

Tribal Pesticide Program Council Fall 2026

Glyphosate: Regulatory and Scientific History of a Successful but Controversial Herbicide

Introduction: What Is Glyphosate?

Originally patented in 1961 for industrial uses, glyphosate was developed as a broad-spectrum herbicide in 1970 by Monsanto chemist John Franz. Although it is an active ingredient used in many pesticide products, Roundup is the most well-known brand of products that contains glyphosate. One of the most widely used herbicides in the United States, it is used to control weeds in a variety of crops including corn, cotton, alfalfa, berry crops, fruiting and leafy vegetables, cereal grains, herbs and spices, and stone fruits. Glyphosate is also applied to non-crop sites including forests, pasture and rangelands, and residential settings, among others. It became so prevalent because it controls a wide range of weeds, has a lack of soil residual activity (it generally does not remain active in soil), and provides systemic crop protection (it migrates within the plant rather than remaining on the surface). The EPA classifies glyphosate as a nonselective Group 9 herbicide, and it is registered for pre- and post-emergence application.

A History of Regulation

Since it was first registered in the United States in 1974, the EPA's assessment of the pesticide has evolved over time. In 1985, the EPA classified glyphosate as a Group C chemical (Possible Human Carcinogen), based on a finding of kidney tumors in male mice. The following year, the EPA requested further evaluation of the carcinogenic potential and asked the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Scientific Evaluation Panel (SAP) to provide feedback. The result was a new classification as a Group D chemical (Not Classifiable as to Human Carcinogenicity). FIFRA SAP found the tumor findings were equivocal, the tumors were adenomas (benign), and the increase was not statistically significant. They advised the EPA to issue a data call-in for further studies examining this question, and two additional rat carcinogenicity studies were completed and evaluated in 1991 by the EPA's Carcinogenicity Peer Review Committee (CPRC). Based on these additional studies, the CPRC classified glyphosate as a Group E chemical (Evidence of Non-Carcinogenicity for Humans) due to a lack of evidence in mice and rats for carcinogenicity, and a lack of concern for mutagenicity.

FOR INFORMATION OR TO SUBSCRIBE CONTACT:
Mark Daniels, TPPC Coordinator
mark.daniels@nau.edu

OR VISIT US ON THE WEB AT: tppcwebsite.org

Glyphosate *(continued)*



In 2009, the EPA initiated the registration review process for glyphosate, to ensure it is still performing the specific purpose it was designed for without creating unreasonable adverse effects to human health and the environment. In 2010, as part of this review, the EPA required additional studies by registrants of glyphosate products to support human health and ecological risk assessments. A few years later in 2015, the EPA reexamined the carcinogenic potential of glyphosate. This in-depth review included data from epidemiological, animal carcinogenicity, and genotoxicity studies. It should also be noted that this same year, the International Agency for Research on Cancer (IARC) classified glyphosate as "probably carcinogenic to humans" (Group 2A) based on a hazard assessment as opposed to a risk assessment.

In 2016, the EPA consulted the FIFRA SAP to further discuss issues related to carcinogenic potential. The FIFRA SAP was split, with some members agreeing with the EPA's conclusion of "not likely to be carcinogenic to humans" and others who felt that it should be replaced with the hazard descriptor "suggestive evidence of carcinogenic potential." In December 2017, the EPA published the glyphosate human health and ecological risk assessments, showing no human health risks of concern for dietary or residential exposures. In May of 2019, the EPA published the Proposed Interim Registration Review Decision and responses to risk assessment comments, with the final decision being published in February 2020. The EPA identified potential risk to mammals and birds, limited to the application area or those near the application area. They also concluded that there is risk to terrestrial and aquatic plants from off-site spray drift, but it is consistent with use as an herbicide.

In March 2020, EPA's interim registration decision was challenged in the U.S. Court of Appeals for the Ninth Circuit over its assessment of human-health and ecological risks, risk mitigation measures, and compliance with the Endangered Species Act (ESA). Following the court proceedings, the Ninth Circuit vacated the human-health portion of the decision and required further consideration of ecological risks. EPA withdrew the interim decision in September 2022, and its reassessment of glyphosate remains ongoing.

How Can People Be Exposed to Glyphosate?

Human exposure to glyphosate can occur in several ways. Farmers, landscapers, and forestry workers are regularly handling and spraying glyphosate as part of their occupation, and a lack of personal protective equipment can increase their risk of exposure. Residential use, such as people using weed killer on their home garden, can expose them to glyphosate by breathing in the spray mist, getting it on their skin and eyes, and not washing hands after use. Another pathway can occur through diet, as residue has been detected on various foods including grains, legumes, fruits, honey, etc. Lastly, people who live in proximity to farms and other lands treated with glyphosate can have increased levels of airborne exposure.

Research and Health Concerns

Cancer

Andreotti et al. (2018) conducted a prospective cohort study of licensed pesticide applicators, also referred to as the Agricultural Health Study (AHS), in which they measured cumulative lifetime exposure to glyphosate

and 49 other pesticides. The findings suggest no associations between glyphosate use and non-Hodgkin lymphoma (NHL) overall. This study design is helpful because they followed agricultural workers over time and collected exposure information from them at multiple points. Other studies are often case control studies where people with cancer recall past exposure after they have already been diagnosed. Acquavella (2023) conducted a review of epidemiolocal evidence and examined exposure frequency, systemic dose, and study quality for nine studies. The AHS was included in this review and found to be the only study out of nine that involved relatively frequent exposure to glyphosate and also addressed potential confounding by personal factors and other pesticide exposures.

A 2019 meta-analysis found support for an association between exposure to glyphosate-based herbicides and risk for NHL (Zhang et al., 2019). This study looked at high cumulative exposures to glyphosate-based herbicides and increased risk of non-Hodgkin lymphoma (NHL) in humans. They included data from the AHS and combined it with five case-control studies (though it is important to note that they interpreted the AHS data differently than the AHS researchers' own analysis). Zhang et al. (2019) also included a discussion of animal and mechanistic studies related to lymphoma. The researchers found a link between exposure to glyphosate-based herbicides and increased risk for NHL, reporting a 41% higher risk among the highest exposure groups.



This connection was explored again in Donato et al. (2020), where they considered occupational exposure to glyphosate and cancer risk by examining seven non-overlapping studies of NHL and three of multiple myeloma. The researchers found no statistically significant overall association of an increased risk for NHL and multiple myeloma. However, when they completed secondary analyses looking at particular subsets of the data, they found that people in the highest exposure category appeared to have a small increase in these cancers, along with an increased risk for diffuse large B-cell lymphoma.

In 2021, another meta-analysis was conducted exploring the link between exposure to glyphosate and risk of NHL (Boffetta et al., 2021). The researchers used six non-overlapping studies and found the overall evidence did not support an association with NHL, however they noted that an association with diffuse large B-cell lymphoma deserves attention and cannot be ruled in their analyses.

A final study worth mentioning is the 2026 meta-analysis that examined glyphosate exposure and NHL risk by Gagnier & O'Conner (2026), which reported increased odds of NHL among people who had ever been exposed to glyphosate and a larger association among those in the highest exposure categories. The authors considered their findings robust to sensitivity analyses.

Questions about glyphosate's potential cancer risks have also played out in the courts. Although court cases are not scientific evidence, they are important context for understanding why cancer has become a prominent part of the glyphosate debate. Bayer acquired Monsanto in 2018 and inherited extensive litigation alleging that exposure to Roundup caused NHL. In 2020, Bayer agreed to pay up to $10.9 billion to settle a substantial portion of the existing and potential litigation, close to 100,000 U.S. lawsuits. In February 2026, Monsanto announced a Roundup class settlement, funded at up to $7.25 billion over as many as 21 years,

to resolve current and future claims. As of October 2026, the proposed settlement remains under judicial review and other Roundup cases continue to move through the courts.

Pregnancy and Early-Childhood Health

In 2024, researchers studied the potential association between glyphosate exposure and perinatal health (Reynier & Rubin, 2024), examining the relationship between the introduction of genetically modified, glyphosate-tolerant crops, increased glyphosate use, and perinatal health outcomes in U.S. counties. The findings suggest glyphosate adversely affected births across several perinatal health measures, specifically birthweight and gestational length. The study provided population-level evidence of an association that the researchers interpret as causal. However, it does not measure individual glyphosate exposure directly and should be considered when evaluating the findings.

Neurological Effects and Neuroinflammation

Researchers have investigated whether glyphosate exposure may affect the brain. In a 2024 study, Bartholomew and colleagues exposed mice, including mice genetically engineered to develop Alzheimer's disease-like pathology, to glyphosate for 13 weeks and then allowed the animals to recover for six months (Bartholomew et al., 2024). The researchers detected glyphosate metabolites in brain tissue after the recovery period and reported persistent changes in inflammatory markers and Alzheimer's disease-related pathology, support suggestions that underlying health issues in the Alzheimer's disease model may be exacerbated by glyphosate exposure. The authors concluded that their findings warrant further investigation into potential effects of glyphosate and its metabolites on the human brain (since their study focused on mice).

What Happens Next? EPA's Ongoing Reviews

Although the EPA withdrew its 2020 interim registration decision, its review of glyphosate has continued. They are reconsidering scientific evidence on human-health risks while also focusing on unanswered questions regarding ecological risks and protections for endangered species.

In February 2026, President Trump issued an executive order directing federal action to ensure an adequate supply of elemental phosphorus and glyphosate-based herbicides. The order identified glyphosate-based herbicides as important to U.S. agricultural productivity and food-supply security and delegated certain authorities under the Defense Production Act to the Secretary of Agriculture to help maintain their supply. The executive order was a national-security and agricultural-supply policy action rather than a scientific assessment of glyphosate's health or environmental risks.

In August 2026, the EPA, as part of its update to the human-health assessment of glyphosate, opened a public feedback period on a glyphosate open-literature search. This process allows for additional scientific evidence to be highlighted and considered as the EPA makes their assessment and decision on the potential health effects of glyphosate. EPA is also collaborating with the Department of Health and Human Services to expand the evidence available for EPA's review. The deadline for comments identifying peer-reviewed studies for the EPA to consider is November 23, 2026.



Glyphosate *(continued)*



The ecological review is also in progress. The EPA initially issued a draft biological evaluation for glyphosate for public comment in November 2020. In May 2021, the EPA requested a partial voluntary remand to reconsider the ecological portion of the interim decision. The final draft of the biological evaluation was issued in November 2021, and a formal consultation was initiated and is still ongoing with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service.

The outcome of these reviews, including EPA's evaluation of newer cancer research, other potential human-health effects, and risks to endangered species, will be instrumental in shaping the regulatory decisions about glyphosate in the coming years.

References

Acquavella, J. (2023). Epidemiologic studies of glyphosate and non-Hodgkin's lymphoma: A review with consideration of exposure frequency, systemic dose, and study quality. Global Epidemiology, 5(100101).

Andreotti, G., Koutros, S., Hofmann, J. N., Sandler, D. P., Lubin, J. H., Lynch, C. F., Lerro, C. C., De Roos, A. J., Parks, C. G., Alavanja, M. C., Silverman, D. T., & Beane Freeman, L. E. (2018). Glyphosate use and cancer incidence in the Agricultural Health Study. Journal of the National Cancer Institute, 110(5), 509–516.

Bartholomew, S. K., Winslow, W., Sharma, R., Pathak, K. V., Tallino, S., Judd, J. M., Leon, H., Turk, J., Pirrotte, P., & Velazquez, R. (2024). Glyphosate exposure exacerbates neuroinflammation and Alzheimer's disease-like pathology despite a 6-month recovery period in mice. Journal of Neuroinflammation, 21(316), 1-19.

Boffetta, P., Ciocan, C., Zunarelli, C., & Pira, E. (2021). Exposure to glyphosate and risk of non-Hodgkin lymphoma: An updated meta-analysis. Med Lav, 112(3), 194–199.

Donato, F., Pira, E., Ciocan, C., & Boffetta, P. (2020). Exposure to glyphosate and risk of non-Hodgkin lymphoma and multiple myeloma: An updated meta-analysis. Med Lav, 111(1), 63–73.

Gagnier, J. J., & O'Connor, J. P. (2026). A systematic review and meta-analysis of glyphosate-based herbicide exposure and risk of non-Hodgkin lymphoma. International Journal of Environmental Research and Public Health, 23(1000), 1-22.

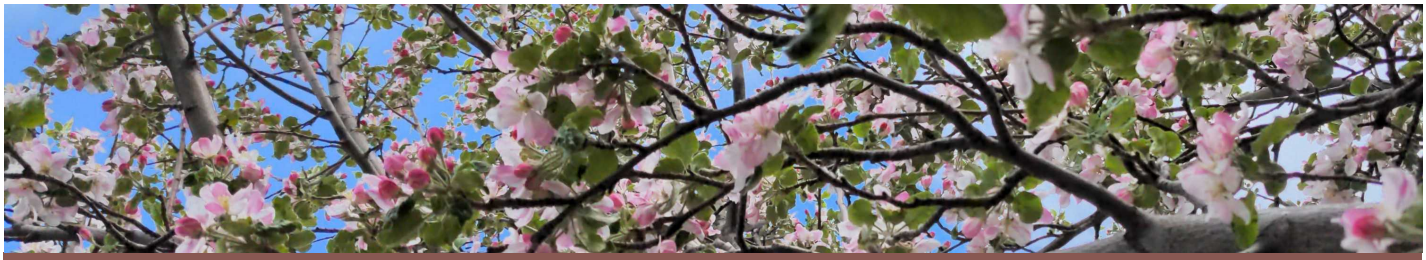
Reynier, E., & Rubin, E. (2025). Glyphosate exposure and GM seed rollout unequally reduced perinatal health. Proceedings of the National Academy of Sciences, 121(3), 1-12.

Zhang, L., Rana, I., Shaffer, R. M., Taioli, E., & Sheppard, L. (2019). Exposure to glyphosate-based herbicides and risk for non-Hodgkin lymphoma: A meta-analysis and supporting evidence. Mutation Research/Reviews in Mutation Research, 781, 186–206.

TPPC Executive Committee Vacant Positions

The Executive Committee consists of TPPC Members elected by their peers to represent their regions on the Council. When fully staffed the Executive Committee includes the Chair and Vice-Chair, representatives from each of the ten EPA regions as well as one from Alaska, and four At-Large positions. Executive Committee members are responsible for ensuring that their region's tribes are represented at TPPC meetings in order to determine and raise issues of importance to these tribes, and relay information back to them. Executive Committee members are encouraged to communicate with their Regional Tribal Operations Committee (RTOCs) and EPA Regional Offices prior to TPPC meetings in order to identify pesticide program needs and issues.

The TPPC is currently seeking regional representatives to fill several vacancies on the Executive Committee and represent their Tribes' and/or Tribal Organizations interests' related to pesticides and environmental concerns. Representatives must be nominated by a TPPC member from their region or may nominate themselves, and the representative must have an authorization letter on file. Current vacancies include Regions 1, 3, 4, 5, 6, and Alaska. If you are interested in representing your region or have questions about participating in the Executive Committee, please contact TPPC Coordinator Mark Daniels at mark.daniels@nau.edu or (928) 523-8897.



Updates and Announcements

Conferences and Meetings:

TPPC Fall Meeting

The TPPC will hold its Fall meeting November 3-5, hosted by the Saint Regis Mohawk Tribe, in person and online. For more information click here.

Full SFIREG Meeting

The State FIFRA Issues Research and Evaluation Group (SFIREG) will hold their Winter meeting December 8-9 in Alexandria, VA. For more information click here.

AAPCO Annual Meeting

The Association of American Pesticide Control Officials (AAPCO) will hold their annual meeting February 28 - March 3 in Alexandria, VA. For more information click here.

Trainings and Courses:

Tribal PIRT

The The NASDA Foundation will hold a Tribal Pesticide Inspector Residential Training program (PIRT) January 11-14 at the Ak-Chin Indian Community. For more information click here.

TPPC Executive Committee Members

Renee Keezer
TPPC Chairperson
White Earth Nation
Renee.Keezer@whiteearth-nsn.gov

Nina Hapner
TPPC Vice Chairperson
Kashia Band of Pomo Indians
nina@stewartspoint.org

(Vacant)
Region 1 Representative

Tyler Jacobs
Region 2 Representative
Saint Regis Mohawk Tribe
tyler.jacobs@srmt-nsn.gov

(Vacant)
Region 3 Representative

(Vacant)
Region 4 Representative

(Vacant)
Region 5 Representative

(Vacant)
Region 6 Representative

Virginia Snake-Bumann
Region 7 Representative
Winnebago Tribe
virginia.snake-bumann@winnebagotribe.com

Gerald Wagner
Region 8 Representative
Blackfeet Nation
beo.director@gmail.com

Tacy Jensen
Region 9 Representative
Gila River Indian Community
Tacy.Jensen.DEQ@gric.nsn.us

Cricket (Joe) Herrera
Region 10 Representative
Yakama Nation
Joe_herrera@yakama.com

Africa Dorame-Avalos
At-Large Representative
Inter Tribal Council of Arizona
africa.dorame-avalos@itcaonline.com

Eric Gjevre
At-Large Representative
Coeur d'Alene Tribe
egjevre@cdatribe-nsn.gov

Jefferson Biakeddy
At-Large Representative
Navajo Nation
jbiakeddy@navajo-nsn.gov

Jessica Raspitha
At-Large Representative
Saint Regis Mohawk Tribe
jessica.raspitha@srmt-nsn.gov

The TPPC is a member-based organization with more than 106 members from 67 Tribes and tribal organizations as of July 2026, whose activities are funded by a cooperative agreement with the EPA. The Council serves as a tribal technical resource, and provides a forum for dialogue between Tribes and the EPA on program and policy development relating to pesticides issues and concerns. Assistance provided to Tribes includes support in building tribal pesticide programs and conducting pesticide education and training, and the preparation of resources for Tribes interested in specialized issues such as Integrated Pest Management and pollinators. Through its interaction with the EPA, the TPPC keeps Tribes informed of developments in the regulation of pesticides and pesticide use, and provides feedback to the EPA on such matters from a tribal perspective (though it is important to note that communication between the EPA and the TPPC does not substitute for direct government-to-government consultation).

For information about how to join the TPPC, contact Mark Daniels at mark.daniels@nau.edu or (928) 523-8897.