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Everything You Wanted to Know about Glyphosate But Were Afraid to Ask

Stephanie Seneff
MIT CSAIL
November 11, 2017

"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."

-- Prof. Don Huber

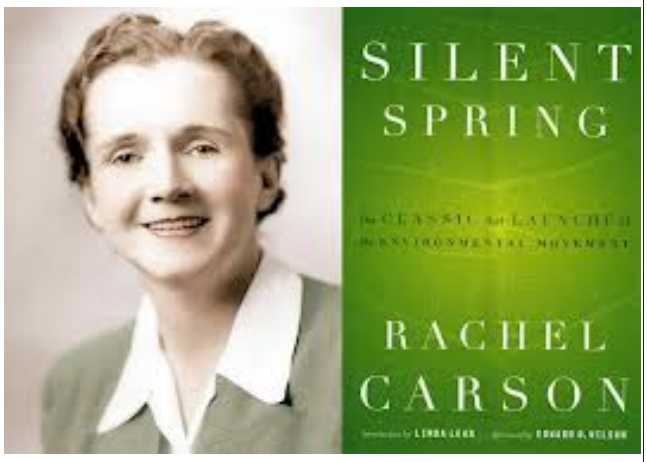
Outline (Part I)

- Overview
- Glyphosate Contamination in Food
- Lab Animals and Farm Animals
- Diabetes, Obesity & Glyphosate
- Glyphosate in Proteins
- Endocrine Disruption and Developmental Disorders
- Kidney Failure
- Species in Distress
- Sustainable Organic Agriculture
- Summary

Overview

Silent Spring (1962)

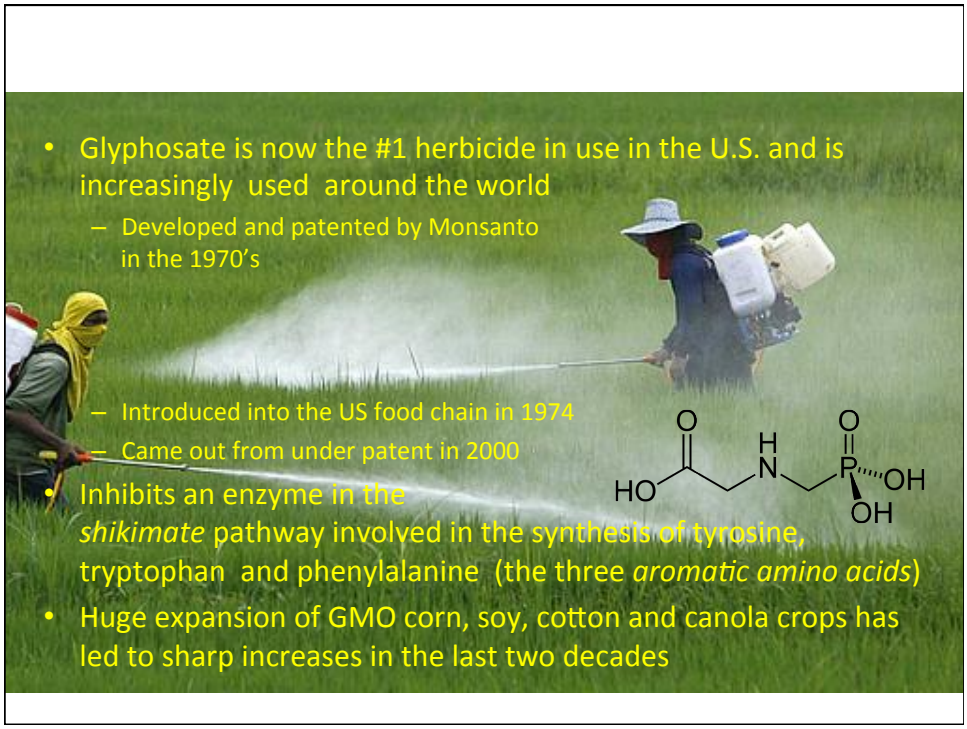
Argued that uncontrolled and unexamined pesticide use was harming and even killing not only animals and birds, but also humans.



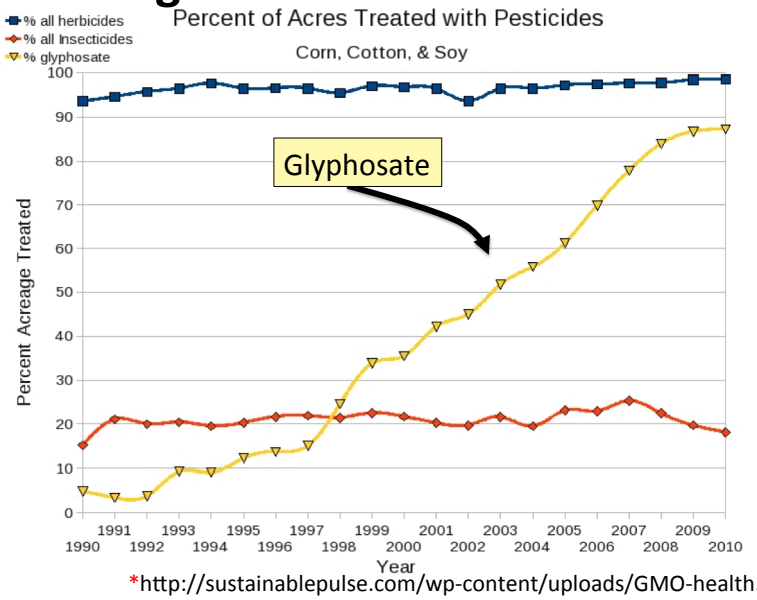
Roundup and GMO Crops

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

Roundup as a Desiccant/Ripener just before Harvest

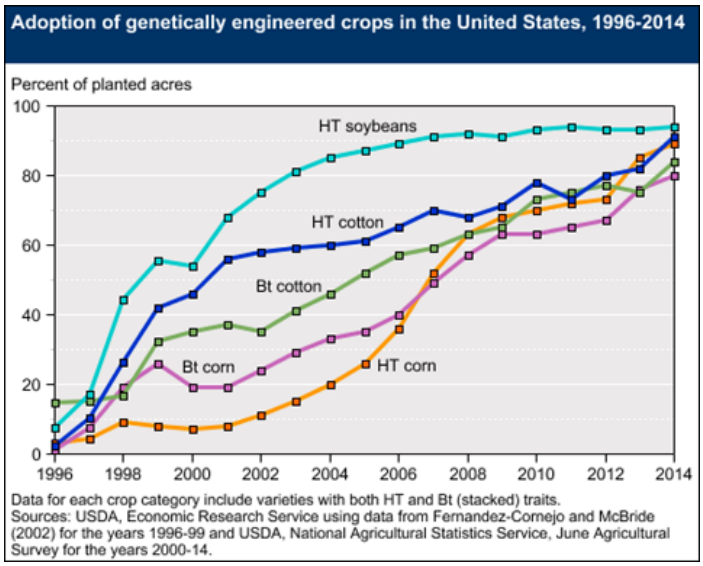


Glyphosate vs. Other Pesticides: Usage in the United States*



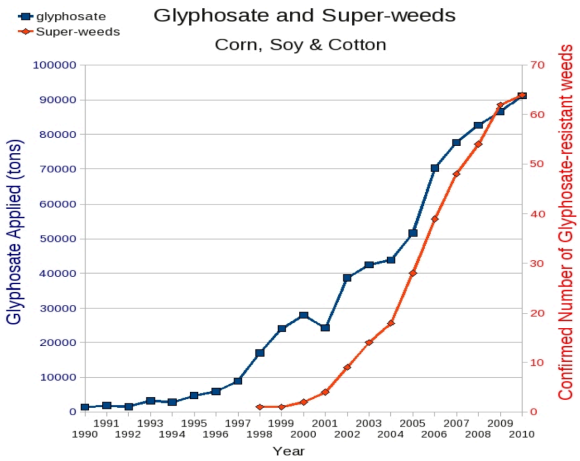
*http://sustainablepulse.com/wp-content/uploads/GMO-health.pdf

Adoption of GM Crops in U.S.

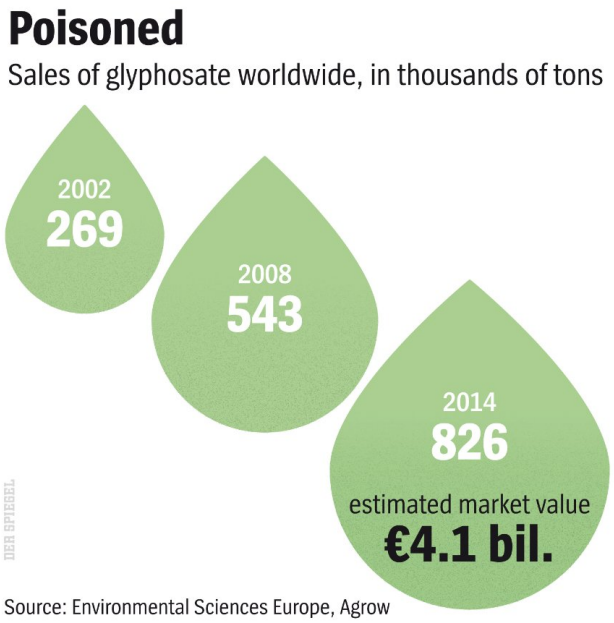


HT = herbicide (glyphosate) tolerant

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

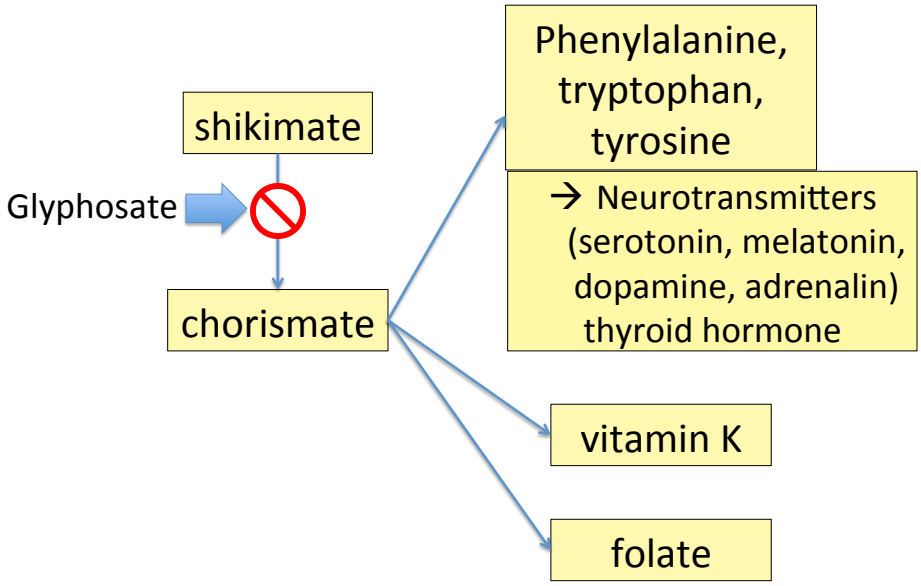
T **Tubule** damage in kidneys: kidney failure

Transition metal chelation, **Tryptophan** deficiency

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

*Thanks to David Fichtenberg

Shikimate Pathway Disruption

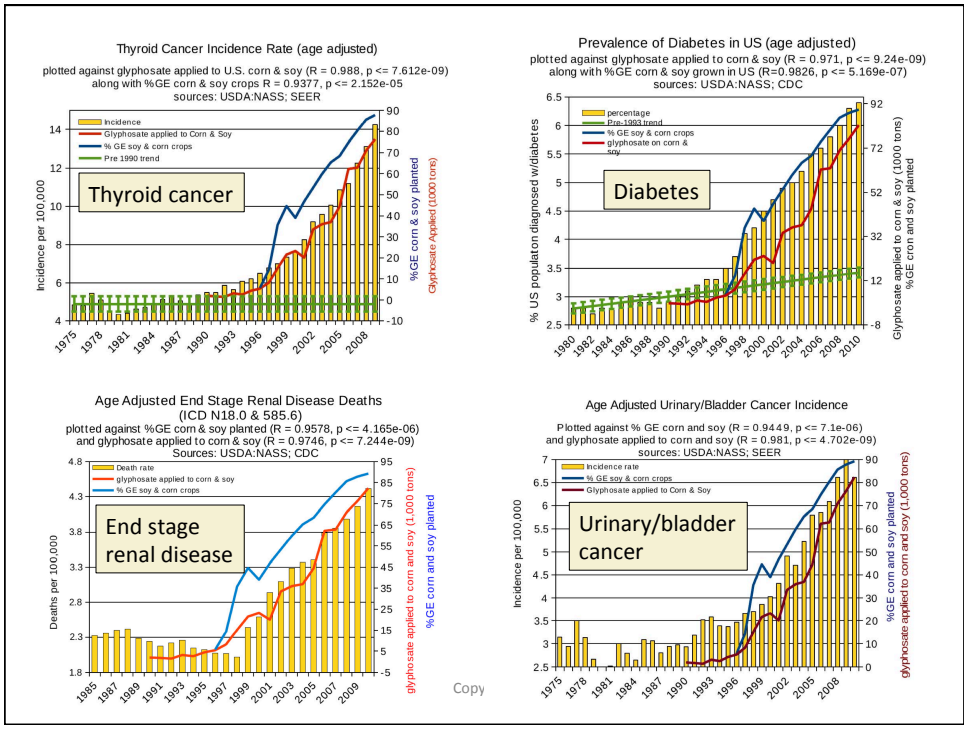


Paper Showing Strong Correlations between Glyphosate Usage and Chronic Disease

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 population 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)
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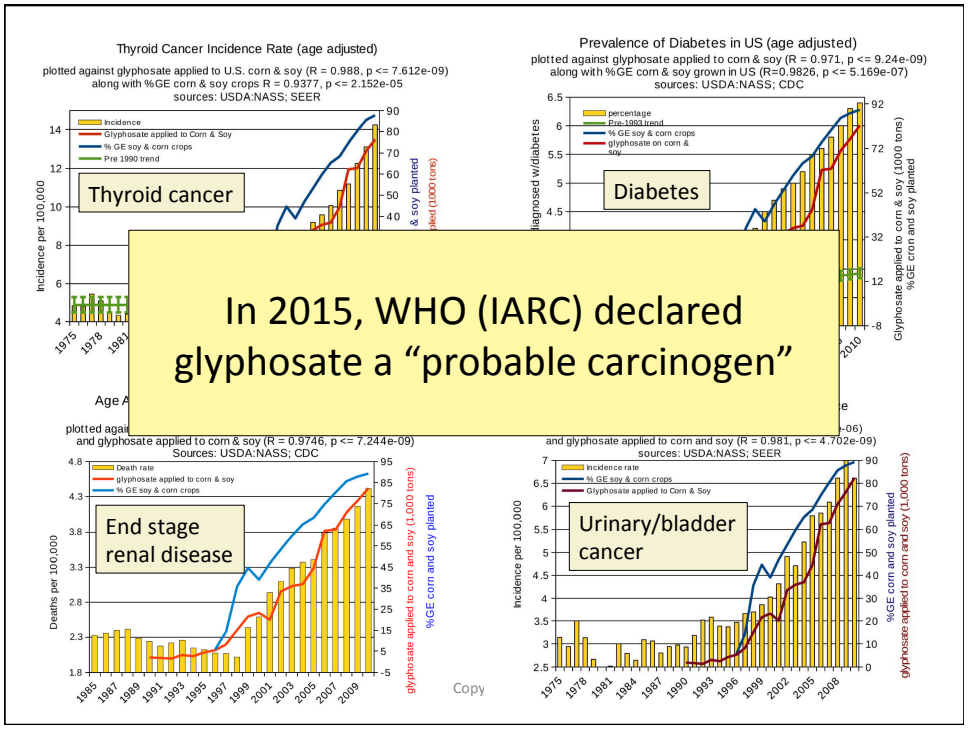
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Thyroid cancer
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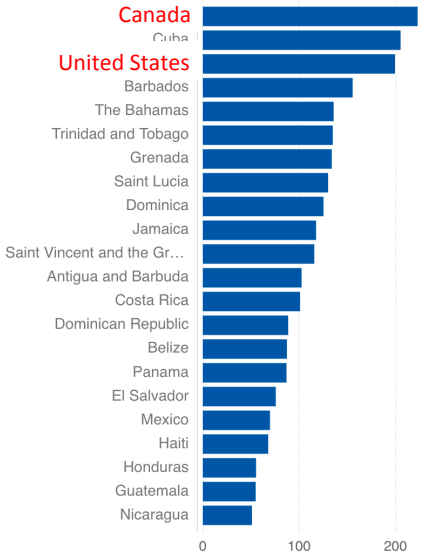
along with %GE corn & soy grown in US (R=0.9826, p <= 5.169e-07)
sources: USDA:NASS; CDC
Diabetes
In 2015, WHO (IARC) declared
glyphosate a “probable carcinogen”
End stage
renal disease
Urinary/bladder
cancer
Copy

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,

Cancer Rates in North America



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

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/

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

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

Class Action Lawsuit*

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

Anecdotal Evidence*

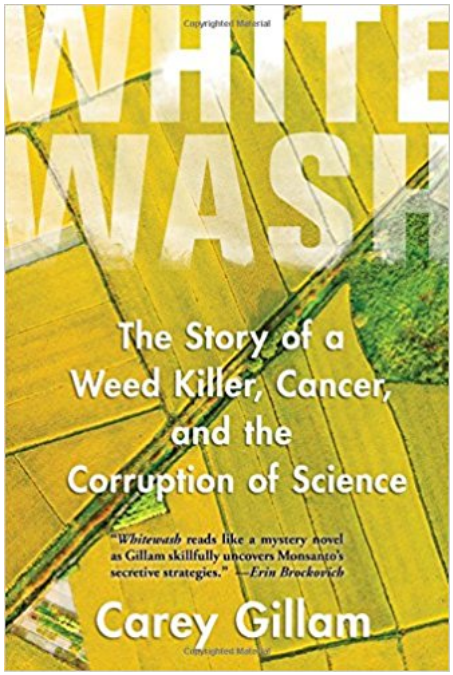
"In any case, Europe's farmers would be well advised to consider the fate of Jack McCall, whose widow Teri is one of the plaintiffs in the United States. The California farmer had sprayed Roundup in his orchards for decades, where he was often accompanied by a loyal companion: his dog Duke. Duke died of lymphoma. McCall died of non-Hodgkin lymphoma a few years later."

*www.spiegel.de/international/world/monsanto-papers-reveal-company-covered-up-cancer-concerns-a-1174233.html

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."

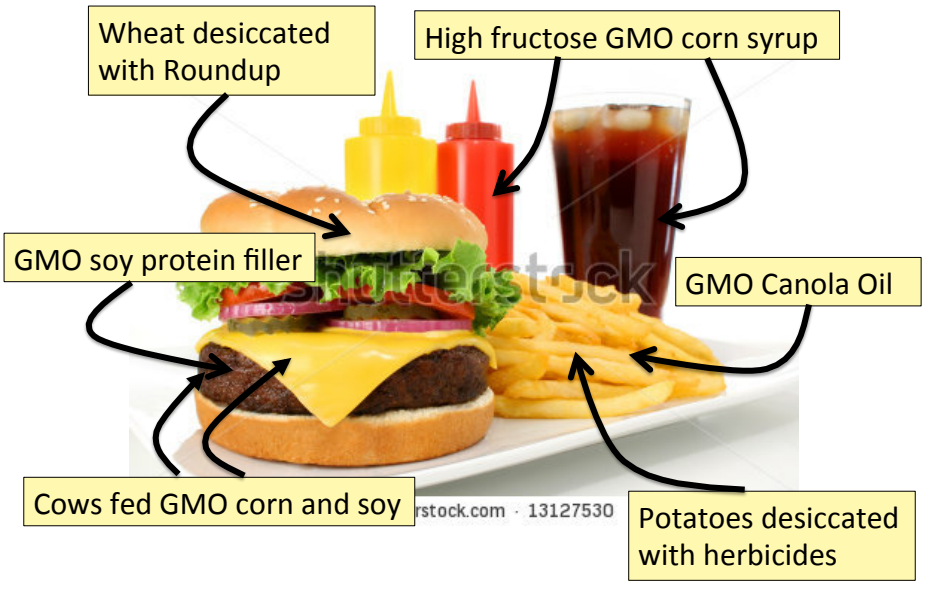
*www.huffingtonpost.com/entry/58cc5541e4b0e0d348b34348



Carey Gillam's New book

Glyphosate Contamination in Food

Is Glyphosate in Our Food?



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.

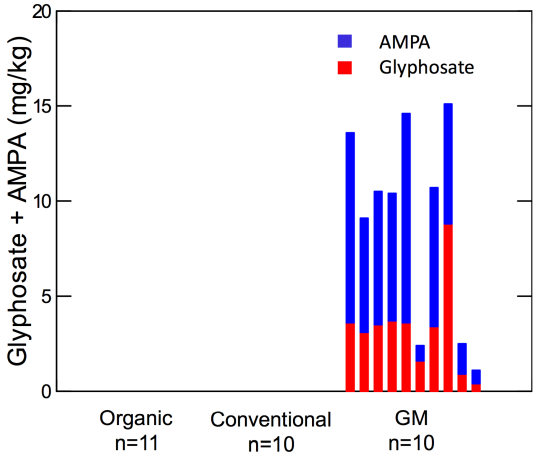


*Figure 1, T. Bøhn et al., Compositional differences in soybeans on the market: glyphosate accumulates in Roundup Ready GM soybeans. Food Chemistry (2013) Epub ahead of print.

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.

Glyphosate Levels in Various Foods

Adapted from: Samsel & Seneff.2017; Sarich.2016; Gallagher.2015; Gillam.2016; Honeycutt/MAA.2016

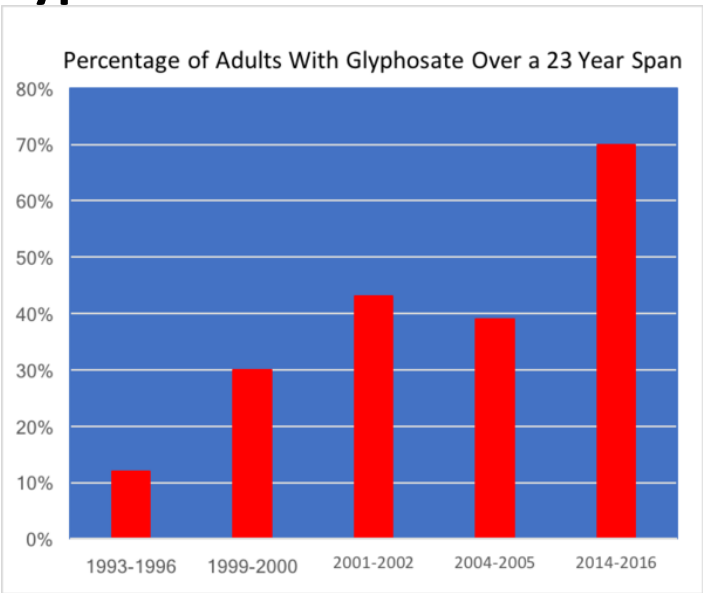
US, Canada, Rest of the World*

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

Glyphosate in Urine in California*

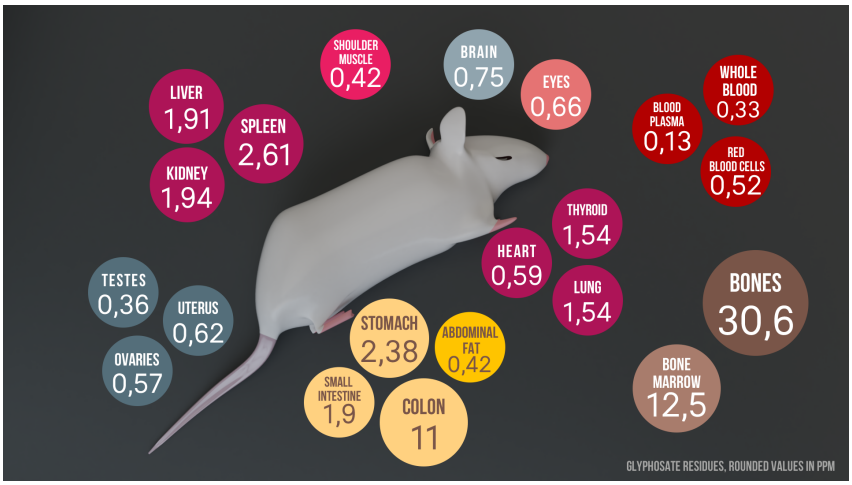


*PJ Mills et al. JAMA. 2017 Oct 24;318(16):1610-1611.

Glyphosate Levels Allowed in Drinking Water (micrograms/liter)

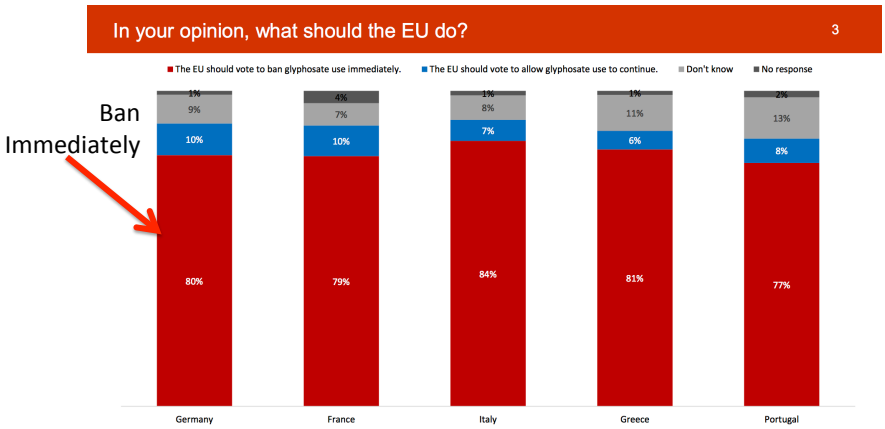
US	Canada	Europe
700	280	0.1

Bioaccumulation of Glyphosate*



*WP Ridley and K Mirly. Unpublished report. Study No. 86139, project No. ML-86e438. Monsanto Environmental Health Laboratory. 1986.
Graphic created by Nico Da Vinci (youtube video: https://www.youtube.com/watch?v=eRRdiq1NXyQ)

European Poll on Glyphosate*



A majority (77 % - 84 %) in all five countries wants the EU to ban glyphosate immediately. Italy shows the highest rejection of glyphosate (84 %), Portugal the least (77 %). Between 6 and 10 percent of the respondents in the five countries want the EU to allow the use of glyphosate.

*https://www.sumofus.org/media/new-glyphosate-polls-2017-en/

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*

Glyphosate in Cotton Products*

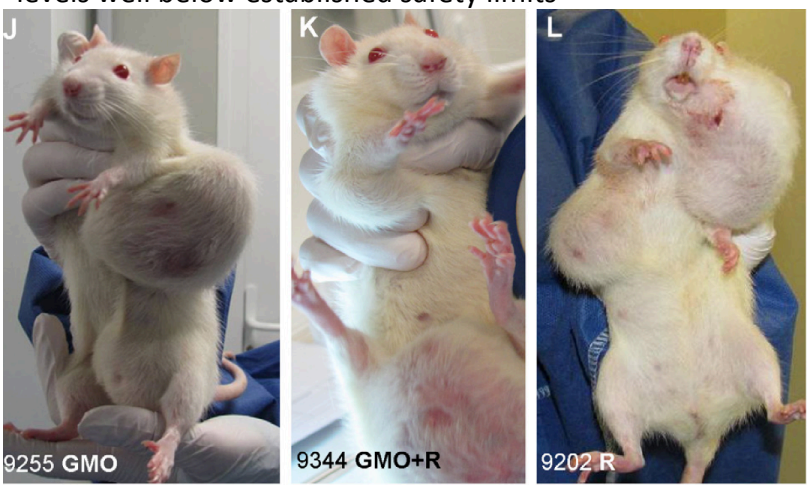
- "The vast majority – 85 percent – of tampons, cotton and sanitary products tested in a new Argentinian study contained glyphosate"
- In 2014, 96 percent of cotton produced in the United States was genetically modified to resist glyphosate

*https://www.rt.com/usa/319524-tampons-cotton-glyphosate-monsanto/

Lab Animals and Farm Animals

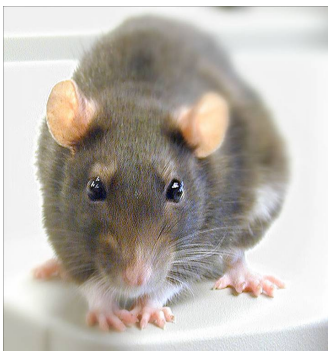
Mammary Tumors in Rats*

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

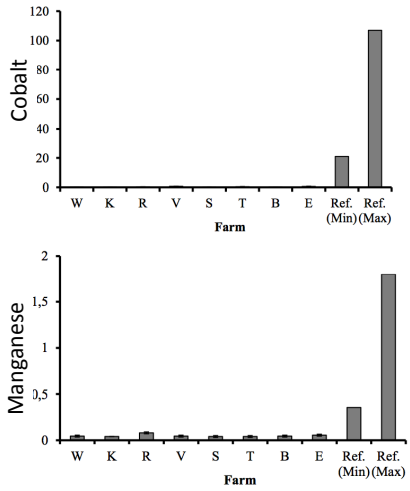
Conclusions from Rat Study *



- *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*



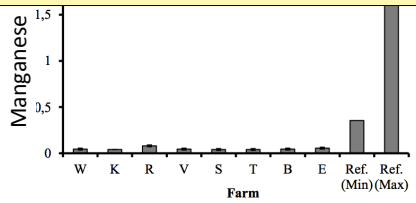
Eight different farms: all cows tested had glyphosate in the urine

*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

A Veterinarian Speaks Out about Glyphosate Damage to Livestock*

Cattle herds in Saskatchewan, Canada, exposed to high glyphosate levels

- One herd:
  - Clostridia overgrowth
  - Large numbers of stillborns and weak calves with skeletal problems
  - Necropsies revealed large fatty livers that were mottled and friable
  - Glyphosate contamination at 448 ppb in the corn feed
- Another herd:
  - Coccidia infection in calves on a creep ration tested at 548 ppb glyphosate contamination
  - Removing feed and supplementing with iron and B vitamins reversed the problems

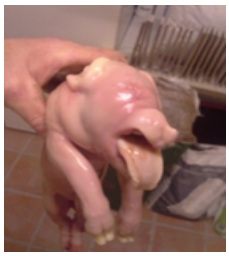
*Karen Briere, Oct. 19, 2017
http://www.producer.com/2017/10/glyphosate-on-feed-affects-livestock-vet/

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."

* M Kruger et al. Detection of Glyphosate in Malformed Piglets J Environ Anal Toxicol 2014, 4:5

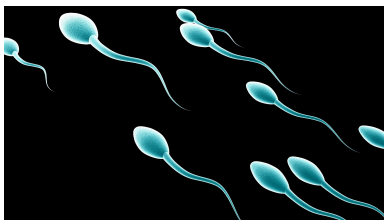
Infertility in China*

Sperm donor applicants in Hunan Province, China

30,000 young Chinese men

Percentage of healthy sperm

- 2001: 56%
- 2015: 18%

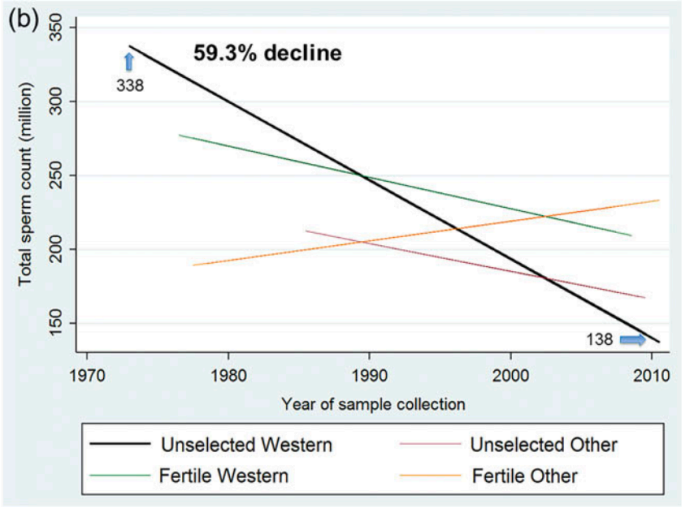


Linear Projection:

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

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

Sperm Counts Declining in Western World*



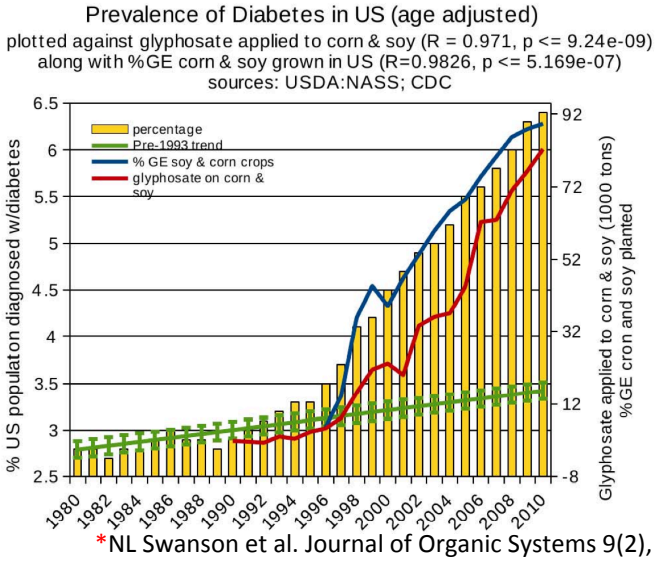
*H Levine et al. Human Reproduction Update September 2017: 1-14.

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*

Diabetes Prevalence in US vs GMOs and Glyphosate*



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

Obesity in US over Time*

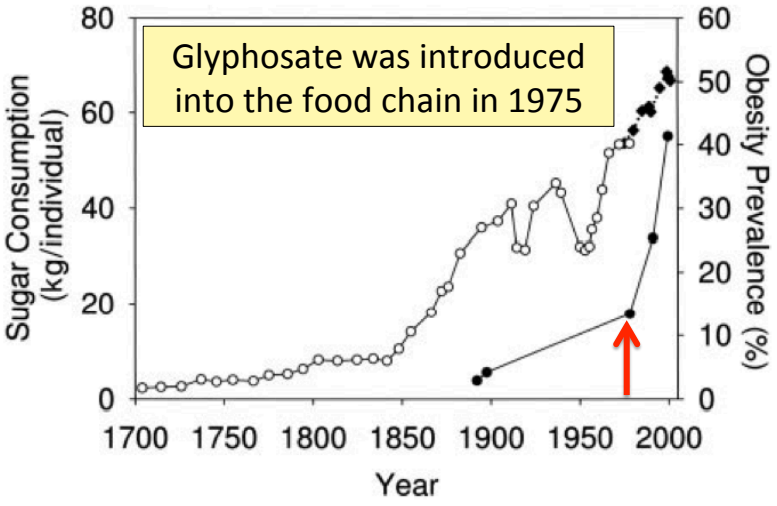


*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.

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**

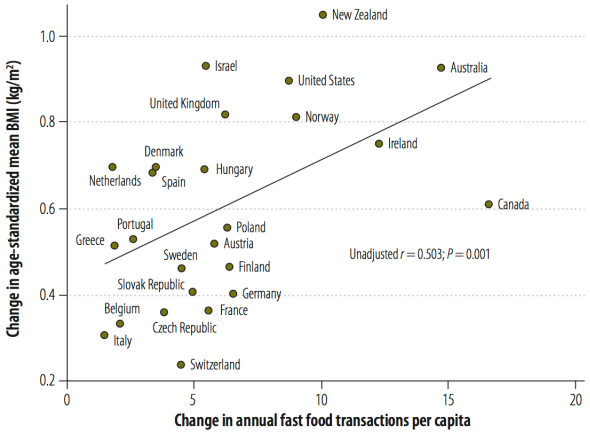
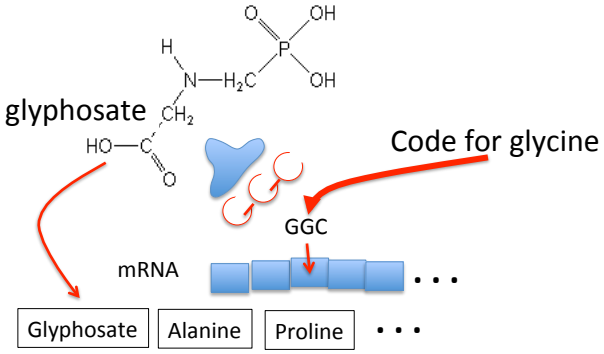


*Figure 1, De Vogli et al., Bull World Health Organ 2014;92:99–107A

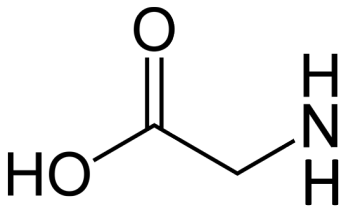
Glyphosate in Proteins

What if Glyphosate Could Insert Itself into Protein Synthesis by Mistake???



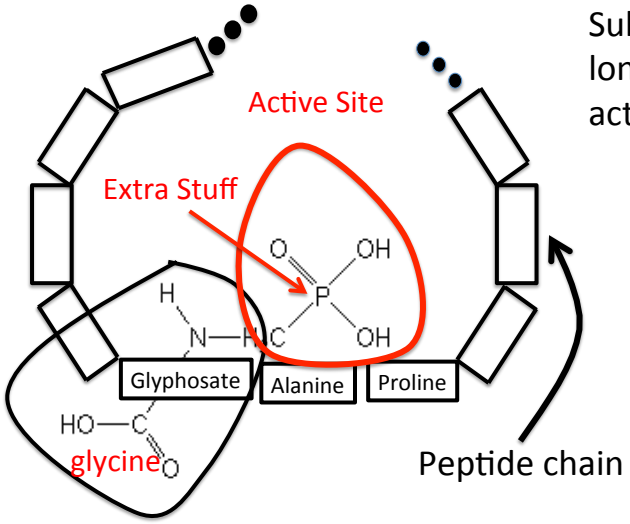
Any proteins with conserved glycine residues are likely to be affected in a major way

Glyphosate is a non-coding amino acid analogue of glycine



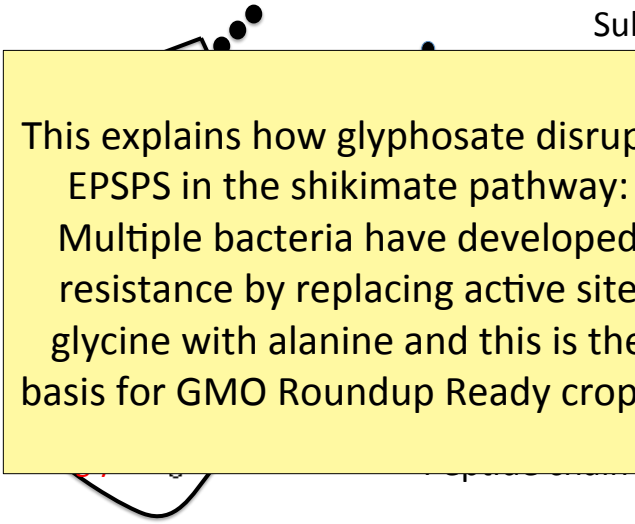
Glycine Glyphosate

Extra Piece Sticks Out at Active Site



Substrate no longer fits in active site

Extra Piece Sticks Out at Active Site



Substrate no fits in site

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

*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*

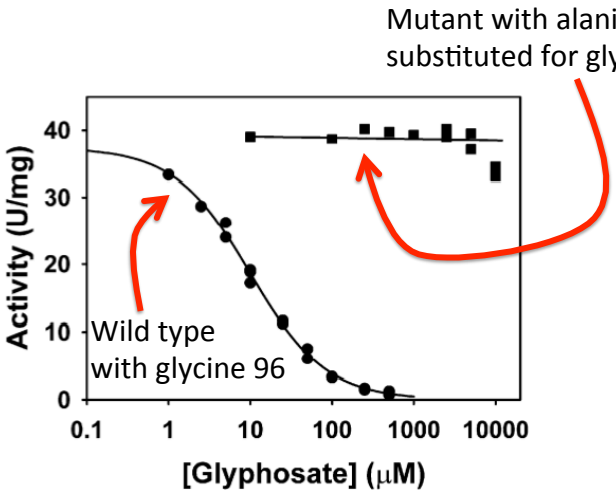


*Figure 3, S Eschenburg et al. Planta 2002;216:129-135.

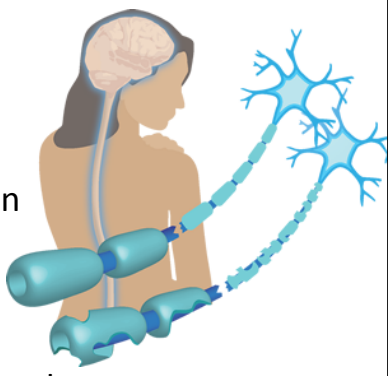
An Analogy: ALS in Guam

- An epidemic in ALS in Guam was traced to a natural toxin found in cycads
- BMAA is a non-coding amino acid that gets inserted by mistake in place of serine

- Defective versions of a glutamate transporter have been linked to ALS*
- The transporter has an essential serine-rich region in its sequence**

*Antioxidants & Redox Signaling 2009;11: 1587-1602.
**DJ Slotboom et al., PNAS 1999; 96(25): 14282-14287.

Another Analogy: MS & Sugar Beets*



- Sugar beets contain an analogue of proline called Aze
- Remarkable correlation between MS frequency and proximity to sugar beet agriculture
- Myelin basic protein contains a concentration of proline residues that are absolutely essential for its proper function

*E. Rubenstein, J Neuropathol Exp Neurol 2008;67(11): 1035-1040.

Some Predicted Consequences*

- Neurological diseases
- Autoimmune diseases
- Chronic fatigue syndrome
- 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.

Some Predicted Consequences*

- Neurological diseases
- Autoimmune diseases
- C
- I
- F
- Obesity and adrenal insufficiency
- Impaired iron homeostasis and kidney failure
- Insulin resistance and diabetes
- Cancer

All of these diseases can be linked to proteins that absolutely depend on glycine to function properly

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

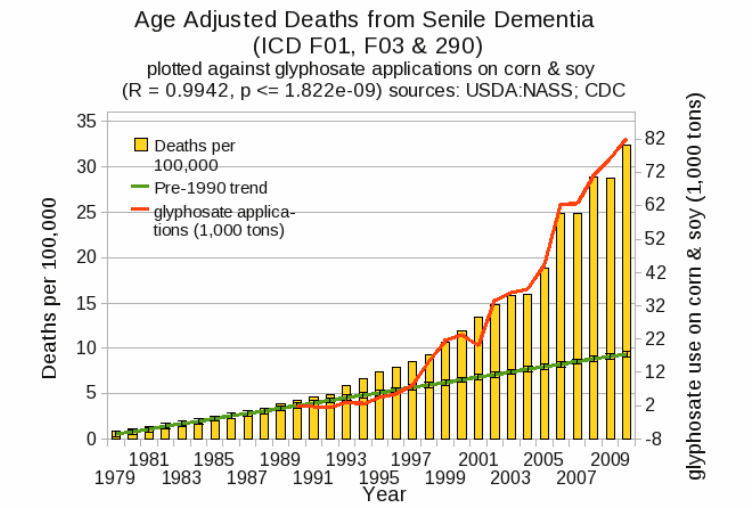
Neurological Diseases

At least four neurological diseases related to misfolded proteins involve conserved glycine residues

Disease	Protein	Reference
Alzheimer's	Amyloid beta	Munter et al.
Parkinson's disease	Alpha synuclein	Du et al.
ALS	TDP-43	Pesiridis et al.
Prion diseases	Prion proteins	Harrison et al.

L-M Munter et al. The EMBO Journal 2007; 26: 1702-1712.
H-N Du et al., Biochemistry 2003; 42: 8870-8878.
S Pesiridis et al., Hum Mol Genet 2009; 18(R2): R156-R162.
CF Harrison et al., J Biol Chem 2010; 285(26): 20213-20223.

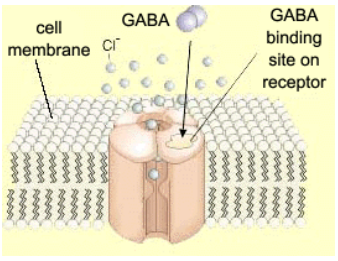
Deaths from Senile Dementia*



*Plot provided by Dr. Nancy Swanson

Impaired GABA Receptor Activity and Autism

- Autism has been linked to a weakened response of the inhibitory GABA receptor to stimuli*
- The GABA receptor has a conserved glycine at the entrance to the first membrane-spanning domain that is essential for its function**



*CD Robertson et al., Current Biology 2016;26: 80-85
**BX Carlson et al., Mol Pharmacol. 2000;57(3):474-84

Protein Phosphatase I and Autism

- Glyphosate exposure to rat dams led to thyroid deficiency in pups*
  - Attributed to suppressed release of thyroid stimulating hormone (TSH) from the dam's pituitary
- Thyroid deficiency in mom during pregnancy predicts significant increased risk to autism in child**
- Glyphosate link to impaired TSH due to disruption of protein phosphatase I***

*JS deSouza et al., Toxicology *To Appear*, 2017
**GC Román, Ann Neurol 2013;74(5):733-42.
***JE Beecham and S Seneff. Journal of Autism 2016;3:1.

Protein Phosphatase 1 Has Many Highly Conserved Glycines!*

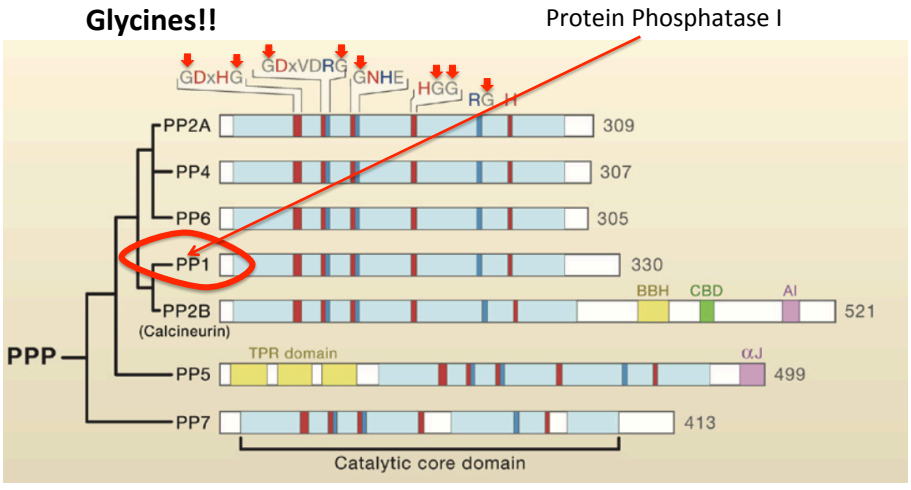


*Figure 1, Y. Shi, Cell 2009;139: 468-484.

Protein Phosphatase 1 Has Many Highly Conserved Glycines!*

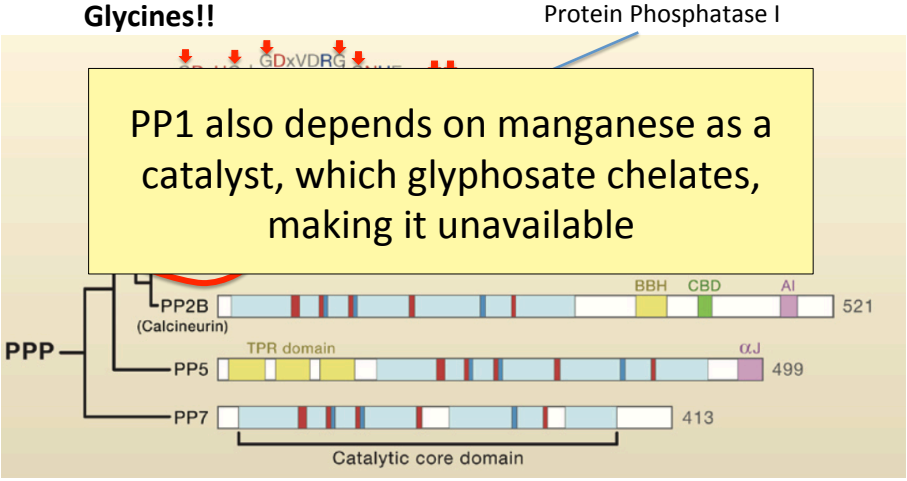


*Figure 1, Y. Shi, Cell 2009;139: 468-484.

"Association of Gestational Maternal Hypothyroxinemia and Increased Autism Risk"*

*GC Román, Ann Neurol 2013;74(5):733-42.

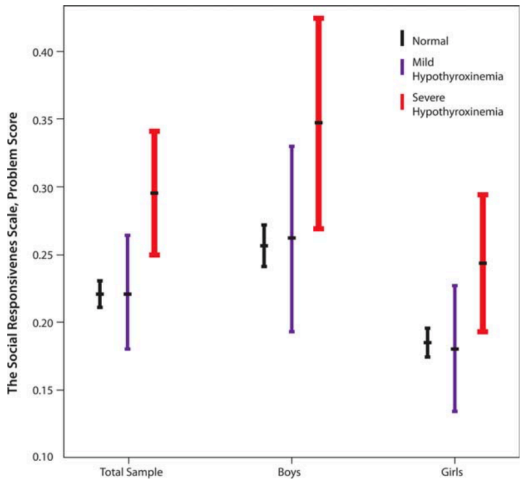


FIGURE 2: Maternal hypothyroxinemia in early pregnancy and autistic symptoms in the children at age 6 years.

Recapitulation

- Glyphosate may substitute for glycine by mistake during protein synthesis – coding error
  - This has huge consequences everywhere
  - Mutating to lose an active-site glycine is how the bacterial enzyme, EPSPS, gets protected from glyphosate suppression
  - This forms the basis of GMO Roundup Ready crops
- Nearly all of the strong correlations between glyphosate usage on core crops and the rapid rise in incidence of a number of debilitating diseases can be explained through protein disruption by glyphosate incorporation
- GABA receptor impairment in autism can be explained by glyphosate substituting for highly conserved glycine residue
- Protein phosphatase I inhibition by glyphosate can result in thyroid deficiency which is linked to autism in the fetus of an affected woman

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*

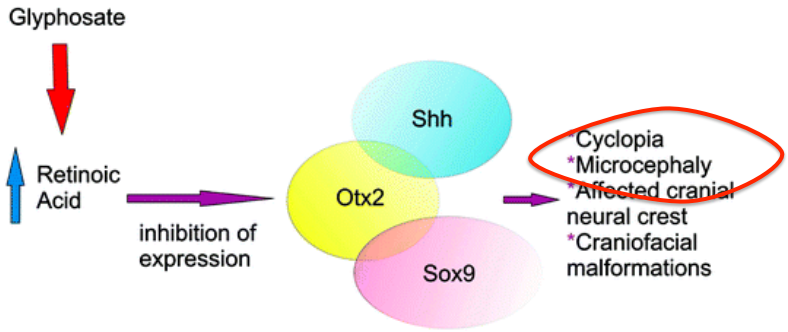
* S. Thongprakaisang et al., Food Chem Toxicol. 2013 Jun 8. S0278-6915(13)00363-3.

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

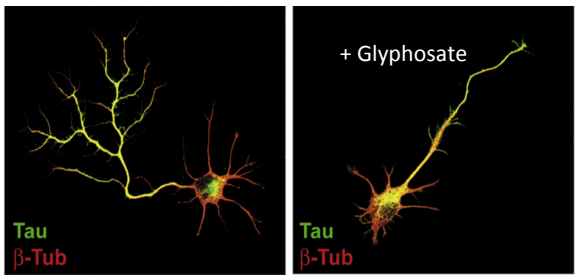
"Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling"*



*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*

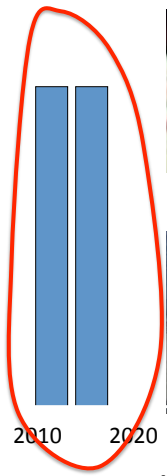
- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
  - 47 (63%) of these were detected
  - Glyphosate was applied in large amounts, *but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

Recent Paper on Glyphosate and Anencephaly

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Review Article Volume: 3.2 Open Access

Glyphosate and Anencephaly: Death by A Thousand Cuts

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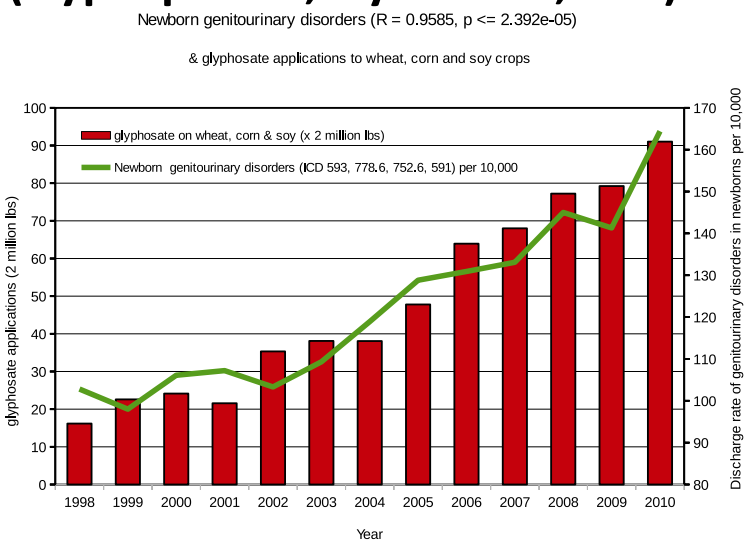
Newborn Genitourinary Disorders* (Hypospadias, Hydrocele, etc.)



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

Kidney Failure

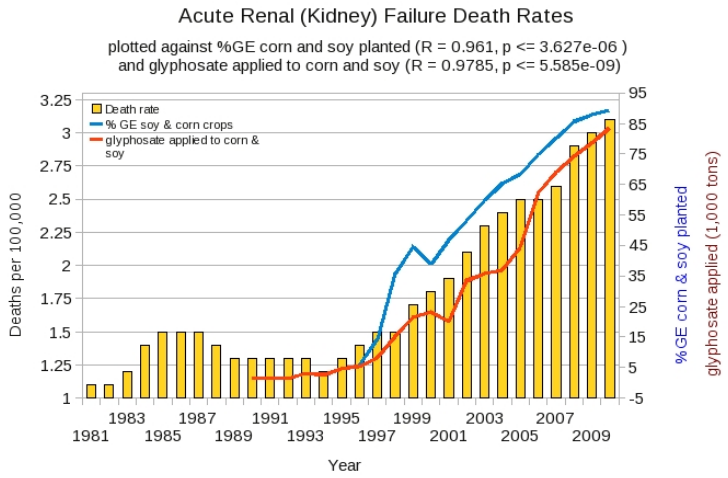
Kidney Failure in Agricultural Workers*

- 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

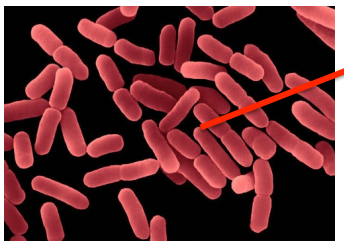
Bacterial Siderophores & Kidney Disease

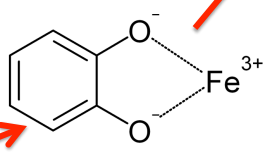
- Proximal tubular necrosis
- Free iron in the tubule causes damage due to oxidative stress
- Defective iron uptake from bacterial siderophores in the proximal renal tubule can cause simultaneous iron deficiency and iron toxicity*

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

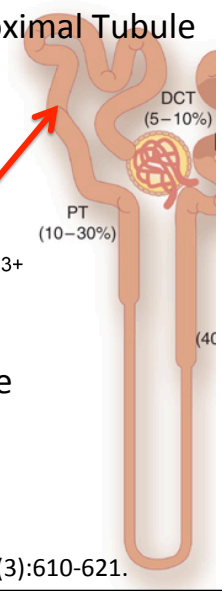
How Proximal Tubule Gets Iron*

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





siderophore



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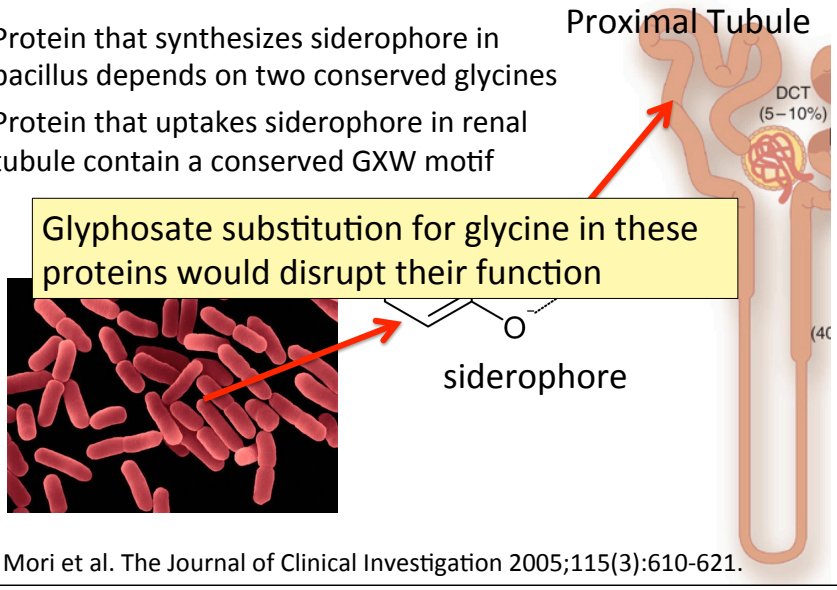


*K Mori et al. The Journal of Clinical Investigation 2005;115(3):610-621.

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

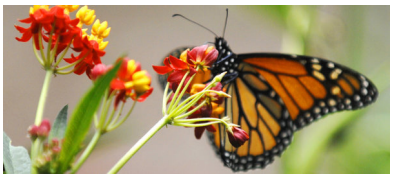
Where Have all the Insects Gone?

"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.

Dissolving starfish

Fungus Infection

Bats eat an enormous number of insects

White-nose bat syndrome

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 shiki-mate 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

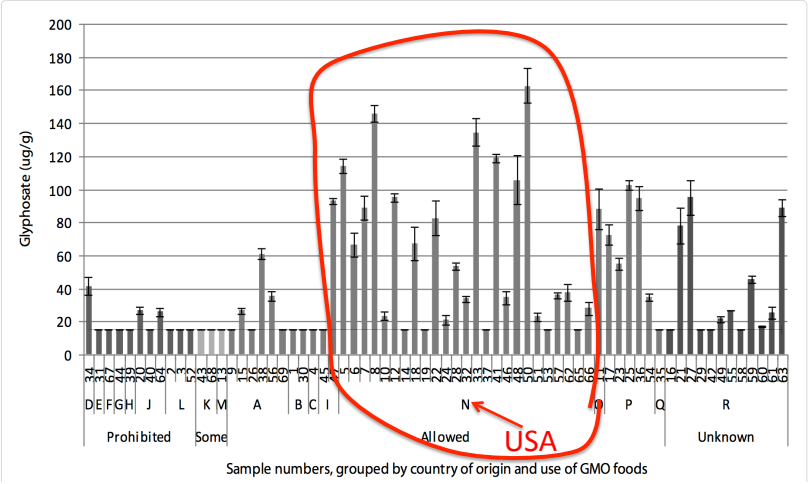
*personal communication

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.

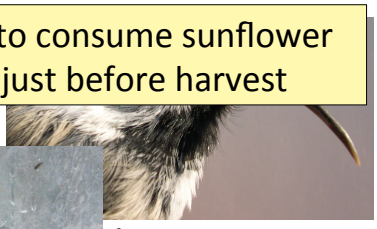
Beak Deformities in Chickadees*

- 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/

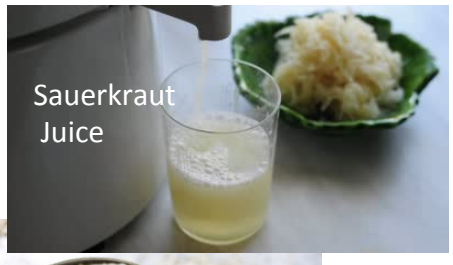
Insect Armageddon

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

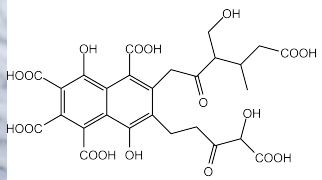
Sustainable Organic Agriculture

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

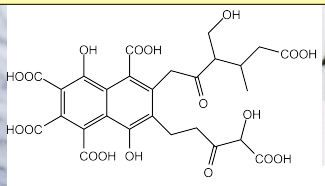
Treating Glyphosate Poisoning in Cows*

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 sauerkraut
n to be effective
vels of
oving animal

Bentonite Clay



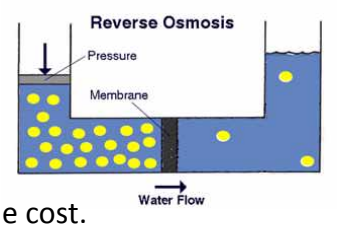
Fulvic Acid

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

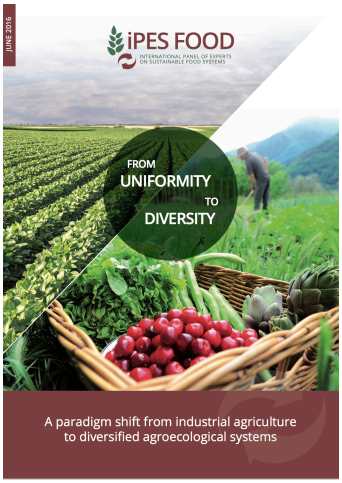
- Dirt is inert; soil is alive
- Missouri farmer JR Bollinger grew corn and soy on a former coal mine
- "We tried … all kinds of goodies: humates, … sea minerals, microbes, fish meal and biochar powder."
  - Earthworms till the soil
  - Soil microbes are crucial for soil health
- Greatly reduce fertilizer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

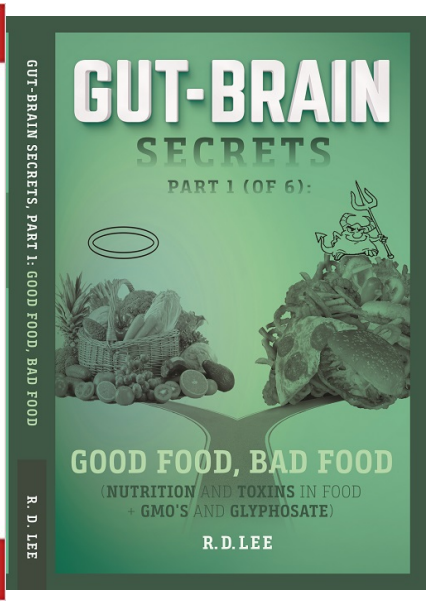
- Demeter is the Greek Goddess of grain and fertility
  - Views the farm as a living "holistic organism"
- The Demeter certification program was established in 1928, and as such was the first ecological label for organically produced foods

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

Small Organic Farms are the Answer

Bluebird Hill Organic Farm, North Carolina

Check Out These Two Books at Booth #215!



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 likely a major causal factor in health problems in farm animals and in massive die-offs of multiple species
- Glyphosate is an insidious, cumulative toxic chemical that needs to be banned, globally
- A key component of glyphosate's toxicity may be its ability to substitute for glycine during protein synthesis by mistake
- We need to find the path back towards sustainable, organic agriculture