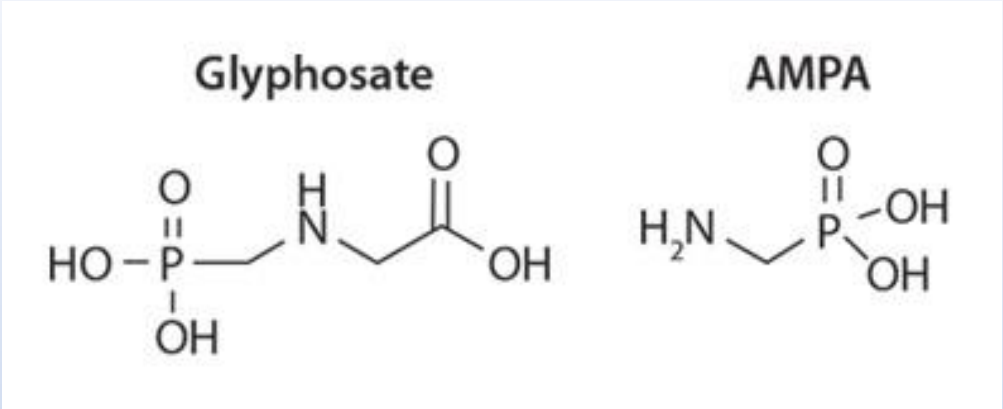


Current understanding of glyphosate's risk profile

Pam Bryer, Ph.D.

Pesticides Toxicologist

Maine Board of Pesticides Control

Where this talk is going:

-Introductory comments

-Public concern over glyphosate in food

-Public concern over glyphosate influencing human microbiome

-Public concern over glyphosate causing cancer

Hmmmm…. Millionth (or so) time I've been asked to present on glyphosate!

- $289 million court verdict to pesticide applicator in California

  Court decisions do not change the scientific understanding.

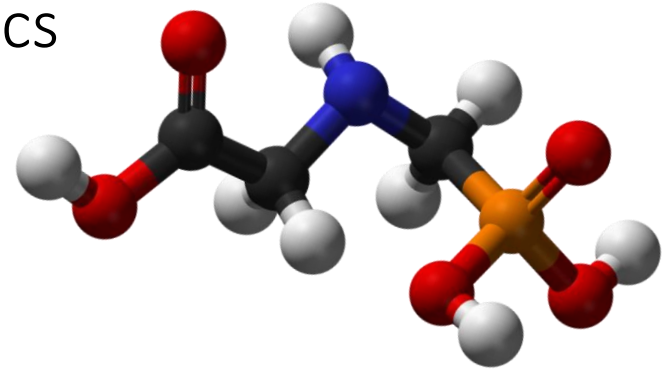
- Glyphosate use is a problem

  40 years reliance and 18.9 billion lbs per year worldwide[1] is a set-up of common sense proportions.

- Glyphosate is a good product

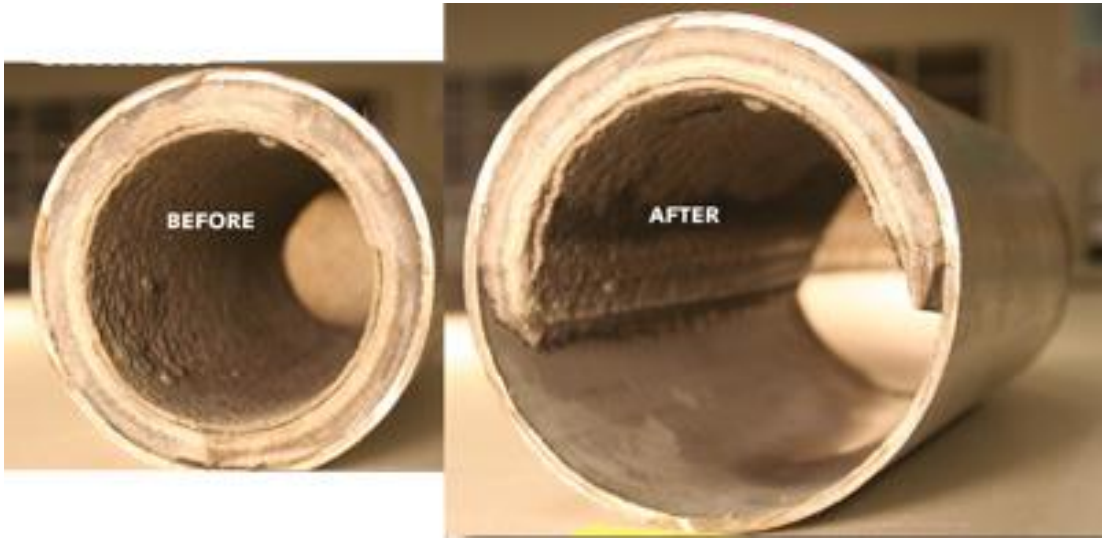
  Despite wide use and creeping resistance glyphosate remains an effective and low risk herbicide.

Glyphosate basics



- Does not volatilize
- Does not photodegrade
- No to slight mobility in soil
  - K_{oc} of 2,600 to 4,900
  - Binds organic carbon and clay in soil; can form metal complexes
- In water, binds to suspended solids and sediment
- Biodegradation largely by bacteria;
  - Soil 1.85 to 7 days (aerobic conditions) but as long as 428 days in other conditions
  - Sediment 8 days
  - Cold temps slow degradation rate
- Low potential to bioaccumulate (BCF 0.52)

What chelators do



Mineral scale build up inside of pipes.

Birthday's are good for your health.

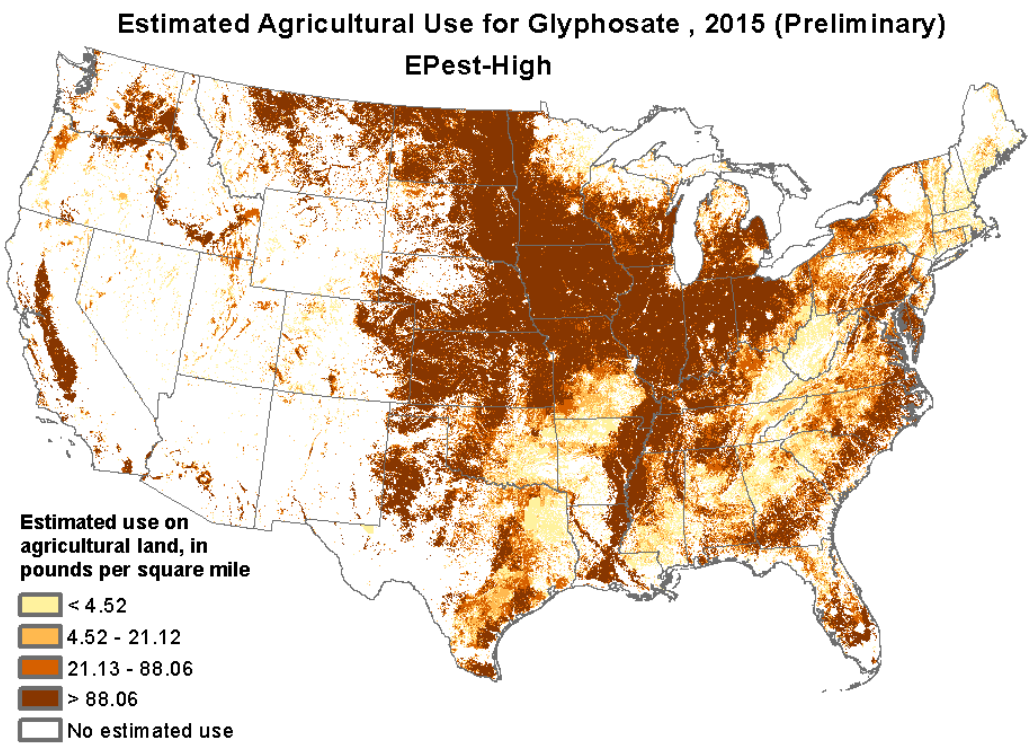
Studies have shown that those who have more, live longer.

someecards
user card

Concerns for glyphosate in our food

Is it probable we are being exposed to glyphosate in our food? *Yes*

- 2018 Indiana study of pregnant women found 93% of participants had glyphosate in their urine[2].
- This usage map[3] ->



Glyphosate residues in federal sampling programs

- USDA sampled just over 10,000 agricultural commodities in 2016 and tested for ~450 different current use and legacy pesticides[4].
- No glyphosate analyzed by USDA.

- FDA sampled 6,406 agricultural commodities in 2015 and tested for ~700 different pesticides and chemicals of concern[5].
- No glyphosate analyzed by FDA.

WHY? ..... Testing for glyphosate is hard!

- Analytical challenges
  - All methods are heavily influenced by what else is in the sample.

    Orange line shows ideal, put 40 ppm in the sample and read out 40 ppm.

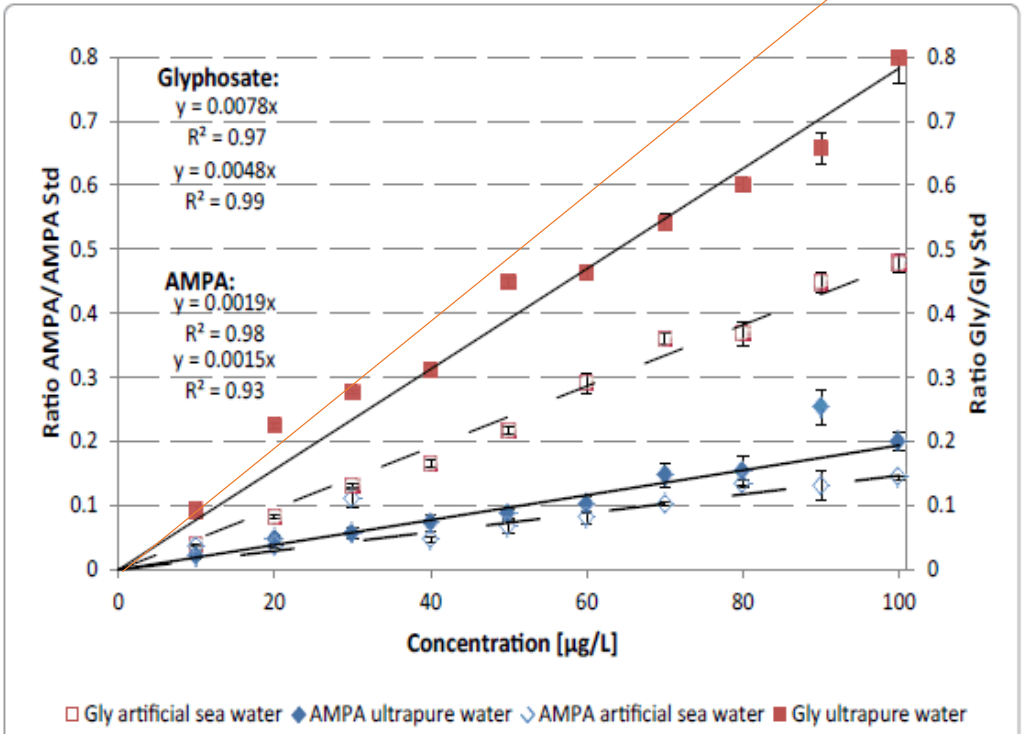


Figure 3: Calibration curves for glyphosate and AMPA in ultrapure water and artificial sea water (10-100 µg/L).

Reference [6]

Despite those limitations, here's what we know about glyphosate residues in our food:

Glyphosate is allowed in food

The amount allowed is regulated as a tolerance listed in the US CFR

§180.364 Glyphosate; tolerances for residues.

(a) *General.* (1) Tolerances are established for residues of glyphosate, including its metabolites and degradates, in or on the commodities listed below resulting from the application of glyphosate, the isopropylamine salt of glyphosate, the ethanolamine salt of glyphosate, the dimethylamine salt of glyphosate, the ammonium salt of glyphosate, and the potassium salt of glyphosate. Compliance with the following tolerance levels is to be determined by measuring only glyphosate (*N*-(phosphonomethyl)glycine).

Commodity	Parts per million
Acerola	0.2
Alfalfa, seed	0.5
Almond, hulls	25
Aloe vera	0.5
Ambarella	0.2
Animal feed, nongrass, group 18	400
Artichoke, globe	0.2
Asparagus	0.5
Atemoya	0.2
Avocado	0.2
Bamboo, shoots	0.2
Banana	0.2
Barley, bran	30
Beet, sugar, dried pulp	25
Beet, sugar, roots	10
Beet, sugar, tops	10
Berry and small fruit, group 13-07	0.20
Betelnut	1.0
Biriba	0.2
Blimbe	0.2
Breadfruit	0.2
Cacao bean, bean	0.2
Cactus, fruit	0.5
Cactus, pads	0.5
Canistel	0.2
Carrot	5.0
Chaya	1.0
Cherimoya	0.2
Citrus, dried pulp	1.5
Coconut	0.1
Coffee, bean, green	1.0
Corn, pop, grain	0.1
Corn, sweet, kernel plus cob with husk removed	3.5

Reference 9

Despite those limitations, here's what we know about glyphosate residues in our food:

§180.364 Glyphosate; tolerances for residues.

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Corn, pop, grain	0.1
Corn, sweet, kernel plus cob with husk removed	3.5

EPA acceptable limits:

Daily Food: RfD = 1.00 mg/kg/day

Health studies (listed next slide)

List of experimental tests EPA required for glyphosate's recent registration review.

December 12, 2017 Glyphosate. Draft Human Health Risk Assessment in Support of Registration Review.

Table B.1. Toxicological Data Requirements for Glyphosate.

Study		Technical	
		Required	Satisfied
870.1100	Acute Oral Toxicity	yes	yes
870.1200	Acute Dermal Toxicity	yes	yes
870.1300	Acute Inhalation Toxicity	yes	no[1]
870.2400	Primary Eye Irritation	yes	yes
870.2500	Primary Dermal Irritation	yes	yes
870.2600	Dermal Sensitization	yes	yes
870.3100	Oral Subchronic (rodent)	yes	yes
870.3150	Oral Subchronic (nonrodent)	yes	no[2]
870.3200	21-Day Dermal	yes	yes
870.3465	90-Day Inhalation	yes	yes
870.3700a	Developmental Toxicity (rodent)	yes	yes
870.3700b	Developmental Toxicity (nonrodent)	yes	yes
870.3800	Reproduction	yes	yes
870.4100a	Chronic Toxicity (rodent)	yes	yes
870.4100b	Chronic Toxicity (nonrodent)	yes	yes
870.4200b	Oncogenicity (mouse)	yes	yes
870.4300	Chronic/Oncogenicity	yes	yes
870.5100	Mutagenicity—Gene Mutation - bacterial	yes	yes
870.5300	Mutagenicity—Gene Mutation - mammalian	yes	yes
870.5xxx	Mutagenicity—Structural Chromosomal Aberrations	yes	yes
870.5xxx	Mutagenicity—Other Genotoxic Effects	yes	yes
870.6100a	Acute Delayed Neurotoxicity (hen)	no	no
870.6100b	90-Day Neurotoxicity (hen)	no	no
870.6200a	Acute Neurotoxicity Screening Battery (rat)	yes	yes
870.6200b	90-Day Neurotoxicity Screening Battery (rat)	yes	yes
870.7485	General Metabolism	yes	yes
870.7600	Dermal Penetration	no	no
870.7800	Immunotoxicity	yes	yes

[1] The requirement for an acute inhalation LC_{50} study was waived.

[2] This is not considered a data gap because there is a chronic dog study in the database.

Despite those limitations, here's what we know about glyphosate residues in our food:

EPA acceptable limits:

Daily Food: RfD = 1.00 mg/kg/day

Despite those limitations, here's what we know about glyphosate residues in our food:

EPA acceptable limits:

Daily Food: RfD = 1.00 mg/kg/day

1.0 mg of glyphosate

Despite those limitations, here's what we know about glyphosate residues in our food:

EPA acceptable limits:

Daily Food: RfD = 1.00 mg/kg/day

for each kilogram of
your body weight

Despite those limitations, here's what we know about glyphosate residues in our food:

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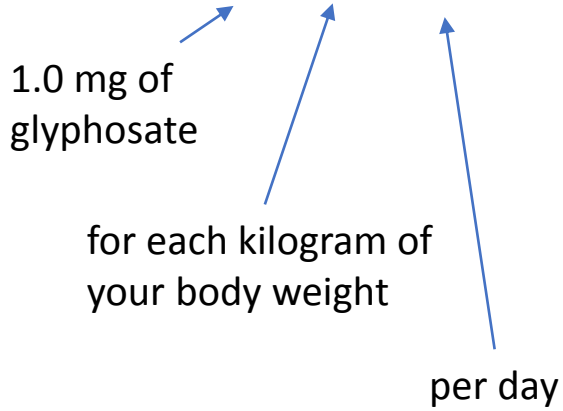
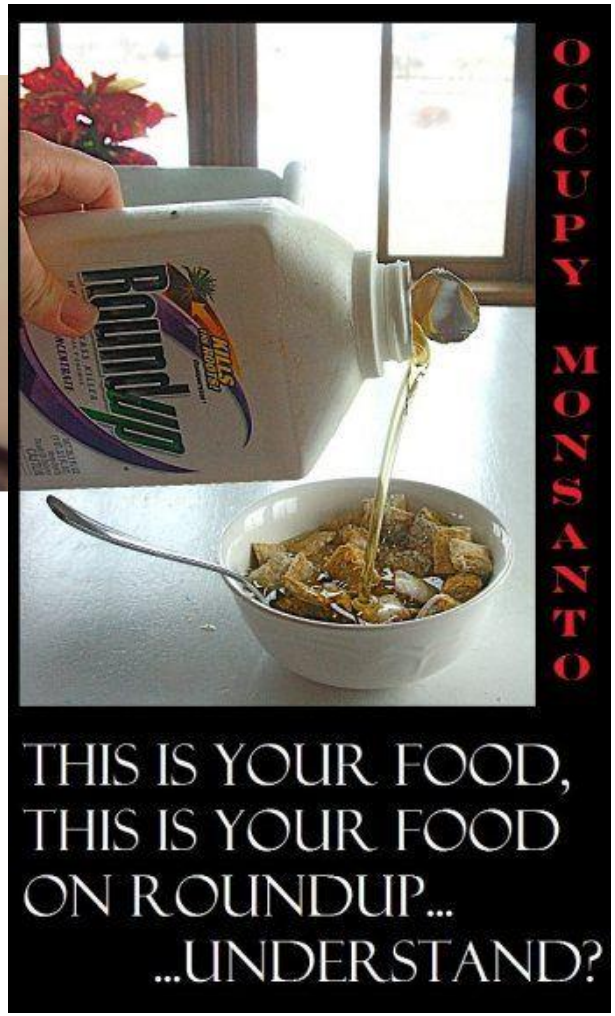


A 65 kg person could allowably consume 65 mg glyphosate per day and expect no long/short term effects including cancer risks.

Recent headlines:

Breakfast With a Dose of Roundup?

Weed Killer in $289 Million Cancer Verdict Found in Oat Cereal and Granola Bars



Comparing EPA's allowable limit to EWG's analysis:

Food Item	Average (ppb)	ug/kg	mg/kg	mg/g	mass eaten (g)	mg glyphosate per item
Granola	229.1	229.1	0.2291	0.000229	60	0.014
Instant oats	461.3	461.3	0.4613	0.000461	60	0.028
Oat breakfast cereal	325.0	325.0	0.3250	0.000325	60	0.020
Snack bar	138.6	138.6	0.1386	0.000139	60	0.008
Whole oats	336.7	336.7	0.3367	0.000337	60	0.020

EWG's report didn't use EPA's allowable limit, instead they created a new one at 0.01 mg/kg/day

EPA acceptable limits:

Daily Food: RfD = 1.00 mg/kg/day

A 65 kg person could allowably consume 65 mg glyphosate per day and expect no long/short term effects including cancer risks.

Syllogism

A tool in deductive reasoning that takes 2 propositions to lead to a conclusion.

All men are mortal.
Socrates is a man.
∴ Socrates is mortal.

All horses have hooves.
No humans have hooves.
∴ Some humans are not horses.

All cats are mortal.
Socrates is mortal.
∴ Socrates is a cat.

Gut bacteria are a part of our health.

Glyphosate shares a mechanism of action with plants and bacteria.

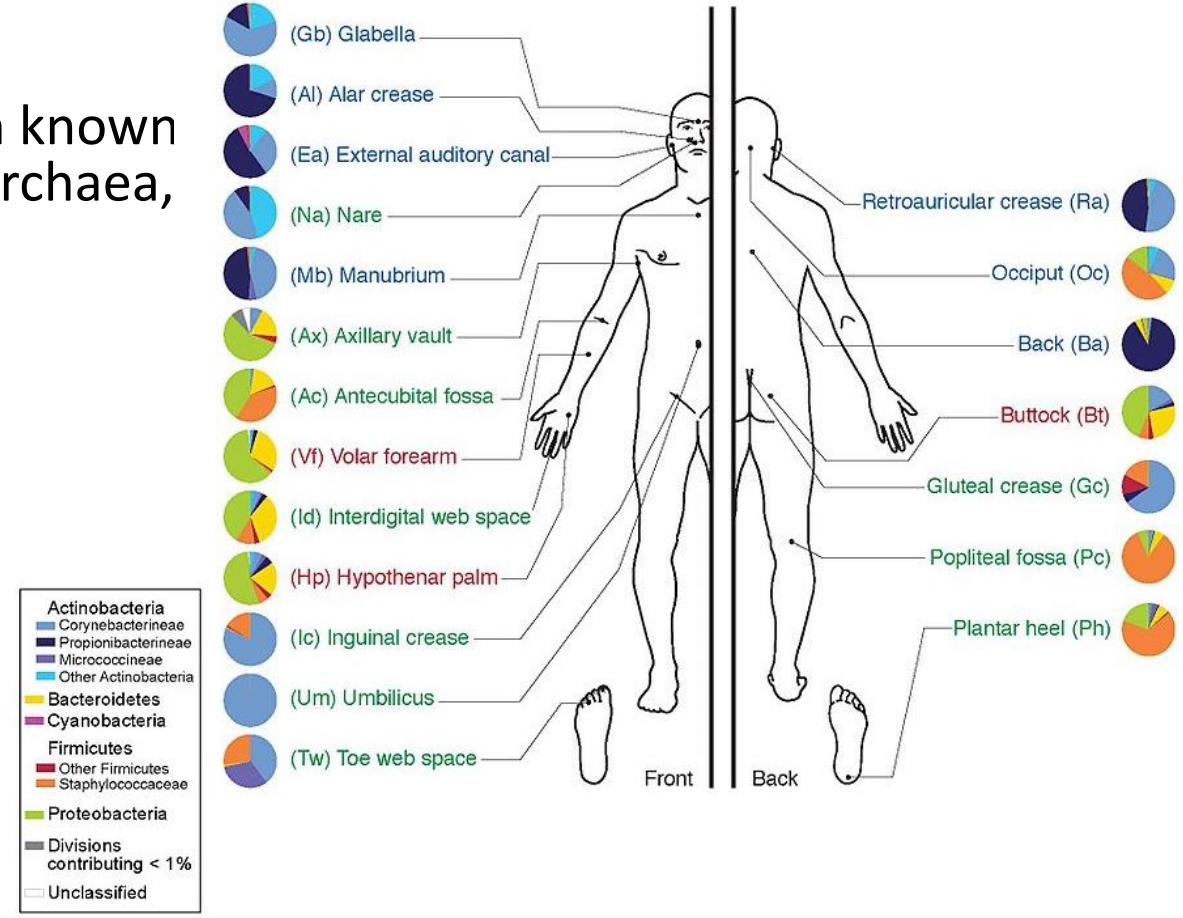
Glyphosate will affect our health.

The Human Microbiome

We are not alone!

Anatomical areas with known organisms (bacteria, archaea, fungi, viruses):

- Skin
- Conjunctiva
- Gut
- Urethra and bladder
- Vagina
- Placenta
- Uterus
- Oral cavity
- Lung
- Biliary tract



Darryl Leja, NHGRI - http://www.genome.gov/dmd/img.cfm?node=Photos/Graphics&id=85320

Gut Health

Excerpt:

SCIENTIFIC AMERICAN

NEUROSCIENCE

How Gut Bacteria Tell Their Hosts What to Eat

By suppressing or increasing cravings, microbes help the brain decide what foods the body "needs"

By Knvul Sheikh on April 25, 2017

Two kinds of bacteria were particularly effective in influencing the appetites of flies this way: *Acetobacter* and *Lactobacillus*. Increasing both was enough to suppress the flies' protein cravings and increase their appetite for sugar.

Could glyphosate be affecting our gut health?

- Given the global exposure we are getting, it would be hard to believe GI effects would go unnoticed. - *weight of evidence approach*
- However, this is an area yet to be fully explored.

Mechanism of action for glyphosate

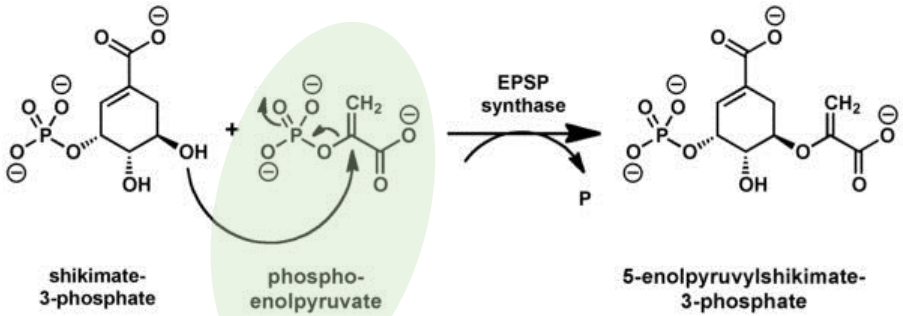
Enzyme EPSP synthase is blocked from working by glyphosate.

PEP Glyphosate

Similarity between PEP and glyphosate!

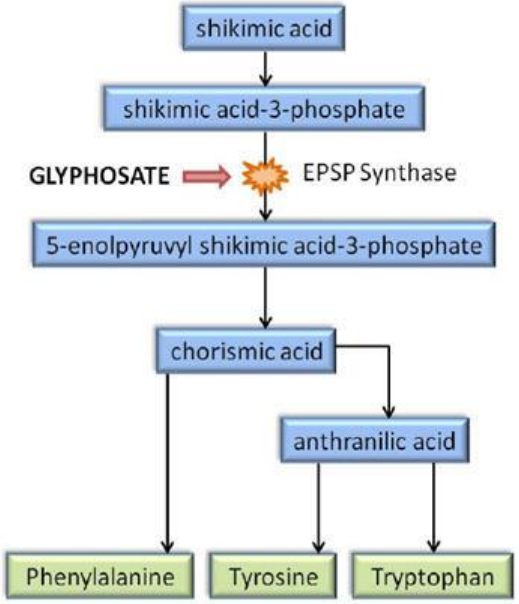
EPSP synthase used by:

- Bacteria,
- Archaea,
- Fungi,
- Algae,
- some Protozoa, and
- Plants



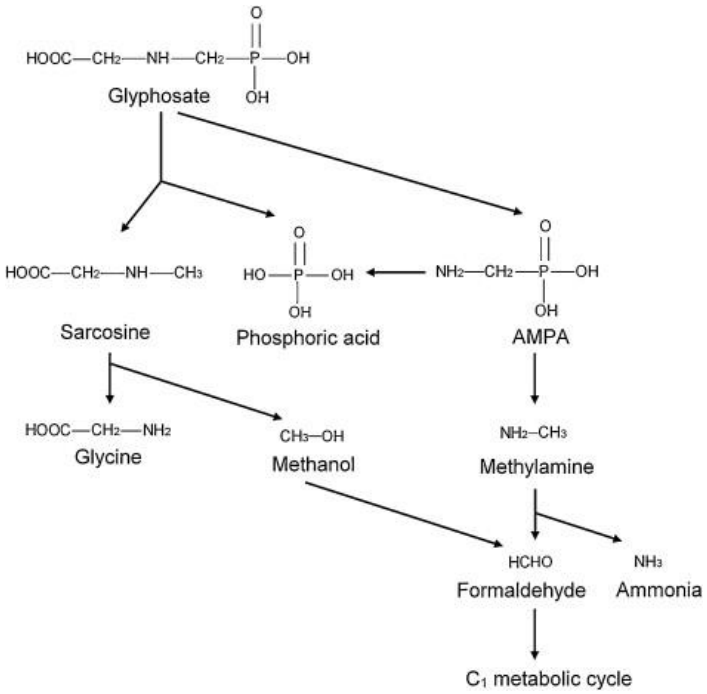
aka PEP

Shikimic acid pathway

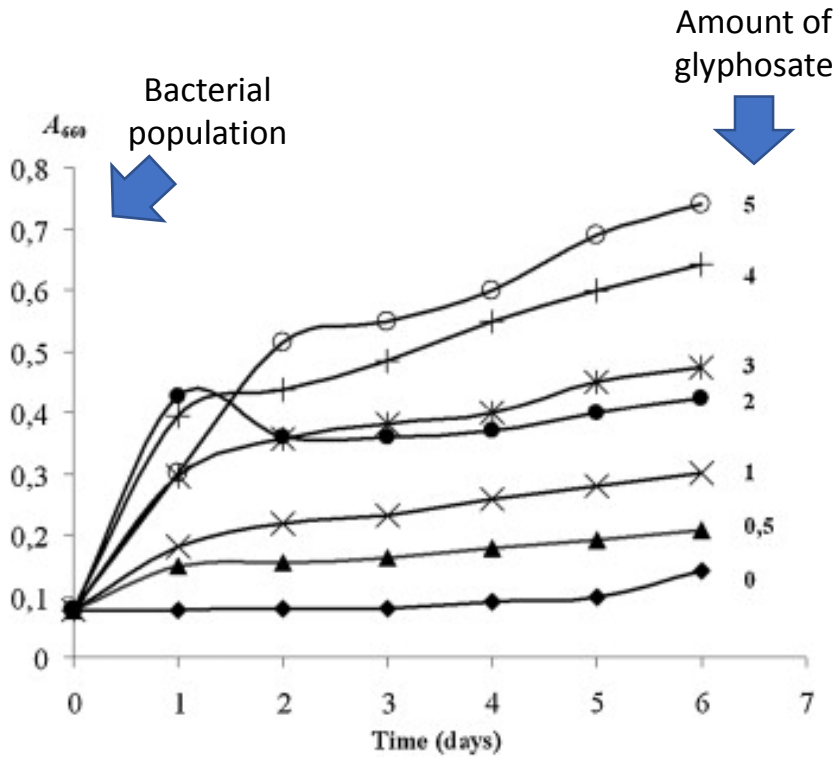


- Glyphosate binds and prevents EPSP synthase from working
- When EPSP synthase isn't working many of the plant molecules are prevented from being made and the plant dies.

Glyphosate promotes bacterial growth too



Pathways for the bacterial degradation of glyphosate.



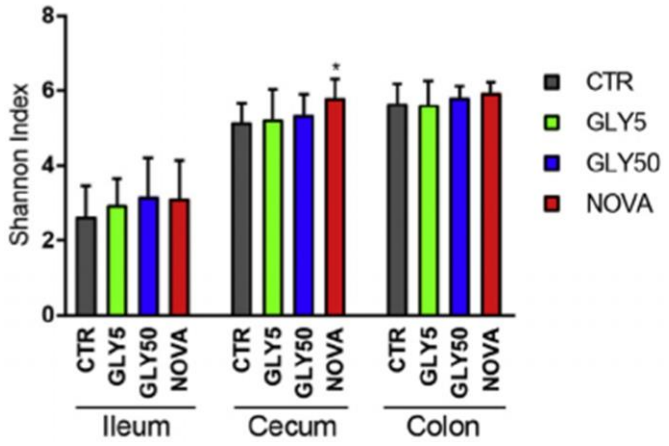
E. cloacae strain, K7 growth on phosphorus deficient media

In the lab:

- Research shows glyphosate:
  - slows growth and kills bacteria
  - feeds bacteria and promotes growth

In living animals:

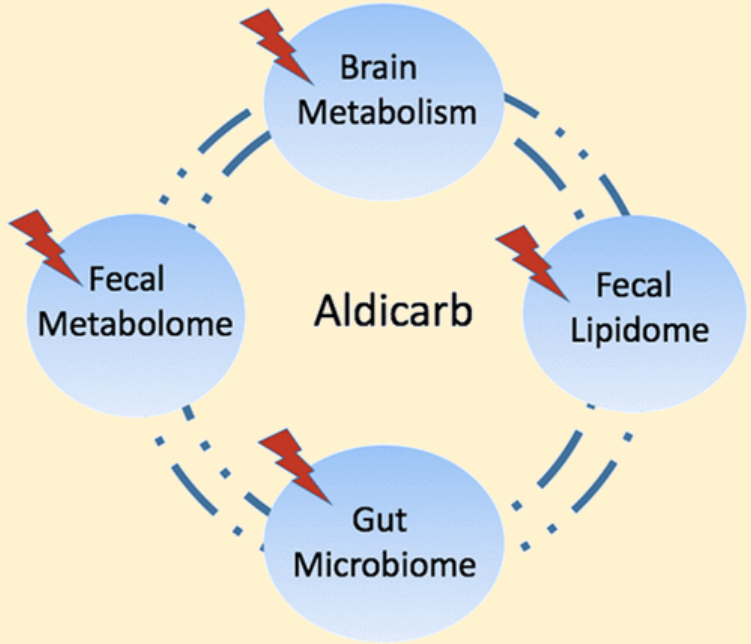
- Research shows glyphosate:
  - does not affect gut bacteria populations in test animals.



Nielsen et al. 2018

Aldicarb induced gut change

- Recent report showing significant change in gut microbiome of mice from aldicarb.
- Changes in microbiome lead to other changes.



The Carbamate Aldicarb Altered the Gut Microbiome, Metabolome, and Lipidome of C57BL/6J Mice.

Bei Gao, Liang Chi, Pengcheng Tu, Nan Gao, and Kun Lu; *Chem. Res. Toxicol.*, 2019, *32* (1), pp 67–79; DOI: 10.1021/acs.chemrestox.8b00179

Gut bacteria are a part of our health.

Yes, however we are only now learning which species of bacteria are important.

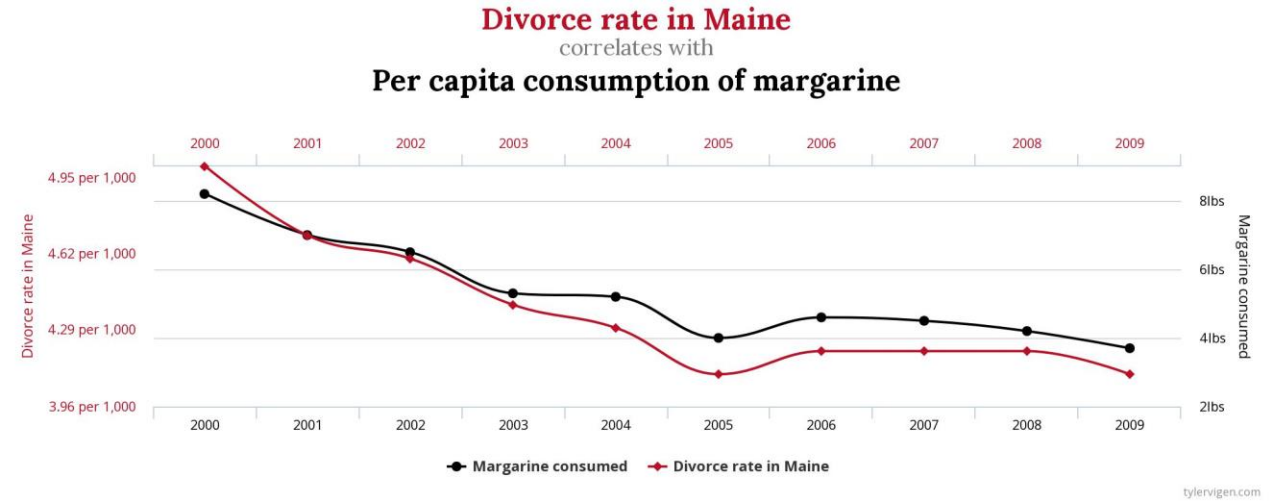
Glyphosate shares a mechanism of action with plants and bacteria.

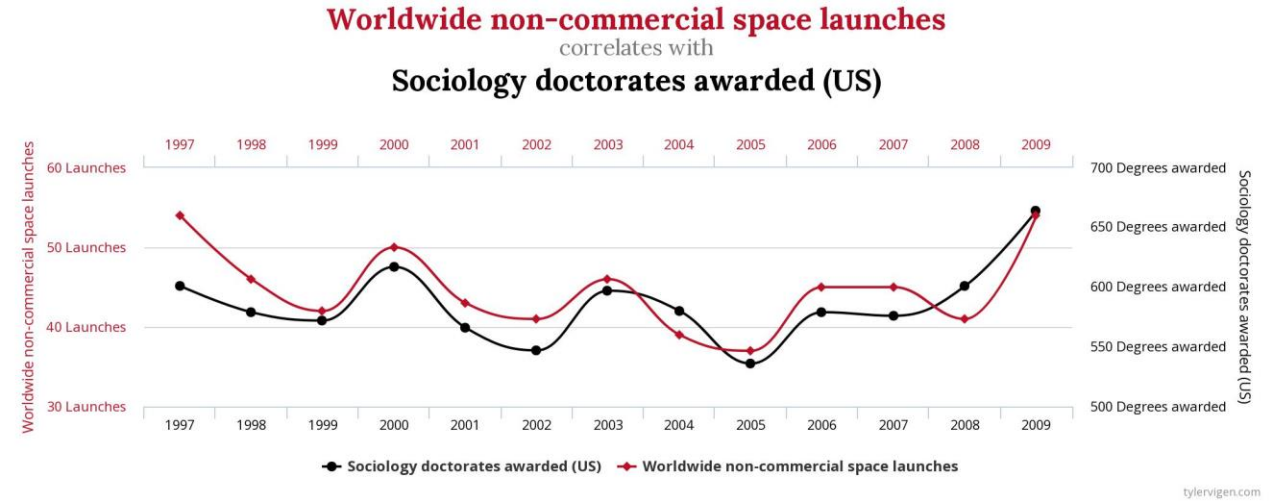
Yes, however only under some circumstances glyphosate can affect bacterial survival.

Glyphosate will affect our health.

Still not proven because we first need to establish which bacteria are affected and under what circumstances. Currently, the evidence suggests no effect to our gut health because of the concentration.

Correlation is not causation.





http://www.tylervigen.com/spurious-correlations

-disclaimer-

The pesticides you use daily are toxic.

The only group of individuals that I feel are at true risk from pesticides are those in contact with them every day.

An ounce of prevention is worth a pound of cure (and piece of mind).

If you get drenched in any pesticide please shower and change your clothes.

Pesticides are not meant to be on your skin.

JNCI J Natl Cancer Inst (2018) 110(5): djx233

doi: 10.1093/jnci/djx233
First published online November 9, 2017
Article

Downloaded from https://academic.oup.com/jnci/article-abstract/110/5/509/4590280 by Maine Department of Public Health user on 26 September 2(

ARTICLE

Glyphosate Use and Cancer Incidence in the Agricultural Health Study

Gabriella Andreotti, Stella Koutros, Jonathan N. Hofmann, Dale P. Sandler, Jay H. Lubin, Charles F. Lynch, Catherine C. Lerro, Anneclaire J. De Roos, Christine G. Parks, Michael C. Alavanja, Debra T. Silverman, Laura E. Beane Freeman

Affiliations of authors: Occupational and Environmental Epidemiology Branch (GA, SK, JNH, CCL, DTS, LEBF), Biostatistics Branch (JHL), and Formerly of Occupational and Environmental Epidemiology Branch (MCA), Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Bethesda, MD; Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, Research Triangle Park, NC (DPS, CGP); Department of Epidemiology, University of Iowa, Iowa City, IA (CFL); State Health Registry of Iowa, Iowa City, IA (CFL); Department of Environmental and Occupational Health, Drexel University Dornsife School of Public Health, Philadelphia, PA (AJDR)

Correspondence to: Laura Beane Freeman, PhD, 9609 Medical Center Drive, Rm 6E136, MSC 9771, Bethesda, MD 20892 (e-mail: freemala@mail.nih.gov).

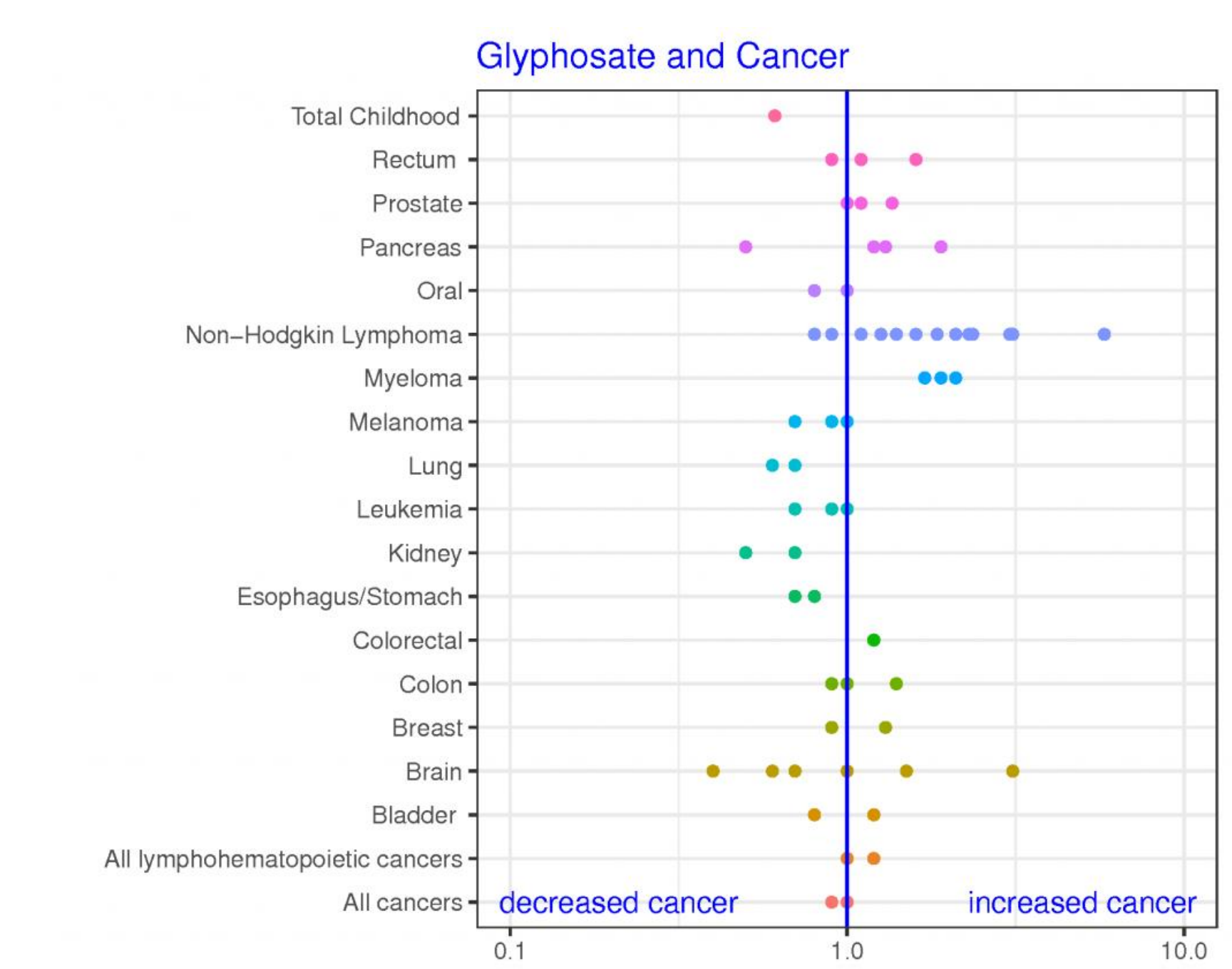
Abstract

Background: Glyphosate is the most commonly used herbicide worldwide, with both residential and agricultural uses. In 2015, the International Agency for Research on Cancer classified glyphosate as "probably carcinogenic to humans," noting strong mechanistic evidence and positive associations for non-Hodgkin lymphoma (NHL) in some epidemiologic studies. A previous evaluation in the Agricultural Health Study (AHS) with follow-up through 2001 found no statistically significant associations with glyphosate use and cancer at any site.

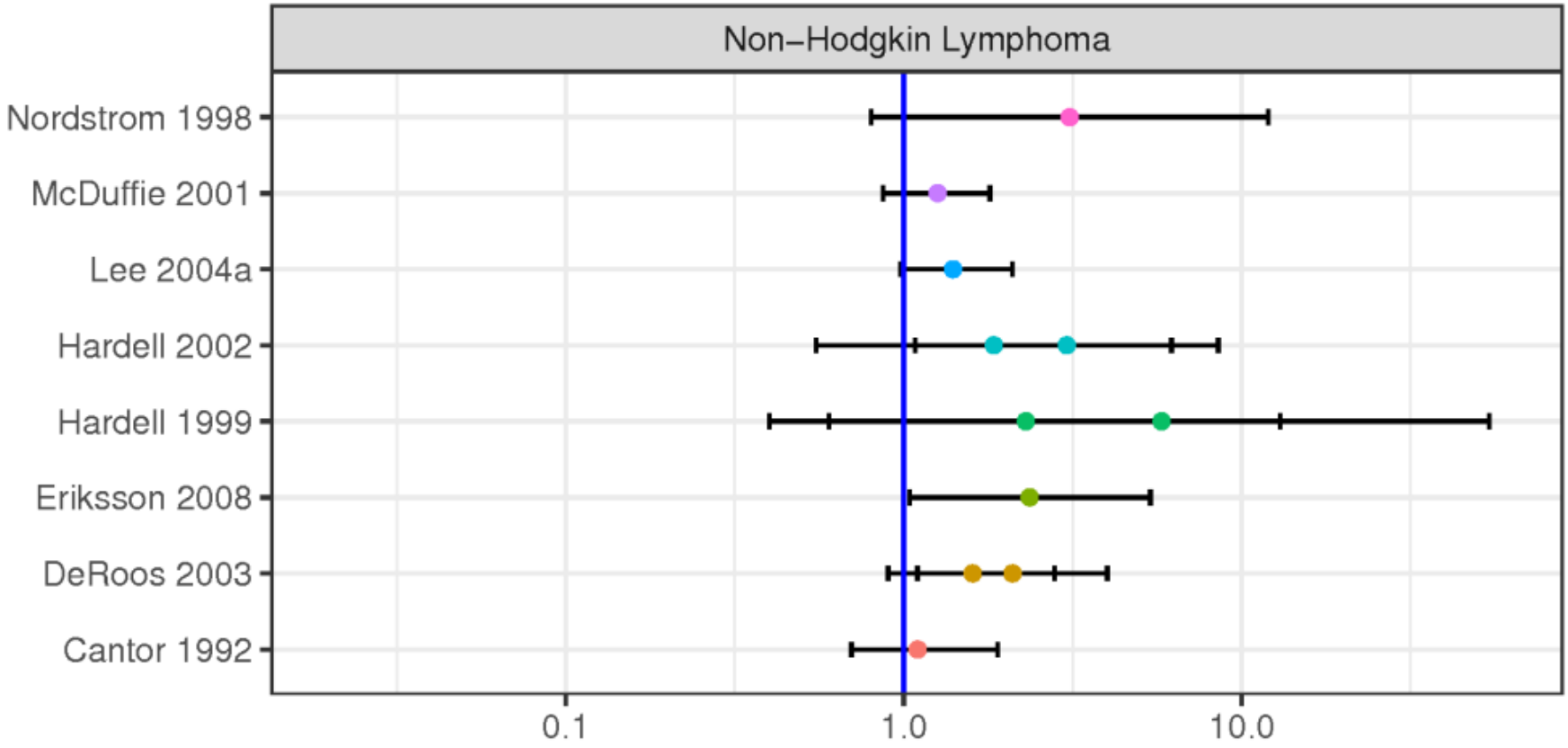
Methods: The AHS is a prospective cohort of licensed pesticide applicators from North Carolina and Iowa. Here, we updated the previous evaluation of glyphosate with cancer incidence from registry linkages through 2012 (North Carolina)/2013 (Iowa). Lifetime days and intensity-weighted lifetime days of glyphosate use were based on self-reported information from enrollment (1993–1997) and follow-up questionnaires (1999–2005). We estimated incidence rate ratios (RRs) and 95% confidence intervals (CIs) using Poisson regression, controlling for potential confounders, including use of other pesticides. All statistical tests were two-sided.

Results: Among 54 251 applicators, 44 932 (82.8%) used glyphosate, including 5779 incident cancer cases (79.3% of all cases). In unlagged analyses, glyphosate was not statistically significantly associated with cancer at any site. However, among applicators in the highest exposure quartile, there was an increased risk of acute myeloid leukemia (AML) compared with never users (RR = 2.44, 95% CI = 0.94 to 6.32, P_{trend} = .11), though this association was not statistically significant. Results for AML were similar with a five-year ($RR_{Quartile\ 4}$ = 2.32, 95% CI = 0.98 to 5.51, P_{trend} = .07) and 20-year exposure lag ($RR_{Tertile\ 3}$ = 2.04, 95% CI = 1.05 to 3.97, P_{trend} = .04).

Conclusions: In this large, prospective cohort study, no association was apparent between glyphosate and any solid tumors or lymphoid malignancies overall, including NHL and its subtypes. There was some evidence of increased risk of AML among the highest exposed group that requires confirmation.



https://plantoutofplace.com/wp-content/uploads/2018/08/AllCancer_Allcites-1-1024x853.png



https://plantoutofplace.com/wp-content/uploads/2018/08/NHL_casecontrol-1024x512.png

So why then is glyphosate considered to cause cancer?

2015 IARC placed glyphosate into their Group 2A category.

US EPA, EU, Japan, Australia, New Zealand, Canada, WHO, and many other governments do not classify glyphosate as carcinogenic to humans.

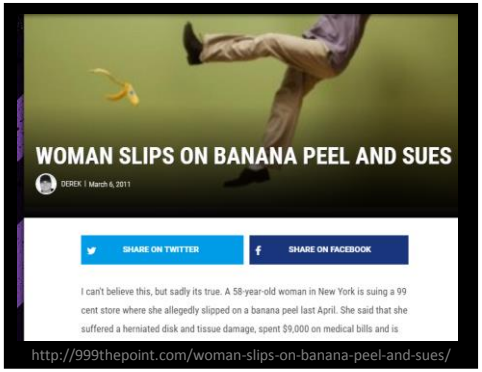
Hazard vs Risk

https://www.compoundchem.com/2015/10/26/carcinogens/

Hazard vs Risk

Banana *vs* vehicle hazard

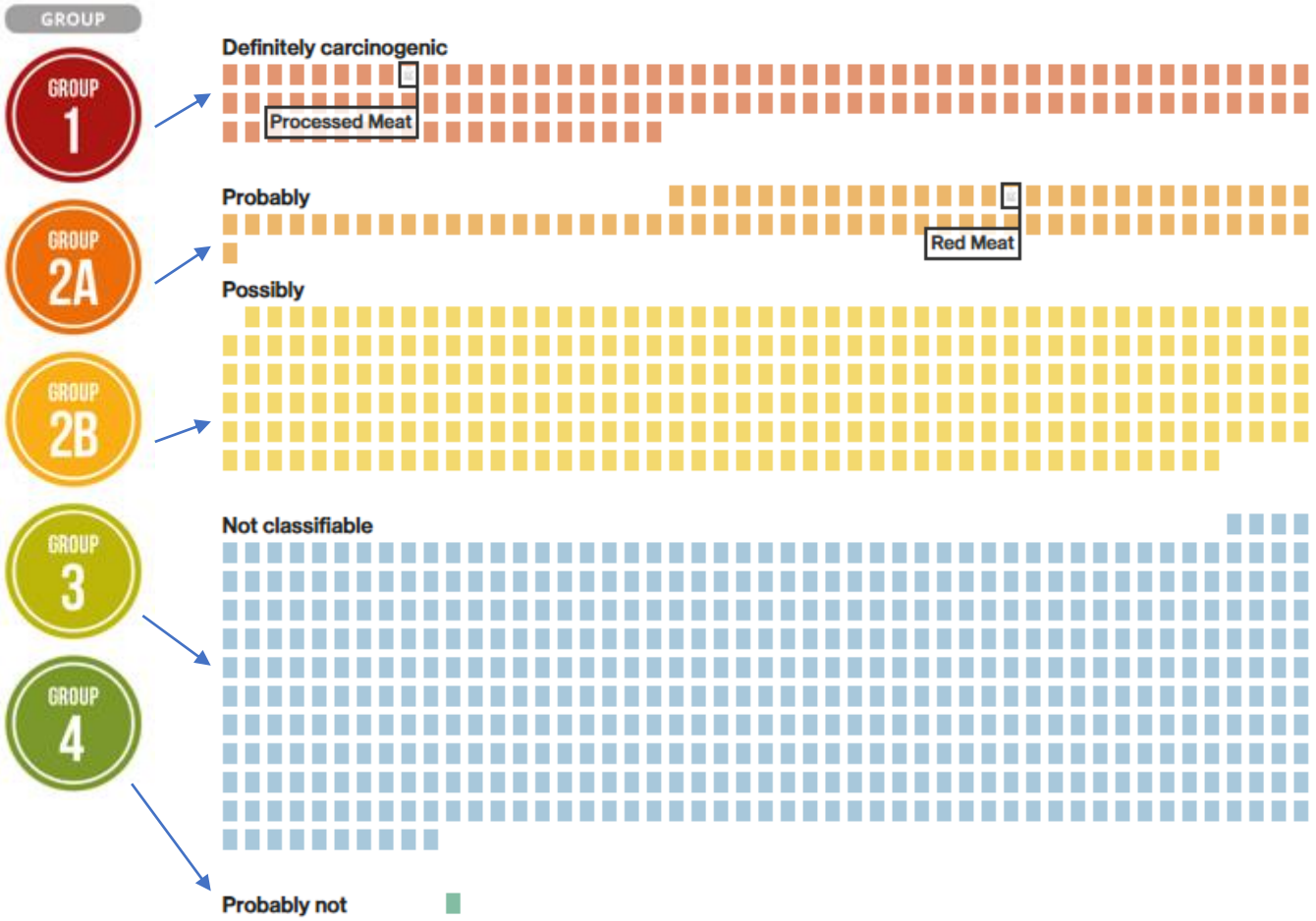
- Both can cause accidents
- Both pose a hazard



Banana *vs* vehicle risk

- Automobile is more risky because you are much more likely to be in a automobile crash than a banana accident.
- Banana accidents pose less risk.

Sum of IARC's cancer determinations grouped by category



https://www.bloomberg.com/graphics/2015-red-meat-cancer/

“Safety” of glyphosate

- No pesticide is without risk
- Safe is not a word we use

Question: Is it safe?

If you answer:	**The client may think:**
"It's so safe you can drink it."	No precautions are necessary.
"It's safe, trust me."	I don't need to do anything.
"It's non-toxic, all natural."	Natural products can't hurt me.

DIY glyphosate?

The recipe is nearly always a subtle modification of:

- **½ gallon of vinegar**
- **½ cup of salt**
- **2 tablespoons of dish soap**

For example, sodium chloride, one of the ingredients in the homemade herbicide solution, is **mutagenic for mammalian somatic cells and bacteria**. Another ingredient, acetic acid, is **highly corrosive**, can **aggravate respiratory disorders**, and even **cause permanent vision loss**. Does this sound like something you want to be spraying in the same yard where your children and pets play? Should you be dousing your yard with a potent chemical cocktail that causes mutations in humans and causes blindness? And now we learn that this chemical cocktail is nearly 10 times more lethal to mammals than glyphosate, one of the most potent weed killers on the planet!

Acute toxicity test	Glyphosate	Acetic Acid	Salt
	(mg/kg)	(mg/kg)	(mg/kg)
Rat oral LD_{50}	5,600	3,350	3,000
Rabbit dermal LD_{50}	>2,000	1,060	>10,000

One gallon of mixed glyphosate solution contains 31,752 mg glyphosate, or enough to **kill 6 rats**.

One gallon of the homemade mixture contains 198,200 mg of acetic acid, or approximately enough to **kill 59 rats**, if administered orally. And this doesn't include the salt.

http://fafdl.org/gmobb/salt-vinegar-and-glyphosate/

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Environmental sampling results for waterbodies

Table 13. Summary of Surface Water Monitoring Data for Glyphosate and AMPA (Data extracted from USGS, CADPR on 1/4/2014).

Monitoring Program	Watershed Land Use	Analyte	N	Detection Frequency (%)	Maximum Concentration (µg/L)		Station ID	State
					Daily Peak	Arithmetic Annual Average		
USGS NAWQA	All Land Uses	glyphosate	1903	61	73	4.03	7288650	MS
		AMPA	1903	81	28	4.25	7288650	MS
	Ag	Glyphosate	574	61	73	4.03	7288650	MS
		AMPA	574	61	28	4.25	7288650	MS
	Mixed	glyphosate	677	61	3.08	0.71	5331580	MN
		AMPA	677	88	4.43	1.39	11303500	CA
	Urban	glyphosate	351	54	5.9	0.86	40869415	WI
		AMPA	351	73	3.51	1.53	6713500	CO
	Other	glyphosate	301	72	38	4.95	3.3315E14	MS
		AMPA	301	88	9.74	2.65	3.3315E14	MS
CADPR	Not Specified	Glyphosate	1908	4	200	112.5	03_2 (100)	CA
		AMPA	183	8	4.43	0.54	39 17(103)	CA

Environmental sampling results for waterbodies

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	Ag	Glyphosate	574	61	73	4.03	7288650	MS
		AMPA	574	61	28	4.25	7288650	MS
	Mixed	glyphosate	677	61	3.08	0.71	5331580	MN
		AMPA	677	88	4.43	1.39	11303500	CA
	Urban	glyphosate	351	54	5.9	0.86	40869415	WI
		AMPA	351	73	3.51	1.53	6713500	CO
	Other	glyphosate	301	72	38	4.95	3.3315E14	MS
		AMPA	301	88	9.74	2.65	3.3315E14	MS
CADPR	Not Specified	Glyphosate	1908	4	200	112.5	03_2 (100)	CA
		AMPA	183	8	4.43	0.54	39 17(103)	CA

RQ > 1 presents increasing risk to organisms

Under most spray scenarios no predicted harm to mammals of any size

Table 39. Chronic Mammalian Dose-Based RQs for Foliar Application of Glyphosate

Food Item	Rangeland	Roundup ready-aerial, max combined annual	Roundup ready-aerial max rate/crop cycle	Most Crops-aerial max rate/crop cycle	Most crops-aerial max combined annual	Roundup ready ground max rate/crop cycle	Sugar cane-aerial max crop & annual	Tree crops-aerial max combined annual	Roundup ready ground max combined annual	Most crops-ground max crop & annual	Food tree, vine, berry, small fruit ground max combined annual	Forestry, pastures, non-crop	Spot Treatment
15 g Mammal													
Short Grass	0.27	0.68	0.62	0.84	0.90	0.96	**1.02**	**1.03**	**1.11**	**1.21**	**1.60**	**2.04**	**10.2**
Tall Grass	0.12	0.31	0.28	0.38	0.41	0.44	0.47	0.47	0.51	0.56	0.73	0.94	**4.68**
Broadleaf plants	0.15	0.38	0.35	0.47	0.51	0.54	0.57	0.58	0.63	0.68	0.90	**1.15**	**5.74**
Fruits/pods	0.02	0.04	0.04	0.05	0.06	0.06	0.06	0.06	0.07	0.08	0.10	0.13	0.64
Arthropods	0.10	0.27	0.24	0.33	0.35	0.37	0.40	0.40	0.44	0.48	0.62	0.80	**4.00**
Seeds	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.14
35 g Mammal													
Short Grass	0.23	0.58	0.53	0.71	0.77	0.82	0.87	0.88	0.95	**1.04**	**1.36**	**1.74**	**8.72**
Tall Grass	0.10	0.27	0.24	0.33	0.35	0.37	0.40	0.40	0.44	0.47	0.62	0.80	**4.00**
Broadleaf plants	0.13	0.33	0.30	0.40	0.43	0.46	0.49	$0_{.50}$	0.53	0.58	0.77	0.98	**4.90**
Fruits/pods	0.01	0.04	0.03	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.09	0.11	0.54
Arthropods	0.09	0.23	0.21	0.28	0.30	0.32	0.34	0.35	0.37	0.41	0.53	0.68	**3.41**
Seeds	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.12
1000 g Mammal													
Short Grass	0.12	0.31	0.28	0.38	0.41	0.44	0.47	0.47	0.51	0.56	0.73	0.93	**4.67**
Tall Grass	0.06	0.14	0.13	0.18	0.19	0.20	0.21	0.22	0.23	0.25	0.33	0.43	**2.14**
Broadleaf plants	0.07	0.18	0.16	0.22	0.23	0.25	0.26	0.27	0.29	0.31	0.41	0.53	**2.63**
Fruits/pods	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.06	0.29
Arthropods	0.05	0.12	0.11	0.15	0.16	0.17	0.18	0.19	0.20	0.22	0.29	0.37	**1.83**
Seeds	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06

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Table 39. Chronic Mammalian Dose-Based RQs for Foliar Application of Glyphosate

Food Item	Rangeland	Roundup ready-aerial, max combined annual	Roundup ready-aerial max rate/crop cycle	Most Crops-aerial max rate/crop cycle	Most crops-aerial max combined annual	Roundup ready ground max rate/crop cycle	Sugar cane-aerial max crop & annual	Tree crops-aerial max combined annual	Roundup ready ground max combined annual	Most crops-ground max crop & annual	Food tree, vine, berry, small fruit ground max combined annual	Forestry, pastures, non-crop	Spot Treatment
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Short Grass	0.27	0.68	0.62	0.84	0.90	0.96	**1.02**	**1.03**	**1.11**	**1.21**	**1.60**	**2.04**	**10.2**
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Broadleaf plants	0.15	0.38	0.35	0.47	0.51	0.54	0.57	0.58	0.63	0.68	0.90	**1.15**	**5.74**
Fruits/pods	0.02	0.04	0.04	0.05	0.06	0.06	0.06	0.06	0.07	0.08	0.10	0.13	0.64
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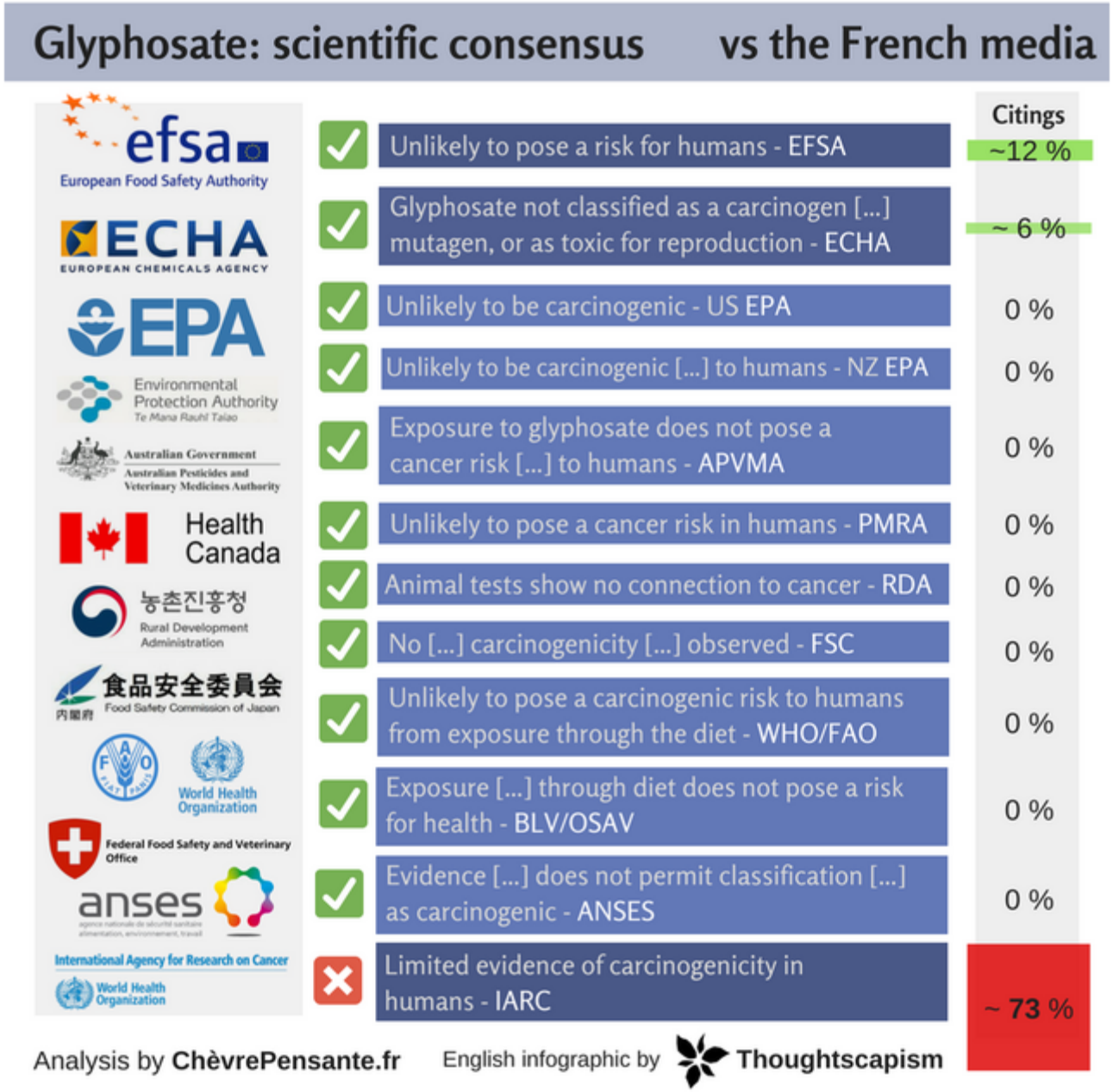
Seeds	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06

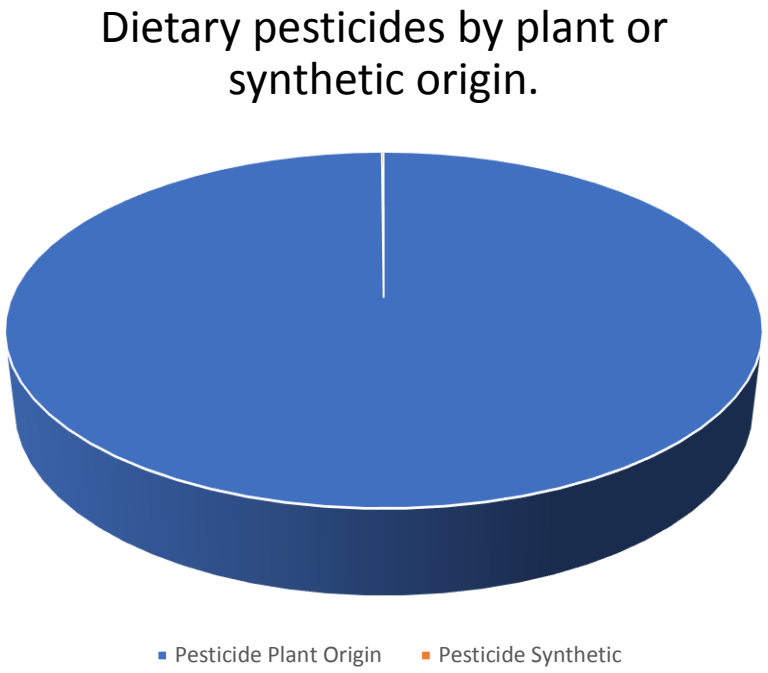
Includes Right-of-way



https://thoughtscapism.com/2016/09/07/does-glyphosate-cause-cancer/

And coffee contains pesticides?

- 99.9% of all pesticides are naturally occurring in the foods we eat[10]
  - Plants are in the business of protecting their tissues
- Only a small number of naturally occurring pesticides have been tested; roughly 50% were mutagenic.



Our diet includes roughly 1,500 mg
of naturally occurring pesticides daily.

… how do we not die?

Our diet includes roughly 1,500 mg
of naturally occurring pesticides daily.

… how do we not die?

Figure 3. Phase I and II Liver Detoxification