By Email

DATE: 16 July 2021
TO: Health Canada Pest Management Regulatory Agency
FROM: Denis G. Rancourt, PhD
Researcher, Ontario Civil Liberties Association (ocla.ca)

RE: Response to HC-PMRA invitation to submit written comments
Proposed Maximum Residue Limit - PMRL2021-10 - Glyphosate - 6 May 2021

Glyphosate should be Banned, Not Increased

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Qualifications to make these comments

I am qualified to make these comments because I am a research scientist having published more than 100 articles in leading peer-reviewed scientific journals. I was the

lead scientist in a large NSERC Strategic Project Grant project (2000-2005) that studied toxic metals and sediment-biogeochemistry in the sediments of 100 boreal forest lakes. My articles about soil, aquatic sediments, and nutrient and metal cycling have been cited hundreds of times by scientists, as per my Google Scholar profile: https://scholar.google.ca/citations?hl=en&pli=1&user=1ChsRsQAAAAJ

I have been actively reviewing the scientific literature on glyphosate and its health impacts, since 2018.

Proposed Maximum Residue Limit - PMRL2021-10 - Glyphosate - 6 May 2021

Your document "Proposed Maximum Residue Limit - PMRL2021-10 - Glyphosate - 6 May 2021" (PMRL2021-10), is the subject of my present comments.

Your Agency is petitioning to increase Maximum Residual Limits (MRLs) for Glyphosate and its metabolite-product AMPA more than two-fold (doubled) for oats, Bran, lentils and peas, and almost four-fold (quadrupled) for the 25 types of beans considered.

In PMRL2021-10, you have also removed "flour" as an explicitly controlled food commodity, "as it is covered by the MRLs in/on the respective raw agricultural commodities (RACs) of oats, barley and wheat". For wheat flour, therefore, in-effect this means that you are increasing the MRL from 5 ppm to 15 ppm (tripling), and that the flour itself will become less likely to be tested for food safety, since it loses its status as a regulated food commodity. The processed commodity "flour" will no longer be MRL-regulated.

Asserted absence of a human-health concern, without giving any justification

In Appendix I of PMRL2021-10, you state

> "Following the review of all available data, MRLs as proposed in Table 1 are recommended to cover residues of glyphosate and AMPA (expressed in parent equivalents). **Residues of glyphosate and AMPA in these imported crop commodities at the proposed MRLs will not pose an unacceptable risk to any segment of the**

> **population, including infants, children, adults and seniors.**" [my emphasis]

Nowhere in PMRL2021-10 (including its appendix) do you enumerate or describe the "all available data" to which you refer. Nowhere is there any mention of or reference to any scientific information about human health.

Your Appendix I contains the only data provided to support your petition: "A summary of the field trial data used to support the proposed MRLs can be found in Appendix I." The only data in your Appendix I corresponds to measured residues of glyphosate and its derivative "AMPA" in select batches of food commodities provided by exporting countries:

> "**Table A1 summarizes the residue data used to calculate the proposed MRLs** for imported dry peas, dry beans and tree nuts from crop group 14-11." [my emphasis]

In other words, you state that the proposed MRLs *are calculated from* "field trial residues".

You are determining proposed MRLs from field trial residue amounts in current legally-prescribed practice; not from any named or disclosed

- health-risk,
- toxicity,
- disease-association,
- generational toxicology,
- chronic ultra-low dose exposure, or
- epidemiological

studies or data.

This is surprising, because there is a large and growing scientific literature, including in the world's leading scientific journals, regarding such studies for glyphosate (see below).

PMRL2021-10 method to calculate MRLs is contrary to stated Health Canada policy

Your approach of calculating MRLs from measured field trial residues, rather than primarily from a thorough health-risk assessment, is incompatible with the public position expressed by Health Canada, as recently as 28 August 2020:

> **"Glyphosate and food**
>
> **Health Canada scientists conduct a thorough risk assessment to confirm that eating foods treated with a pesticide would not result in any human health concern to any segment of the population, including pregnant women, infants, children and seniors. These scientists then establish Maximum Residue Limits (MRLs)**, which is the legal maximum allowable amount of pesticide residues that may remain in or on foods." [my emphasis]
>
> **Health Canada (28 August 2020) "Glyphosate in Canada", https://www.canada.ca/en/health-canada/services/consumer-product-safety/reports-publications/pesticides-pest-management/fact-sheets-other-resources/glyphosate.html (accessed 11 July 2021)**

Health Canada never develops concerns about health risks from glyphosate

Unfortunately, it seems that the "thorough risk assessment to confirm that eating foods treated with a pesticide would not result in any human health concern" (Health Canada, 28 August 2020) has consistently led to the same conclusion, irrespective of the scientific literature. This is illustrated by the following examples.

On 28 April 2017:

> "Health Canada has published the final re-evaluation decision on glyphosate. Following a rigorous science-based assessment, Health Canada has determined that when used according to the label, products containing glyphosate are not a concern to human health and the environment."
>
> **Health Canada (28 April 2017) "Statement from Health Canada – Final Re-evaluation Decision on Glyphosate", https://www.canada.ca/en/health-canada/news/2017/04/statement_from_healthcanadafinalre-evaluationdecisiononglyphosat.html (accessed 11 July 2021)**

On 11 January 2019:

> "Following the release of the Department's final re-evaluation decision on glyphosate in 2017, Health Canada received eight notices of objection. There have also been concerns raised publicly about the validity of some of the science around glyphosate in what is being referred to as the Monsanto Papers.
>
> Health Canada scientists reviewed the information provided in these notices, and assessed the validity of any studies in question, to determine whether any of the issues raised would influence the results of the assessment and the associated regulatory decision.
>
> **After a thorough scientific review, we have concluded that the concerns raised by the objectors could not be scientifically supported when considering the entire body of relevant data. The objections raised did not create doubt or concern regarding the scientific basis for the 2017 re-evaluation decision for glyphosate. Therefore, the Department's final decision will stand.**
>
> Health Canada follows a transparent and rigorous science-based regulatory process when making decisions about the safety of pesticides. As part of this process, Health Canada will publish its response to each notice of objection in the Pest Management Regulatory Agency's Public Registry on January 14.

> Our scientists left no stone unturned in conducting this review. They had access to all relevant data and information from federal and provincial governments, international regulatory agencies, published scientific reports and multiple pesticide manufacturers. **This includes the reviews referred to in the Monsanto Papers.** Health Canada also had access to numerous individual studies and raw scientific data during its assessment of glyphosate, including additional cancer and genotoxicity studies. To help ensure an unbiased assessment of the information, Health Canada selected a group of 20 of its own scientists who were not involved in the 2017 re-evaluation to evaluate the notices of objection." [my emphasis]
>
> **Health Canada (11 January 2019) "Statement from Health Canada on Glyphosate", https://www.canada.ca/en/health-canada/news/2019/01/statement-from-health-canada-on-glyphosate.html (accessed on 11 July 2021)**

A search of the Canadian Food Inspection Agency's database (https://inspection.canada.ca/food-safety-for-industry/food-chemistry-and-microbiology/food-safety-testing-bulletin-and-reports/eng/1453324778043/1453327843364) entitled "Food safety testing bulletin and reports", using the term "glyphosate", produces only two food safety reports, as follows.

From the food safety report published on 11 April 2017:

> "When residues of glyphosate were detected in foods, the results were compared to the MRLs set by Health Canada. If the level found in a food sample was higher than the MRL, the information was reviewed and the appropriate follow up was taken, this may have included notifying the manufacturer or importer, requesting corrective action, conducting further directed sampling, or product recall. […]
>
> **Summary**
>
> In 2015-2016, the CFIA tested a total of 3,188 food samples for glyphosate. Glyphosate was found in 29.7% of samples. Glyphosate residues above MRLs were found in only 1.3% of

samples. This data was evaluated by Health Canada and no human health concerns were identified."

CFIA - Science Branch (11 April 2017) "Safeguarding with Science: Glyphosate Testing in 2015-2016", https://inspection.canada.ca/DAM/DAM-food-aliments/STAGING/text-texte/chem_testing_report_2015-2016_glyphosate_srvy_rprt_1491855525292_eng.pdf

From the food safety report published as a scientific article on 8 July 2020:

ABSTRACT

[…] Health Canada determined that there was no long-term health risk to Canadian consumers from exposure to the levels of glyphosate found in the samples of a variety of foods surveyed. […]

INTRODUCTION

[…] The human health effects have been evaluated by Health Canada (HC), the European Food Safety Authority (EFSA),(20) the U.S. Environmental Protection Agency (EPA),(21) and the Joint Meeting of the Food and Agriculture Organization of the United Nations Committee (FAO) Panel of Experts on Pesticide Residues in Food and the Environment and the World Health Organization (WHO) Core Assessment Group on Pesticide Residues (JMPR).(22) **Glyphosate is safe because neither glyphosate nor its primary degradation product, aminomethylphosphonic acid (AMPA), is associated with any known human health effects.** […] [my emphasis]

"Analysis of Glyphosate Residues in Foods from the Canadian Retail Markets between 2015 and 2017". Beata M. Kolakowski, Leigh Miller, Angela Murray, Andrea Leclair, Henri Bietlot, and Jeffrey M. van de Riet. *Journal of Agricultural and Food Chemistry* 2020 68 (18), 5201-5211. DOI: 10.1021/acs.jafc.9b07819 - https://pubs.acs.org/doi/full/10.1021/acs.jafc.9b07819

Health Canada pronouncements about glyphosate safety are contrary to science

The above and many such Health Canada statements about a complete absence of health concerns related to glyphosate are contrary to current leading expert scientific opinion, and contrary to the most recent leading scientific studies, as described below.

For example, Robin Mesnage (https://scholar.google.ca/citations?hl=en&user=sPASFLAAAAAJ) and MN Antoniou summarized the situation this way in 2017:

> "Although it has long been asserted by both industry and regulatory agencies that glyphosate is safe even at relatively high daily intake levels (for example, 1.75 mg/kg bw/day in the US), major gaps in its evaluation have been identified and need to be addressed in order to definitely conclude on its safety (9, 10). For example, **glyphosate has never been tested alone at its acceptable daily intake or at doses relevant for human exposures. Only recently have studies been published that reveal kidney and especially liver structure and functional damage in rats following chronic ingestion of an ultra-low, environmentally relevant dose of a glyphosate-based herbicide** (Roundup) (37, 38). In addition, **major endpoints of toxicity, such as developmental, reproductive, transgenerational, and even chronic effects in adults still need to be investigated under controlled laboratory animal conditions, at environmentally relevant doses**, using feed and water free from incidental glyphosate contamination." [my emphasis]
>
> **Mesnage R and Antoniou MN (2017) "Facts and Fallacies in the Debate on Glyphosate Toxicity". *Frontiers in Public Health* 5:316. doi: 10.3389/fpubh.2017.00316 - https://www.frontiersin.org/articles/10.3389/fpubh.2017.00316/full**

Proven toxicity from prolonged exposure below regulatory residue limits

Indeed, Health Canada has in-effect ignored the large body of scientific studies, published prior to, up to, and after 2017, which establishes that glyphosate-based herbicides can be toxic below regulatory residue limits.

For example:

> (2015) "Glyphosate-based herbicides (GlyBH), including Roundup, are the most widely used pesticides worldwide. […] We reveal a coherent body of evidence indicating that GlyBH could be toxic below the regulatory lowest observed adverse effect level for chronic toxic effects. It includes teratogenic, tumorigenic and hepatorenal effects. […] Toxic effects of commercial formulations can also be explained by GlyBH adjuvants, which have their own toxicity, but also enhance glyphosate toxicity. […] Neurodevelopmental, reproductive, and transgenerational effects of GlyBH must be revisited, since a growing body of knowledge suggests the predominance of endocrine disrupting mechanisms caused by environmentally relevant levels of exposure."
>
> **(cited >300 times) Mesnage, R., Defarge, N., Spiroux de Vendômois, J., & Séralini, G. E. (2015). "Potential toxic effects of glyphosate and its commercial formulations below regulatory limits".** ***Food and chemical toxicology : an international journal published for the British Industrial Biological Research Association*****, 84, 133-53. https://doi.org/10.1016/j.fct.2015.08.012 - https://kclpure.kcl.ac.uk/portal/en/publications/potential-toxic-effects-of-glyphosate-and-its-commercial-formulations-below-regulatory-limits(e185bac2-4db2-4568-b1d2-f258ed2fe7f3).html**

Here, the observation that "toxic effects of commercial formulations can also be explained by glyphosate-based herbicide adjuvants, which have their own toxicity, but also enhance glyphosate toxicity" is important, and suggests that Health Canada may need to examine commercial formulations rather than rely solely on regulating glyphosate itself and its transformation products.

A most-recent (pre-print) study in this regard found:

(2021) "[…] We thus performed the first in-depth comparative toxicogenomic evaluation of glyphosate and a typical European Union Roundup formulation by determining alterations in transcriptome and epigenome profiles. […]
[…] DNA methylation profiling of liver revealed 5,727 and 4,496 differentially methylated CpG sites between the control group and the group of rats exposed to glyphosate and MON 52276 [Roundup], respectively. Direct DNA damage measurement by apurinic/apyrimidinic lesion formation in liver was increased with glyphosate exposure. Mechanistic evaluations showed that two Roundup herbicides but not glyphosate activated oxidative stress and misfolded protein responses.
Conclusions: **Taken together, the results of our study show that Roundup herbicides are more toxic than glyphosate, activating mechanisms involved in cellular carcinogenesis and causing gene expression changes reflecting DNA damage.** […]" [my emphasis]

"In-depth comparative toxicogenomics of glyphosate and Roundup herbicides: histopathology, transcriptome and epigenome signatures, and DNA damage". Robin Mesnage, Mariam Ibragim, Daniele Mandrioli, Laura Falcioni, Fiorella Belpoggi, Inger Brandsma, Emma Bourne, Emanuel Savage, Charles A Mein, Michael N Antoniou. bioRxiv 2021.04.12.439463; doi: https://doi.org/10.1101/2021.04.12.439463

More examples, regarding toxicity of glyphosate below regulatory residue limits:

(2015) "Conclusion: **Our results suggest that chronic exposure to a GBH in an established laboratory animal toxicity model system at an ultra-low, environmental dose can result in liver and kidney damage with potential significant health implications for animal and human populations.**"

(cited >100 times) Mesnage R, Arno M, Costanzo M, Malatesta M, Séralini GE, Antoniou MN. "Transcriptome profile analysis reflects rat liver and kidney damage following chronic ultra-low dose Roundup exposure". *Environ Health.* 2015 Aug 25;14:70. doi: 10.1186/s12940-015-0056-1. Erratum in: Environ Health. 2017 Mar 23;16(1):28. PMID: 26302742; PMCID: PMC4549093. - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4549093/

(2017) "Overall, metabolome and proteome disturbances showed a substantial overlap with biomarkers of non-alcoholic fatty liver

> disease and its progression to steatohepatosis and thus confirm liver functional dysfunction resulting from chronic ultra-low dose [glyphosate-based herbicide] exposure."
>
> **(cited >100 times) Mesnage, R., Renney, G., Séralini, GE. et al. "Multiomics reveal non-alcoholic fatty liver disease in rats following chronic exposure to an ultra-low dose of Roundup herbicide". *Scientific Reports* 7, 39328 (2017). https://doi.org/10.1038/srep39328 - https://www.nature.com/articles/srep39328**

This means that recent authoritative and unrefuted published studies prove that chronic disease is caused by prolonged exposure to (ingestion of) environmental glyphosate (sub-regulatory residue levels), in a recognized animal model (rodents). Therefore, the Health Canada statements, reviewed above, on absence of evidence of risk, are contrary to science, and are not tenable without valid counter arguments.

Direct observation in human subjects and human cells

Furthermore, you have in-effect ignored or overlooked the recent breakthrough establishing a human-patient-specific association between non-alcoholic liver disease and glyphosate exposure:

> (2019) "Nonalcoholic fatty liver disease (NAFLD) is currently the most common chronic liver disease in developed countries.1 Patients with nonalcoholic steatohepatitis (NASH) are considered to be at a higher risk of fibrosis progression and development to cirrhosis and hepatocellular carcinoma. […] This study examined excretion levels of glyphosate and its primary metabolite aminomethylphosphonic acid (AMPA) in a well-characterized and prospectively recruited cohort of patients with biopsy-proven NAFLD.
> […] **We report that glyphosate excretion is significantly higher in patients with NASH compared to patents without NASH. In addition, we also report a significant dose-dependent increase of glyphosate exposure with increase in fibrosis stages.**" [my emphasis]
>
> **Mills PJ, Caussy C, Loomba R. "Glyphosate Excretion is Associated With Steatohepatitis and Advanced Liver Fibrosis in Patients With Fatty Liver Disease". *Clin Gastroenterol Hepatol.* 2020 Mar;18(3):741-743. doi: 10.1016/j.cgh.2019.03.045. Epub 2019 Apr 4. PMID: 30954713; PMCID: PMC6776714. - https://pubmed.ncbi.nlm.nih.gov/30954713/**

Such studies on chronically diseased patients are needed for all the (more than 20) diseases that, in epidemiologic studies (see below), have been identified to be strongly associated with glyphosate. Health Canada should be partnering with independent academics to encourage or co-fund these needed studies, rather than continue to claim that there is no risk to the health of Canadians.

Similarly, a recent (2019) laboratory study on human cells demonstrated that exposure to glyphosate "primes cells for oncogenic response in the presence of another potential risk factor" and that this warrants "further investigation of glyphosate-mediated breast cancer risk.

> **"Glyphosate Primes Mammary Cells for Tumorigenesis by Reprogramming the Epigenome in a TET3-Dependent Manner". Duforestel Manon, Nadaradjane Arulraj, Bougras-Cartron Gwenola, Briand Joséphine, Olivier Christophe, Frenel Jean-Sébastien, Vallette François M., Lelièvre Sophie A., Cartron Pierre-François. *Frontiers in Genetics*. (27 September 2019), 10(2019)885.**
> **https://doi.org/10.3389/fgene.2019.00885**

Pathologies induced by glyphosate are transgenerational

You have also in-effect ignored or overlooked the recent research, published in leading journals, which uses an established animal model (rodents) to demonstrate that the pathologies caused by glyphosate exposure are transgenerational, that the conditions are transmitted to future generations.

> (2019) "[…] An increasing number of recent published studies suggest a potential risk of direct glyphosate exposure (refs). Regulatory agencies consider the herbicide to be minimally or not toxic (refs). **The published literature has been focused on the direct exposure of an individual to glyphosate which is the primary current standard for toxicology risk assessment studies. No previous studies have examined the potential transgenerational impacts of glyphosate on successive generations not having continued direct glyphosate exposure.** […] Abstract: […] The current study using a transient exposure of gestating F0 generation female rats found negligible impacts of glyphosate on the directly exposed F0 generation, or F1 generation

> offspring pathology. **In contrast, dramatic increases in pathologies in the F2 generation grand-offspring, and F3 transgenerational great-grand-offspring were observed. The transgenerational pathologies observed include prostate disease, obesity, kidney disease, ovarian disease, and parturition (birth) abnormalities.** Epigenetic analysis of the F1, F2 and F3 generation sperm identified differential DNA methylation regions (DMRs). A number of DMR associated genes were identified and previously shown to be involved in pathologies. Therefore, we propose glyphosate can induce the transgenerational inheritance of disease and germline (e.g. sperm) epimutations. Observations suggest the generational toxicology of glyphosate needs to be considered in the disease etiology of future generations." [my emphasis]
>
> **(cited >80 times) Kubsad, D., Nilsson, E.E., King, S.E. et al. "Assessment of Glyphosate Induced Epigenetic Transgenerational Inheritance of Pathologies and Sperm Epimutations: Generational Toxicology". *Scientific Reports* 9, 6372 (2019). https://doi.org/10.1038/s41598-019-42860-0**

Epidemiology: More than twenty (20) diseases are strongly associated with glyphosate

Health Canada's most glaring blind spot regarding health risks from glyphosate is that you ignore or overlook the strongest available evidence that glyphosate poses a high public-health risk.

The research to which I refer is:

- not classic toxicology, as measured using large exposure events,
- nor is it ultra-low-dose exposure-period studies in animal models,
- nor is it studies of glyphosate excretions from patents rigorously diagnosed with chronic diseases,
- nor is it studies of toxicity or cancer-genesis mechanisms using human cells or animal models, and molecular and genetic characterizations,
- nor is it studies of transgenerational pathologies induced by glyphosate in animal models,

all of which are important, as described above.

No, I now turn to classic epidemiology. That is, the branch of medical science which deals with the incidence, distribution, and possible control of diseases, including known environmental or time varying factors, without limiting itself by insisting that causal mechanisms (at the molecular, cell and organ levels) be identified and demonstrated.

It has been published and broadly cited since 2013 that the incidences and death rates for many chronic diseases are strongly correlated to glyphosate application amounts (tons applied per year to cash crops), in the USA, since the surge of glyphosate use, which started in the mid-1990s. Key reports include the following:

(cited >380 times) "Glyphosate's Suppression of Cytochrome P450 Enzymes and Amino Acid Biosynthesis by the Gut Microbiome: Pathways to Modern Diseases", by A. Samsel and S. Seneff, Entropy, vol. 1, no. 4, April 2013, pages 1416-1463. DOI: 10.3390/e15041416. -
https://www.researchgate.net/publication/236211603_Glyphosate's_Suppression_of_Cytochrome_P450_Enzymes_and_Amino_Acid_Biosynthesis_by_the_Gut_Microbiome_Pathways_to_Modern_Diseases

(cited >230 times) "Glyphosate, pathways to modern diseases II: Celiac sprue and gluten intolerance", by A. Samsel and S. Seneff, Interdisciplinary Toxicology, vol. 6, no. 4, 2013, pages 159-184. DOI: 10.2478/intox-2013-0026. -
https://www.researchgate.net/publication/261189254_Glyphosate_pathways_to_modern_diseases_II_Celiac_sprue_and_gluten_intolerance

(cited >130 times) "Glyphosate, pathways to modern diseases III: manganese, neurological diseases, and associated pathologies", by A. Samsel and S. Seneff, Surgical Neurology International, vol. 6, no. 4, 2015, pages 1-52. DOI: 10.4103/2152-7806.153876. -
https://www.researchgate.net/publication/295608981_Glyphosate_pathways_to_modern_diseases_III_manganese_neurological_diseases_and_associated_pathologies

(cited >40 times) "Glyphosate, pathways to modern diseases IV: cancer and related pathologies", by A. Samsel and S. Seneff, *Journal of Biological Physics and Chemistry* 15 (2015) 121–159. doi: 10.4024/11SA15R.jbpc.15.03 -
http://people.csail.mit.edu/seneff/SamselSeneffGlyphosateIV.pdf

(cited >60 times) "Glyphosate pathways to modern diseases V: Amino acid analogue of glycine in diverse proteins", by A. Samsel and S. Seneff, *Journal of Biological Physics and Chemistry* 16 (2016) 9-49. doi: 10.4024/03SA16A.jbpc.16.01 -
https://www.amsi.ge/jbpc/11616/03SA16A.pdf

Mesnage and Antoniou (2017) [Mesnage R and Antoniou MN (2017) "Facts and Fallacies in the Debate on Glyphosate Toxicity". *Frontiers in Public Health* 5:316] were critical of the above reports of Samsel and Seneff, however, their criticism was solely that the proposed hypothetical molecular causal mechanisms were argued to be unlikely because they were not supported by

laboratory studies (nor were they disproved by laboratory studies). Their criticism was not that the strong correlations between disease and glyphosate were not real or were not strong. Mesnage and Antoniou argued that the correlations were coincidental, or too good to be true in that there should be a large time lag between exposure to glyphosate and onset of cancer, for example.

Four (4) typical examples of the said strong correlations between yearly disease incidence/prevalence/deaths and yearly glyphosate-application tonnage, which occur for more than 20 diseases, are illustrated graphically below.

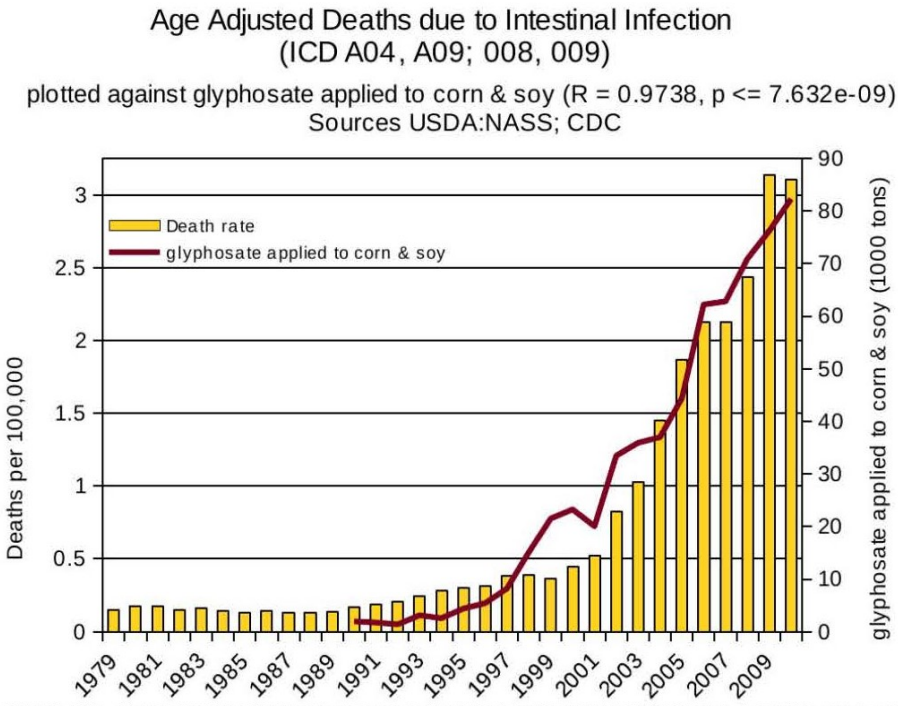

Figure 21. Correlation between age-adjusted intestinal infection deaths and glyphosate applications to US corn and soy crops.

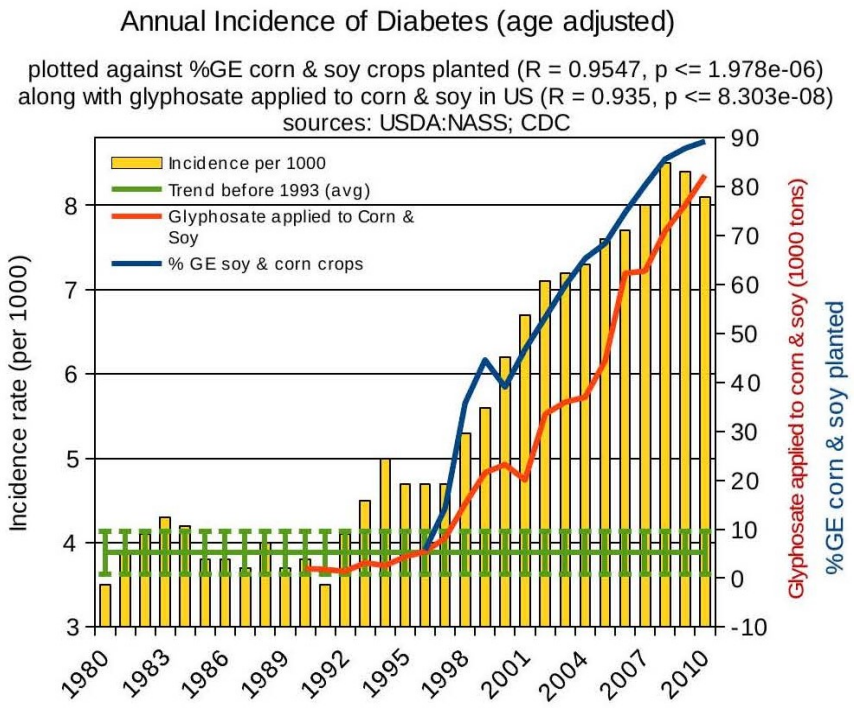

Figure 14. Correlation between age-adjusted diabetes incidence and glyphosate applications and percentage of US corn and soy crops that are GE.

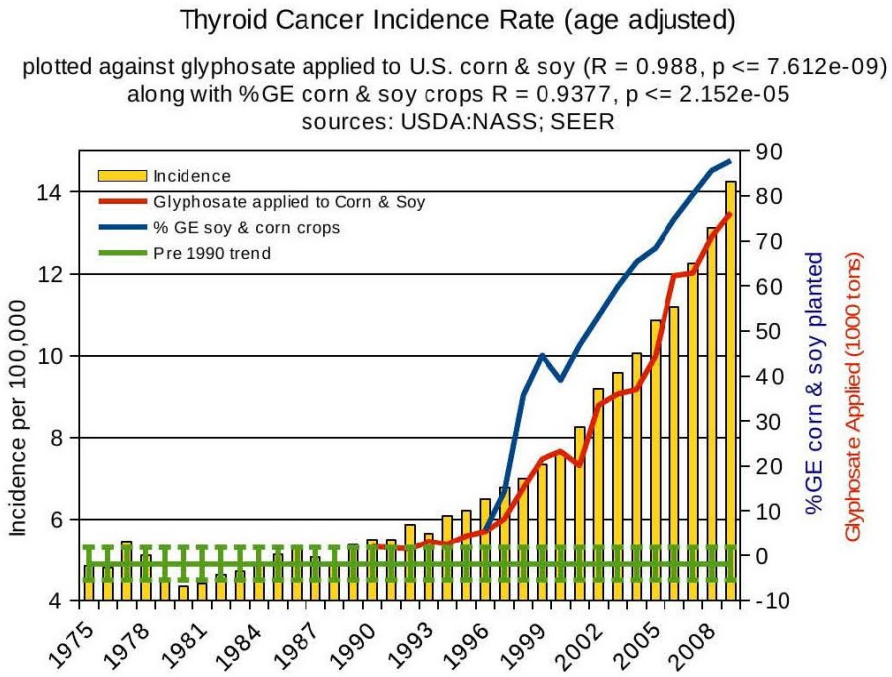

Figure 10. Correlation between age-adjusted thyroid cancer incidence and glyphosate applications and percentage of US corn and soy crops that are GE.

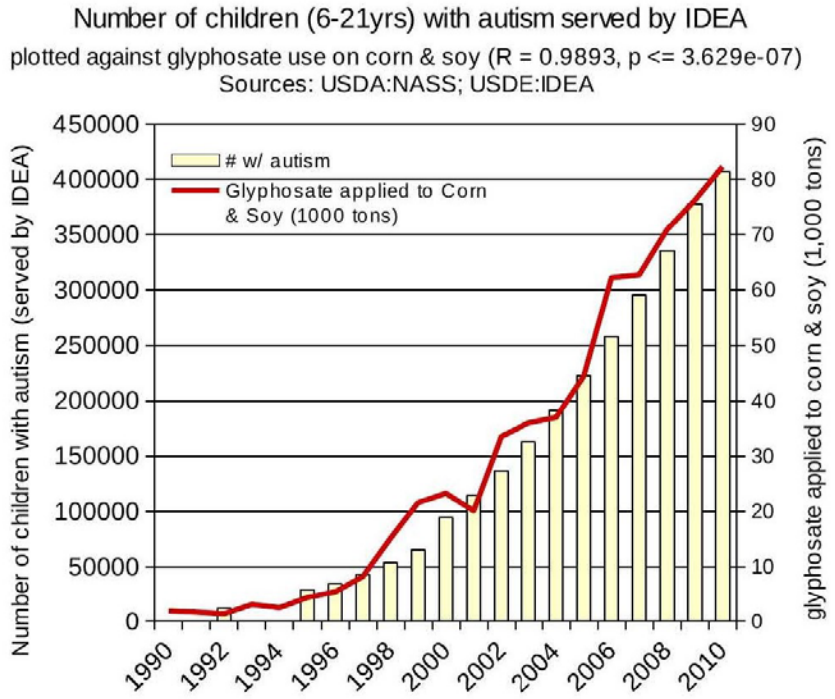

Figure 23. Correlation between children with autism and glyphosate applications.

The above figures are from Swanson et al. (2014).

> **(cited >150 times) "Genetically engineered crops, glyphosate and the deterioration of health in the United States of America", by Swanson, NL, Leu, A, Abrahamson, J, and Wallet, B.** ***Journal of Organic Systems*****, 9(2) (2014) 6-37. - https://www.organic-systems.org/journal/92/abstracts/Swanson-et-al.html**

I emphasize that there are such strong associations between incidences/prevalence/deaths and glyphosate for more than 20 diseases, including:

- thyroid cancer
- liver cancer
- bladder cancer
- pancreatic cancer
- kidney cancer
- myeloid leukaemia
- lipoprotein metabolism

- hypertension
- stroke
- obesity
- diabetes
- end-stage renal disease (ESRD)
- renal failure
- autism
- Alzheimer's
- Parkinson's
- dementia
- multiple sclerosis
- intestinal infection
- inflammatory bowel

Swanson et al. (2014) provide a table of examined diseases that correlate with glyphosate, with the corresponding Pearson correlation coefficients (R), percentage of variation accounted for (R^2 x 100%), and probability (*p*) that the R-value occurred if the correlation coefficient is in fact zero (null hypothesis):

Table 3. Pearson's coefficients between disease and glyphosate applications (N=21 encompassing 1990-2010), except autism (N=16; autism data only available for 1995-2010).

Disease	Coefficient, R	$R^2 \times 100$	Probability, p
Thyroid cancer (incidence)	0.988	97.6	≤7.6E-9
Liver cancer (incidence)	0.960	92.1	≤4.6E-8
Bladder cancer (deaths)	0.981	96.2	≤4.7E-9
Pancreatic cancer (incidence)	0.918	84.2	≤4.6E-7
Kidney cancer (incidence)	0.973	94.8	≤2.0E-8
Myeloid leukaemia (deaths)	0.878	77.1	≤1.5E-6
Lipoprotein metabolism (deaths)	0.973	94.8	≤7.9E-9
Hypertension (deaths)	0.923	85.2	≤1.6E-7
Stroke (deaths)	0.925	85.5	≤1.5E-7
Obesity	0.962	92.5	≤1.7E-8
Diabetes (prevalence)	0.971	94.3	≤9.2E-9
Diabetes (incidence)	0.935	87.4	≤8.3E-8
ESRD (deaths)	0.975	95.0	≤7.2E-9
Renal failure (deaths)	0.978	95.6	≤6.0E-9
Autism (prevalence)	0.989	97.9	≤3.6E-7
Alzheimer's (deaths)	0.917	84.1	≤2.2E-7
Parkinson's (deaths)	0.875	76.6	≤1.6E-6
Dementia (deaths)	0.994	98.8	≤1.8E-9
Multiple sclerosis (deaths)	0.828	68.5	≤1.1E-5
Intestinal infection (deaths)	0.974	94.8	≤7.6E-9
Inflammatory bowel	0.938	88.0	≤7.1E-8

These results are stunning, by any measure, in epidemiology. A single disease exhibiting such strong and robust association with glyphosate would in itself be noteworthy. More than 20 diseases, followed for more than two decades, in a period that saw skyrocketing glyphosate use, constitutes a context of undeniable epidemiological significance.

In virtually all cases, there are likely or plausible causal molecular mechanisms for the associations, as highlighted and studied by many authors, including those cited herein. Furthermore, below-regulatory-limit long-term exposure has now been proven to cause a multitude of diseases in an established animal model (see Mesnage et al. articles discussed above).

Therefore, it is unconscionable that Health Canada has in-effect ignored the epidemiological results. Your petition for increased Maximum Residual Limits (MRLs) for glyphosate is reckless.

Health Canada has hidden behind: irrelevant toxicology tests, the absence of controlled long-term low-dose (below regulatory limits) exposure studies with human subjects, and the decisions of other agencies.

One cannot ignore the strong epidemiological results, and the plausible and lab-demonstrated mechanisms, using the pretext that "*no studies have yet proven a causal relationship*". To in-effect argue in this way, with knowledge of the existing studies, is to act contrary to health safety.

Nutrient-depleted food from glyphosate use

A recent review described two pathways by which glyphosate application reduces the health of crops: by disrupting the rhizosphere (soil) microbial ecology, and by restricting uptake of essential nutrients to crops. This means, on the global scale, our food is made sickly and deficient in nutrients by the use of glyphosate, irrespective of the status of soil fertilization. I know of no studies to date that examined the impact to public health from food and animal feed that is thereby made deficient, on the global scale.

> **"Impacts of glyphosate-based herbicides on disease resistance and health of crops: a review". Martinez, D.A., Loening, U.E. & Graham, M.C. *Environmental Sciences Europe* 30, 2 (2018). https://doi.org/10.1186/s12302-018-0131-7**

Glyphosate-induced emergence of deadly new pathogens

There is a large and growing body of scientific work showing that glyphosate may serve as a driver for antibiotic resistance, via shifts in microbial community composition in soil, plants and animal guts. In this regard, it is important to note that the regulatory limits for glyphosate in animals feeds are much higher than for food crops. As such, it appears that the extensive use of glyphosate has produced health risks far beyond direct toxicity of the chemical itself, into the realm of new threats from microbial pathogens.

> **(cited >380 times) "Review: Environmental and health effects of the herbicide glyphosate". A.H.C. Van Bruggen, M.M. He, K. Shin, V. Mai, K.C. Jeong, M.R. Finckh, J.G. Morris. Science of The Total Environment, Volumes 616–617, 2018, Pages 255-268, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2017.10.309 - https://www.global2000.at/sites/global/files/Literatur-Geissen-2.pdf**

Concluding comments

The organic chemical compound glyphosate — $C_3H_8NO_5P$ — is the most used herbicide on the planet.

When glyphosate was introduced (as Roundup, in 1974), it was promoted as completely safe because its supposed mechanism of toxicity to plants involved interfering with a metabolic pathway (the shikimate pathway) that does not exist in animals, including humans.

However, the gut microbes of humans and animals do critically use the shikimate pathway, and there is now (from the last decade, or so) a large scientific literature linking the human gut microbiome to health and disease:

> (2020) "Until recently, intestinal microbiome was considered to be involved in processes that take place exclusively in the intestine, such as fermentation of carbohydrates, synthesis of vitamins (in particular vitamin B and K), and xenobiotic metabolism as well as acting as a barrier to pathological bacteria. However, over the last 15 years, **the functions of the intestinal microbiome have been revised owing to the establishment of a direct link between density and species composition of the intestinal microbiome and a number of pathological conditions including diabetes, obesity, and cardiovascular diseases**." [my emphasis]
>
> **"Review: The Links Between the Gut Microbiome, Aging, Modern Lifestyle and Alzheimer's Disease". Askarova S, Umbayev B, Masoud A-R, Kaiyrlykyzy A, Safarova Y, Tsoy A, Olzhayev F and Kushugulova A (2020)** ***Front. Cell. Infect. Microbiol.*** **10:104. doi: 10.3389/fcimb.2020.00104 - https://doi.org/10.3389/fcimb.2020.00104**

> (2017) "Here, we focus on the interactions between the human microbiota and the host in order to provide an overview of the microbial role in basic biological processes **and in the development and progression of major human diseases such as infectious diseases, liver diseases, gastrointestinal cancers,**

> **metabolic diseases, respiratory diseases, mental or psychological diseases, and autoimmune diseases**." [my emphasis]
>
> **(cited >400 times) "Review: The Human Microbiota in Health and Disease". B Wang, M Yao, L Lv, Z Ling, L Li. *Engineering*, Volume 3, Issue 1, 2017, Pages 71-82, ISSN 2095-8099, https://doi.org/10.1016/J.ENG.2017.01.008.**

Glyphosate toxicity researcher Stephanie Seneff succinctly expresses her view as:

> (2021) "[Glyphosate's] insidious, cumulative mechanism of toxicity, which begins with the seemingly simple substitution of glyphosate for the amino acid glycine during protein synthesis, explains the correlations we are seeing with diverse diseases that seem to have little in common (ref: Swanson et al., 2014).
>
> **(book) "*Toxic Legacy: How the Weedkiller Glyphosate is Destroying Our Health and the Environment*". Stephanie Seneff. Chelsea Green Publ. (June 2021) ISBN 9781603589291 (Hardcover), pp. 262, at pages 4-5.**

Glyphosate is toxic and it ubiquitously contaminates food, agricultural soil and the environment, with largely unknown long-term and genetic effects in humans, including amplifying susceptibility to many diseases, both common and less-common.

Health Canada should lead the way towards "zero glyphosate" agriculture, zero-herbicide production of food, to replace the present agri-food corporate-profit treadmill. That is where public-interest research and development are needed.

More than 38 weed species developed resistance to glyphosate, causing 20 countries to restrict or ban its use. The always increasing weed resistance to glyphosate drives increases in glyphosate application. You appear to be motivated to accommodate these foreseeable increases rather than primarily motivated to protect the health of Canadians.

If the present Maximum Residue Limits (MRLs) are based on "a thorough risk assessment to confirm that eating foods treated with a pesticide would not result in any human health concern to any segment of the population, including pregnant women,

infants, children and seniors", as publicly asserted by Health Canada ("Glyphosate in Canada", 28 August 2020; see above), then it is inconceivable how you would have concluded that new scientific research supports increasing the MRLs. In fact, the recent public-domain scientific work unambiguously points in the opposite direction: towards fundamental re-assessment, given newly identified risks.

Of course, I do not have the benefit of the data secretly provided to you by the corporate "stake holders", nor are you in the habit of proactively disclosing such data, not even when you request comments on your petitions.

If you have reliable scientific data that justifies increasing the MRLs, please disclose it.

Please acknowledge receipt of these comments.

Sincerely,

Denis Rancourt, PhD
Researcher, Ontario Civil Liberties Association (ocla.ca)