

Health Effects of 40 Commonly Used Lawn Pesticides



	Health Effects						
	Cancer	Endocrine Disruption	Reproductive Effects	Neurotoxicity	Kidney/Liver Damage	Sensitizer/Irritant	Birth Defects
Herbicides							
2,4-D*	X ⁴	X ¹⁰	X ⁷	X ⁸	X ⁸	X ¹	X ¹¹
Atrazine ‡	X ⁹	X ⁶	X ⁸	X ¹¹	X ¹¹	X ¹¹	X ⁸
Benfluralin	X ¹	X ¹			X ¹	X ¹	
Bensulide				X ²	X ¹	X ²	
Clopyralid			X ⁷			X ⁷	X ⁷
Dicamba *	Possible ¹⁵		X ¹	X ²	X ²	X ¹	X ¹
Diquat Dibromide			X ¹²		X ¹¹	X ¹	
Dithiopyr					X ¹	X ¹	
Fluazipop-p-butyl			X ¹		X ¹		X ¹
Glyphosate *	X ¹²	X ⁸	X ¹		X ⁸	X ¹	X ¹
Imazapyr	Suggestive ²¹				X ⁷	X ²	
Isoxaben	X ³				X ²		Possible ²¹
MCPA	Possible ¹⁹	X ⁶	X ²	X ²	X ¹¹	X ¹	
Mecoprop (MCP) [†]	Possible ³	X ⁶	X ²	X ¹	X ⁹	X ¹	X ¹
Oxadiazon	X ²	X ¹	X ¹	Possible ²²	X ¹		X ¹
Oxyfluorfen	X ³		X ¹¹		X ¹¹	X ¹¹	X ¹¹
Pendimethalin *	Possible ³		X ¹		X ¹	X ²	X ¹
Proflumaric acid	X ¹	Suggestive ¹	Possible ¹⁶	X ¹			Possible ¹⁶
Sulfentrazone			X ¹³	Possible ¹³		X ¹³	X ¹³
Triclopyr			X ⁷		X ⁹	X ¹	X ⁷
Trifluralin	Possible ³	X ⁹	X ¹	X ²³	X ²	X ¹	
Insecticides							
Abamectin/ Avermectin B1			X ¹¹	X ¹¹			X ⁹
Acephate *	Possible ³	X ⁶	X ¹¹	X ⁹		X ²	
Bifenthrin* [†]	Possible ³	Suspected ^{6,10}		X ⁸		X ¹	X ⁹
Carbaryl	X ³	X ¹⁰	X ⁸	X ¹	X ¹¹	X ¹¹	X ⁷
Cyfluthrin [†]		Possible ¹⁷	X ⁹	X ⁹	X ⁹	X ⁹	
Deltamethrin [†]		X ¹⁰		X ⁸		X ⁹	
Fipronil	Possible ³	X ⁶	X ⁸	X ⁸	X ⁸	X ⁸	
Imidacloprid [‡]		X ⁶	X ⁷	Possible ¹⁴	X ²		X ⁷
Malathion *	Probable ¹²	X ¹⁰	X ¹¹	X ⁹	X ²	X ²	X ²
Permethrin* [†]	X ³	Suspected ^{6,10}	X ^{1,7}	X ^{7,9}	X ⁹	X ¹	
Trichlorfon	X ³	X ⁶	X ¹¹	X ²	X ²	X ¹¹	X ²
Fungicides							
Azoxystrobin					X ²	X ²	
Chlorothalonil	X ³		X ⁷	X ¹⁴	X ⁹	X ¹	
Metalaxyl	Possible ²⁰	Possible ²⁰			X ⁹	X ¹	
Myclobutanil		Probable ⁶	X ²		X ²		
Propiconazole	Possible ³	X ⁶	X ²		X ¹	X ¹	
Sulfur β						X ¹	
Thiophanate methyl	X ³	X ¹	X ¹	Suspected ¹	X ¹	X ²	X ¹
Ziram	Suggestive ³	Suspected ⁶		X ²	X ²	X ²	
Totals:	26	24	29	24	32	33	21

Pesticides

*These pesticides are among the top 10 most heavily used pesticides in the home and garden sector from 2008-2012, according to the latest sales and usage data available from EPA (2017), available at https://www.epa.gov/sites/default/files/2017-01/documents/pesticides-industry-sales-usage-2016_0.pdf.

† EPA lists all synthetic pyrethroids under the same category. While all synthetic pyrethroids have similar toxicological profiles, some may be more or less toxic in certain categories than others. See Beyond Pesticides' synthetic pyrethroid fact sheet at bit.ly/TLBuP8 for additional information.

‡ Imidacloprid is a systemic insecticide in the neonicotinoid chemical class, which is linked to bee decline.

¥ Atrazine has residential uses in Southeast United States.

β Least Toxic

Suggestive = Suspected

Description

This chart bases most toxicity determination on interpretations and conclusions of studies by university, government, or organization databases that classify chemical compounds and supports the strongest evidence. However, there is a body of scientific literature which aims to resolve discrepancies in health effects through the Beyond Pesticides' Gateway on Pesticide Hazards and Safe Pest Management. Empty cells may refer to either insufficient data or if the chemical is considered relatively non-toxic based on currently available data.

The list of 40 commonly used lawn chemicals is based on information provided by the General Accounting Office 1990 Report, "Lawn Care Pesticides: Risks Remain Uncertain While Prohibited Safety Claims Continue," U.S. Environmental Protection Agency (EPA) National Pesticide Survey (1990), Farm Chemicals Handbook (1989), The National Home and Garden Pesticide Use Survey by Research Triangle Institute, NC(1992), multiple state reports, current EPA Environmental Impact Statements and Risk Assessments, EPA national sales and usage data, best-selling products at Lowe's and Home Depot, and Beyond Pesticides' information requests.

For more information on hazards associated with pesticides, including peer-reviewed studies not incorporated in this document, please see Beyond Pesticides' Gateway on Pesticide Hazards and Safe Pest Management at www.beyondpesticides.org/gateway. For questions and other inquiries, please contact our office at 202-543-5450, email info@beyondpesticides.org or visit us on the web at www.beyondpesticides.org. [Include silent spring study in the gateway]

Citations

1. U.S. EPA. Office of Pesticide Program *Reregistration Eligibility Decisions (REDs), Interim REDs (iREDs), and RED factsheets*. <http://www.epa.gov/pesticides/reregistration/>.
2. National Library of Medicine, TOXNET, *Hazardous Substances Database*, <http://toxnet.nlm.nih.gov/>.
3. U.S. EPA. 2019. Office of Pesticide Programs, *Chemicals Evaluated for Carcinogenic Potential*. http://npic.orst.edu/chemicals_evaluated.pdf.
4. California Environmental Protection Agency. *Proposition 65: Chemicals Known to the State to Cause Cancer or Reproductive Toxicity*. Office of Environmental Health Hazard Assessment. <https://oehha.ca.gov/media/downloads/proposition-65/p65chemicalslistsingletable2021p.pdf>.
5. The Pesticide Management Education Program at Cornell University. *Pesticide Active Ingredient Information*. <http://pmep.cce.cornell.edu/profiles/index.html>.
6. The Endocrine Disruption Exchange. 2011. *List of Potential Endocrine Disruptors*. <http://www.endocrinedisruption.com/interactive-tools/tedx-list-of-potential-endocrine-disruptors/search-the-tedx-list>.
7. Northwest Coalition for Alternatives to Pesticides (NCAP), *Pesticide Factsheets*. https://www.pesticide.org/pesticide_factsheets.
8. Beyond Pesticides *ChemWatch Factsheets*, <http://www.beyondpesticides.org/pesticides/factsheets/index.htm>.
9. U.S. EPA. *Chronic (Non-Cancer) Toxicity Data for Chemicals Listed Under EPCRA Section 313*. Toxic Release Inventory Program. http://www.epa.gov/tri/trichemicals/hazardinfo/hazard_chronic_non-cancer95.pdf.
10. European Union Commission on the Environment. *List of 146 substances with endocrine disruption classifications, Annex 13*. http://ec.europa.eu/environment/endocrine/strategy/substances_en.htm#report2.
11. Extension Toxicology Network (EXTOXNET) *Pesticide Information Profiles*. <http://extoxnet.orst.edu/ghindex.html>.
12. International Agency for Research on Cancer, World Health Organization (IARC) category 2A, the agent (mixture) is probably carcinogenic to humans based on sufficient evidence of carcinogenicity in laboratory animal studies. <http://monographs.iarc.fr/ENG/Classification/index.php>.
13. U.S. EPA, Office of Prevention, Pesticides and Toxic Substances, New Active Ingredients Factsheets: <http://web.archive.org/web/20120107215849/http://www.epa.gov/opprd001/factsheets/index.htm>
14. Environmental Defense Fund, Scorecard Database. <http://www.scorecard.org/chemical-profiles/>.
15. Lerro, C.C., Hofmann, J.N., Andreotti, G., Koutros, S., Parks, C.G., Blair, A., Albert, P.S., Lubin, J.H., Sandler, D.P. and Beane Freeman, L.E., 2020. Dicamba use and cancer incidence in the agricultural health study: an updated analysis. *International journal of epidemiology*, 49(4), pp.1326-1337. [National Cancer Institute]
16. Knudsen, T.B., Martin, M.T., Kavlock, R.J., Judson, R.S., Dix, D.J. and Singh, A.V., 2009. Profiling the activity of environmental chemicals in prenatal developmental toxicity studies using the US EPA's ToxRefDB. *Reproductive toxicology*, 28(2), pp.209-219. <https://doi.org/10.1016/j.reprotox.2009.03.016> [National Center for Computational Toxicology (NCCT), Office of Research and Development, U.S. Environmental Protection Agency]
17. [Zhejiang University] Zhang, J., Zhu, W., Zheng, Y., Yang, J. and Zhu, X., 2008. The antiandrogenic activity of pyrethroid pesticides cyfluthrin and β-cyfluthrin. *Reproductive toxicology*, 25(4), pp.491-496. <https://doi.org/10.1016/j.reprotox.2008.05.054> [Zhejiang University]; Rajawat, N.K., Soni, I., Mathur, P. and Gupta, D., 2014. Cyfluthrin-induced toxicity on testes of Swiss albino mice. *Int J Curr Microbiol App Sci*, 3(3), pp.334-343. https://www.researchgate.net/publication/291003196_Cyfluthrin-induced_toxicity_on_testes_of_Swiss_albino_mice. [IIS University/ All India Institute of Medical Sciences]
18. Abou-Donia, M.B., Goldstein, L.B., Bullman, S., Tu, T., Khan, W.A., Dechkovskaia, A.M. and Abdel-Rahman, A.A., 2008. Imidacloprid induces neurobehavioral deficits and increases expression of glial fibrillary acidic protein in the motor cortex and hippocampus in offspring rats following in utero exposure. *Journal of Toxicology and Environmental Health, Part A*, 71(2), pp.119-130. doi.org/10.1080/15287390701613140 [Department of Pharmacology and Cancer Biology, Duke University Medical Center]
19. Alavanja, M.C., Ross, M.K. and Bonner, M.R., 2013. Increased cancer burden among pesticide applicators and others due to pesticide exposure. *CA: A Cancer Journal for Clinicians*, 63(2), pp.120-142. <https://doi.org/10.3322/caac.21170> [National Cancer Institute/ U.S. Government Work]
20. Lerro, C.C., Freeman, L.E.B., DellaValle, C.T., Andreotti, G., Hofmann, J.N., Koutros, S., Parks, C.G., Shrestha, S., Alavanja, M.C., Blair, A. and Lubin, J.H., 2021. Pesticide exposure and incident thyroid cancer among male pesticide applicators in agricultural health study. *Environment International*, 146, p.106187. [National Cancer Institute]
21. USDA, Forestry Service. 2000. Human Health and Ecological Risk Assessment—Isoxaben (Final Report). https://www.fs.fed.us/foresthealth/pesticide/pdfs/Isoxaben_RA.PDF.
22. Degl'Innocenti, D., Ramazzotti, M., Sarchielli, E., Monti, D., Chevanne, M., Vannelli, G.B. and Barletta, E., 2019. Oxadiazon affects the expression and activity of aldehyde dehydrogenase and acylphosphatase in human striatal precursor cells: a possible role in neurotoxicity. *Toxicology*, 411, pp.110-121. <https://doi.org/10.1016/j.tox.2018.10.021>. [University of Florence, Italy]
23. World Health Organization, 1990. *Public health impact of pesticides used in agriculture*. World Health Organization. <https://apps.who.int/iris/handle/10665/39772>; Fernandes, T.C., Pizano, M.A. and Marin-Morales, M.A., 2013. Characterization, modes of action and effects of trifluralin: a review. *Herbicides-Current Research and Case Studies in Use*. <https://www.intechopen.com/chapters/44986> [São Paulo State University]