Widespread Glyphosate Contamination in USA

Most comprehensive study reveals glyphosate and AMPA in the environment over 9 years and across 38 states

Dr Eva Sirinathsinghji

The most comprehensive research to date on environmental glyphosate levels exposes the widespread contamination of soil and water in the US, as well as its water treatment system. Looking at a wide range of geographical locations, researchers from the US Geological Survey (USGS) analysed 3 732 water and sediment samples and 1 081 quality assurance samples collected between 2001 and 2010 from 38 states in the US and the district of Colombia. They found glyphosate in 39.4 % of samples (1 470 out of 3 732) and its metabolite AMPA (aminomethylphosphonic acid) in 55 % of samples [1]. Water samples included streams, groundwater, ditches and drains, large rivers, soil water, lakes, ponds and wetlands, precipitation, soil and sediment, and waste water treatment plants. ***Waterways including rivers and lakes were not included in this report, for reasons unknown.***

Results expected

These results are to be expected when the use of glyphosate has steadily increased in the US (and similarly in Canada) over the years, particularly since the introduction of genetically-modified crops tolerant to the herbicide. The rise of glyphosate-resistant weeds also means that farmers need to spray more chemicals than before in order to protect their crops (see [2] Monsanto Defeated by Roundup Resistant Weeds, *SiS* 53). Glyphosate accounted for 32-36% of all pesticide (insecticides, herbicides and fungicides) use in the US in 2007 according to EPA data [3]. It is the top pesticide in agriculture and the second for home and garden and commercial settings. Agricultural use has gone up from 3 180 tonnes (of active ingredient) in 1987 to 82 800 tonnes in 2007. Non-agricultural use of the herbicide has also risen steadily in the US, from 2 270 tonnes in 1993 to 9 300 tonnes in 2007 (Figure 1). The common use of glyphosate in urban areas is also exacerbated by the impervious surfaces of cities, resulting in substantial pesticide inputs to urban drainage systems. Until recently data had been lacking on glyphosate occurrence in the environment, though studies published over the last couple of years are raising concerns. Detecting glyphosate in surface waters, rain and even groundwater, contradicts the producers' claim that its chemical propensity to bind to sediment will prevent it from leaching into groundwater supplies (see [4] GM Crops and Water - A Recipe for Disaster, *SiS* 58).

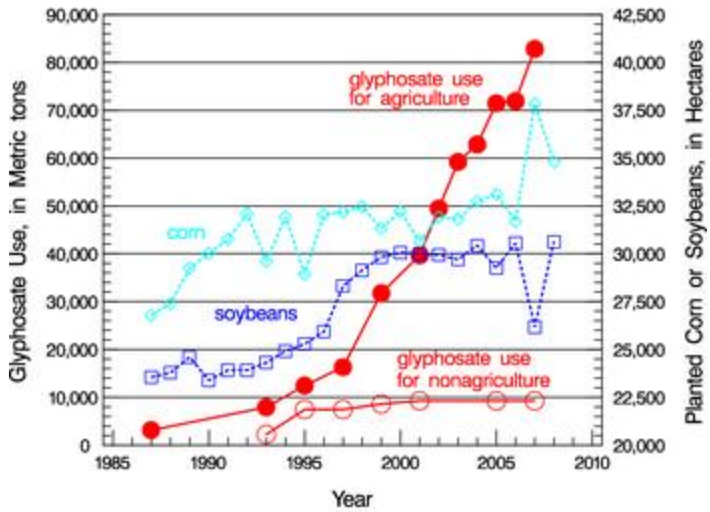

Figure 1 *Use of Glyphosate and Planted Hectares of Corn and Soybeans From 1987-2008*

Data collection had previously been limited not only by glyphosate's high solubility and polarity which make its detection more difficult, especially at environmentally relevant levels, but also due to the official line taken by authorities that glyphosate is safe. This makes assessment of its presence in our environment less of a priority, and hence left unstudied and unregulated. The safety claim has also encouraged farmers to overuse glyphosate, mostly sprayed on crops "post-emergence" or after crops and weeds have emerged from the soil and often applied repeatedly throughout the season, especially with the rise of glyphosate-resistant weeds. In addition, they are liberally used on non-GM crops as a dessicant (drying agent) to facilitate harvesting (see [5] How Roundup® Poisoned my Nature Reserve, *SiS* 64).

To address the lack of knowledge in this area, researchers at the USGS began developing their own methods in the 2000s, using solid-phase extraction and liquid chromatography/mass spectroscopy, which is able to detect both glyphosate and its metabolite AMPA at levels as low as 0.02 μg/l (0.02 part per billion, ppb) for both compounds.

The results are shown in Table 1. Glyphosate and AMPA were most frequently detected in soil, followed by drains and ditches, rain and large rivers. For soil and sediment, and soil water a total of 45 soil and sediment samples were collected from seven sites in Mississippi and Indiana, with both glyphosate and AMPA being detected at least once in samples from all seven sites. Both were detected in 90 % of sediment samples with concentrations frequently above 10 μg/kg, with an average of 9.6 μg/kg. In 116 soil samples glyphosate and AMPA were detected in 34.5 % and 66.5 % respectively. Large rivers showed average levels of 0.03 μg/kg in 53.1 % of samples tested. Least frequent but detectable levels were found in groundwater samples, with 5.8 % and 14 % of samples testing positive for glyphosate and AMPA respectively.

Glyphosate is claimed by biotech proponents not to leach into groundwater supplies, but this work and a previous study performed in Catalonia, Spain have both detected its presence in groundwater supplies [4], a major source of drinking water.

The present study also found an increase in concentrations over time, showing higher levels from 2006-2010 compared to earlier years (2001-2005), consistent with rises in both agricultural, home and commercial use of the herbicide. Temporal patterns however, were not recorded and these likely change with agricultural seasons.

The study highlights the ubiquitous contamination of the environment with glyphosate herbicides at ever increasing levels. This herbicide is highly toxic to humans, farm animals, and wildlife, and at levels as low as 0.1 ppb; there is indeed a strong case for halting its use altogether (see [6] Ban GMOs Now, *Special ISIS report*).

Table 1 Concentrations of both glyphosate and its metabolite AMPA in US environment

Hydrologic Setting	Number of Samples	Percentage and (number) with Glyphosate Detections	Median Glyphosate in µg/l or µg/kg	Maximum Glyphosate in µg/l or µg/kg	Percentage and (number) with AMPA Detections	Median AMPA in µg/l or µg/kg	Maximum AMPA in µg/l or µg/kg
All sites	3 732	39.4 (1,470)	<0.02	476	55.0 (2,052)	0.04	397
Streams	1 508	52.5 (791)	0.03	73	71.6 (1,079)	0.20	28
Groundwater	1 171	5.8 (68)	<0.02	2.03	14.3 (168)	<0.02	4.88
Ditches and drains	374	70.9 (265)	0.20	427	80.7 (302)	0.43	397
Large rivers	318	53.1 (169)	0.03	3.08	89.3 (284)	0.22	4.43
Soil water	116	34.5 (40)	<0.02	1.00	65.5 (76)	0.06	1.91
Lakes, ponds, and wetlands	104	33.7 (35)	<0.02	301	29.8 (31)	<0.02	41
Precipitation	85	70.6 (60)	0.11	2.50	71.8 (61)	0.04	0.48
Soil and sediment	45	91.1 (41)	9.6	476	93.3 (42)	18.0	341
WWTP outfall	11	9.09 (1)	<0.02	0.30	81.8 (9)	0.45	2.54

References

1. Battaglin WA, Meyer MT, Kuivila KM, and Dietze JE. Glyphosate and Its Degradation Product AMPA Occur Frequently and Widely in U.S. Soils, Surface Water, Groundwater, and Precipitation. *Journal of the American Water Resources Association (JAWRA)* 2014, 50, 275-290. DOI: 10.1111/jawr.12159
2. Sirinathsinghji E. Monsanto Defeated By Roundup Resistant Weeds. *Science in Society 53*, 40-41, 2011.
3. 2006-2007 Pesticide Market Estimates, 3.4 Amount of Pesticides Used in the United States: Conventional. US Environmental Protection Agency. http://www.epa.gov/oppo0001/pestsales/07pestsales/usage2007_2.htm
4. Sirinathsinghji E. GM Crops and Water – A Recipe for Disaster. *Science in Society 58*, 8-10, 2013.
5. Mason, R. How Roundup Poisoned My Nature Reserve, *SiS* 64, to appear

6. Ho MW and Sirinathsinghji E. Ban GMOs Now, ISIS, London, June 2013, http://www.i-sis.org.uk/Ban_GMOs_Now.php