Glyphosate Fact Sheet: Cancer and Other Health Concerns

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Glyphosate, a synthetic herbicide patented in 1974 by the Monsanto Company and now manufactured and sold by many companies in hundreds of products, has been associated with cancer and other health concerns. Glyphosate is best known as the active ingredient in Roundup-branded herbicides, and the herbicide used with "Roundup Ready" genetically modified organisms (GMOs).

Herbicide tolerance is the most prevalent GMO trait engineered into food crops, with some 90% of corn and 94% of soybeans in the U.S. engineered to tolerate herbicides, according to USDA data. A 2017 study found that Americans' exposure to glyphosate increased approximately 500 percent since Roundup Ready GMO crops were introduced in the U.S in 1996. Here are some key facts about glyphosate:

Most Widely Used Pesticide

According to a February 2016 study, glyphosate is the most widely used pesticide: "In the U.S., no pesticide has come remotely close to such intensive and widespread use." Findings include:

- Americans have applied 1.8 million tons of glyphosate since its introduction in 1974.
- Worldwide 9.4 million tons of the chemical has been sprayed on fields – enough to spray nearly half a pound of Roundup on every cultivated acre of land in the world.
- Globally, glyphosate use has risen almost 15-fold since Roundup Ready GMO crops were introduced.

Statements from scientists and health care providers

Cancer concerns

The scientific literature and regulatory conclusions regarding glyphosate and glyphosate-based herbicides show a mix of findings, making the safety of the herbicide a hotly debated subject.

In 2015, the **World Health Organization's International Agency for Research on Cancer (IARC)** classified glyphosate as "probably carcinogenic to humans" after reviewing years of published and peer-reviewed scientific studies. The team of international scientists found there was a particular association between glyphosate and non-Hodgkin lymphoma.

U.S. agencies: At the time of the IARC classification, the Environmental Protection Agency (EPA) was conducting a registration review. The EPA's Cancer Assessment Review Committee (CARC) issued a report in September 2016 concluding that glyphosate was "not likely to be carcinogenic to humans" at doses relevant to human health. In December 2016, the EPA convened a Scientific Advisory Panel to

review the report; members were divided in their assessment of EPA's work, with some finding the EPA erred in how it evaluated certain research. Additionally, the EPA's Office of Research and Development determined that EPA's Office of Pesticide Programs had not followed proper protocols in its evaluation of glyphosate, and said the evidence could be deemed to support a "likely" carcinogenic or "suggestive" evidence of carcinogenicity classification. Nevertheless the EPA issued a draft report on glyphosate in December 2017 continuing to hold that the chemical is not likely to be carcinogenic. In April 2019, the EPA reaffirmed its position that glyphosate poses no risk to public health. But earlier that same month, the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) reported that there are links between glyphosate and cancer. According to the draft report from ATSDR, "numerous studies reported risk ratios greater than one for associations between glyphosate exposure and risk of non-Hodgkin's lymphoma or multiple myeloma."

European Union: The European Food Safety Authority and the European Chemicals Agency have said glyphosate is not likely to be carcinogenic to humans. A March 2017 report by environmental and consumer groups argued that regulators relied improperly on research that was directed and manipulated by the chemical industry. A 2019 study found that Germany's Federal Institute for Risk Assessment report on glyphosate, which found no cancer risk, included sections of text that had been plagiarized from Monsanto studies. In February 2020, reports surfaced that 24 scientific studies submitted to the German regulators to prove the safety of glyphosate came from a large German laboratory that has been accused of fraud and other wrongdoing.

WHO/FAO Joint Meeting on Pesticide Residues determined in 2016 that glyphosate was unlikely to pose a carcinogenic risk to humans from exposure through the diet, but this finding was tarnished by conflict of interest concerns after it came to light that the chair and co-chair of the group also held leadership positions with the International Life Sciences Institute, a group funded in part by Monsanto and one of its lobbying organizations.

California OEHHA: On March 28, 2017, the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment confirmed it would add glyphosate to California's Proposition 65 list of chemicals known to cause cancer. Monsanto sued to block the action but the case was dismissed. In a separate case, the court found that California could not require cancer warnings for products containing glyphosate. On June 12, 2018, a U.S. District Court denied the California Attorney General's request for the court to reconsider the decision. The court found that California could only require commercial speech that disclosed "purely factual and uncontroversial information," and the science surrounding glyphosate carcinogenicity was not proven.

Agricultural Health Study: A long-running U.S. government-backed prospective cohort study of farm families in Iowa and North Carolina has not found any connections between glyphosate use and non-Hodgkin lymphoma, but the researchers reported that "among applicators in the highest exposure quartile, there was an increased risk of acute myeloid leukemia (AML) compared with never users…" The most recent published update to the study was made public in late 2017.

Recent studies report cancer links and concerns about validity of EPA classification:

- February 2020 paper in Environmental Health, “A comprehensive analysis of the animal carcinogenicity data for glyphosate from chronic exposure rodent carcinogenicity studies,” reviewed chronic exposure animal carcinogenicity studies of glyphosate and reported toxicologically plausible pathways for why glyphosate may cause various cancers in rodents.
- April 2019: the U.S. Agency for Toxic Substances and Disease Registry issued its draft toxicological profile for glyphosate, which reports an increased cancer risk from glyphosate exposures. Emails released via court proceedings show officials at EPA and Monsanto tried to hinder the ATSDR report.
- March 2019 study published in the International Journal of Epidemiology analyzed data from more than 30,000 farmers and agricultural workers from studies done in France, Norway and the U.S., and reported links between glyphosate and diffuse large B-cell lymphoma.
- February 2019: A meta-analysis published in Mutation Research/Reviews in Mutation Research reported a “compelling link” between glyphosate-based herbicides and non-Hodgkin lymphoma. Three of the study authors were members of the EPA’s scientific advisory panel on glyphosate who have stated publicly that the EPA failed to follow proper scientific practices in its glyphosate assessment.
- January 2019: An analysis published in Environmental Sciences Europe argues that the U.S. EPA’s classification of glyphosate disregarded substantial scientific evidence of genotoxicity (the negative impact on a cell’s genetic material) associated with weed killing products such as Roundup.

Cancer lawsuits

More than 42,000 people have filed suit against Monsanto Company (now Bayer) alleging that exposure to Roundup herbicide caused them or their loved ones to develop non-Hodgkin lymphoma (NHL), and that Monsanto covered up the risks. As part of the discovery process, Monsanto has had to turn over millions of pages of internal records. We are posting these Monsanto Papers as they become available. For news and tips about the ongoing legislation, see Carey Gillam’s Roundup Trial Tracker. The first three trials ended in large awards to plaintiffs for liability and damages, with juries ruling that Monsanto’s weed killer was a substantial contributing factor in causing them to develop NHL. Bayer is appealing the rulings.

Monsanto influence in research: In March 2017, the federal court judge unsealed some internal Monsanto documents that raised new questions about Monsanto’s influence on the EPA process and about the research regulators rely on. The documents suggest that Monsanto’s long-standing claims about the safety of glyphosate and Roundup do not necessarily rely on sound science as the company asserts, but on efforts to manipulate the science.

More information about scientific interference:

- “The Monsanto Papers: Poisoning the Scientific Well,” by Leemon McHenry (2018)
- “Roundup litigation discovery documents: implications for public health and journal ethics,” by Sheldon Krimsky and Carey Gillam (June 2018)
- Letter to Nature by Stéphane Horel and Stéphane Foucart (March 2018)

Endocrine disruption and other health concerns

Some research suggests that glyphosate may be an endocrine disruptor. It has also been linked to liver disease, birth defects and reproductive problems in laboratory animals; and may kill beneficial gut bacteria and damage the DNA in human embryonic, placental and umbilical cord cells. A 2019 study in a Nature journal reported increases in obesity, reproductive and kidney diseases, and other problems in the second- and third-generation offspring of rats exposed to glyphosate. See the study and Washington State University press release.

Recent studies have shown adverse biological effects from low-dose exposures to glyphosate at levels to which people are routinely exposed.

- A 2017 study associated chronic, very low-level glyphosate exposures to non-alcoholic fatty liver disease in rats. According to the researchers, the results "imply that chronic consumption of extremely low levels of a GBH formulation (Roundup), at admissible glyphosate-equivalent concentrations, are associated with marked alterations of the liver proteome and metabolome," the biomarkers for NAFLD.
- A birth cohort study in Indiana published in 2017 – the first study of glyphosate exposure in US pregnant women using urine specimens as a direct measure of exposure – found detectable levels of glyphosate in more than 90% of the pregnant women tested and found the levels were significantly correlated with shortened pregnancy lengths.
- A 2018 ecological and population study conducted in Argentina found high concentrations of glyphosate in the soil and dust in agricultural areas that also reported higher rates of spontaneous abortion and congenital abnormalities in children, suggesting a link between environmental exposure to glyphosate and reproductive problems. No other relevant sources of pollution were identified.
- A 2018 rat study conducted by the Ramazzini Institute reported that low-dose exposures to Roundup at levels considered safe significantly altered the gut microbiota in some of the rat pups. Another 2018 study reported that higher levels of glyphosate administered to mice disrupted the gut microbiota and caused anxiety and depression-like behaviors.
- A 2018 rat study by Argentinian researchers linked low-level perinatal glyphosate exposures to impaired female reproductive performance and congenital anomalies in the next generation of offspring.

Glyphosate has also been linked by recent studies to harmful impacts on bees and monarch butterflies.

- A 2018 study reported that glyphosate damaged the beneficial gut bacteria in honeybees and made them more prone to deadly infections. This followed research from China showing that honeybee larvae grew more slowly and died more often when exposed to glyphosate, and a 2015 study that found field-levels of exposure impaired the cognitive capacities of honeybees.
- Research from 2017 correlated glyphosate use with reduced populations of monarch butterflies, possibly due to reductions in milkweed, the main food source for monarch butterflies.

Sri Lankan scientists awarded AAAS freedom award for kidney disease research

The AAAS has awarded two Sri Lankan scientists, Drs. Channa Jayasumana and Sarath Gunatilake, the 2019 Award for Scientific Freedom and Responsibility for their work to “investigate a possible connection between glyphosate and chronic kidney disease under challenging circumstances.” The scientists have reported that glyphosate plays a key role in transporting heavy metals to the kidneys of those drinking contaminated water, leading to high rates of chronic kidney disease in farming communities. See papers in SpringerPlus (2015), BMC Nephrology (2015), Environmental Health (2015), International Journal of Environmental Research and Public Health (2014). The AAAS award had been under review since February amidst a fierce opposition campaign by pesticide industry allies to undermine the work of the scientists.

Desiccation: another source of dietary exposures

Some farmers use glyphosate on non-GMO crops such as wheat, barley, oats, and lentils to dry down the crop ahead of harvest in order to accelerate the harvest. This practice, known as desiccation, may be a significant source of dietary exposure to glyphosate.

Glyphosate in food: U.S. drags its feet on testing

The USDA quietly dropped a plan to start testing food for residues of glyphosate in 2017. Internal agency documents obtained by U.S. Right to Know show the agency had planned to start testing over 300 samples of corn syrup for glyphosate in April 2017. But the agency killed the project before it started. The U.S. Food and Drug Administration began a limited testing program in 2016, but the effort was fraught with controversy and internal difficulties and the program was suspended in September 2016. Both agencies have programs that annually test foods for pesticide residues but both have routinely skipped testing for glyphosate.

Before the suspension, one FDA chemist found alarming levels of glyphosate in many samples of U.S. honey, levels that were technically illegal because there have been no allowable levels established for honey by the EPA. Here is a recap of news about glyphosate found in food:

- October 2018: FDA issued its first-ever report showing the results of its glyphosate residue in food testing. The FDA said no residues of glyphosate were found in milk or eggs, but residues were found in 63.1 percent of corn samples and 67 percent of soybean samples, according to FDA data. The agency did not disclose in that report the findings of glyphosate in oatmeal or honey products.
- April 2018: internal FDA emails indicated the agency had trouble finding food sample without traces of glyphosate.
- Sept. 2016: FDA found glyphosate in US honey at double the levels allowed in the EU, and FDA tests confirm oatmeal and baby foods contain glyphosate.
- Nov. 2016: FDA chemist found glyphosate in honey in Iowa at 10X higher levels than allowed in EU. Also in November, independent testing by consumer group Food Democracy Now found glyphosate in Cheerios, oatmeal cookies, Ritz crackers and other popular brands at high levels.

Pesticides in our food: Where’s the safety data?

USDA data from 2016 shows detectable pesticide levels in 85% of more than 10,000 foods sampled, everything from mushrooms to grapes to green beans. The government says there are little to no health risks, but some scientists say there is little to no data to back up that claim. See “Chemicals on our food: When “safe” may not really be safe: Scientific scrutiny of pesticide residue in food grows; regulatory protections questioned,” by Carey Gillam (11/2018).