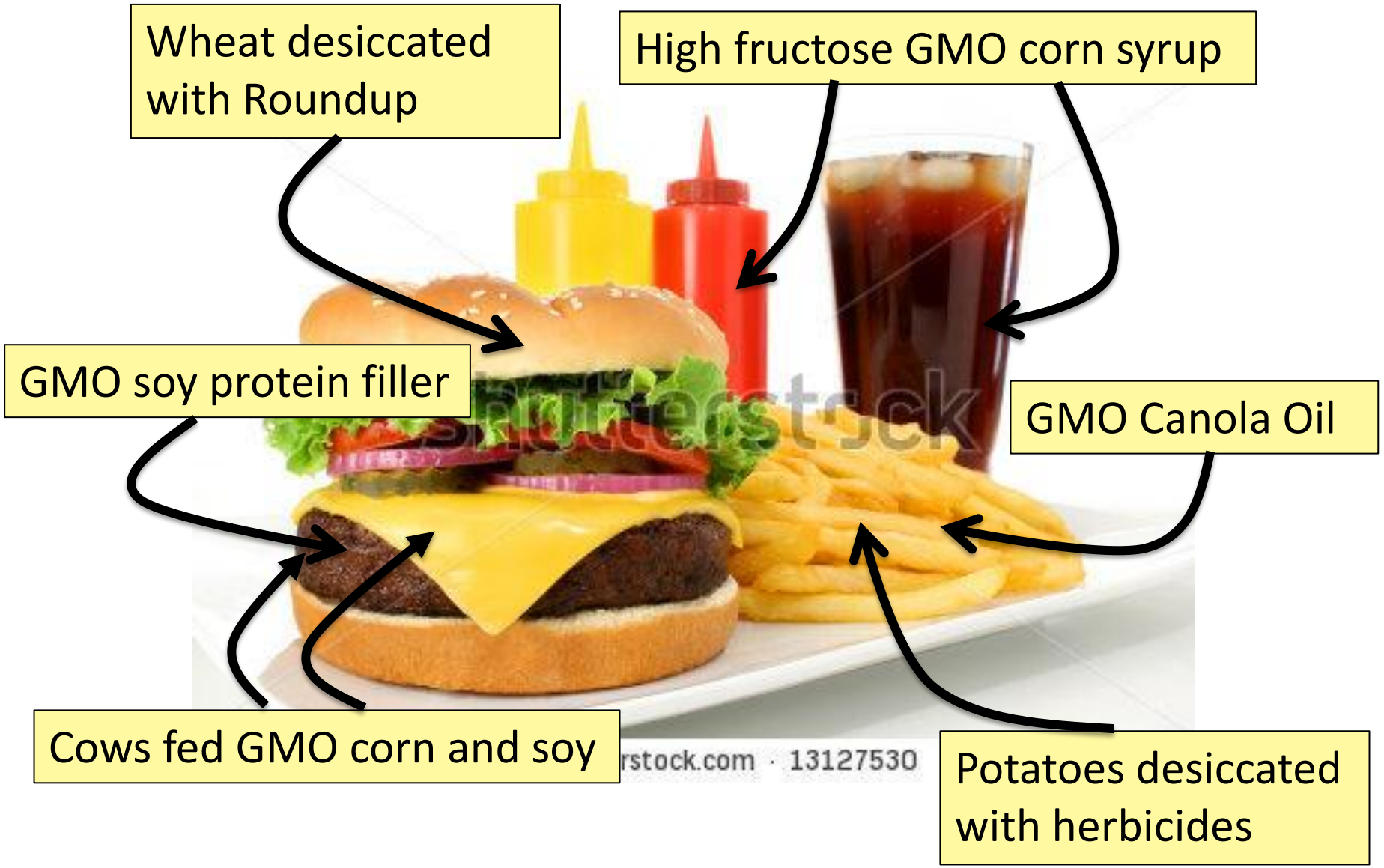
"The documents show discussions by Monsanto officials about many troubling practices, including *ghostwriting* a glyphosate manuscript that would appear to be authored by a highly regarded, independent *scientist* who Monsanto and other chemical industry players would *pay* for participation. One such scientist would need `less than *10 days*' to do the work needed but would require payment of more than *$21,000*, the records show."

*www.huffingtonpost.com/entry/58cc5541e4b0e0d348b34348

Class Action Lawsuit*

*https://www.classaction.com/roundup-weed-killer/lawsuit/

Is Glyphosate in Our Food?

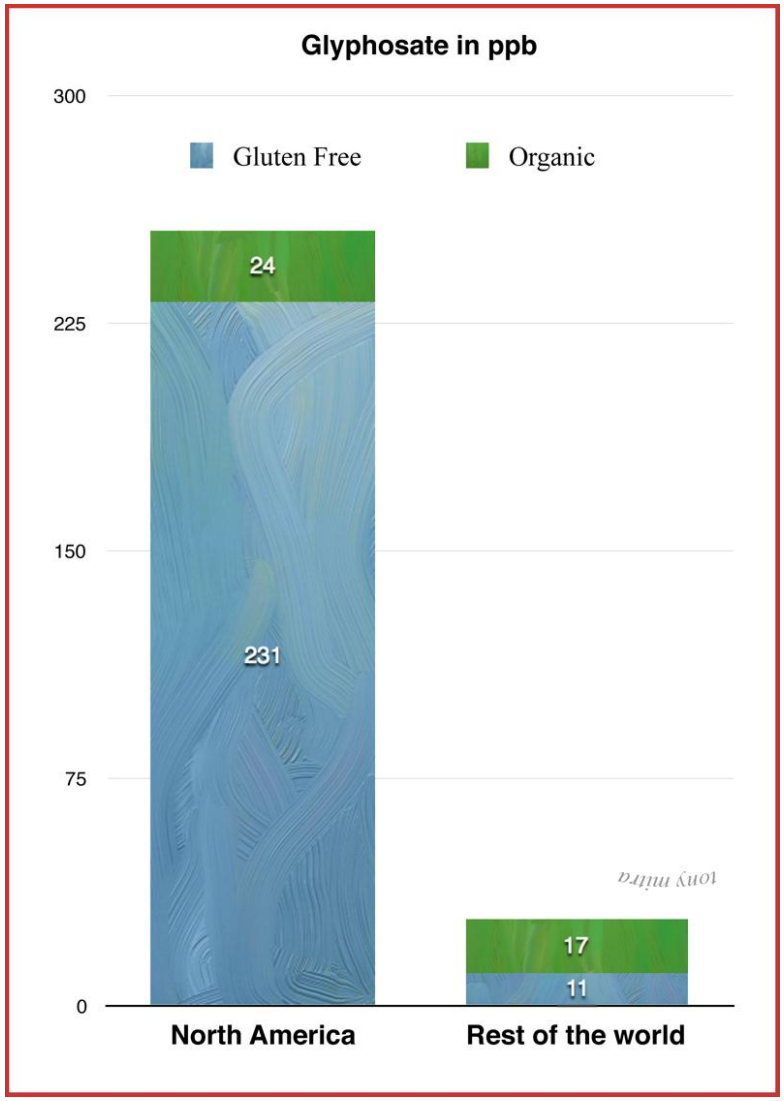


Glyphosate Levels in Foods (ppb)*

GLYPHOSATE IN NORTH AMERICA (SANS MEXICO) VERSUS THE REST OF THE WORLD		
FOOD TYPE	**NORTH AMERICA**	**REST OF THE WORLD**
Flour - Chickpea	**970**	10
Flour - Soy	**718**	1
Chickpea	**555**	3
Lentil	**357**	291
Oatmeal	**254**	12
Pea Products	**246**	31
Crackers	**214**	47
Pasta	**157**	2
Bean - Other	**136**	101
Cereal - Infant	**132**	0
Bean - Pinto	**128**	34
Millet	**127**	44

*From the Canadian government, analyzed by Tony Mitra, Canadian activist

More Data from Tony Mitra



On Glyphosate Contamination in Food Products …

"It is heartbreaking to see how this toxic, dangerous and unnecessary technology can strong arm its way into every facet of a supposedly democratic system and pollute its science, regulatory mechanism, academia, media, and the widest imaginable swath of political process, leaving virtually no clear avenue for the people to correct this wholesale chemical attack on society and an assault on nature."

Tony Mitra, *Canadian activist*

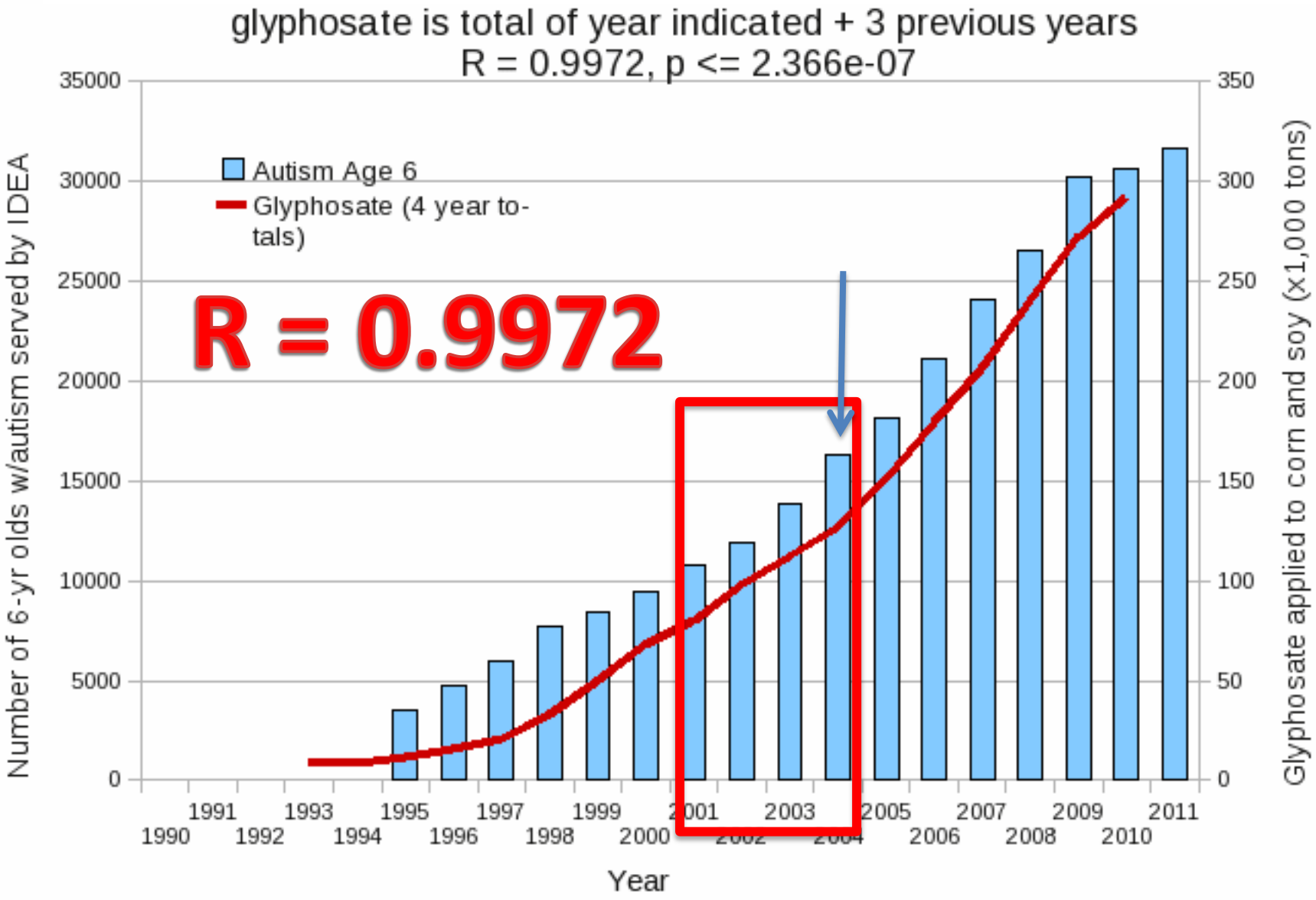
Some symptoms of severe glyphosate poisoning*

- Pulmonary edema
- Respiratory distress sometimes necessitating intubation
- Dysrrhythmia
- Renal failure
- Altered consciousness
- Shock (very low blood pressure)
- Blood parameters
  - Acidosis
  - Low serum oxygen
  - High white blood cell count
  - High serum phosphate, potassium; low serum bicarbonate

*H-L Lee et al, Academic Emergency Medicine 2000; 7(8):906-910.

Gut Dysbiosis and Autism

Autism Prevalence: 6 year olds*



* Figure 15, Seneff et al., Agricultural Sciences, 2015, 6, 42-70

CASE REPORT

Elevated Urinary Glyphosate and Clostridia Metabolites With Altered Dopamine Metabolism in Triplets With Autistic Spectrum Disorder or Suspected Seizure Disorder: A Case Study *

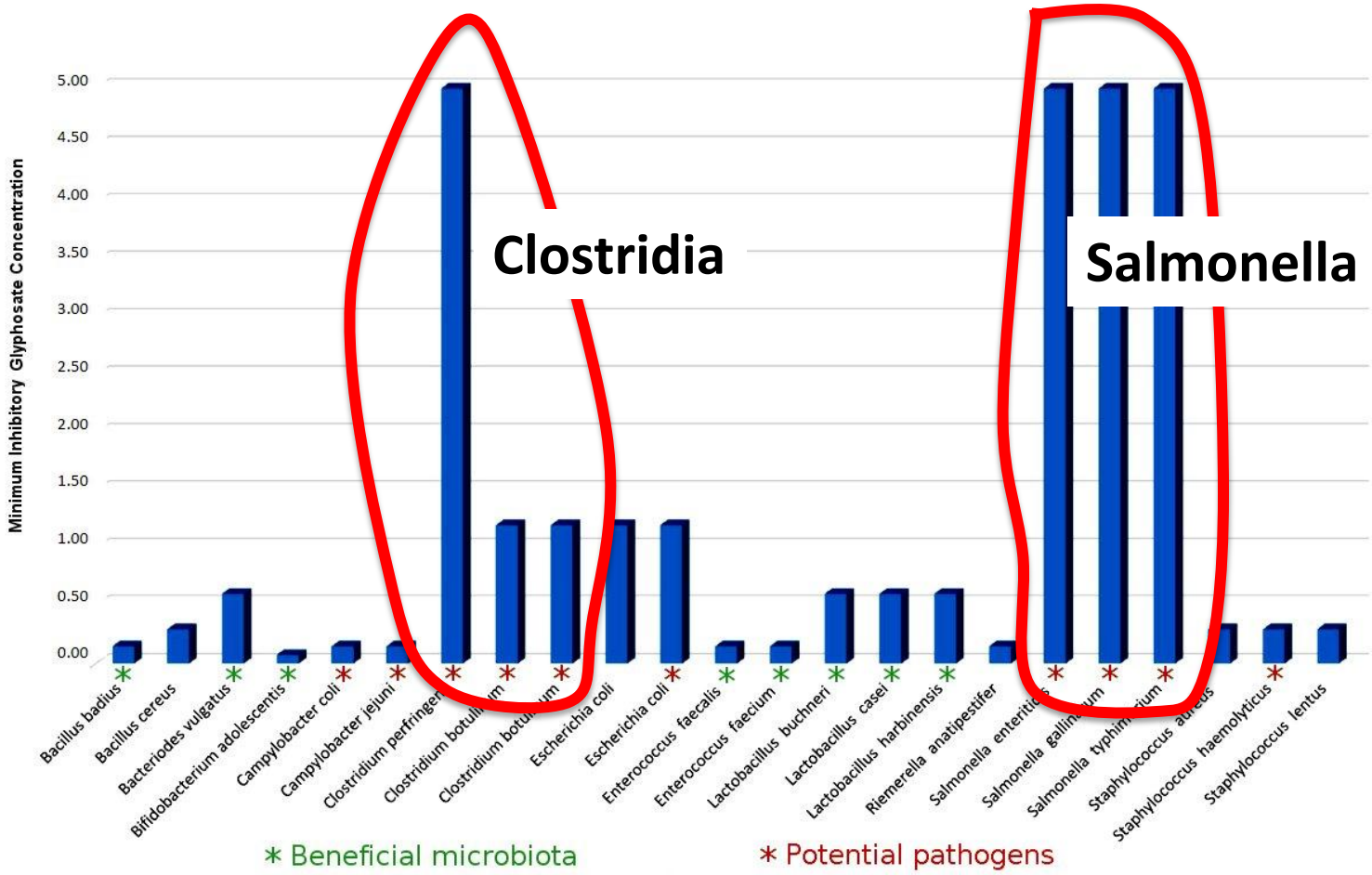
William Shaw, PhD

- Triplets: two boys, one girl. Both boys have autism and girl has seizure disorder
- Very high levels of glyphosate in urine in all three
- *Clostridia* overgrowth due to glyphosate disruption of gut microbes
  - Toxic Clostridia metabolites lead to excess dopamine expression
- Damage to neurons in the brain through oxidative stress

*W. Shaw. Integrative Medicine 2017;16(1);50-57.

Pathogen Overgrowth in Poultry*

Shehata AA, Schrödl W, Aldin AA, Hafez HM, Krüger M. The effect of glyphosate on potential pathogens and beneficial members of poultry microbiota in vitro. Curr Microbiol. 2013 Apr;66(4):350-8.



*Plot provided by Dr. Martin Michener

More evidence linking autism to Clostridia overgrowth*

- 14 autistic children with gut disorder compared to 21 controls
- Significant increase in *Clostridia* species in the gut in autistic children
- Associated with reduced tryptophan levels and increased expression of inflammatory markers
  - Tryptophan is a product of the shikimate pathway, which glyphosate blocks
- Proposed role for antibiotics
  - Glyphosate is a patented antimicrobial agent (2010)

*RA Luna et al., Cellular and Molecular Gastroenterology and Hepatology 2017;3(2): 218-230

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.

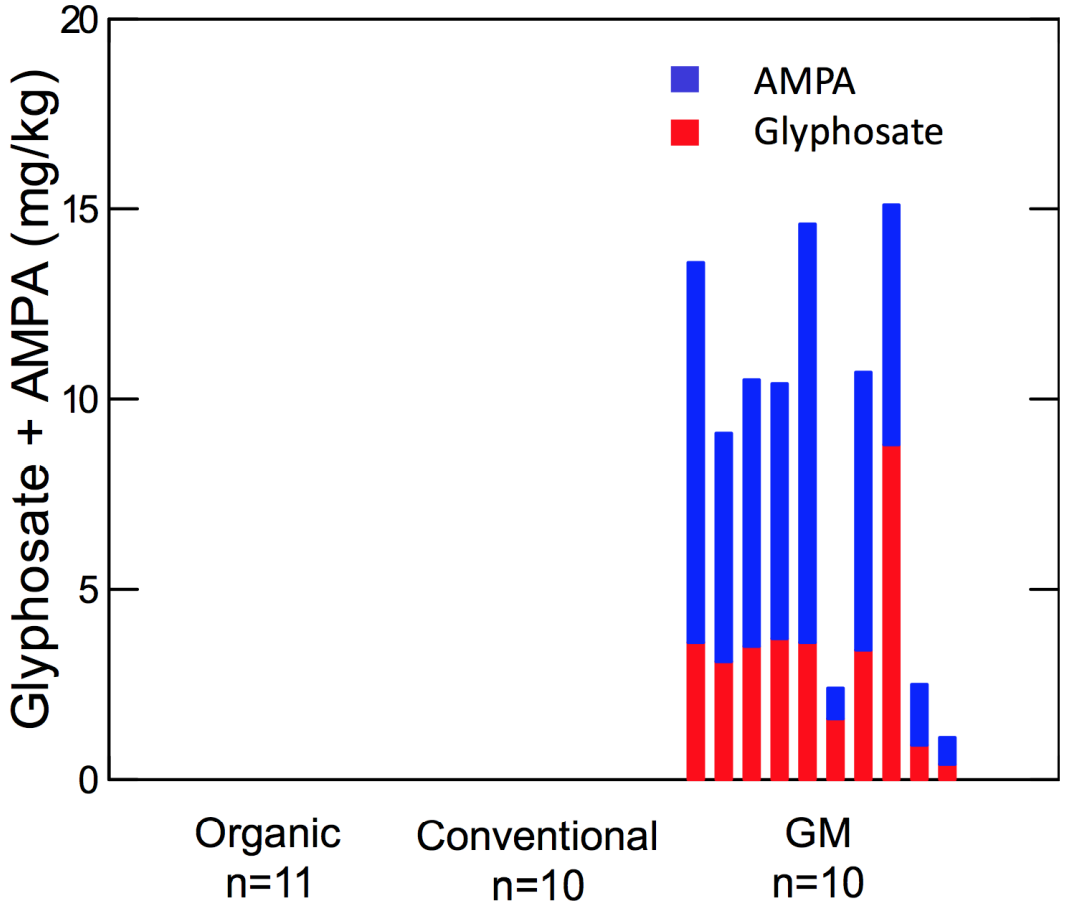


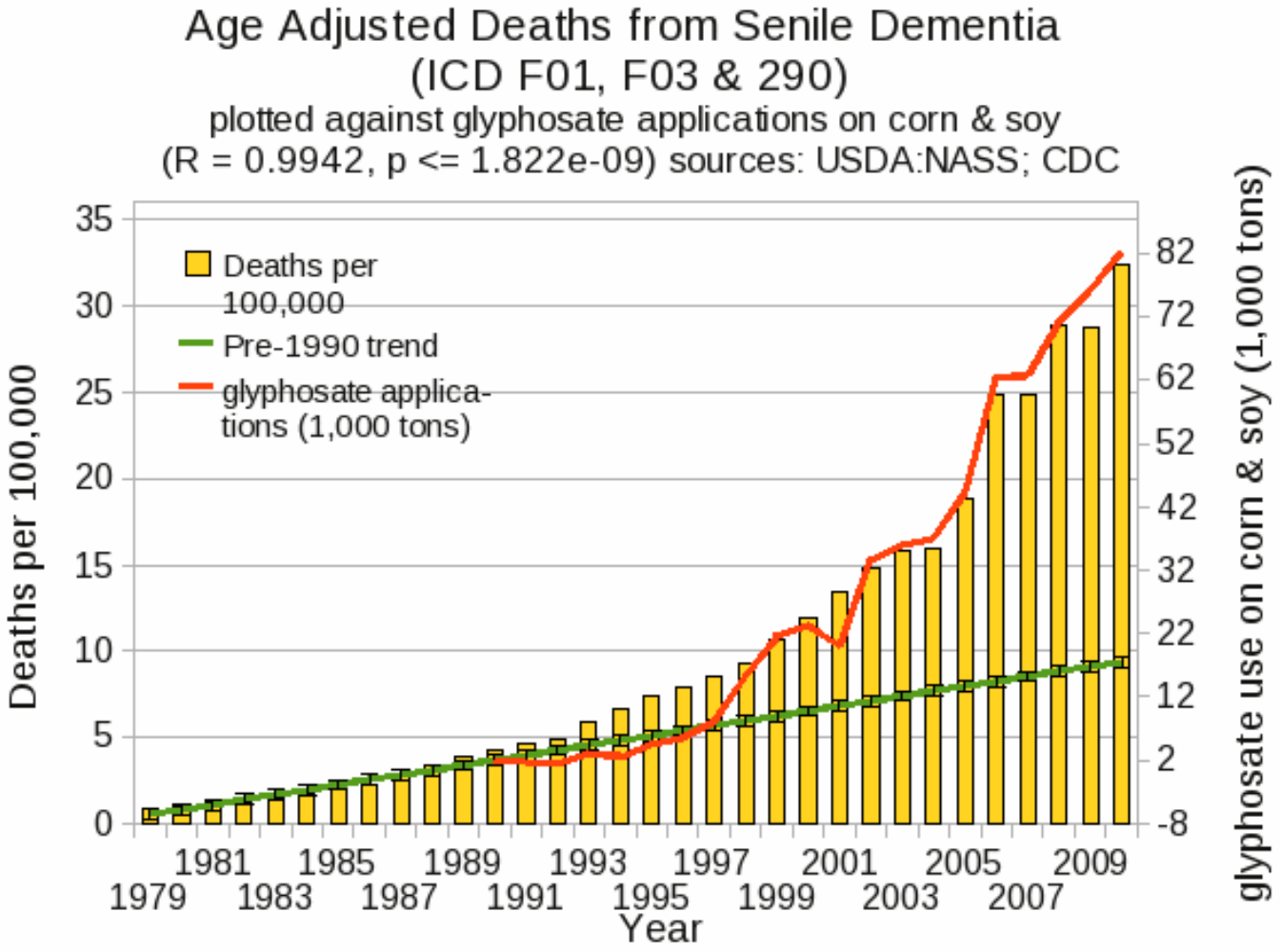
*Figure 1, T. Bøhn et al., Compositional differences in soybeans on the market: glyphosate accumulates in Roundup Ready GM soybeans. Food Chemistry (2013) Epub ahead of print.

Soy Formula Linked to Seizures in Autism*

"There was a 2.6-fold higher rate of febrile seizures, a 2.1-fold higher rate of epilepsy comorbidity and a 4-fold higher rate of simple partial seizures in the autistic children fed soy-based formula"

*CJ Westmark, PLOSOne March 12, 2014, DOI: 10.1371/journal.pone.0080488.

Deaths from Senile Dementia*

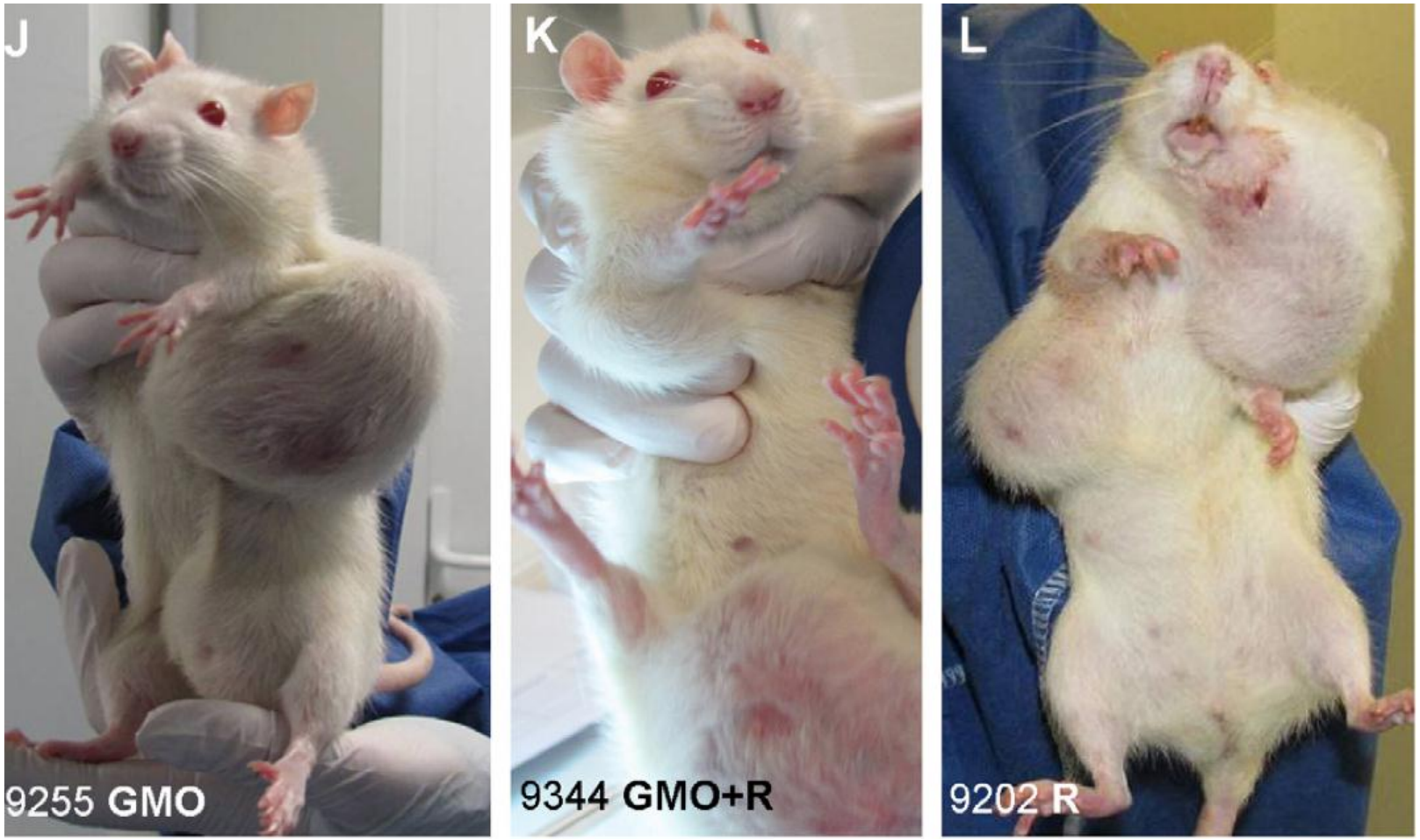


*Plot provided by Dr. Nancy Swanson

Lab Animals and Farm Animals

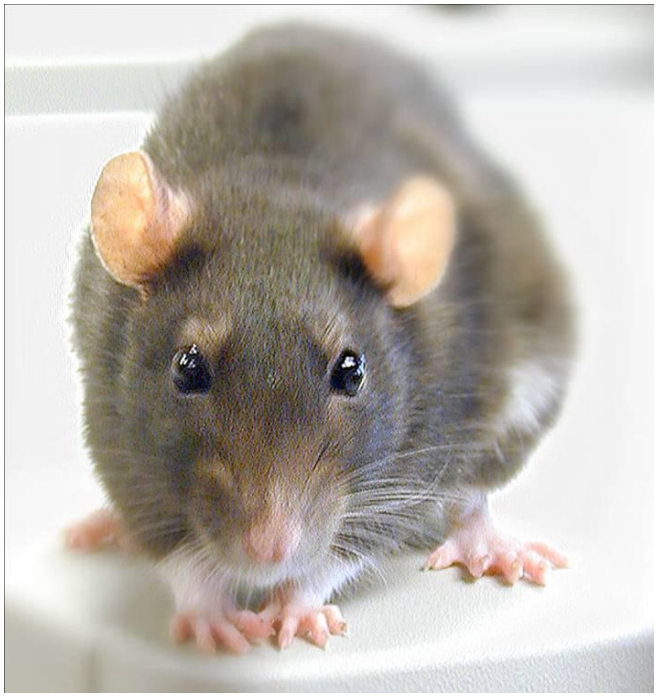
Mammary Tumors in Rats*

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



*G-E Séralini et al. Environmental Sciences Europe 2014, 26:14

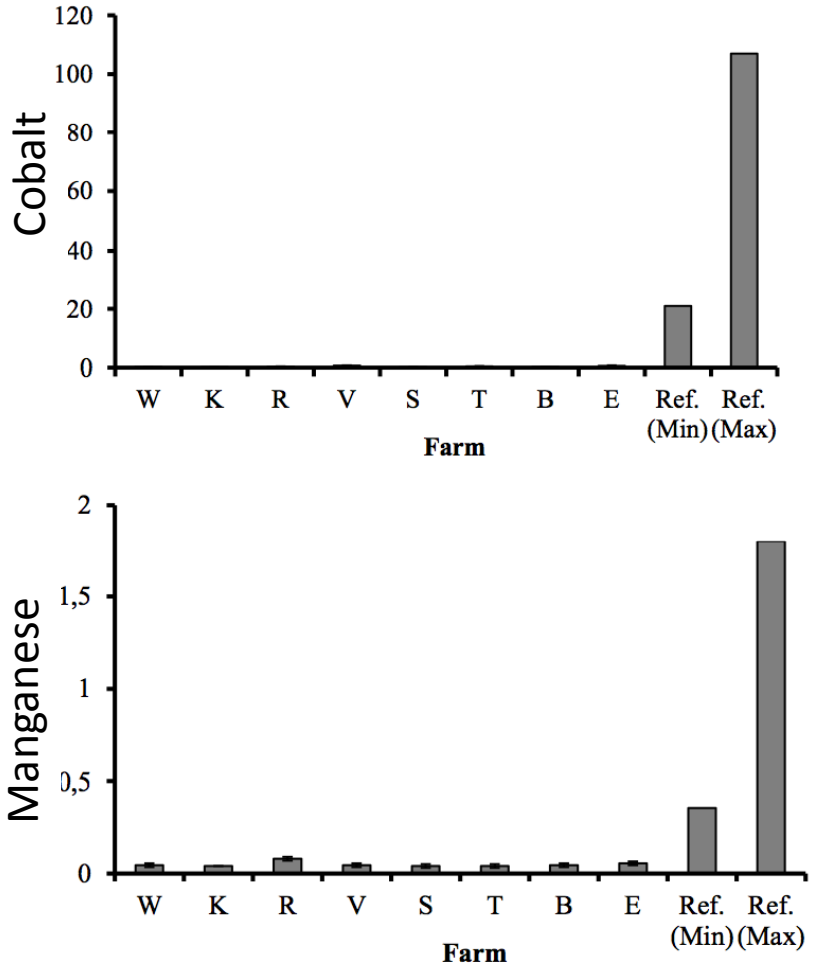
Conclusions from Rat Study *



- *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. Environmental Sciences Europe 2014, 26:14

Severe Deficiency in Manganese and Cobalt in Cows*



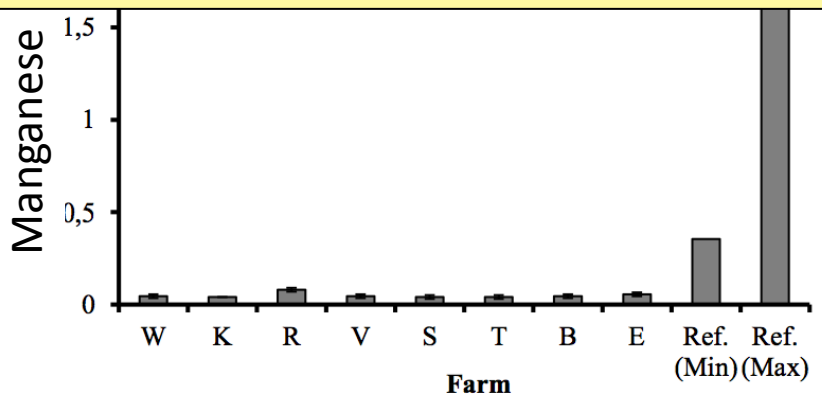
Eight different farms: all cows tested had glyphosate in the urine

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

Severe Deficiency in Manganese and Cobalt in Cows*

Manganese deficiency has also been linked to autism**

**A Samsel and S Seneff. Surgical Neurology International 2015, 6:45.



Eight different farms: all cows tested had glyphosate in the urine

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

Infertility in Cattle*

- Cows with fatty liver disease had statistically significant indicators of impaired fertility

- Elevated GGT and deficient glutathione in the follicular fluids
- Evidence of ketosis leading to impaired glucose supply to the developing egg

*B Sarentonglaga et al., J. Reproduction and Development 2013;59(2): 168-173.

Ib Pedersen: Pig Farmer in Europe*

"The summary of my findings is, without a doubt, that Roundup sprayed on crops is the direct reason for the increase in fertility problems, abortions and deformities in animals and as a farmer, knowing how nature works, I quite expect that people are already affected. Glyphosate is everywhere."

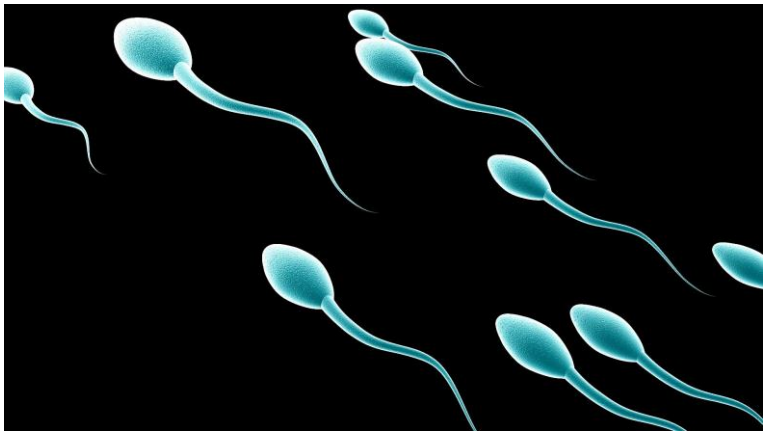
Infertility in China*

Sperm donor applicants in Hunan Province, China

30,000 young Chinese men

Percentage of healthy sperm

- 2001: 56%
- 2015: 18%



Linear Projection:

- 2022: 0%
- Infertility is a growing problem in the industrialized world

*C Huang et al., Fertility and Sterility Jan. 2017; 107(1): 83-88.

Diabetes, Obesity & Glyphosate

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 25% of the world supply of glyphosate*

Obesity in US over Time*

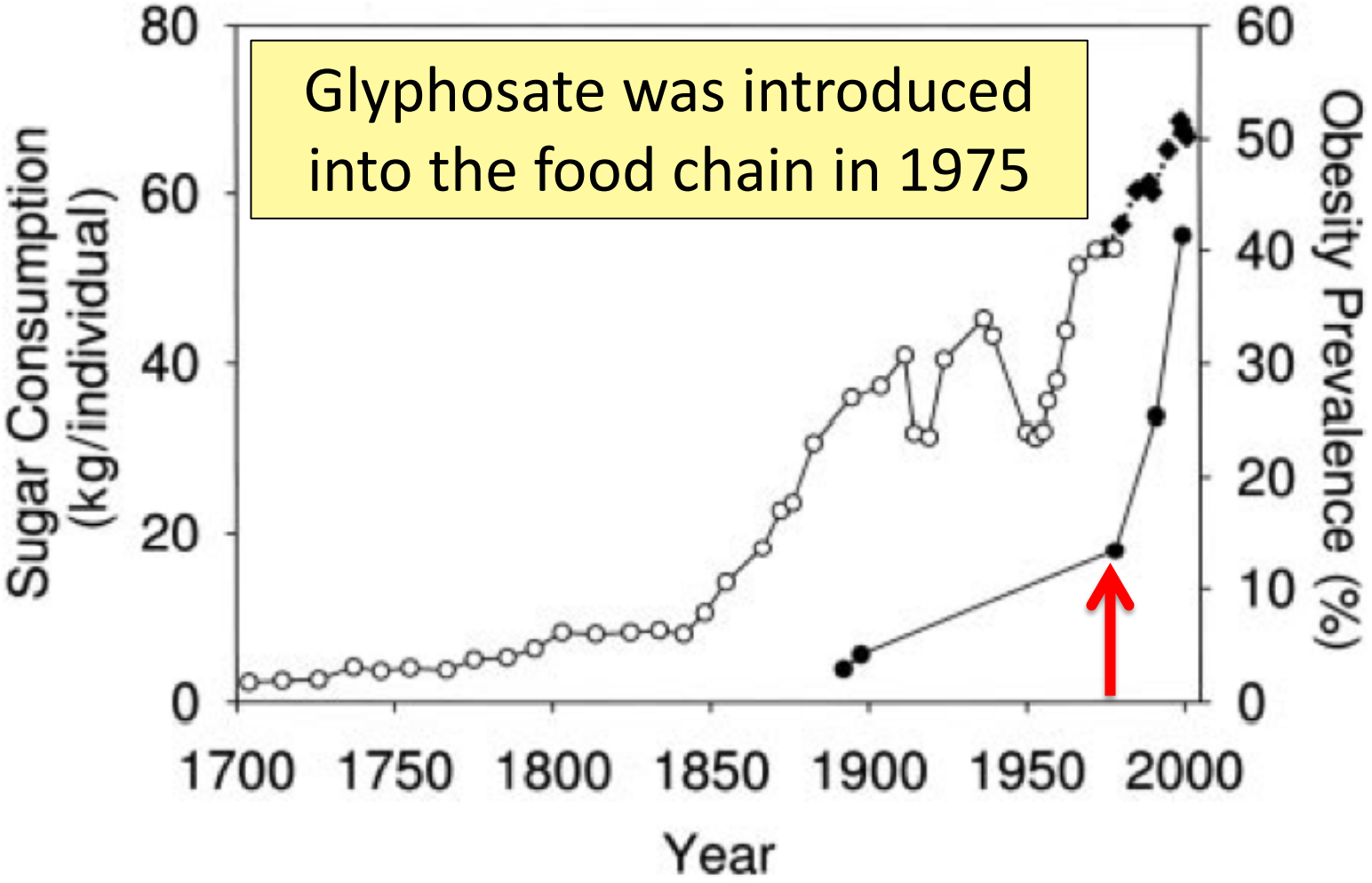


*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.

The First Signs of Obesity in Certain Arctic Groups Have Been Linked to Instant Noodles*

- Yamalo-Nenets region: autonomous district on Arctic Ocean in NW Siberia
- Only exposed to "convenience foods" in last few years

- Already showing signs of obesity for the first time in history
- Wheat is now routinely sprayed with glyphosate right before harvest

*.sciencealert.com/the-first-signs-of-obesity-in-certain-arctic-groups-have-been-linked-to-instant-noodles

Obesity vs Fast Food Diet*

Fig. 1. **Change in age-standardized mean body mass index (BMI) as a function of change in average annual fast food transactions per capita[a] in 25 high-income countries of the Organisation for Economic Co-operation and Development, 1999–2008**

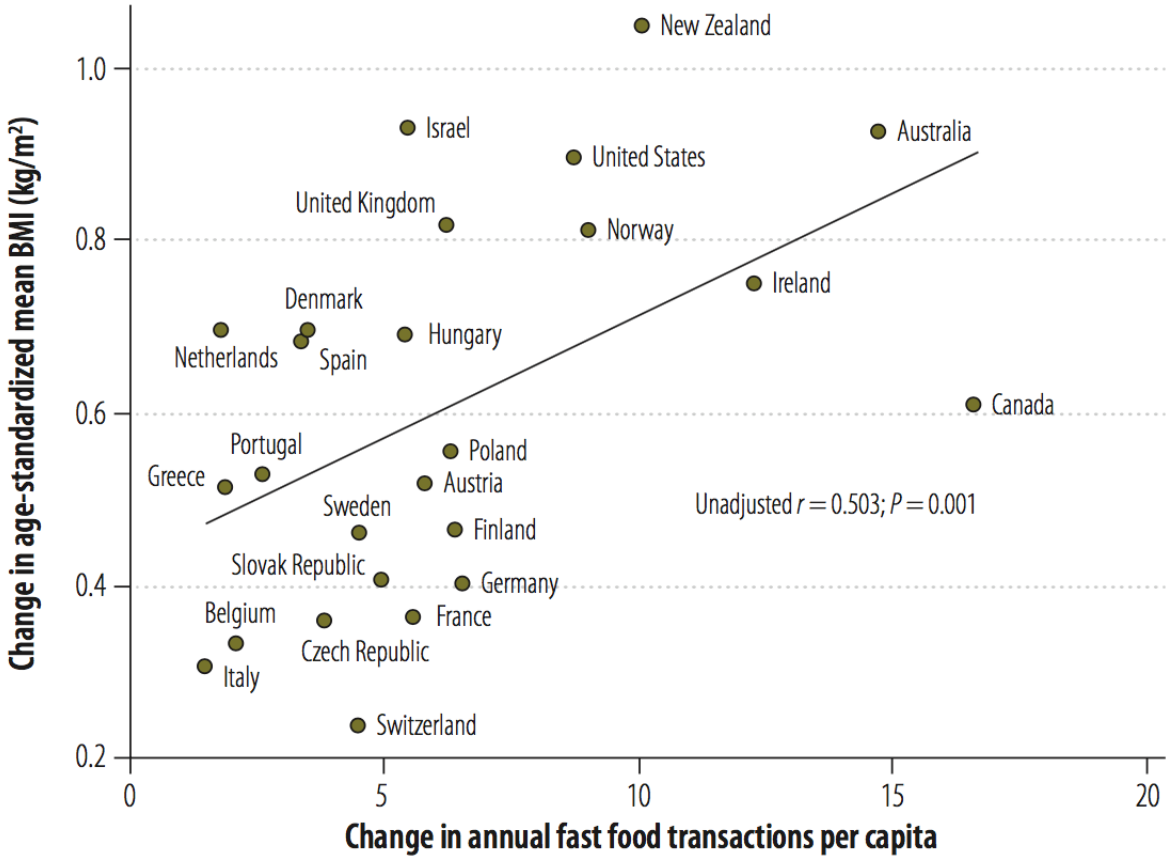
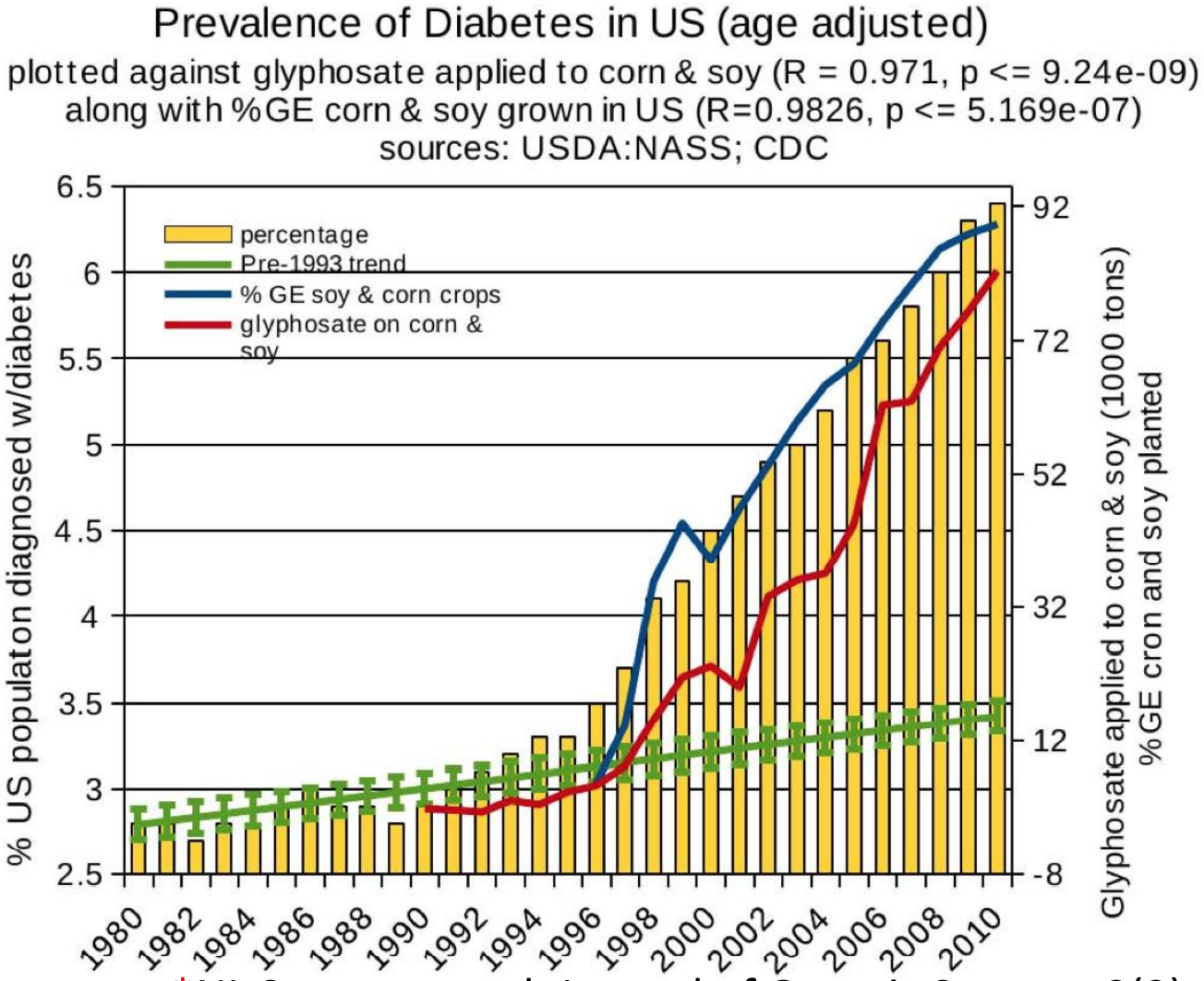


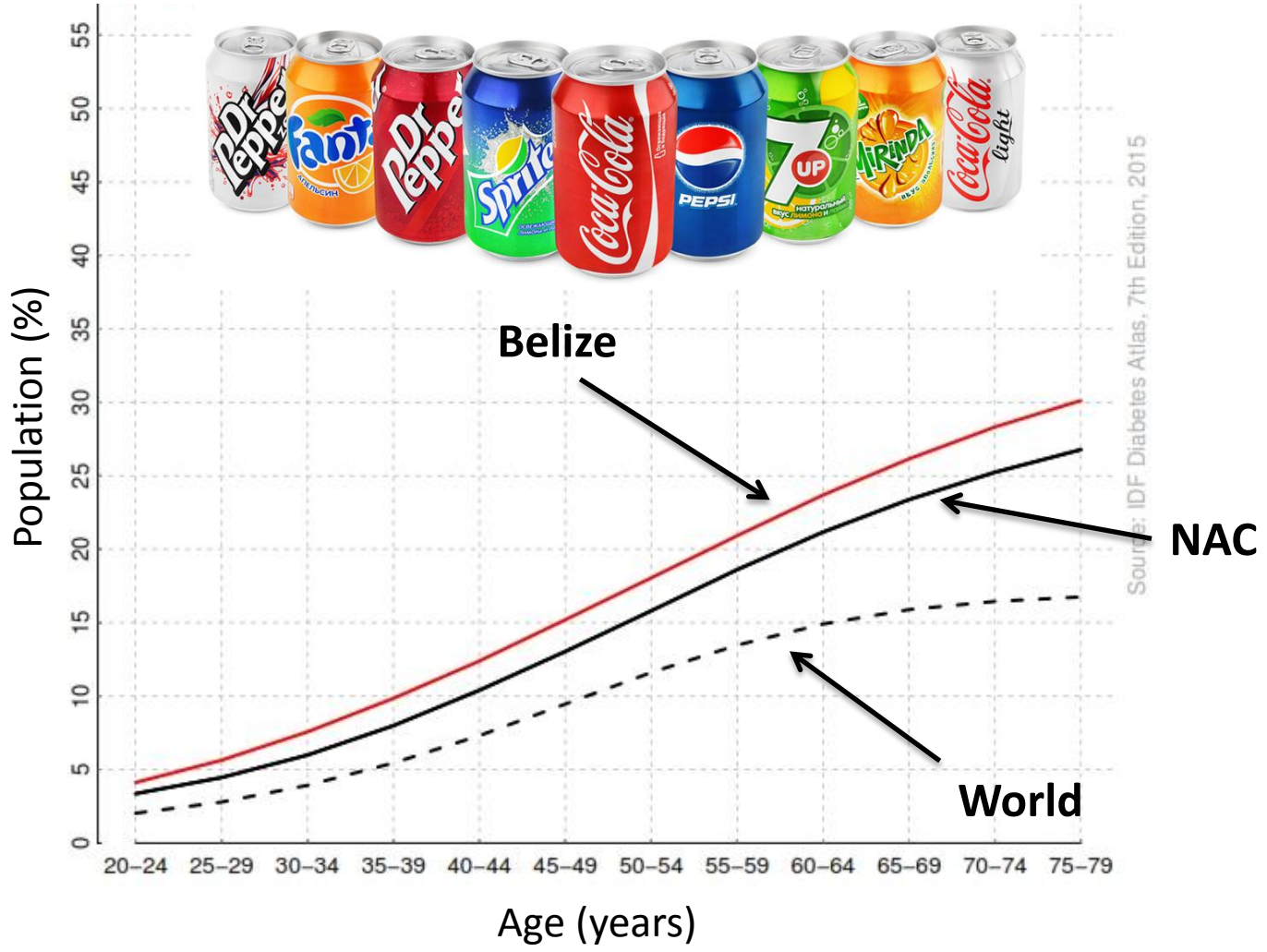
*Figure 1, De Vogli et al., Bull World Health Organ 2014;92:99–107A

Diabetes Prevalence in US vs GMOs and Glyphosate*



*NL Swanson et al. Journal of Organic Systems 9(2), 2014, p. 32,

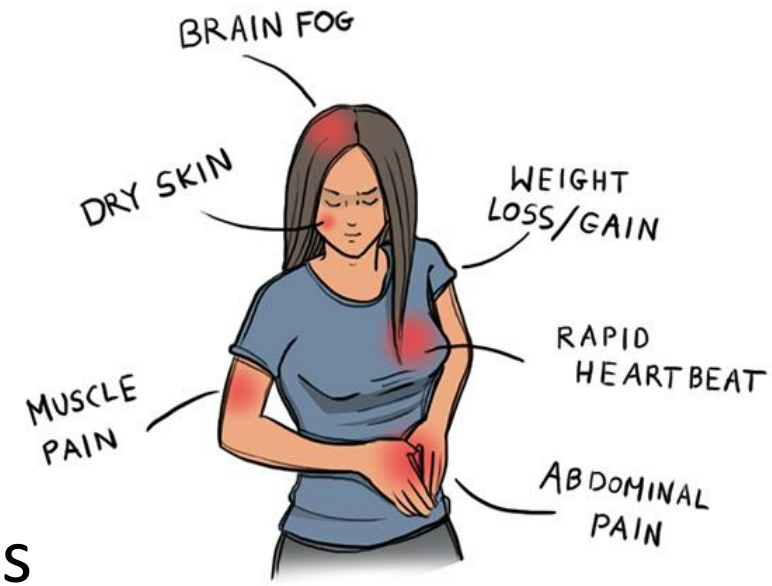
Diabetes in Belize (Prevalence by Age in 2015)*



*http://www.idf.org/membership/nac/belize

Autoimmune Disease

Autoimmune Disease Statistics*



- Autoimmune Disease (AD) is a major health problem
- 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?

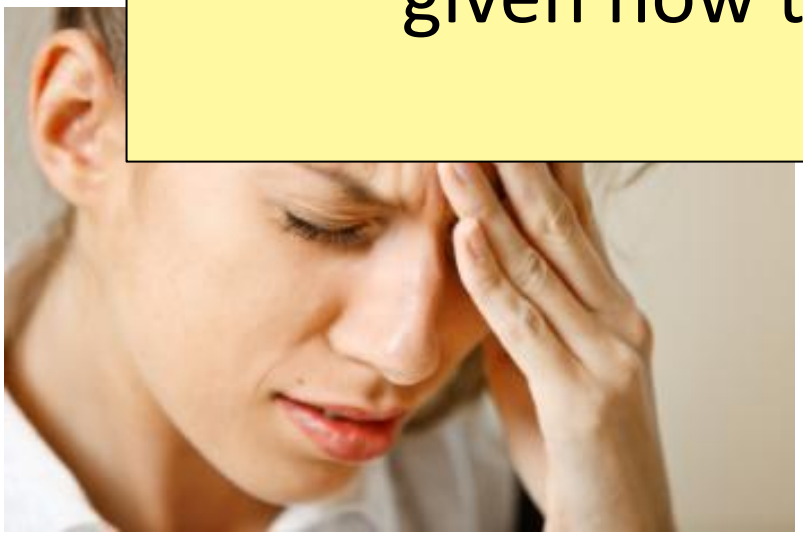
Hypothesis

- 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
- 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

Food Allergies

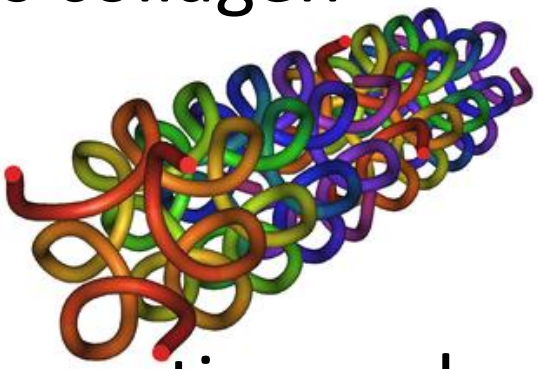
Food Allergies

All of these foods can be expected to be contaminated with glyphosate, given how they're produced



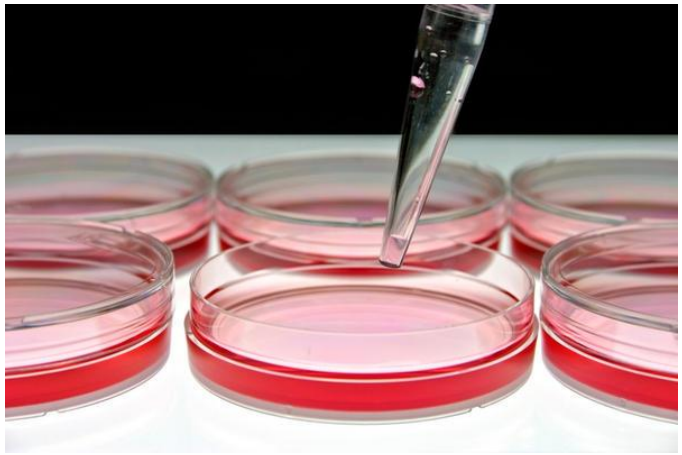
Collagen and Gelatin

- 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 !!



Drugs and Autoimmune Disease*

- Drugs that treat autoimmune disease have a huge problem with side effects
  - They suppress the immune system, and increase risk to tuberculosis, invasive fungal infections and lymphomas (cancers of the immune system)
- Humira is a TNF-alpha inhibitor, which blocks the immune response
  - It costs about $3,100 per month
  - U.S. prescriptions for Humira have taken off in recent years: 1.5 million in 2011; 2.4 million in 2015.
  - It was linked to more than 209,000 adverse event reports since 2013, including more than 4,200 deaths.

* usatoday.com/story/news/nation-now/2017/03/19/analysis-reports-drug-side-effects-increase-fivefold-12-years/99384190/

Chronic Pain*

"The list of different types of chronic pain syndrome seems to be growing every day, including complex regional pain syndrome, failed back syndrome, fibromyalgia, interstitial cystitis, myofascial pain syndrome, postvasectomy pain, vulvodynia, pelvic pain syndrome – and on and on."

*P. 42, Anna Lembke, Drug dealer, MD
.John's Hopkins U Press, Baltimore, MD

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/

Endocrine Disruption and Developmental Disorders

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*

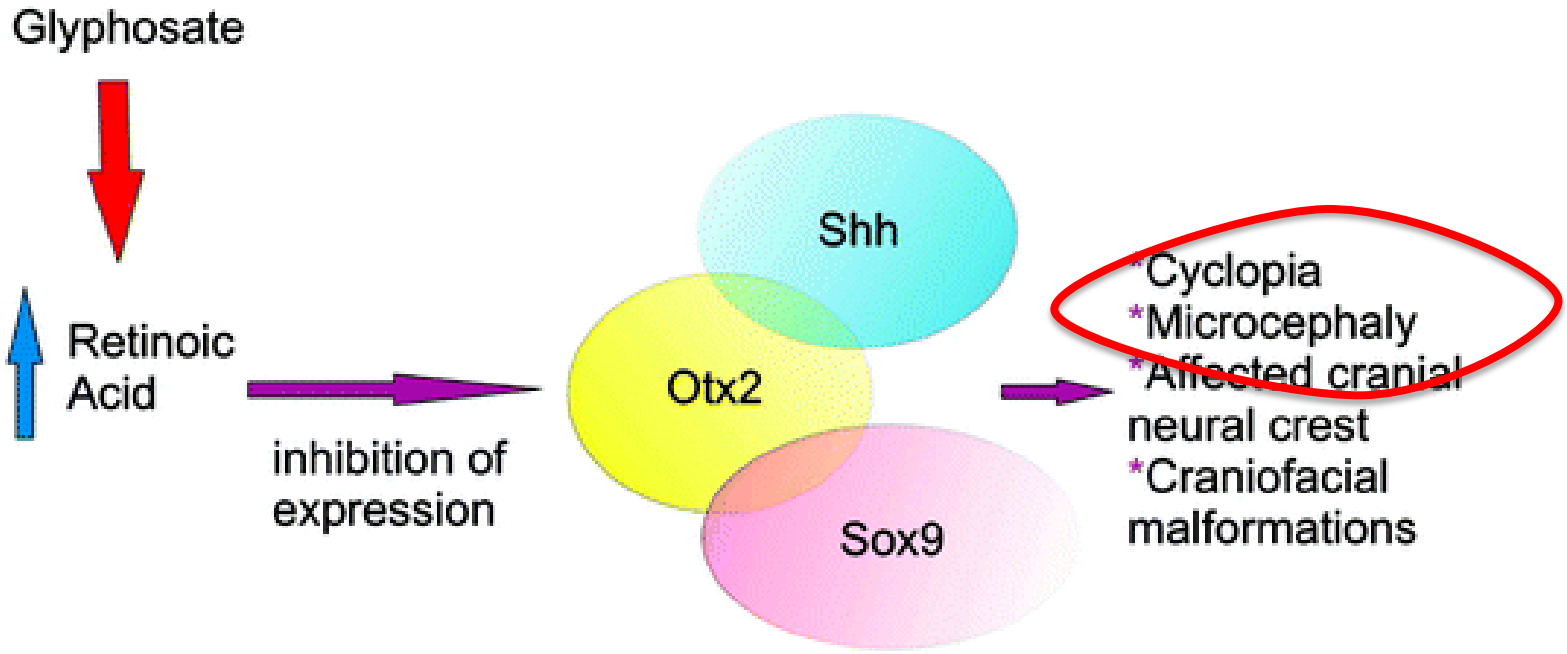
* S. Thongprakaisang et al., Food Chem Toxicol. 2013 Jun 8. S0278-6915(13)00363-3.

Roundup Inhibits Steroidogenesis by Disrupting StAR Protein Expression*

- In vitro study on testicular Leydig cells
- Roundup reduced testosterone synthesis *by 94%*
  - Effect due to both StAR suppression and CYP suppression
- Roundup reduced StAR protein levels by 90%
- Reduction in StAR expression in the adrenal gland disrupts synthesis of stress hormones and sex hormones

*LP Walsh et al., Environ Health Perspect 2000; 108:769-776

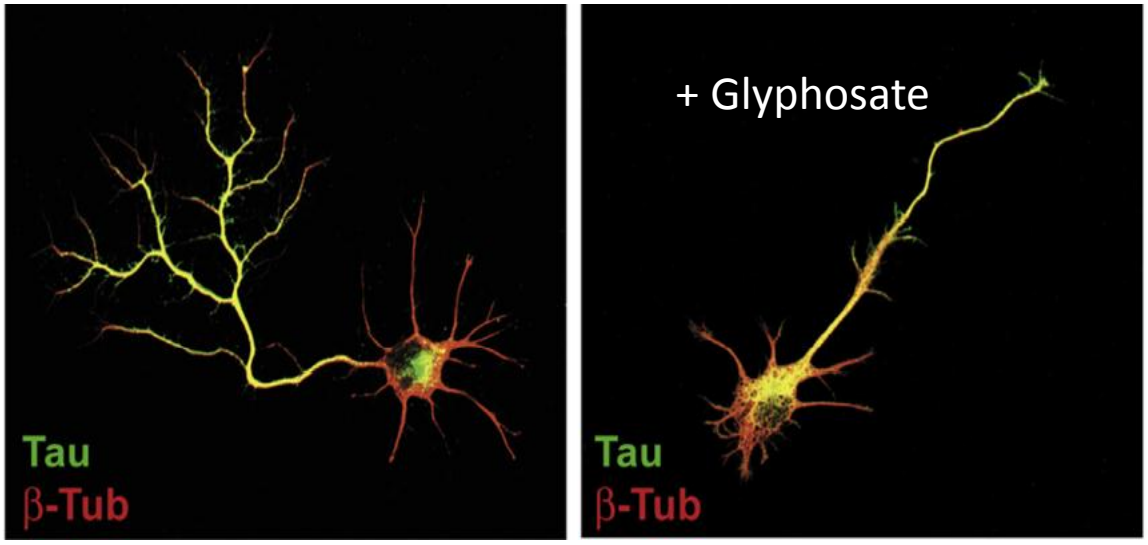
“Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling”*



*A Paganelli et al., Chem Res Toxicol 2010; 23(10):1586-1595.

"Neuronal development and axon growth are altered by glyphosate through a WNT non-canonical signaling pathway"*

- Neurons grown in culture & exposed to glyphosate
- "They elicited shorter and unbranched axons and they also developed less complex dendritic arbors compared to controls"



*RP Coullery et al., NeuroToxicology 2016;52:150-161.

Glyphosate Could Cause Microcephaly through Impaired Methylation Pathway

- Glyphosate disrupts methionine synthesis in plants and in E. coli
  - Methionine is the universal methyl donor
- Disrupted folate one-carbon metabolism (methylation pathway)
  - Folate carries the methyl group that methylates DNA during development to regulate gene expression
  - Folate is produced for the host by gut microbes from the shikimate pathway
- Methyl group is provided by metabolism of glycine; a critical enzyme in this pathway depends on a glycine-rich region that glyphosate could disrupt

Glyphosate and Anencephaly*

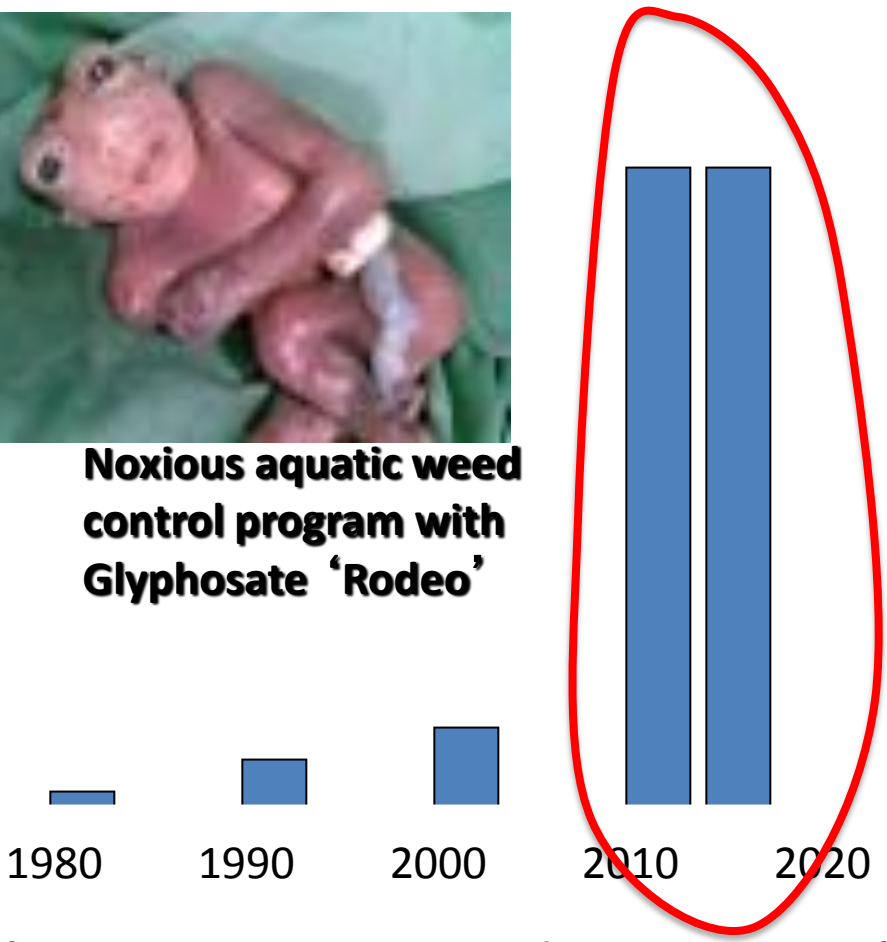
- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by anencephaly

- 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”

*Barbara H. Peterson. **Farm Wars**, http://farmwars.info/?p=11137

“Glyphosate, Brain Damaged Babies, and Yakima Valley - A River Runs Through It”*

Noxious aquatic weed control program with Glyphosate ‘Rodeo’



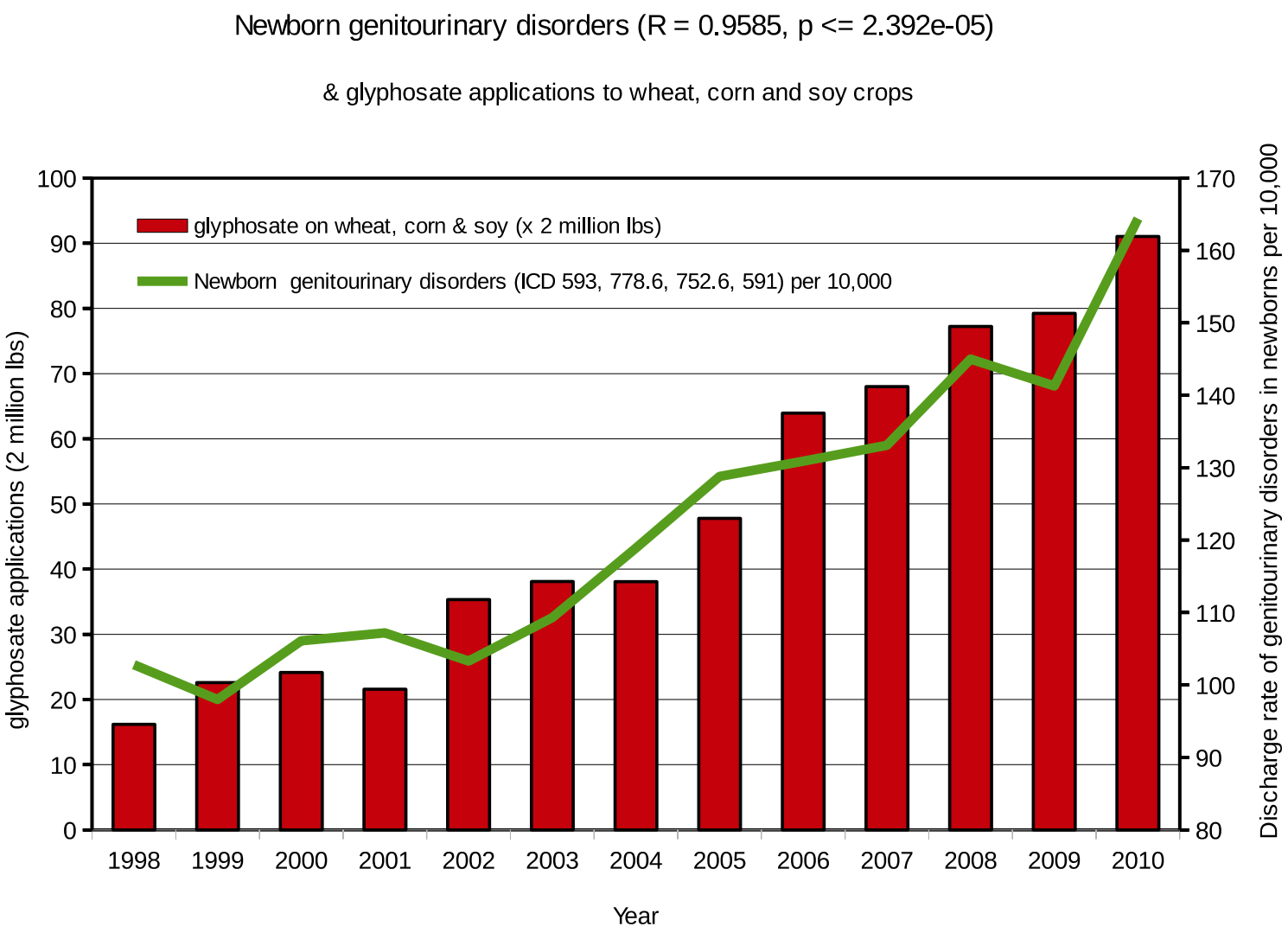
“Glyphosate, Three Rivers, and Anencephaly”

Yakima Harold Republic

Slide thanks to Prof. Don Huber, with permission

***Farm Wars 3/6/14**

Newborn Genitourinary Disorders* (hypospadias, hydrocele, etc.)



*Hoy et al., Poult Fish Wildl Sci 2015, 3:1

Kidney Failure

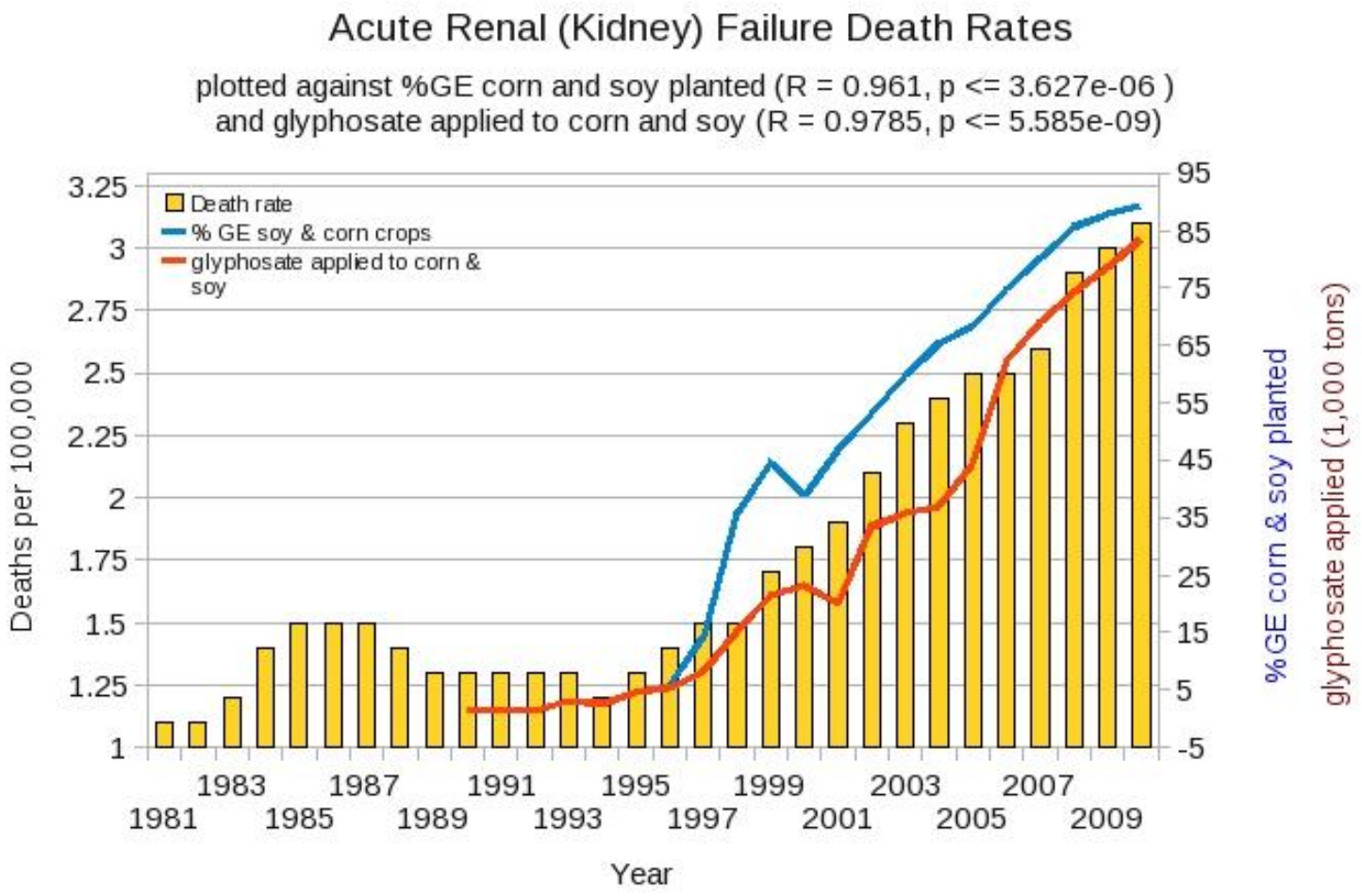
Kidney Failure in Agricultural Workers*

- Agricultural workers in sugar cane fields in Central America and in India and Sri Lanka are dying at a young age in record numbers from kidney failure
  - Second-most common cause of death in men in El Salvador
- Attributed to toxic metals (arsenic, cadmium) + nitrates in well water + glyphosate
- *Glyphosate chelates arsenic and then unloads it in the acidic environment of the renal tubules***

* CM Orantes-Navarro et al., Adv Chronic Kidney Dis 2017;24(2):101-106.

**C Jayasumana et al. Int. J. Environ. Res. Public Health 2014, 11, 2125-2147.

U.S. Acute Kidney Disease Death Rate Plotted Against Glyphosate and GMOs*



*Plot prepared by Nancy Swanson from available data online

Bacterial Siderophores & Kidney Disease

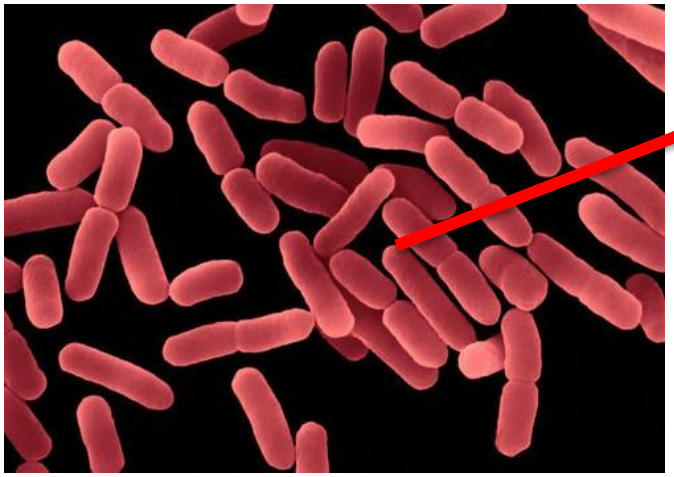
- Proximal tubular necrosis
- Free iron in the tubule causes damage due to oxidative stress
- Defective iron uptake from bacterial siderophores in the proximal renal tubule can cause simultaneous iron deficiency and iron toxicity*

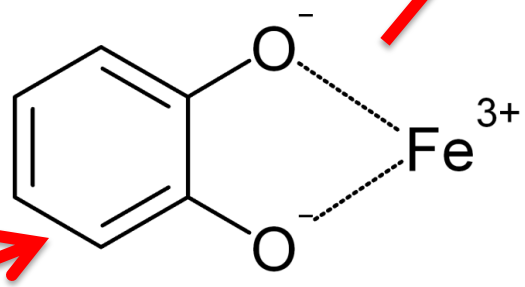
*K Mori et al. The Journal of Clinical Investigation 2005;115(3):610-621.

How Proximal Tubule Gets Iron*

- Protein that synthesizes siderophore in Bacillus depends on two conserved glycines
- Protein that uptakes siderophore in renal tubule contain a conserved GXW motif

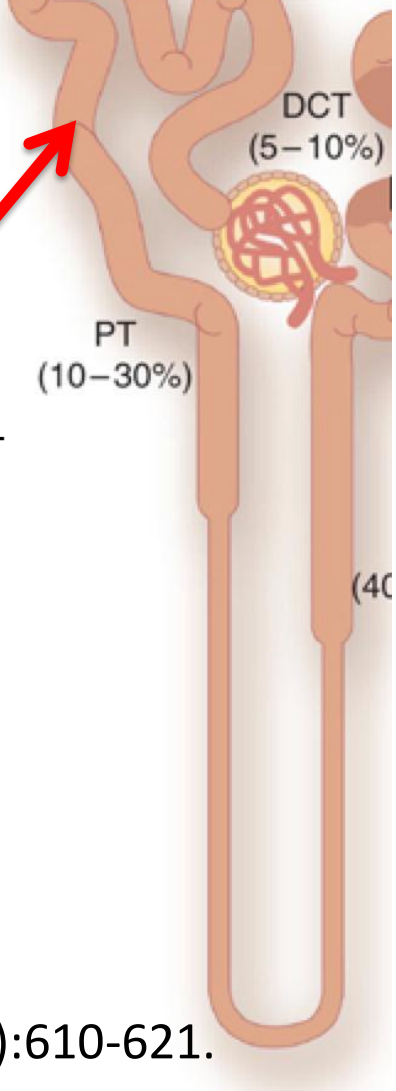
Bacillus





siderophore

Proximal Tubule

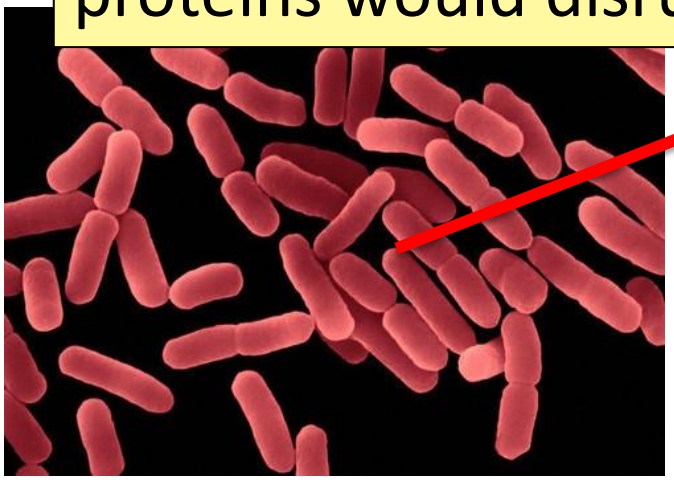


*K Mori et al. The Journal of Clinical Investigation 2005;115(3):610-621.

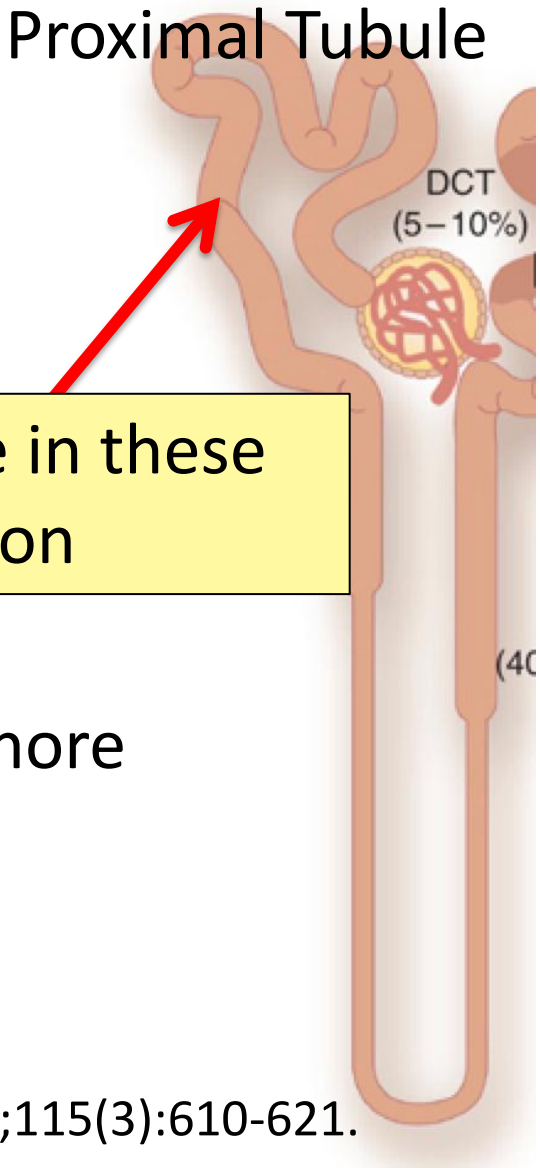
How Proximal Tubule Gets Iron*

- Protein that synthesizes siderophore in bacillus depends on two conserved glycines
- Protein that uptakes siderophore in renal tubule contain a conserved GXW motif

Glyphosate substitution for glycine in these proteins would disrupt their function



siderophore



*K Mori et al. The Journal of Clinical Investigation 2005;115(3):610-621.

May, 2015

Sri Lanka's Newly Elected President Bans Glyphosate Effective Immediately

As glyphosate spikes deadly chronic kidney disease 5-fold

Print

BY CHRISTINA SARICH

POSTED ON MAY 26, 2015

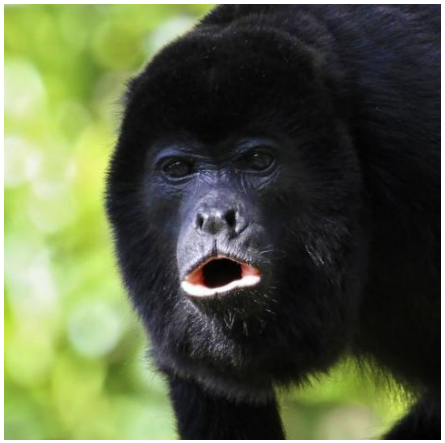
1.5K Like Tweet 4 Share

*naturalsociety.com/sri-lankas-newly-elected-president-bans-glyphosate-effective-immediately/

Species in Distress

Belize has one of the world's most rich and diverse flora and fauna

River Turtle



Black Howler Monkey

Bromeliad Tree Frog

Toucan

Baird's Tapir

Ocellated Turkey

Bull Environ Contam Toxicol (2011) 86:56–59
DOI 10.1007/s00128-010-0167-x

Preliminary Study of Pesticide Drift into the Maya Mountain Protected Areas of Belize

Kristine Kaiser

- Many farms surrounding the Maya Mountain Protected Area make heavy use of glyphosate to control weeds
- Glyphosate was detected in ALL sites where water samples were drawn
  - Chiquibul, Las Cuevas, Mount Margaret, Natural Arch, Outlier, Tiger Fern and Victoria Peak
- One sample tested above the maximum sensitivity of the test kit (> 5 ppb)

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*

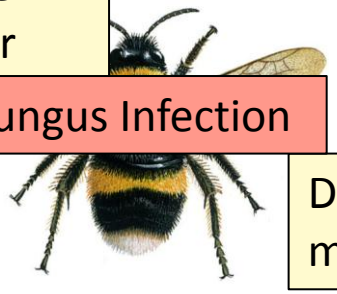
"‥ farmers have switched in droves to new varieties of crops that are genetically engineered to tolerate *the most widely used weed killer in the United States*. The resulting use of weed killers has wiped out much of the milkweed that once grew between crop rows and on buffer strips separating fields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

We Should be Alarmed!*

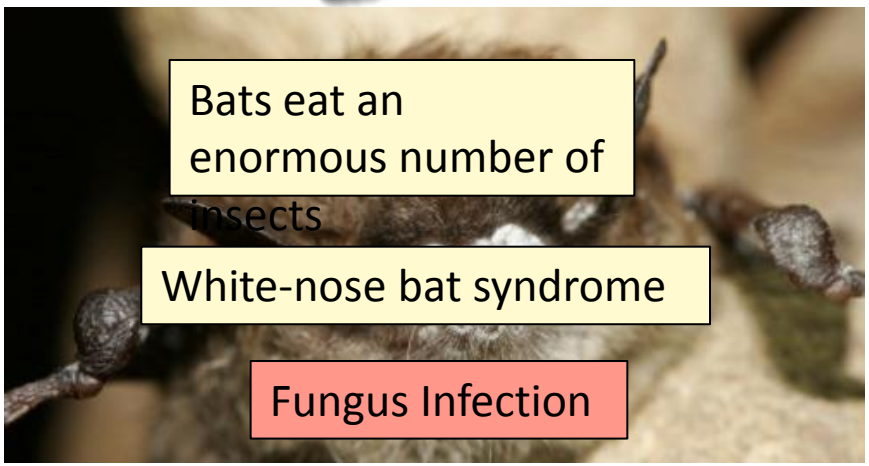
Bee Colony Collapse Disorder



Fungus Infection

Disappearing monarch butterflies

After bees, butterflies are the second largest pollinators.



Bats eat an enormous number of insects

White-nose bat syndrome

Fungus Infection

Dissolving starfish

Fungus Infection

Fungus Infection

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

“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 2012;484(7393), 186-194.

Glyphosate and Fungus*

"Glyphosate stimulation of fungal growth and enhanced virulence of pathogens such as *Fusarium*, *Gaeumannomyces*, *Phytophthora*, *Pythium*, and *Xylella* can have serious consequences for sustainable production of a wide range of susceptible crops and lead to the functional loss of genetic resistance that is dependent on metabolites through the shikimate pathway (Larson et al., 2006)."

*GS Johal and DM Huber, European Journal of Agronomy 2009;31(3):144-152.

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

"Why Honeybees Don't Have A Chance In The Midst Of Pesticides"*

- Glyphosate depletes micronutrients in nectar
- Glyphosate kills beneficial microbes in gut
  - Lactobacillus and Bifidobacterium
- Glyphosate disrupts honeybee hormones, leading to inefficient foraging and disorientation
- Neonicotinoids are a straightforward nerve poison

"Put glyphosate and neonics [neonicotinoids] together in the environment, as we have, and the bees don't have a chance!"

Prof. Don Huber

*Evaggelos Vallianatos, huffingtonpost.com/entry/why-honeybees-dont-have-a-chance-in-the-midst-of-pesticides_us_58c1ec02e4b0c3276fb7831c

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.

Prof. Don Huber on Bee Colony Collapse Syndrome*

- Glyphosate chelates minerals making them unavailable, especially manganese
- Glyphosate kills Lactobacillus and Bifidobacter which interferes with digestion of honey and bee bread by larvae
  - Makes bees more susceptible to mites and viruses
- Acting as an endocrine disruptor, glyphosate causes brain fog in the bees, and they can't find their way back to the hive after foraging
  - Neonicotinoids have a similar, synergistic effect
- Glyphosate is a contaminant even in organic honey because it is pervasive
- Probiotics + mineral solutions counter glyphosate's effects remarkably

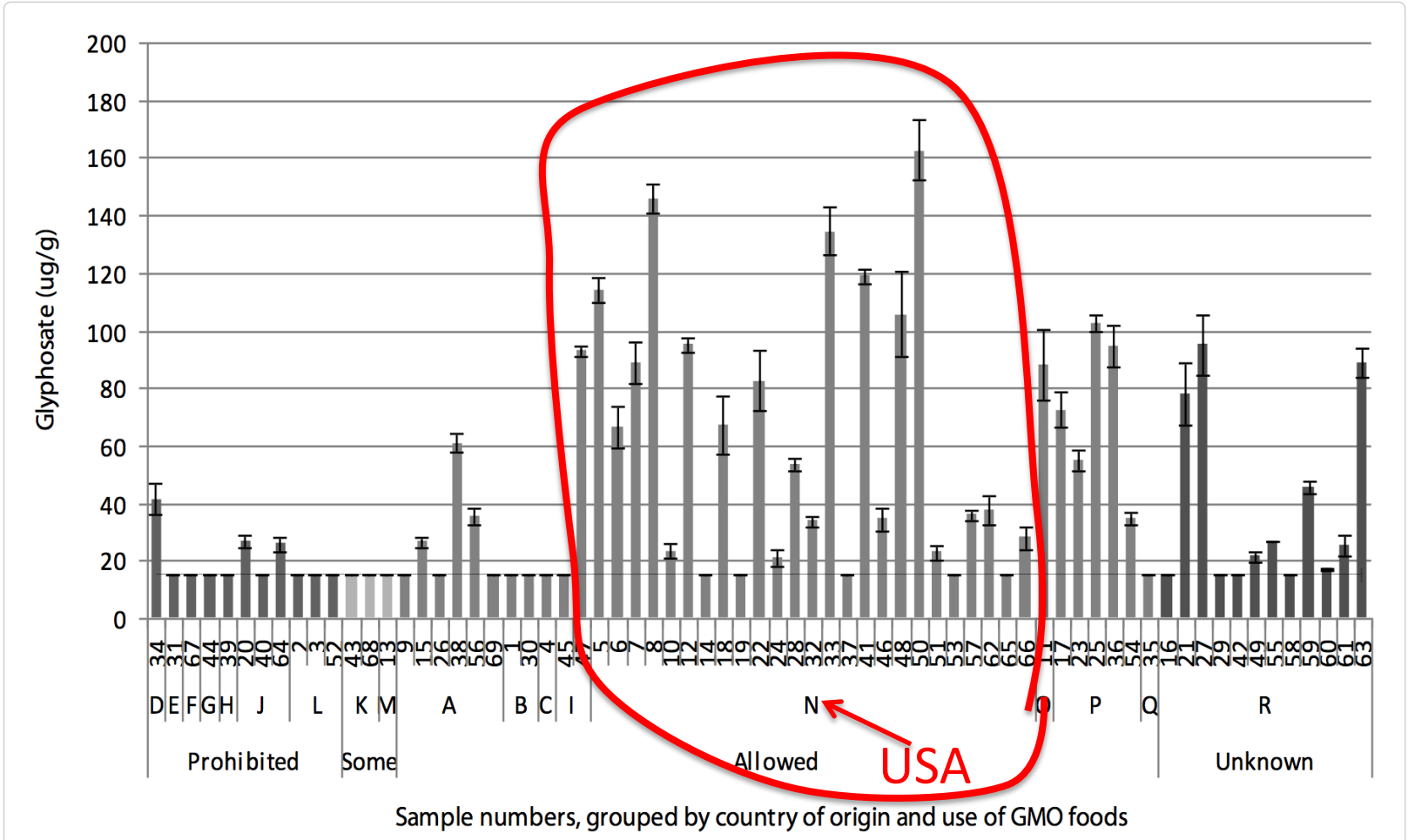
*personal communication

Successful Treatment Protocol for Bees*

- Average loss rates in bee hives in the U.S. for the winter of 2015-2016 was 38%
- Slide Ridge Honey had only a 5% loss rate
  - Their success was attributed to mineral supplements and probiotics

*biomineralstechnologies.com/save-the-bees/honeybee-update-2017

Glyphosate was found in 59% of Honey Samples*



*F Rubio et al., J Environ Anal Toxicol 2014, 5:1

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.

Beak Deformities in Chickadees*

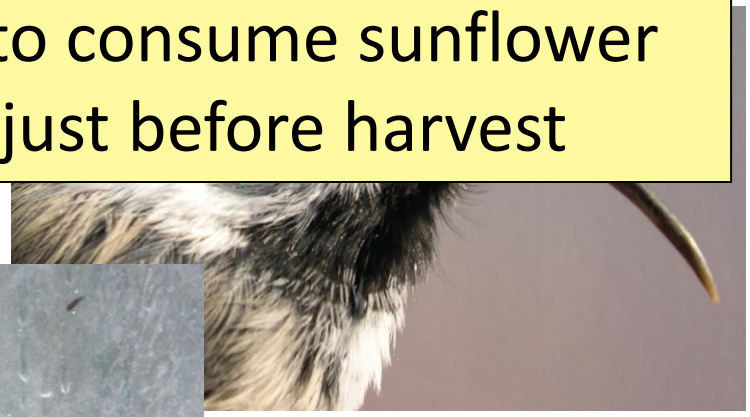
- Beak deformities involving excess *keratin* synthesis have been appearing among chickadees and other birds in the Great Lakes region, in central Alaska and in areas exposed to California agricultural run-off

- No link could be found with investigated toxic chemicals and metals
- Glyphosate was not investigated

*CM Handel and C van Hemert, Environ Toxicol Chem 34, 2015; 314-327.

Beak Deformities in Chickadees*

Chickadees frequent bird feeders to consume sunflower seeds sprayed with glyphosate just before harvest



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*CM Handel and C van Hemert, Environ Toxicol Chem 34, 2015; 314-327.

A personal witness to the devastating demise of wild pollinators and other species as glyphosate herbicide residues increase in the environment*

- Dr. Rosemary Mason's nature reserve in South Wales
- Overnight moth count from 2006
  - 143 species in numbers up to 500.
- Same experiment, 2013
  - 51 species, max count 50

"By August 2014, a naturalist friend with a reserve 3 miles away had stopped doing moth counts. He said there were so few that it wasn't worth the effort."

*https://gmandchemicalindustry9.wordpress.com/tag/dr-rosemary-mason/

Recapitulation

- Many species are under stress today – ladybugs, bees, bats, starfish, birds, butterflies, etc.
- Although glyphosate is easily implicated in many cases, investigations rarely consider glyphosate due to its perceived nontoxicity and high cost of testing
- Glyphosate explains the explosive growth in fungus infection associated with many species die-offs

Fusarium and Root Rot

Fusarium Infection in Bananas

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

- Fungus is a growing threat in GMO Roundup-Ready corn
- Research is 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.

Glyphosate and Fusarium*

- Long-term exposure of soil micro-organisms to glyphosate leads to a fungal community dominated by Fusarium spp.
- Fusarium species increase following glyphosate exposure for both peanuts and maize crops.
- Significant increase in soil Fusarium within 2 weeks after glyphosate application at recommended rates
- Culture-based studies showed that five strains of Fusarium could metabolize glyphosate, using its phosphorus atom as a source of phosphorus.

*RJ Kremer and NE Means. European Journal of Agronomy 2009;31(3): 153-161.

Fusarium in Cotton*

There has been a resurgence of Fusarium wilt in Roundup-Ready cotton crops in Australia and "previous high levels of wilt resistance appear to be less effective under glyphosate management programs”

*Johal GS, Huber DM. 2009. Eur J Agron 31(3):144-52.

"*Aspergillosis* has been the culprit in several rapid die-offs among waterfowl. From 8 December until 14 December 2006, over 2,000 Mallards died in the Burley, Idaho area of the USA, an agricultural community approximately 150 miles southeast of Boise. Moldy waste *grain* from the farmland and feedlots in the area is the suspected source."*

*http://www.proliberty.com/observer/20061209.htm

Corynespora Root Rot in Soybeans*

Non-inoculated control

Inoculated

Inoculatd + glyphosate

*figure 1, S Johal and DM Huber, European Journal of Agronomy 2009;31(3):144-152.

Take-all root rot in wheat*

Glyphosate exposed

*figure 2, S Johal and DM Huber, European Journal of Agronomy 2009;31(3):144-152.

Some Mechanisms*

- Glyphosate is toxic to Mn-reducing and N-fixing organisms in the soil
- Residual glyphosate reduces root uptake of Fe, Mn and Cu.
- Cereals exposed to glyphosate experience reduced resistance to disease due in part to Mn deficiency, inhibition of root growth by glyphosate, and increase in Mn-oxidizing organisms in the rhizosphere

* S Johal and DM Huber, European Journal of Agronomy 2009;31(3):144-152.

Massive Die-off of Sea Life

Dead fish, crabs and lobsters: Nova Scotia marine mystery growing*

"As many as 20,000 fish, lobsters, starfish, scallops, crabs and other animals have turned up dead at Savary Park."

December 27, 2016

*www.ctvnews.ca/canada/dead-fish-crabs-and-lobsters-nova-scotia-marine-mystery-growing-1.3218705

News / Halifax

Starfish, crabs, mussels and lobster washing up on Nova Scotia beaches

Joan Comeau went to the beach in Plympton and saw it covered in herring, but she also saw hundreds of starfish, crabs, mussels and clams and seven lobsters.

TC MEDIA/JOAN COMEAU

*www.metronews.ca/news/halifax/2016/12/27/starfish-crabs-mussels-lobster-wash-up-nova-scotia-beaches.html

Why are dead lobsters, crabs and herring washing up along this Nova Scotia shore? *

Boxing Day find comes after weeks of reports of dead herring washing up along shores

By Michael Gorman, CBC News Posted: Dec 27, 2016 11:46 AM AT | Last Updated: Dec 27, 2016 12:26 PM AT

Dead Whale

"A marine mystery is confounding residents of southwest Nova Scotia who are watching thousands of dead fish, starfish, crabs, clams, scallops and lobster wash up on the shore."

*www.cbc.ca/news/canada/nova-scotia/fish-kill-off-st-marys-bay-lobster-clams-crabs-beach-1.3913265

The Answer to the Mystery!

Nova Scotia gives OK to spray hundreds of hectares of woodland with glyphosate

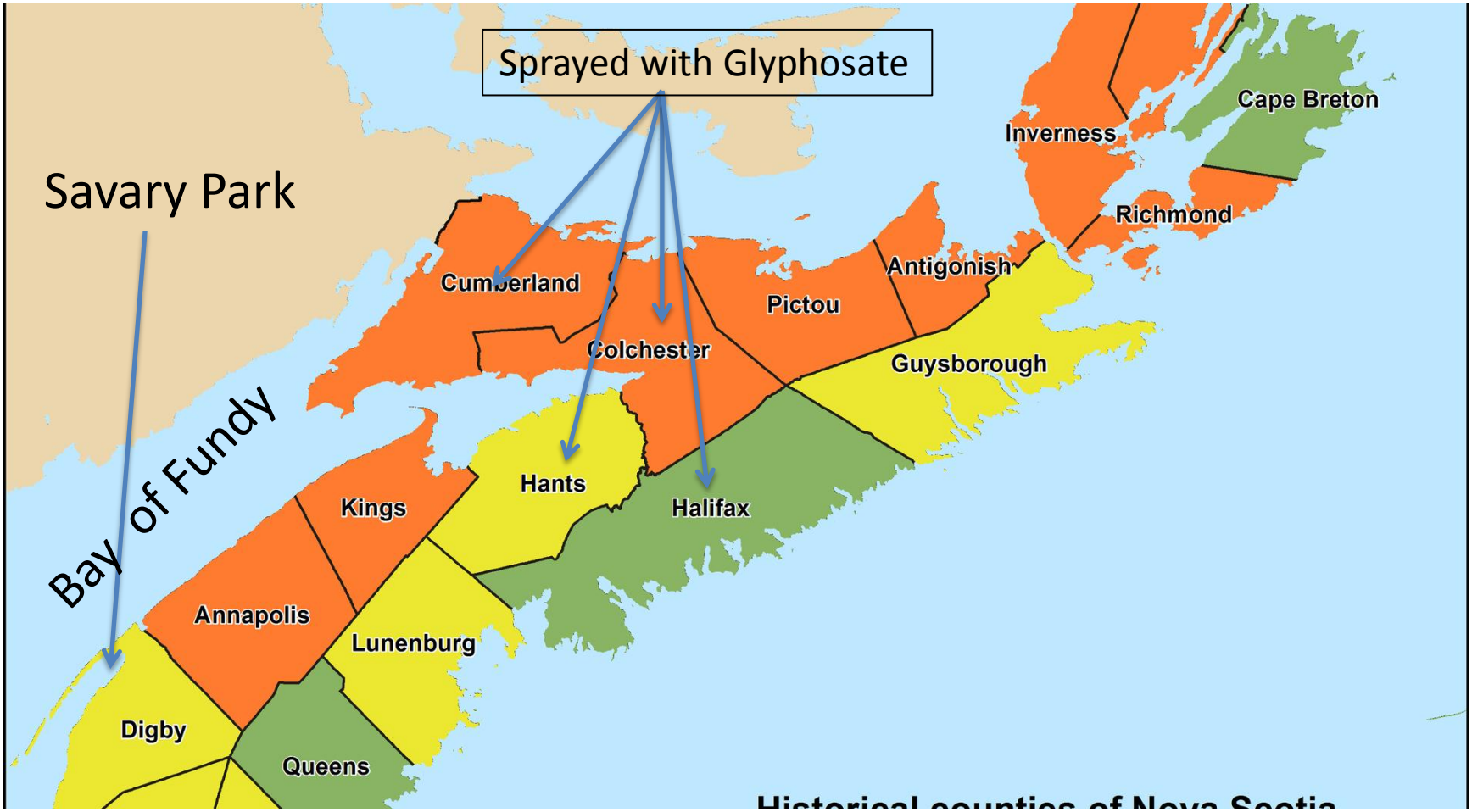
11K

shares

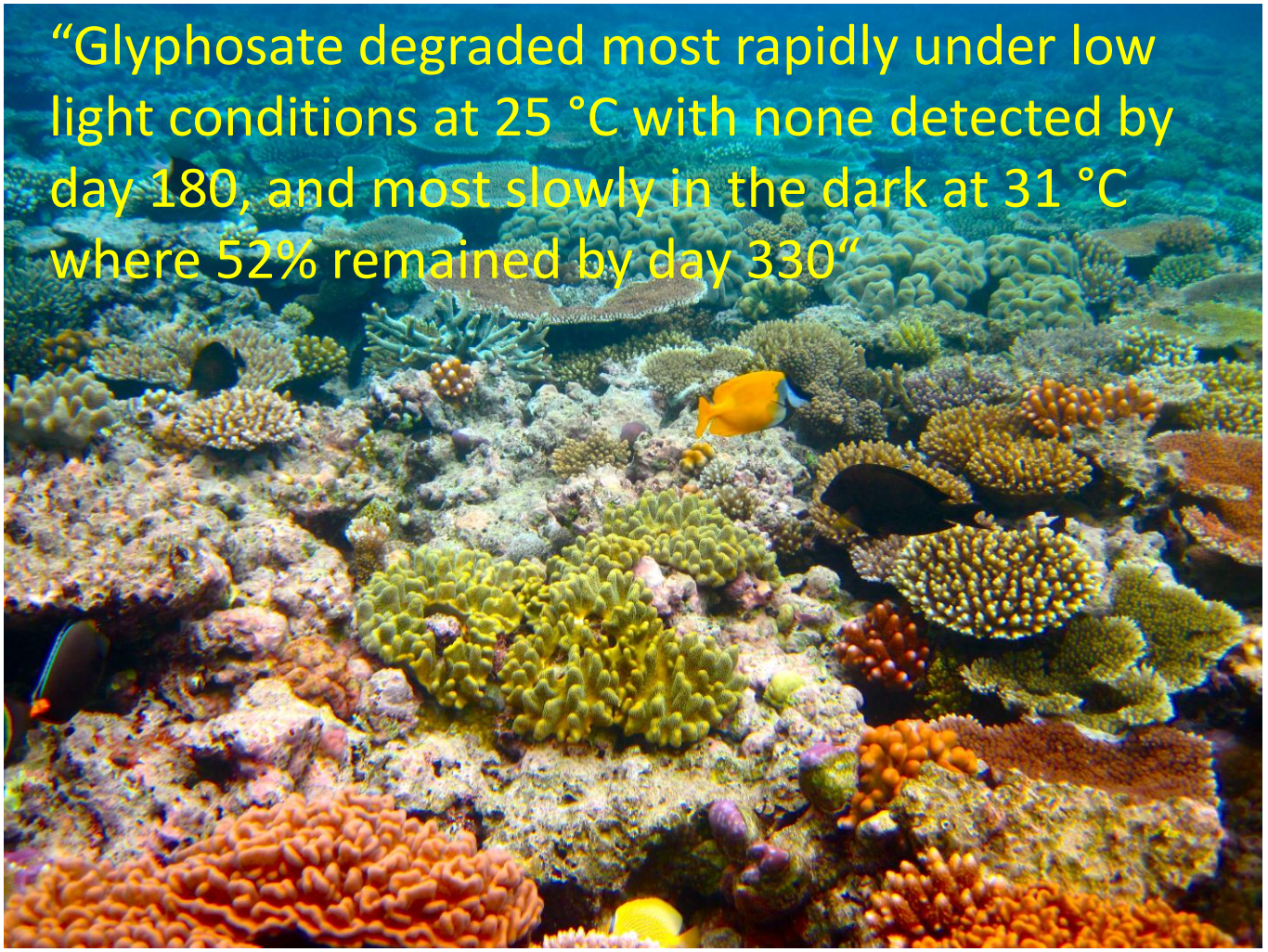
The province has approved the applications of Northern Pulp and five other companies to spray more than 2,600 hectares of woodland with VisionMax, a herbicide containing the active ingredient glyphosate. Northern Pulp will be carrying out about half of the spraying, which is intended to choke out hardwoods and provide for the unimpeded growth of coniferous trees.

Aug 31, 2016 9:05 PM by: Francis Campbell

Counties in Nova Scotia Where Forests Were Sprayed with Glyphosate



“Glyphosate persistence in seawater”*



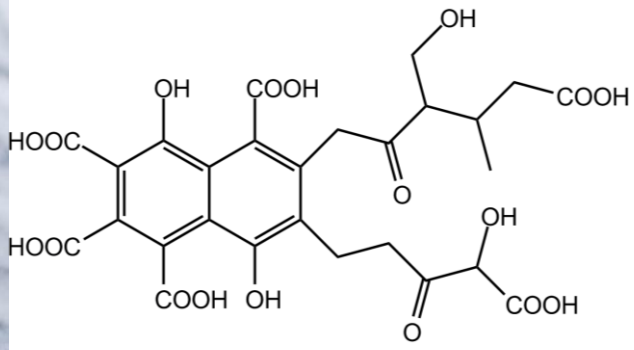
*P. Mercurio et al., Marine Pollution Bulletin, 2014, *In press*

Solutions

Treating Glyphosate Poisoning in Cows*

Activated charcoal, bentonite clay, humic and fulvic acids, and sauerkraut juice have been shown to be effective in reducing urinary levels of glyphosate and improving animal health

Bentonite Clay



Fulvic Acid

Activated Charcoal

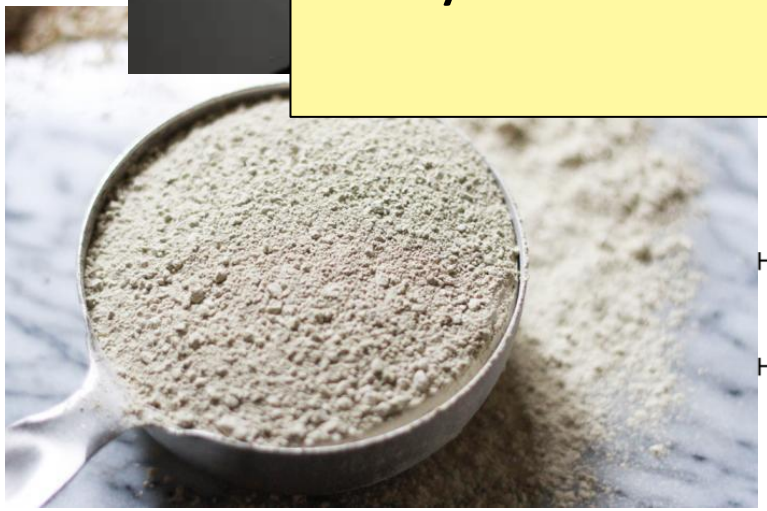
*H Gerlach et al., J Environ Anal Toxicol 2014, 5:2

Treating Glyphosate Poisoning in Cows*

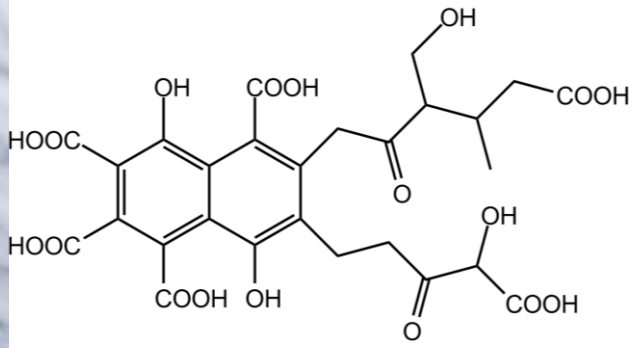
Saue
Juic

Acetobacter in sauerkraut juice (and apple cider vinegar) are on the very short list of microbes that can fully metabolize glyphosate (detox it)

entonite clay,
s, and
been shown to
ng urinary levels
proving animal



Bentonite Clay



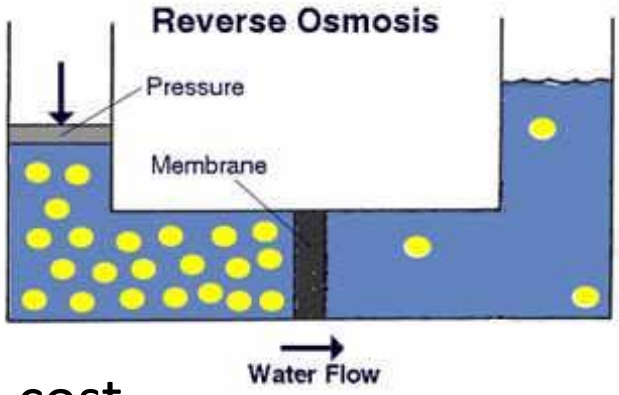
Fulvic Acid

Activated Charcoal

*H Gerlach et al., J Environ Anal Toxicol 2014, 5:2

Reverse Osmosis: Water Treatment*

- Tens of thousands of people in Rajarata, Sri Lanka have died due to kidney failure.
- Reverse osmosis technique can produce clean and safe water for human consumption at reasonable cost.
  - Sieves out arsenic, cadmium, glyphosate and other agrochemicals, fluoride, viruses, bacteria and algae.
- Evidence supports drop in kidney disease following adoption of RO drinking water
- Agrichemical lobby fears repercussion when message gets out to the world



Eng Harsha Kumar Suriyaarachchi, Former Vice chairman of NWSDB, Former General Manager of Water Resources Board. Sri Lanka.

Posted on December 24, 2016

Superweeds Are Now a Huge Problem*

- 76.8% of samples submitted to a U of Illinois Plant Clinic from 10 states across the Midwest showed glyphosate resistance
- "GM crops are on the edge of failure in the U.S. as farmers are asked to fork out more and more money on herbicides to try to control the superweeds. We simply can't afford it! It is near the end of the road for these crops and many of my friends in the Midwest are on the edge of turning back to conventional farming methods."
  - Bill Giles, an Illinois farmer

*sustainablepulse.com/2017/02/04/farmers-losing-midwest-superweeds-fight-as-glyphosate-resistance-reaches-over-75/#

Fixing the Soil*

JR Bollinger

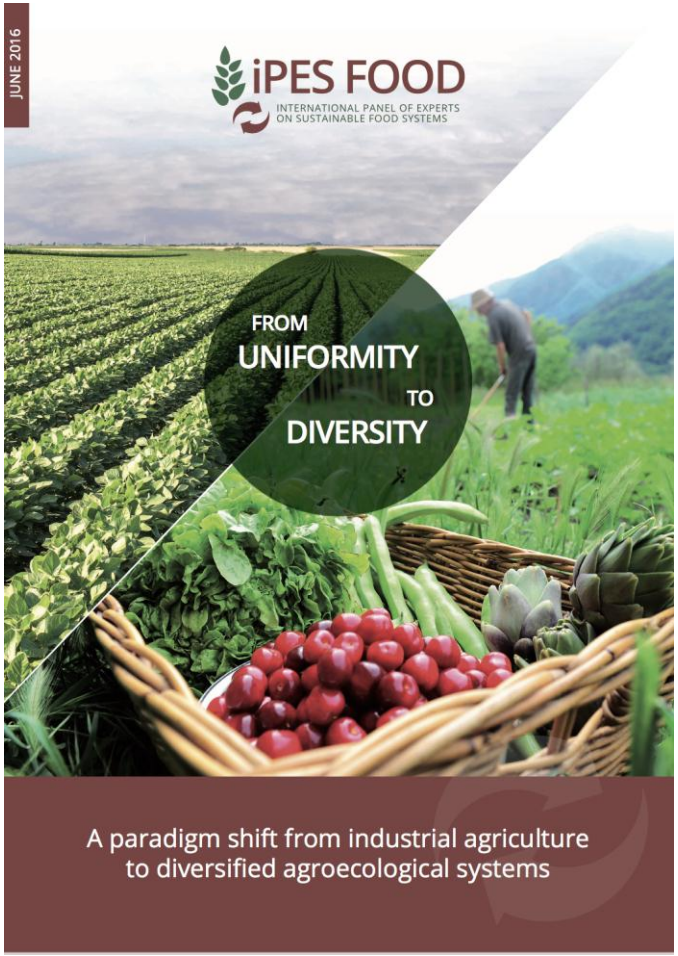
- Dirt is inert; soil is alive
- Missouri farmer JR Bollinger grew corn and soy on a former coal mine
- "We tried … all kinds of goodies: humates, … sea minerals, microbes, fish meal and biochar powder."
  - Earthworms till the soil
  - Soil microbes are crucial for soil health
- Greatly reduce fertilizer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

*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.

From Uniformity to Biodiversity*

- "Industrial Agriculture:" crop monocultures and industrial-scale feedlots
  - Chemical fertilizers, pesticides, antibiotics → multiple negative outcomes
- Diversify farming landscapes: holistic strategies
  - Retain carbon in the ground, support biodiversity, rebuild soil fertility, sustainable high yields
- Political incentives must be shifted to promote ecofriendly agriculture.



*Emile A. Frison, REPORT 02. 2016

IPES Food: International Panel of Experts on Sustainable Food Systems

Solving Global Climate Change through Agriculture*

"Agriculture, with its unique ability to sequester carbon on … billions and billions of acres, is the only industry poised to *reverse* global warming. Improved management of cropping and grazing heals land, boosts soil fertility, prevents flooding, enhances drought resilience, increases the nutritional content of food and restores wildlife habitat — while sequestering carbon.

*http://www.rutlandherald.com/articles/using-soil-to-fight-climate-change/

Beyond Organic: Certified Demeter Biodynamic

- Demeter is the Greek Goddess of grain and fertility
  - Views the farm as a living "holistic organism"
- The Demeter certification program was established in 1928, and as such was the first ecological label for organically produced foods

*www.demeter-usa.org/learn-more/biodynamic-farm-standard.asp

Small Organic Farms are the Answer

Bluebird Hill Organic Farm, North Carolina

One More 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 usage is going up dramatically in the US and around the world, in step with the dramatic rise in a number of debilitating diseases and conditions
  - Autism, dementia, diabetes, obesity, kidney failure, several different cancers, autoimmune disease, endocrine disruption, infertility, etc.
- Glyphosate is a major causal factor in health problems in farm animals and in massive die-offs of multiple wild species on land and in the sea
- Glyphosate is an insidious, cumulative toxic chemical that needs to be banned, globally
- We need to find the path back towards sustainable, organic agriculture

The Big Picture

Background

- Weeds => Roundup => Glyphosate
- Mega farms => GMOs (Roundup-Ready Crops)

The Problem

- We were told Glyphosate is safe, since it disrupts the Shikimate pathway that humans do not have
- But our gut bacteria have it, and they provide essential services to us

Consequences

- Incidents of many diseases have sky-rocketed
- Many creatures are affected; the earth is suffering

What to do

- Educate
- Advocate => legislate, litigate
- Change the way we grow and consume food
- Extend our time horizon => for our grandchildren's' grandchildren

It's everyone's responsibility, but why Belize?

- Small countries have advantages
- New opportunities, eco-tourism, teaching organic farming, etc
- Become a world leader