

# Part 1: What's at Stake? Health, Climate, and Biodiversity

## The Rise of Glyphosate

Glyphosate is now the most widely used agricultural chemical in the world — it is registered in 130 countries, approved for use on over 100 crops, and marketed as 750 different types of products.<sup>22</sup> Traces of the chemical are found in many everyday foods, from cereal and hummus to honey and wine.<sup>23, 24</sup> Glyphosate is now so ubiquitous in the environment, it is even found in rain, contaminating 86 percent of samples gathered from across the United States.<sup>25</sup> And it's ubiquitous in our bodies, too. A June 2022 Centers for Disease Control study found the chemical in the urine of more than 80% of the children and adults they tested.<sup>26</sup> Never before have we sprayed so much of a chemical on our food, on our yards, and even on our children's playgrounds. But it wasn't always so widely used.

In 1970, a Monsanto chemist discovered that glyphosate, formerly used as a descaling agent, could be an effective herbicide. The company patented its use as a weedkiller that year and first marketed it under the trade name Roundup in 1974. For two decades, it was used less frequently than other herbicides, such as 2,4-D, dicamba, and atrazine. But, as Carey Gillam details in her investigative book on the history of glyphosate — *Whitewash: The Story of a Weed Killer, Cancer, and the Corruption of Science* — in the 1990s, as companies like Monsanto began gaining the technological capacity to genetically engineer crops, scientists at Monsanto discovered organisms in the sludge-filled waste ponds surrounding its Roundup production plant in Louisiana that could confer resistance to glyphosate.<sup>27</sup> The company successfully inserted genetic material from those bacteria into soybeans and found that the crop could withstand being sprayed with Roundup and continue to grow. The company saw huge potential. Historically, farmers would have to take care not to spray herbicides on their crops as it would kill them, but these new genetically engineered

“Roundup Ready” crops allowed farmers to spray glyphosate directly on their fields throughout the growing season, killing weeds without damaging their crops.

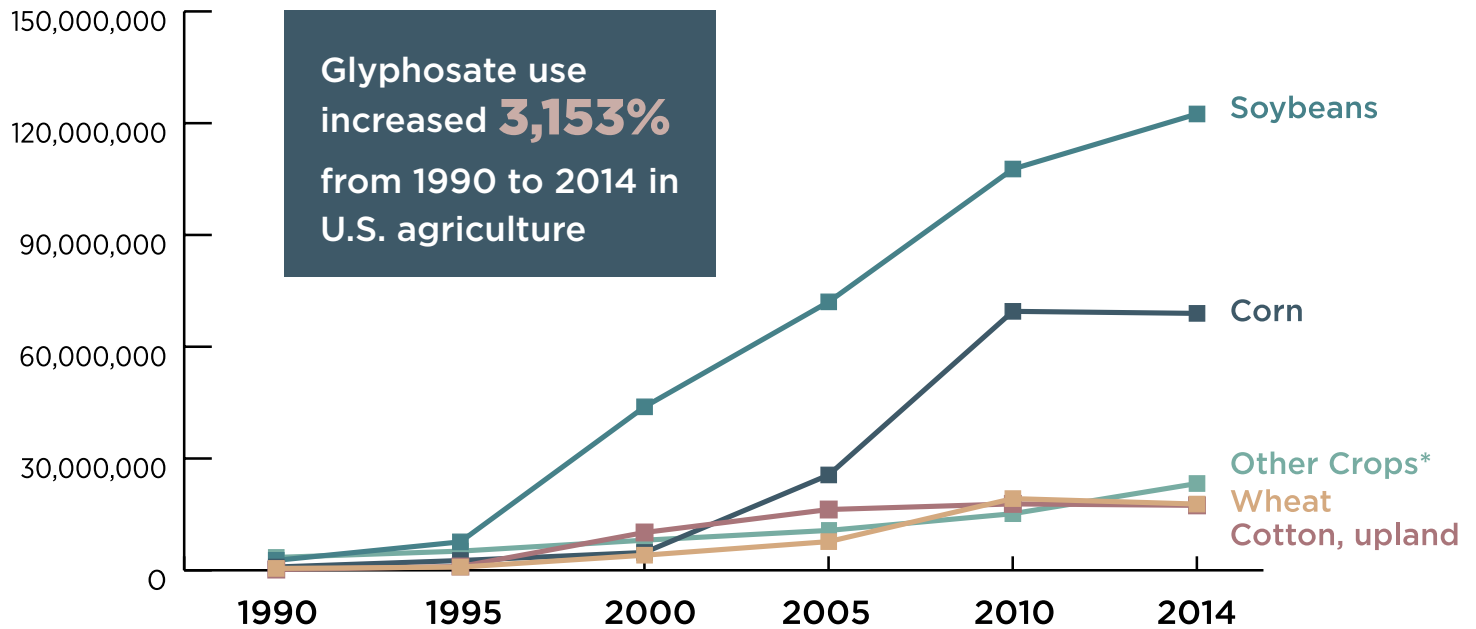


*“In the U.S., no pesticide has come remotely close to such intensive and widespread use.”*

Charles Benbrook,  
*Environmental Sciences Europe*

In 1996, Monsanto released GMO Roundup Ready soybeans followed in 1998 by Roundup Ready corn; these are two of the most widely planted crops in the U.S., representing over 180 million acres of production in 2021.<sup>28</sup> Engineering these crops to go hand-in-hand with glyphosate was a major market coup for Monsanto. Largely as a result of Roundup Ready corn and soy, use of glyphosate in the U.S. spiked 3,100 percent between 1990 and 2014,<sup>29</sup> by which point 94 percent of soybeans and 92 percent of corn acreage in the U.S. were Roundup Ready.<sup>30</sup> By the 2000s, Monsanto was making billions in revenue on glyphosate and the GMO seeds that go with it.<sup>31</sup>

**Figure 2: Increase in Agricultural Glyphosate Use in the United States**



\*Includes sorghum, sugar beets, canola, oranges, barley, and alfalfa

Source: Benbrook, C. (2016). Trends in glyphosate herbicide use in the United States and globally. *Environ Sci Eur.* 28(1): 3. Data are pounds of active ingredient applied

In 2018, German agrichemical giant Bayer AG purchased the company for \$63 billion, evaluating it as a solid investment,<sup>32</sup> presumably based on current and projected profits from the lucrative herbicide and GMO seed segment of the company's operations. But by that year, there had already been evidence emerging about the safety of glyphosate — evidence Bayer chose to ignore and continues to deny.<sup>33</sup> Mounting concern about the safety of glyphosate would soon cost the company billions of dollars. (In this report, we will refer to Monsanto for activity before its purchase by Bayer AG, which since 2003 has been structured as a holding company for its pharmaceutical and chemical businesses as well as its agricultural input business, known as Bayer CropScience. For post-2018 activity, we will refer to Bayer).

## The science of glyphosate's harms

Despite the fact that scientists at the U.S. Environmental Protection Agency [flagged](#) glyphosate as having the potential to cause cancer as far back as 1984,<sup>34</sup> Monsanto's spin tactics, many of which are detailed in this

report, have long suppressed these concerns and maintained a widely held public narrative that the herbicide is benign.<sup>35</sup> The company even ran ads claiming glyphosate was safer than table salt.<sup>36</sup>

However, in March 2015, thirty years after the EPA first raised cancer concerns about glyphosate, the herbicide was publicly classified as a probable human carcinogen.<sup>37</sup> The finding came from the world's premiere independent cancer research agency — the World Health Organization's International Agency for Research on Cancer (IARC). The agency is tasked with identifying cancer hazards, and its classifications have global implications, influencing public policy, regulatory decisions, public health recommendations, and litigation.<sup>38</sup> IARC found "strong" evidence of genotoxicity (damage to genetic information within a cell causing mutations, which may lead to cancer) and a "statistically significant association between non-Hodgkin lymphoma and exposure to glyphosate."<sup>39</sup>



DeWayne “Lee” Johnson, a groundskeeper for California schools, was the first cancer victim to take Monsanto to court.

©Josh Edelson/Getty Images

## The Roundup Trials

In the years following the IARC classification, more than 125,000 people have sued Monsanto over claims that Roundup and other glyphosate-based herbicides caused them or their loved ones to develop non-Hodgkin lymphoma, a cancer that affects the immune system. Plaintiffs include farmers, school and park groundskeepers, and homeowners who used products like Roundup on their lawns and gardens.

The first trial, *Dewayne Johnson v. Monsanto Company*, concluded in August 2018.<sup>40</sup> School groundskeeper Dewayne “Lee” Johnson developed non-Hodgkin lymphoma after routinely using glyphosate-based herbicides at his job. Johnson reports that, despite wearing protective gear, he was soaked in the herbicide after a hose broke on his equipment. He later developed rashes, lesions, and was soon diagnosed with cancer.<sup>41</sup> A jury awarded Johnson \$289 million (reduced to \$78 million by the judge), which included compensation for damages along with punitive damages based on the finding that Monsanto failed to warn consumers of its products’ potential dangers.

The next two trials were brought by homeowners who frequently used Roundup on their properties, first Edward Hardeman and then a married couple, Alberta and Alva Pilliod. In both cases, juries unanimously found that Roundup caused the plaintiffs’ non-Hodgkin lymphoma and also found that Monsanto acted negligently by not warning about risk. Hardeman was awarded \$80 million in damages, while the jury awarded the Pilliods over \$2 billion, which was then cut to \$86.7 million by the judge.

After losing the first three trials, Monsanto owner Bayer set aside roughly \$14 billion to cover Roundup cancer claims. Litigation and settlement talks are ongoing. In June 2022, The Supreme Court of the United States rejected Bayer’s bids to dismiss legal claims in two cases. The court left in place lower court decisions upholding the judgements and jury awards for Hardeman and the Pilliods.<sup>42</sup>

For more information see: <https://usrtk.org/monsanto-papers/>



Cancer is not the only health concern associated with glyphosate. Research has linked the chemical to high rates of kidney disease in farming communities and to shortened pregnancy and low birth weight in a cohort of women in the Midwest.<sup>43,44</sup> Animal studies and bioassays have linked glyphosate and its formulations to endocrine disruption, decreased sperm function, and disruption of the gut microbiome.<sup>45,46,47,48,49</sup> One animal study found a link with increased risk of fatty liver disease even at ultra-low doses of glyphosate.<sup>50</sup> Research also shows that glyphosate is genotoxic, causing DNA damage in human cells that can lead to cancer.<sup>51</sup>

What's more, research shows that when glyphosate is combined with other chemicals in commercial formulations, such as Roundup, the end product may be much more harmful than glyphosate alone.<sup>52</sup> While research has raised important health concerns about ingredients such as surfactants that help glyphosate penetrate the surface of plants, regulators have failed to address the safety of these ingredients or how they may interact with glyphosate to harm human health.<sup>53</sup>

In the environment, glyphosate can kill or harm 93 percent of the plants and animals protected under the Endangered Species Act, according to the EPA.<sup>54</sup> Researchers have identified glyphosate use as a primary driver of the decimation of monarch butterfly populations because the ubiquity of spraying is wiping out the milkweed plants their young depend on.<sup>55</sup> And glyphosate is now linked to bee declines as emerging research shows that it can have a range of negative impacts, from killing bees outright to reducing their ability to reproduce and find food.<sup>56,57,58,59</sup> Mounting evidence also shows that glyphosate harms critical soil organisms, from the mycorrhizal fungi that enable the flow of carbon to the soil, to the earthworms that are responsible for healthy soil structure.<sup>60,61</sup>

The ecological sourcing of glyphosate — largely from phosphate mines in southeastern Idaho — is also problematic. To produce glyphosate, phosphate ore is extracted and refined into elemental phosphorus. This mining involves stripping the soil off mountaintops, which destroys vegetation, contaminates water, creates noise and air pollution, and destroys acres of habitat for critical species.<sup>62</sup>

Processing the ore into glyphosate raises further concerns. A plant in Soda Springs, Idaho formerly owned by Monsanto and now owned by Bayer, is the only site in North America that can refine phosphate ore into elemental phosphate. The plant has been designated as a Superfund site and has resulted in decades-long contamination of groundwater and contributes to surface-water pollution that violates Idaho water-quality standards in several nearby streams and creeks.<sup>63,64</sup>

An overwhelming body of science suggests that, from sourcing to processing to end product, glyphosate imperils the health of ecosystems and people.

## The spin and its consequences

As illustrated in the section that follows, the story of glyphosate is one of spin and deflection by Monsanto — and subsequently Bayer — and their product defense consultants, PR firms, and others. We describe how Monsanto worked to shape the scientific record for over 40 years to protect its use of glyphosate. We show how the company co-opted academic institutions and paid academics to promote and defend its products, and lobby for deregulation. We document how the company deployed a wide range of third-party allies — many of whom falsely claimed to be independent of industry — to defend its products, attack the scientists who raised cancer concerns about glyphosate, and dominate online spaces, including Google “news” searches, with pesticide industry messaging.

These tactics have had very real consequences. Despite evidence of harm, the federal government turned a blind eye when it came to monitoring glyphosate — failing to test for it on food until 2016 and in our bodies until 2022, despite doing so for other commonly used pesticides for decades. And rather than restricting the use of glyphosate, the EPA has raised the legal threshold for residues on some foods up to 300-fold since the 1990s.<sup>65</sup> Glyphosate now finds its way into our food supply at alarming levels not only because it is used so widely on genetically engineered corn and soy, but also because it is increasingly sprayed on crops such as wheat, oat, and beans just before harvest to kill them so that they dry uniformly — a process known as desiccation.

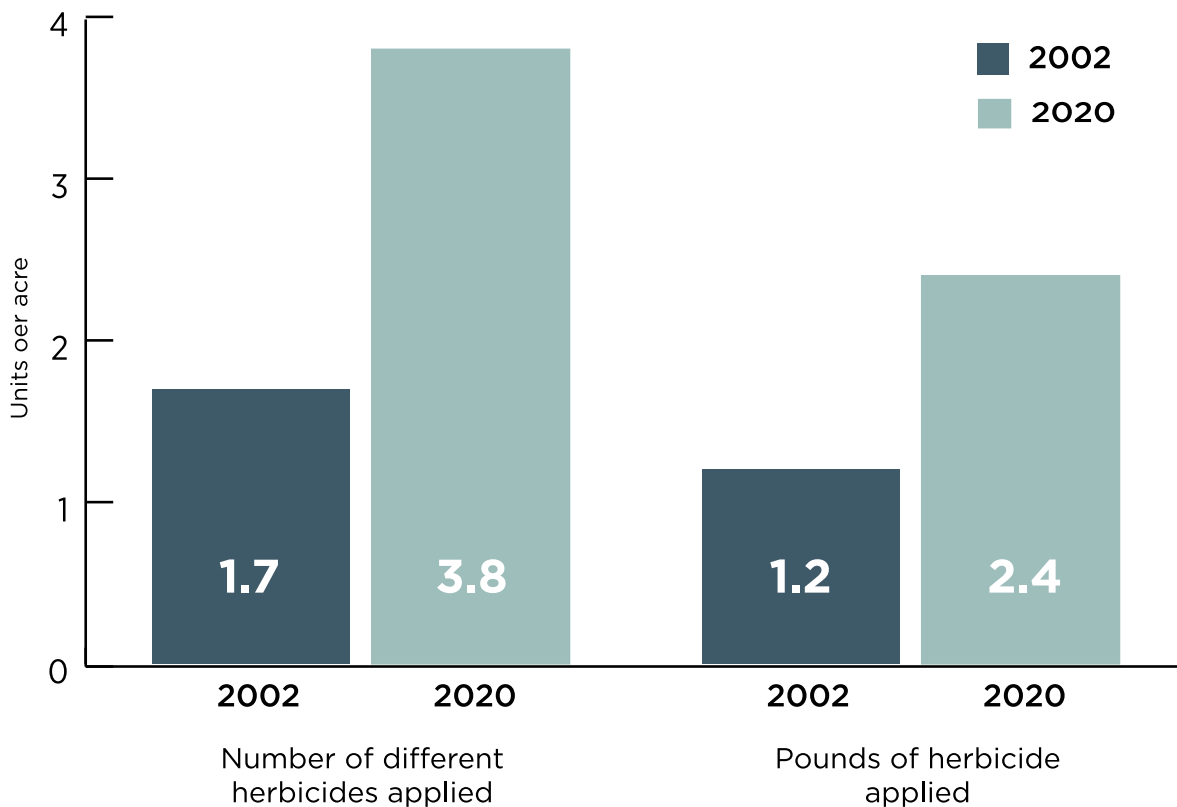
The EPA's slipshod regulation of glyphosate has led to a dramatic increase in exposure. Research shows that the percentage of the U.S. population with detectable levels of glyphosate in their bodies increased from 12 percent in the early 1990s to 70 percent by 2014.<sup>66</sup> A 2020 study suggests even more widespread exposure, finding glyphosate in all study participants.<sup>67</sup>



Genetically engineered crops have accelerated a pesticide treadmill. Bayer AG is now developing a corn seed that is genetically engineered to resist five herbicides at once.

What's more, Roundup Ready genetically engineered crops have accelerated a destructive pesticide treadmill. "Superweeds" that no longer respond to glyphosate now plague more than 60 million acres of U.S. farmland.<sup>68</sup> As the efficacy of glyphosate has waned over the past decade, the use of herbicides across the American Midwest has doubled as farmers attempt to deal with herbicide-resistant weeds.<sup>69</sup> In fact, despite using significantly more pesticides than they did more than half a century ago, farmers are actually losing more of their crops to pests — including weeds, insects, and fungi. The pesticide industry is doubling down on this failing but lucrative approach, with the latest genetically engineered crops designed to tolerate multiple herbicides, for example glyphosate and 2,4-D combined. As of 2020, farmers were using 19 times more 2,4-D and dicamba — antiquated chemicals linked to increased risk of cancer, reproductive problems, genetic damage and more.<sup>70</sup> And Bayer AG is now developing a corn seed engineered to resist five herbicides at once: 2,4-D, dicamba, glufosinate, glyphosate, and quizalofop.<sup>71</sup> USDA is reviewing the proposal, as of publication.

**Figure 3: Average use of herbicides per acre on soybeans in the U.S. doubled from 2002 to 2020**



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Pete Myers, PhD, chief scientist,  
Environmental Health Sciences

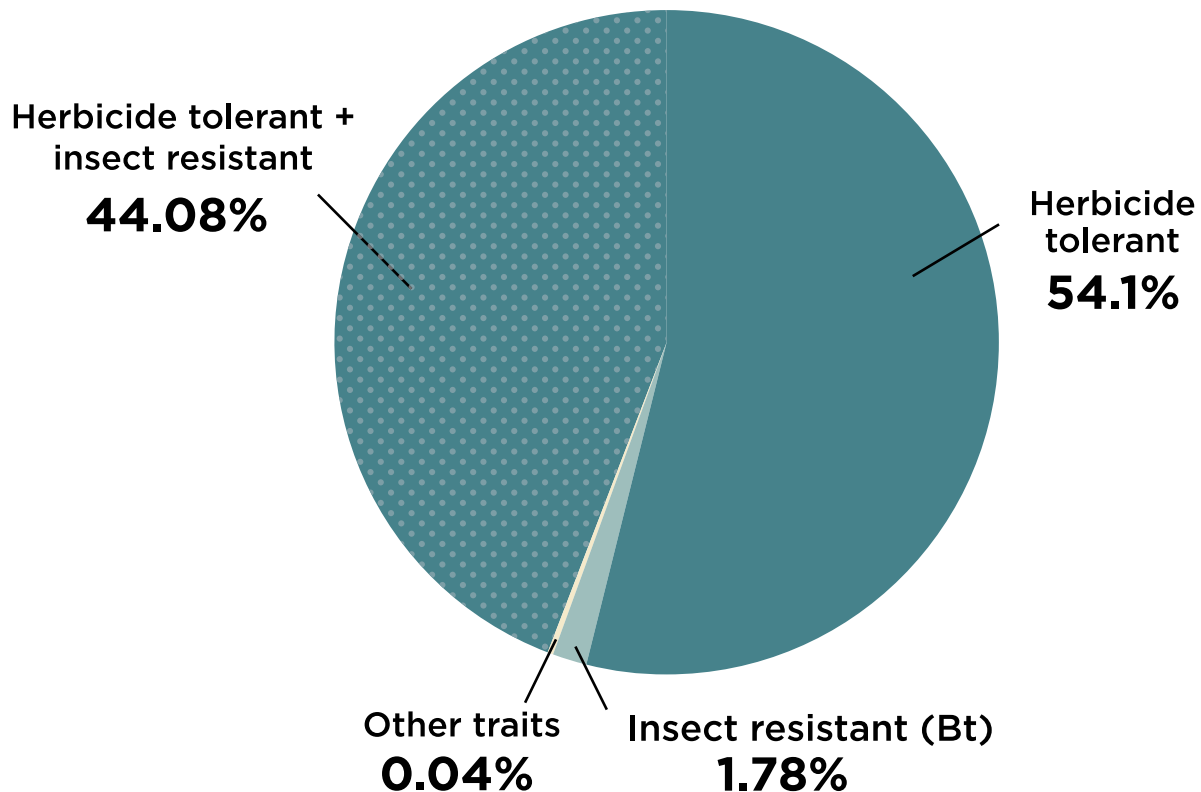
These consequences highlight the urgency of understanding and combating the pesticide industry’s spin as we face a future in which hazardous pesticide use is likely to rise. This must go along with holding regulators accountable and pushing to modernize the

way EPA uses scientific data. As the biologist Pete Myers states: “Regulatory agencies use science out of the Jurassic. The possibility that they might begin to use modern science is an existential threat to the chemical industry as we know it.”

[For more information, see Appendix II: Debunking the Myth that Pesticides Are Safe and Necessary.](#)

To continue with the overuse of toxic pesticides to grow our food is like continuing dependence on coal as an energy source: the preponderance of scientific data points to more sustainable and economically efficient solutions (See Appendix III: Science of Solutions). It is in this context that it is necessary to understand the pesticide industry’s efforts to silence concerns and dilute the voices of communities and agroecological experts — using a range of spin tactics we dive into next.

### Total herbicide tolerant acreage: 98.18%



**Figure 4: Genetically Engineered Seed Traits by Crop Acreage in United States**

Source: ISAAA Briefs 52 Global Status of Commercialized Biotech/GM Crops: 2016