



“Forever Chemicals” are Pesticides, Too

There are millions of per- and polyfluoroalkyl substances (PFAS), which are fluorinated substances that are used for many different industrial applications.¹ Some notorious examples are perfluorooctanoic acid (PFOA), used in nonstick coatings, and perfluorooctanesulfonate (PFOS), used in grease proofing coatings for paper food containers. Both PFOA and PFOS have been listed under the Stockholm Convention for Persistent Organic Pollutants, a global ban on the most harmful and persistent chemicals that are carried via environmental processes to remote locations such as the Arctic, where they affect the health of indigenous Arctic peoples.²

One important characteristic of PFAS is that the carbon-fluorine bond is very strong, which makes the chemicals resistant to breaking down. This means that PFAS chemicals are persistent, and slow to break down in the environment. This persistence makes them very concerning for public health.

Many health effects are associated with PFAS exposure, and most people are exposed to them in daily life.³ There are also a number of PFAS pesticides registered in the U.S., which is an important concern for human health and the environment.

Definitions of PFAS

Defining PFAS is important for regulating them. EPA’s regulatory definition is relatively narrow compared to some other existing PFAS definitions, and encompasses one of three types of structures that include at least two fluorinated carbons.⁴ EPA’s definition excludes thousands of “forever chemicals” from PFAS classification—including some pesticides that are considered PFAS—and provides a major regulatory loophole widely supported by the chemical industry. States have the right to define PFAS more broadly than EPA to include a greater number of these chemicals under protective regulations.

Minnesota law defines PFAS as “... a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom.”⁵ A widely used Organization for Economic Co-operation and Development (OECD) definition of PFAS includes chemicals that have at least one perfluorinated methyl ($-\text{CF}_3$) or methylene group ($-\text{CF}_2-$). The OECD definition is a preferred definition for many environmental and health advocates, as it includes a greater number of PFAS chemicals and would thus be more health protective.⁶

Pesticide ingredients & breakdown products

Agricultural pesticides are used to manage pests, including weeds, in crops. Pesticide formulations consist of active ingredients (AI) and “inert” ingredients. Inert ingredients in pesticide formulations are protected as confidential business information and are not required to be publicly disclosed on the pesticide label.⁷ Additional products that can be applied during a pesticide application are called adjuvants. Adjuvants are not regulated as pesticides by EPA and can aid in application, efficacy, or can reduce pesticide drift. Some states regulate adjuvants—for example, California requires adjuvants to be registered as pesticides.⁸

These three components (AIs, inert ingredients, and adjuvants) are important for understanding more about how PFAS could be introduced into a pesticide product.

Pesticide AIs can degrade, and these breakdown products still have potential to affect health and the environment. For example, EPA found that the PFAS pesticide broflanilide and its fluorinated breakdown products are likely to accumulate in the environment and have potential to bioconcentrate, or accumulate in aquatic organisms.⁹

PFAS pesticides

Donley et al. (2024) analyzed EPA data on PFAS pesticides used in the U.S. Of the 471 conventional pesticide AIs identified in the study, there were 107 that had at least one carbon-fluorine bond. Sixty-six of the 471 conventional AIs met the OECD definition of PFAS (see Table 1). The list of PFAS AIs registered in the U.S. includes registration dates ranging from 1964 to 2021.¹⁰

The study also found that fluorination is a recent trend among new registrations of pesticide AIs, with 61% of the 54 conventional AIs registered from 2012 to 2021 classified as organofluorines and 30% classified as PFAS.

The majority of PFAS AIs identified by the study are “intentional” PFAS pesticides. However, inert ingredients and adjuvants could potentially be PFAS themselves. Some inert ingredients disclosed by EPA via public records request by the authors were recently canceled. This leaves 11 organofluorine inerts still registered in the U.S., with eight of those meeting the OECD definition of PFAS.

Table 1. Conventional U.S. pesticide active ingredients (AI) that are organofluorines or PFAS as of 2021.

Of the 471 unique, conventional AIs registered in the U.S., 107 were fluorinated and 66 met OECD’s definition of PFAS. In the last 10 years (2012–2021), 33 of 54 approved AIs were organofluorines, and 16 of 54 were PFAS.

	Organofluorines	PFAS
Conventional AIs/ all registered AIs	107/471 23%	66/471 14%
Conventional AIs/ all AIs registered 2012–2021	33/54 61%	16/54 30%

Table adapted from Figure 1 in Donley et al. (2024). PFAS: per- and polyfluoroalkyl substances, OECD: Organization for Economic Co-operation and Development.

Some AIs are “intentional” PFAS pesticides, others may have been contaminated by PFAS due to their storage containers or unknown sources, and others may have PFAS in their inert ingredients. Finally, leaching of PFAS from fluorinated storage containers has been found by multiple researchers. And, there may be other types of unintentional PFAS contamination, as discussed in the Donley et al. (2024) study.

The adjuvants mystery

Since adjuvants are not federally regulated in the same way as pesticides, publicly accessible data are not readily available. The authors were able to get a very limited amount of information disclosed about adjuvants used in California and Washington—however, their analysis was limited to those states, incomplete, and inconclusive due to the limited amount of information available.¹⁰ It’s not clear whether there are any PFAS adjuvants used in the U.S. Adjuvants are, however, known to be used intensively in California.¹¹

Policy recommendations for PFAS and pesticides

Defining PFAS

State bills around PFAS should use the broader chemical definition proposed by OECD, rather than relying on EPA’s narrow PFAS definition. At the federal level, legislation like the 2021 PFAS Definition Improvement Act seeks to hold EPA accountable for full regulatory responsibility over this whole class of chemicals.¹²

Banning PFAS in pesticides

Banning PFAS contamination of pesticides is crucial to avoid long-lasting and widespread damage to many acres of farmland—but enacting such restrictions poses legislative challenges. Because chemical companies are protected from disclosing pesticide formulation ingredients other than the AI, it is impossible for a legislative body to determine which pesticide products containing PFAS must be banned or reformulated. Maine addressed this issue by requiring that companies sign an affidavit for products registered, guaranteeing that they are PFAS-free.¹³ In Minnesota, legislation banning PFAS in pesticides passed without a clear indication of how the law will be implemented, and will not go into effect until 2032. Beware of the precedent set in Minnesota: language allowing regulatory exemptions for PFAS-containing pesticides that have an “essential use.”¹⁴ “Essential use” language opens a dangerous loophole for continued use of PFAS in pesticides, and further perpetuates the agrichemical industry’s false claim that pesticides are essential in agriculture. We know there are safer, economically viable alternatives to pesticides.¹⁵

Disclosure of adjuvants used in pesticide applications

Due to trade secret laws, the adjuvants in pesticides are not publicly disclosed. Environmental health advocates have long pushed for changing these laws and making all pesticide ingredients public. Without disclosure, we can’t know whether there are PFAS adjuvants being used and dispersed in the environment.

On-farm PFAS remediation

Hundreds of thousands of acres of U.S. farmland are known to have been contaminated by PFAS, largely through inputs of waste treatment plant sludge that is commonly marketed to farmers as a source of fertilizer. Contamination by PFAS-containing pesticides is a greater unknown, with most acreage in the U.S. remaining untested for PFAS. Farmers who are impacted by PFAS contamination need support—because they are often facing far-off remediation options, some land that cannot be used for farming again, and months, if not years, of halted operations. Federal bills like the Relief for Farmers Hit by PFAS Act (2023) provide needed testing, financial assistance, and remediation research.¹⁶

As of June 2023, Minnesota Department of Agriculture’s (MDA) interim report found that there were 95 pesticide active ingredients (AI) registered in the state that are PFAS under Minnesota law. MDA’s report did not disclose any inert pesticide PFAS ingredients, but MDA reported that it had identified at least six such ingredients using EPA’s database of inert ingredients.*

* Minnesota Department of Agriculture. PFAS in Pesticides: Interim Report to the Legislature.; 2024. <https://www.mda.state.mn.us/environment-sustainability/active-inert-pfas>

Notes

1. Schymanski EL, et al. Per- and Polyfluoroalkyl Substances (PFAS) in PubChem: 7 Million and Growing. *Environ Sci Technol*. 2023;57(44):16918-16928. doi:10.1021/acs.est.3c04855
2. Stockholm Convention on POPs, <https://chm.pops.int/>. Accessed 19 October, 2024.
3. Committee on the Guidance on PFAS Testing and Health Outcomes, et al., National Academies of Sciences, Engineering, and Medicine. *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up*. National Academies Press; 2022:26156. doi:10.17226/26156
4. U.S. EPA, TSCA Section 8(a)(7) Reporting and Recordkeeping Requirements for Perfluoroalkyl and Polyfluoroalkyl Substances, <https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/tsca-section-8a7-reporting-and-recordkeeping>. Accessed 19 October, 2024.
5. Minn.Statute 18B.01 subd. 15(c) and Minn. Stat. 116.943 subd. 1(p)
6. Wang Z, et al. A New OECD Definition for Per- and Polyfluoroalkyl Substances. *Environ Sci Technol*. 2021;55(23):15575-15578. doi:10.1021/acs.est.1c06896
7. U.S. EPA Inert Ingredients Overview and Guidance, <https://www.epa.gov/pesticide-registration/inert-ingredients-overview-and-guidance>. Accessed 19 October, 2024.
8. Cox C, Zeiss M. Health, Pesticide Adjuvants, and Inert Ingredients: California Case Study Illustrates Need for Data Access. *Environ Health Perspect*. 2022;130(8):085001. doi:10.1289/EHP10634
9. U.S. EPA 2020. *Broflanilide: Ecological Risk Assessment for the Proposed Section 3 New Chemical Registration*. EPA-HQ-OPP-2018-0053-0027.
10. Donley N, et al. Forever Pesticides: A Growing Source of PFAS Contamination in the Environment. *Environ Health Perspect*. 2024;132(7):075003. doi:10.1289/EHP13954
11. California Department of Pesticide Regulation (CDPR). “The Top 100 Chemicals by Acres Treated in Total Statewide Pesticide Use in 2021,” https://www.cdpr.ca.gov/docs/pur/pur21rep/top100lists/top_100_chemicals_by_acres_treated.pdf. Accessed 19 October, 2024.
12. H.R. 5987- PFAS Definition Improvement Act, <https://www.congress.gov/bills/117th-congress/house-bill/5987>. Accessed 19 October, 2024.
13. Public Law 2021, c. 477, <https://www.mainelegislature.org/legis/bills/getPDF.asp?paper=HP1113&item=5&sum=130>, Accessed 19 October, 2024.
14. Minnesota Pesticide Control Law, Statute Chapters 18B and 18B.26, <https://www.revisor.mn.gov/statutes/cite/18B>. Accessed 19 October, 2024.
15. Pesticide Action & Agroecology Network, *Pesticides and Climate Change: A Vicious Cycle*; 2023. <https://www.panna.org/resources/pesticides-and-climate-change-a-vicious-cycle/>. Accessed 21 October, 2024.
16. H.R. 1517, Relief for Farmers Hit by PFAS Act. <https://www.congress.gov/bills/118th-congress/house-bill/1517/text>. Accessed 19 October, 2024.