Extra, extra – read all about it!

S. Eliza Dunn, MD

Disclosures

I work for Bayer Crop Science

Dilemma

Dilemma

Pesticide development very slow

- 8-10 years to test, develop and register
- Costs ~$200 million (not including cost of building production facilities)

Difficult to balance concerns over pesticides and insect borne illnesses

Questionable reports allege associations between pesticide exposure an neurologic illness, cancer, ADHD, autism and many other diseases

Pesticides

Insecticides kill bugs – ticks, mosquitoes, fleas, lice, bed bugs

Herbicides kill weeds & invasive plants – kudzu, honeysuckle

Antibiotics kill bacteria – *Strep, Staph,* typhus, plague

Fungicides kill fungi – Athlete's foot, fungi that produce carcinogenic toxins

Misleading Headlines

Newsweek

U.S. WORLD BUSINESS TECH & SCIENCE CULTURE SPORTS OPINION

TECH & SCIENCE

STUDY FINDS 25 PERCENT HIGHER RATE OF AUTISM WHERE MOSQUITO KILLER IS SPRAYED FROM PLANES

BY ZOË SCHLANGER ON 4/30/16 AT 6:16 AM

Natural Pesticides – 1990 study

99% of pesticides consumed are chemicals that are produced by plants to defend themselves

52 natural pesticides tested in this 1990 study

27 of these are rodent carcinogens

// Commonly found thousands of times higher than synthetic pesticides

Americans eat ~ 1.5 g of these natural pesticides/day

// ~10,000x higher than synthetic residues

Vegans likely eat more

Ames, B et.al. Dietary pesticides (99.99% all natural). PNAS 1990; 87:7777-81

“You are going to treat my kid with what?”

Acute Toxicity Studies

Hazard Assessment

Standard Battery of Studies

- Physical Properties
- Residue Chemistry
- Environmental fate
  - General fate
  - Degradation/Metabolism
  - Mobility/Dissipation
  - Accumulation
- Spray Drift
- Non-Target Organisms
  - Acute
  - Chronic
- Product Performance
- Applicator and Re-entry

HUMANS/DOMESTIC ANIMALS

- Acute oral, dermal & inhalation
- Eye & skin irritation
- Dermal sensitization
- 21-d dermal
- 90-day rat, mouse & dog
- 1-year dog chronic
- 18-mo. mouse oncogenicity
- 2-year rat chronic/ oncogenicity
- Genotoxicity battery
- Developmental toxicity (rat & rabbit)
- 2-Gen. rat reproduction
- Acute neurotoxicity
- Subchronic neurotoxicity
- Developmental neurotoxicity
- Immunotoxicity
- Rat ADME

$ 200 million and 10 years

Findings Across the Database are Consistent

Toxicological studies demonstrate that glyphosate is:

- **Not acutely toxic – oral, dermal, inhalation**
- **Not irritating to skin, not a sensitizer**
- **Not genotoxic, not carcinogenic**
- **Not a reproductive toxicant, not an endocrine disruptor, not a teratogen**
- **Not neurotoxic, not immunotoxic**

Chronic Low-Level Exposures

Agricultural Health Study

Cancer Incidence among Glyphosate-Exposed Pesticide Applicators in the Agricultural Health Study

Anneclaire J. De Roos,[1] Aaron Blair,[2] Jennifer A. Rusiecki,[2] Jane A. Hoppin,[3] Megan Svec,[1] Mustafa Dosemeci,[2] Dale P. Sandler,[3] and Michael C. Alavanja[2]

Author information ▶ Article notes ▶ Copyright and License information ▶

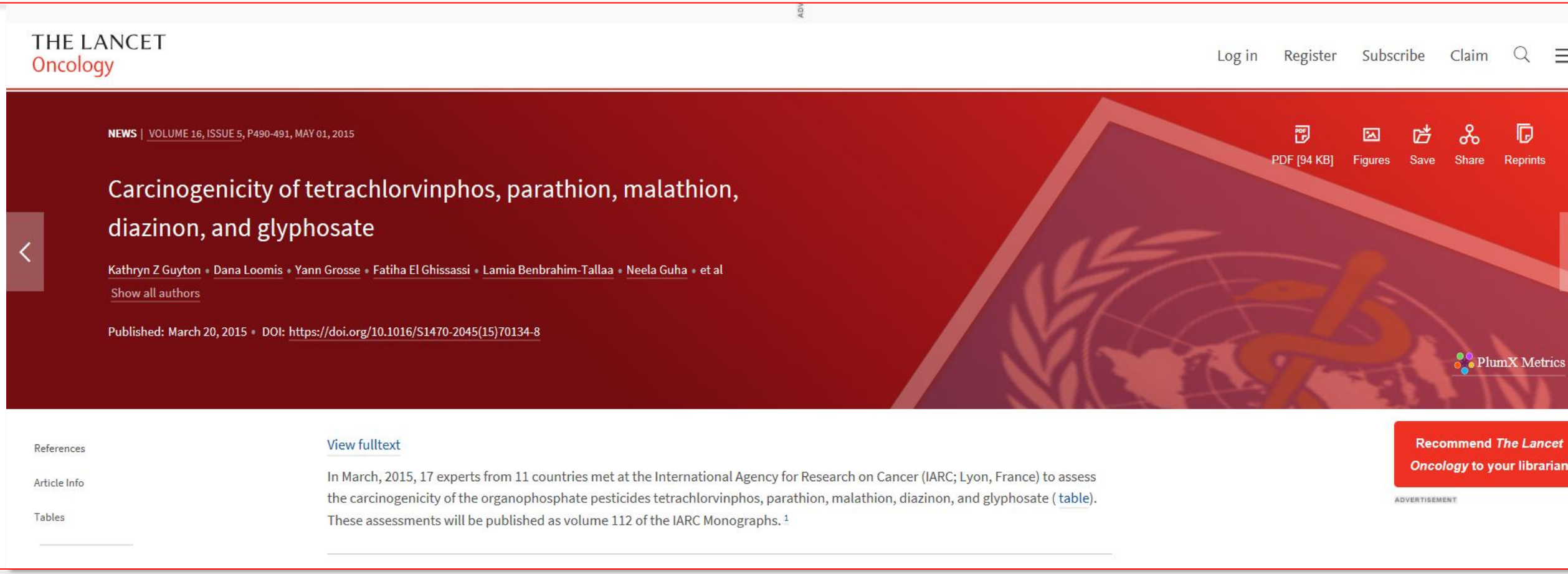
Table 2. Association of glyphosate exposure (ever/never used) with common cancers[a] among AHS applicators.

Cancer site	Total no. of cancers[c]	Ever used glyphosate (% of total)	RR (95% CI)[b] Effect estimates adjusted for age (n = 54,315)[d]	RR (95% CI)[b] Adjusted for age, demographic and lifestyle factors, and other pesticides[d]
All cancers	2,088	73.6	1.0 (0.9–1.1)	1.0 (0.9–1.2)
Lung	204	72.1	1.0 (0.7–1.3)	0.9 (0.6–1.3)
Oral cavity	59	76.3	1.1 (0.6–2.0)	1.0 (0.5–1.8)
Colon	174	75.3	1.1 (0.8–1.6)	1.4 (0.8–2.2)[e]
Rectum	76	77.6	1.2 (0.7–2.1)	1.3 (0.7–2.3)
Pancreas	38	76.3	1.2 (0.6–2.5)	0.7 (0.3–2.0)[e]
Kidney	63	73.0	1.0 (0.6–1.7)	1.6 (0.7–3.8)[e]
Bladder	79	76.0	1.2 (0.7–2.0)	1.5 (0.7–3.2)[e]
Prostate	825	72.5	1.0 (0.8–1.1)	1.1 (0.9–1.3)
Melanoma	75	84.0	1.8 (1.0–3.4)	1.6 (0.8–3.0)
All lymphohematopoietic cancers	190	75.3	1.1 (0.8–1.5)	1.1 (0.8–1.6)
NHL	92	77.2	1.2 (0.7–1.9)	1.1 (0.7–1.9)
Leukemia	57	75.4	1.1 (0.6–2.0)	1.0 (0.5–1.9)
Multiple myeloma	32	75.0	1.1 (0.5–2.4)	2.6 (0.7–9.4)[f]

[a]Cancers for which at least 30 subjects had sufficient information for inclusion in age-adjusted analyses. [b]RRs and 95% CIs from Poisson regression models. [c]Frequencies among subjects included in age-adjusted analyses. [d]Numbers of sub-

De Roos AJ, Blair A, Rusiecki JA, et al. Cancer Incidence among Glyphosate-Exposed Pesticide Applicators in the Agricultural Health Study. *Environmental Health Perspectives*. 2005;113(1):49-54. doi:10.1289/ehp.7340

IARC



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NEWS | VOLUME 16, ISSUE 5, P490-491, MAY 01, 2015

PDF [94 KB] Figures Save Share Reprints

Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate

Kathryn Z Guyton • Dana Loomis • Yann Grosse • Fatiha El Ghissassi • Lamia Benbrahim-Tallaa • Neela Guha • et al

Show all authors

Published: March 20, 2015 • DOI: https://doi.org/10.1016/S1470-2045(15)70134-8

PlumX Metrics

References

Article Info

Tables

View fulltext

In March, 2015, 17 experts from 11 countries met at the International Agency for Research on Cancer (IARC; Lyon, France) to assess the carcinogenicity of the organophosphate pesticides tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate (table). These assessments will be published as volume 112 of the IARC Monographs. [1]

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Worldwide Regulatory Reviews

Have repeatedly concluded that glyphosate is **not genotoxic** and is **not a carcinogenic** hazard to humans

2017	EU ECHA RAC Classification
	Canada PMRA
	Australia APVMA
	US EPA Registration
	Korean RDA
2016	New Zealand EPA
	WHO/JMPR
	Japan FSC
2015	US EPA CARC Report
	EU EFSA Peer Review
	EU Annex I Renewal (BFR)
	Canada PMRA Registration Rev. (draft published)
	WHO/IARC
2013	Australia APVMA
2012	US EPA Human Health RA
2011	WHO/JMPR
2008	US EPA Effects Determination
2007	Brazil ANVISA (ongoing)
	OEHHA
2005	WHO/Water Sanitation Health
2004	WHO/JMPR
2002	EU Annex I
2000	FAO Specifications
1999	Japan FSC
1994	WHO/IPCS
1993	US EPA RED
1991	Canada PMRA
1987	WHO/JMPR

Glyphosate Use and NHL

Swanson, Leu, Abrahamson & Wallet — *Journal of Organic Systems*, 9(2), 2014

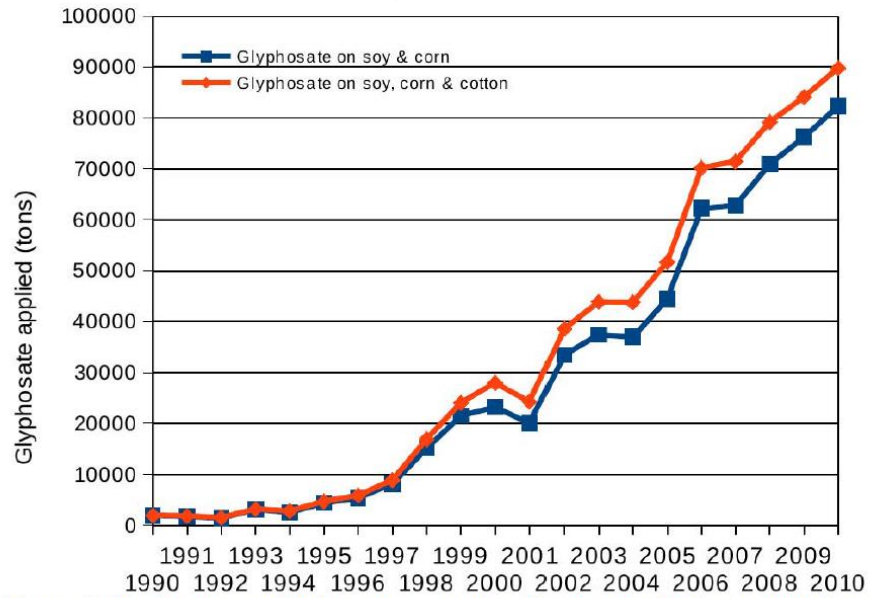
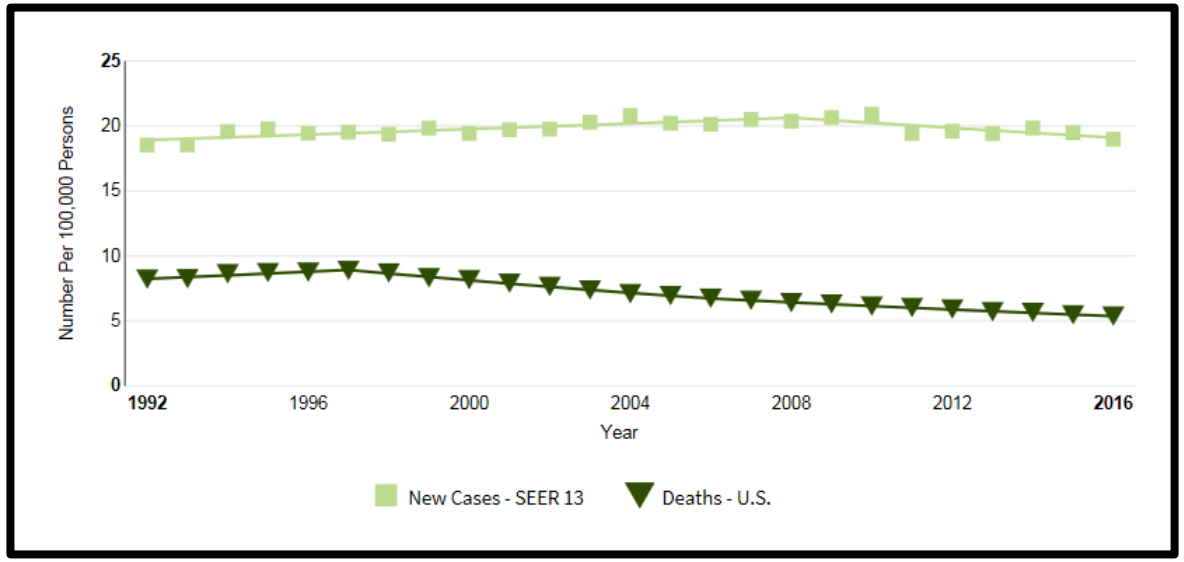


Figure 6. Glyphosate applied to corn, cotton and soy crops in the surveyed states. Standard errors (corn & soy): 2007-2010: 3-10%; 2000-2006: 7-16%; 1998-2000: 16-62%; 1992-1997: 16-100%; 1990-1991: 22-100%. Errors calculated from the USDA reported standard errors.

1996			
	Data	**Observed Rate**	**Modeled Rate**
	New Cases	**19.4**	**19.3**
	Deaths	**8.8**	**8.8**

2016			
	Data	**Observed Rate**	**Modeled Rate**
	New Cases	**19.0**	**19.1**
	Deaths	**5.4**	**5.4**

NHL data U.S. 1992-2016



http://seer.cancer.gov/statfacts/html/nhl.html

JOURNAL of the NATIONAL CANCER INSTITUTE

Article Navigation

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, ... Show more

JNCI: Journal of the National Cancer Institute, Volume 110, Issue 5, 1 May 2018, Pages 509–516,
https://doi.org/10.1093/jnci/djx233

JNCI JOURNAL of the NATIONAL CANCER INSTITUTE

“In this updated evaluation of glyphosate use and cancer risk….we observed no associations between glyphosate use and overall cancer risk or with total lymphohematopoetic cancers including NHL and multiple myeloma”

EPA United States Environmental Protection Agency

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News Releases

News Releases from Headquarters > Chemical Safety and Pollution Prevention (OCSPP)

EPA Takes Next Step in Review Process for Herbicide Glyphosate, Reaffirms No Risk to Public Health

04/30/2019

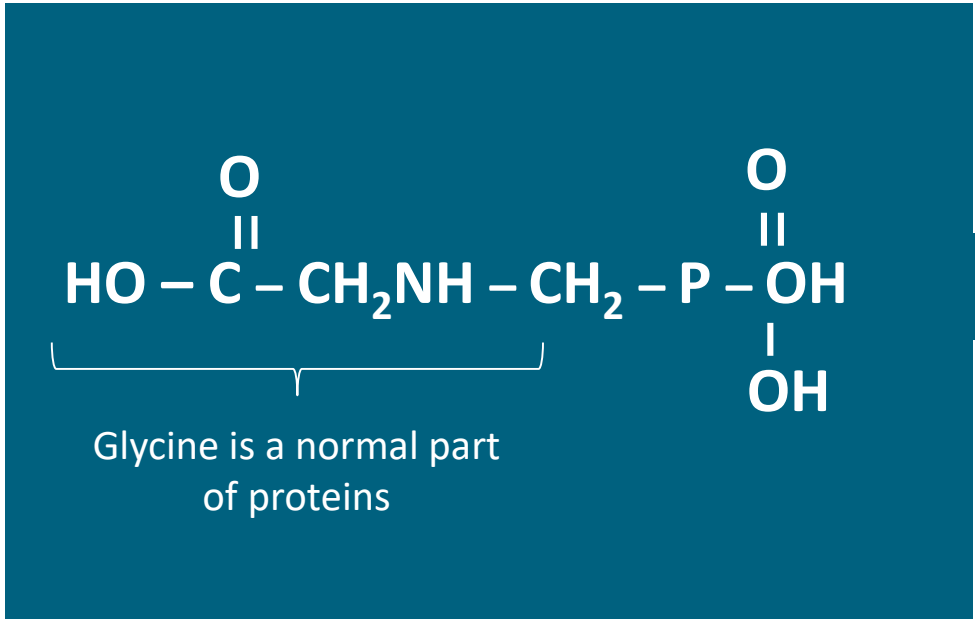
Contact Information:
EPA Press Office (press@epa.gov)

The Safety of

GLYPHOSATE

What is Glyphosate?

Organophosphonate (not organophosphate)



- Not an insecticide.
- Works by preventing plants from making certain amino acids needed for growth.
- BUT, animals and humans are not affected, as they do not have this enzyme.

Formulations

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Formulations are simple:

- Glyphosate
- Surfactant (a detergent, like shampoo)
- Anti-foam (like simethicone for intestinal gas)
- Sometimes colorant (food coloring).
- Water

Most surfactant exposure comes from shampoos, soaps, and detergents at home.

Globally, glyphosate from major producers meets the FAO standard for purity.

Properties of Glyphosate

Glyphosate…

- Has relatively high water solubility and low fat solubility –
  - Does not bioaccumulate
- Has low absorption through the skin
- It is not metabolized -
  - Quickly eliminated from the body.

Glyphosate

Myths

Glyphosate and Breast Milk

MYTH

Glyphosate is found in breast milk.

FACT

- **This claim was made by an activist group that used an unvalidated test on breast milk.**
- **When the study was conducted using a validated test, no glyphosate was detected in breast milk.**

OXFORD ACADEMIC

The American Journal of CLINICAL NUTRITION

Volume 103, Issue 5

Glyphosate and aminomethylphosphonic acid are not detectable in human milk

Michelle K McGuire ✉, Mark A McGuire, William J Price, Bahman Shafii, Janae M Carrothers, Kimberly A Lackey, Daniel A Goldstein, Pamela K Jensen, John L Vicini Author Notes

The American Journal of Clinical Nutrition, Volume 103, Issue 5, 1 May 2016, Pages 1285–1290, https://doi.org/10.3945/ajcn.115.126854

Glyphosate and The Gut Microbiome

MYTH

- Glyphosate disrupts the gut microbiome

FACT

- **Glyphosate works by inhibiting EPSPS enzyme which is found in some microbes**
- **Plants use enzyme to make certain amino acids**
- **Gut flora are bathed in amino acids so microbes can live without it**
- **Tiny amount of glyphosate compared to gut microbes**

Glyphosate and the Gut Microbiome

Environmental Pollution 233 (2018) 364–376

Contents lists available at ScienceDirect

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol

Glyphosate has limited short-term effects on commensal bacterial community composition in the gut environment due to sufficient aromatic amino acid levels☆

Lene Nørby Nielsen [a], Henrik M. Roager [a], Mònica Escolà Casas [b], Henrik L. Frandsen [a], Ulrich Gosewinkel [b], Kai Bester [b], Tine Rask Licht [a], Niels Bohse Hendriksen [b], Martin Iain Bahl [a,*]

[a] National Food Institute, Technical University of Denmark, Kgs. Lyngby, Denmark
[b] Department of Environmental Science, Aarhus University, Roskilde, Denmark

Glyphosate and Human Health

MYTH

Glyphosate (Roundup®) causes a wide variety of human health issues:

- Autism
- Celiac disease
- Parkinson's disease
- Obesity

FACT

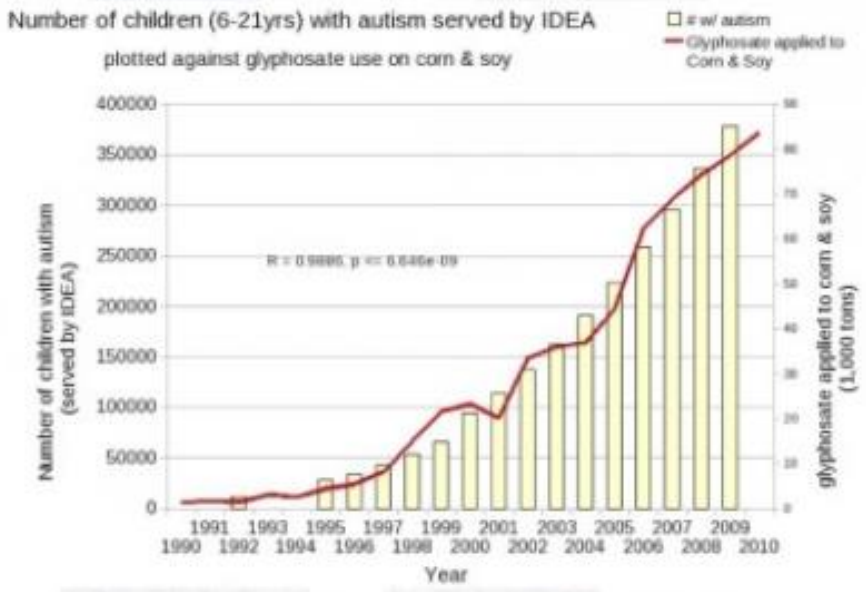
These are SPECULATIVE relationships based on a mixture of:

- Correlation (Which is NOT causation)
- Not supported by laboratory data – no mechanism

Confusing Correlation with Causation

Rate of illness in the US vs Glyphosate use

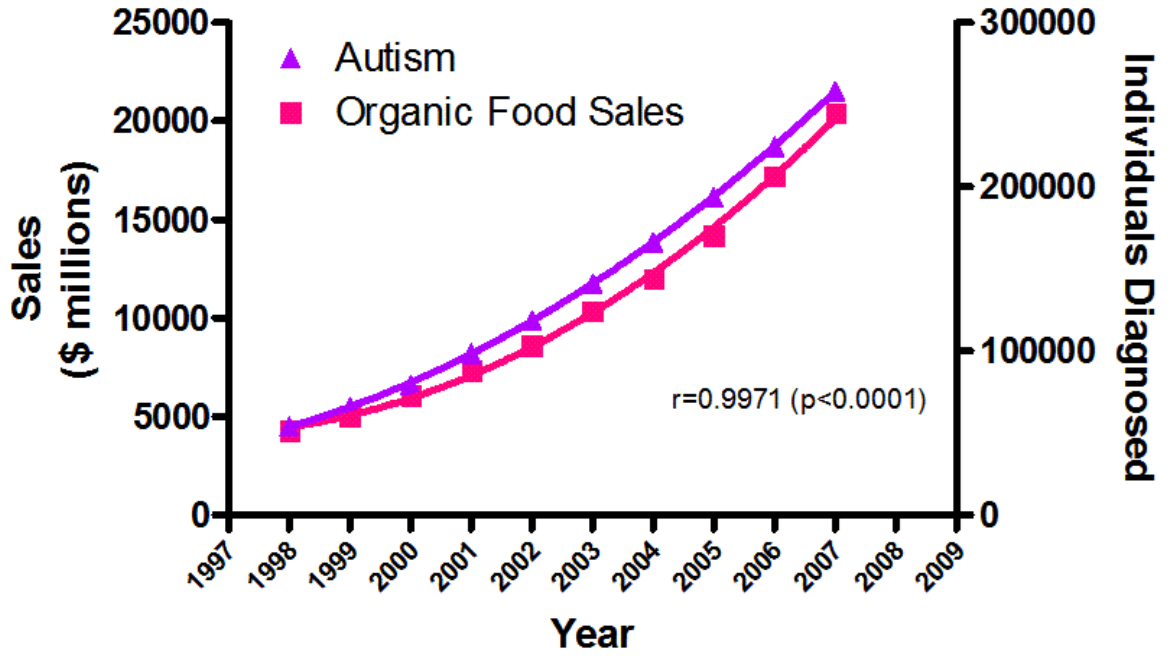
Glyphosate and Autism*



Pearson Correlation Coefficient = 0.985

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

The real cause of increasing autism prevalence?



Sources: Organic Trade Association, 2011 Organic Industry Survey; U.S. Department of Education, Office of Special Education Programs, Data Analysis System (DANS), OMB# 1820-0043: "Children with Disabilities Receiving Special Education Under Part B of the Individuals with Disabilities Education Act

Implications of Ban

BUSINESS TIMES

Major crisis in Sri Lankan plantations due to ban on weedicides

View(s): 7

The Planters Association of Ceylon (PA), faced with devastating crop losses in excess of Rs. 15 billion in 2016, is urging the Government to immediately provide a rational and effective solution to the managemen

http://www.sundaytimes.lk/170108/business-times/major-crisis-in-sri-lankan-plantations-due-to-ban-on-weedicides-222776.html

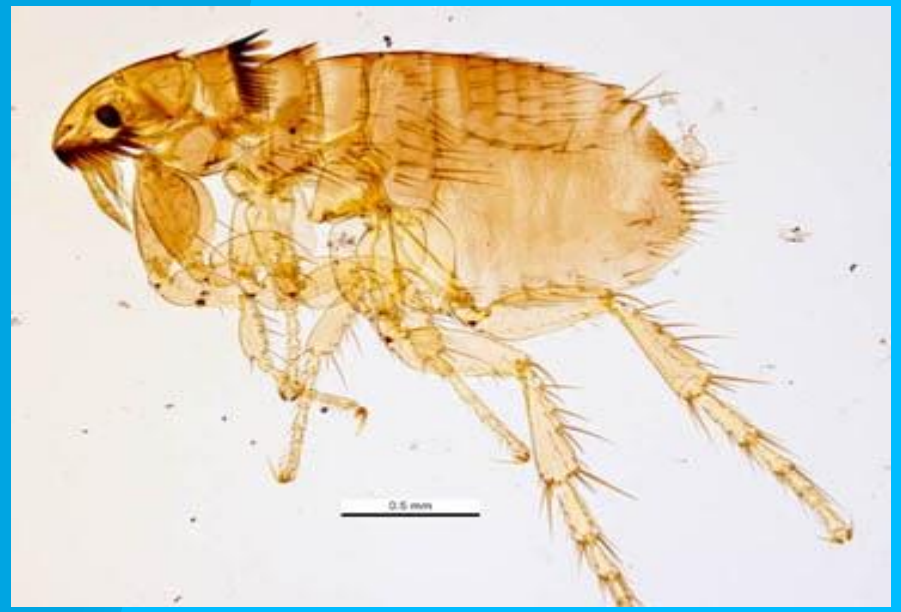
Pesticide Ban

Pesticide Ban

FAO

Implications of a ban

Pesticides are Critical for Human Health



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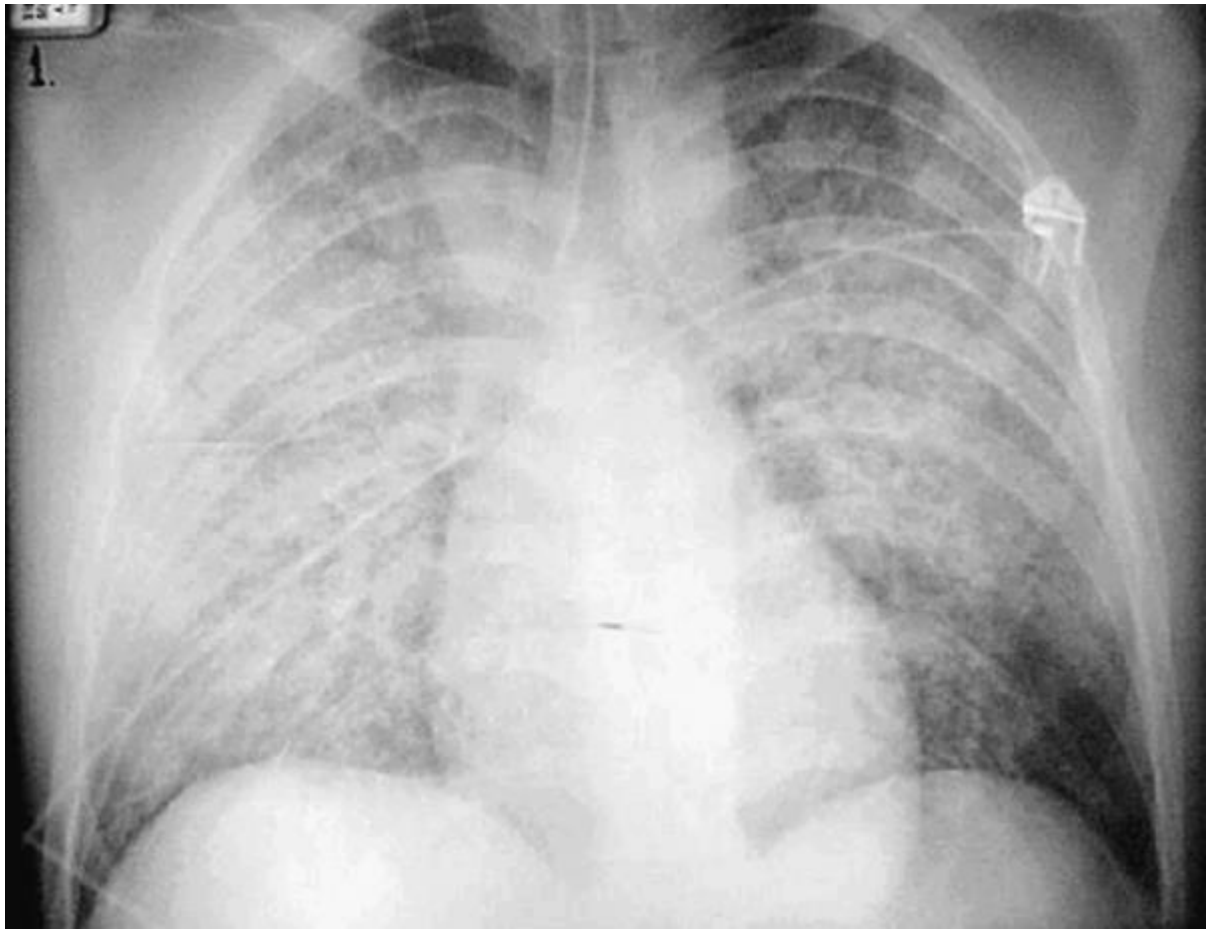
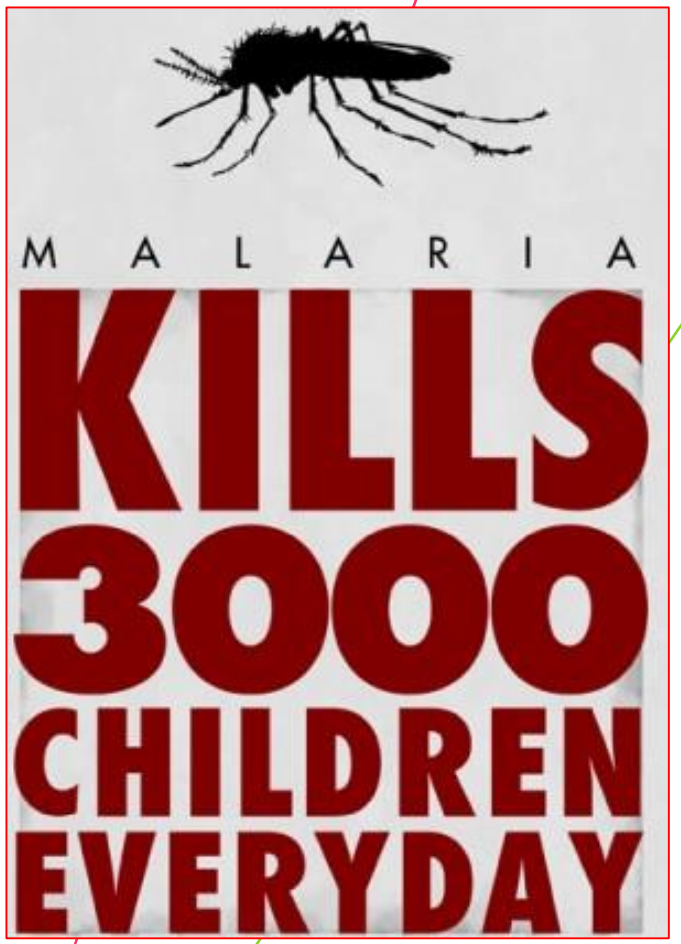


http://www.scielo.edu.uy/scielo.php?pid=S1688-12492003000200009&script=sci_arttext

www.Wikipedia.org

Human Health

- Pesticides are some of the most important advances in the control of infectious disease
- >1 million insect borne deaths/year
- > ½ the world's population at risk of insect borne diseases
  - Dengue
  - Yellow Fever
  - Filariasis
  - Onchocerciasis
  - Zika



Parting thoughts

Malaria & other infectious diseases were wiped out in the USA and Europe by draining swamps and using pesticides

Pesticides are more regulated than antibiotics

Major contribution to public health

Bans put food supply and children’s health at risk