BEYOND PESTICIDES
701 E Street, SE ■ Washington DC 20003
202-543-5450 phone ■ 202-543-4791 fax
info@beyondpesticides.org ■ www.beyondpesticides.org

Statement of

Max Sano, Organic Program Associate, Beyond Pesticides
in support of SB 645 with our proposed amendment
to
Committee on Natural Resources and Agriculture

March 18, 2024

Honorable Members of the Committee on Natural resources and Agriculture. Thank you for the opportunity to testify in support of SB 645 with an amendment to require use notification for all pesticides, including general use, ready-to-use pesticides. We urge that SB 645 be amended to **exclude the words "other than a general-use pesticide**" from the law (1994 PA 451, 324.8316b(1) Pesticide notification registry; notification requirements; exclusions; definitions).

Our recommendation is based on two key understandings:

1. **All pesticides are registered as poisons and can harm children, pets, and families.** All pesticides in commerce—with the exception of "minimum risk pesticide" under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) §25(b) and listed in 40 C.F.R. §152.25(f)—are registered by the U.S. Environmental Protection Agency (EPA) and the state of Michigan and can have both acute (headaches, rashes, nausea, etc.) and chronic effects (cancer, nervous and immune system effects, reproductive system effects, etc.). Please see Appendix C, *Health Effects of 40 Commonly Used Lawn Chemicals*—all general use pesticides.

2. **Protection of children, pets, and families starts with notification for all pesticides.** This committee must recognize that general use pesticides can have both acute and chronic effects and limiting the legislative language to only restricted use pesticides (those of high acute toxicity) or "other than a general-use pesticide**"** (as the underlying law and SB 645 allows) undermines the purpose of notification—which is to enable people to avoid involuntary exposure.

While we appreciate that the legislation eliminates the requirement of a medical condition to utilize the notification registry, not including notification for general use pesticides undercuts the purpose of the legislation because of the science identifying adverse effects associated with the use of these chemicals. Given the poisonous nature of pesticides, people have a right-to-

know that they are going to be exposed so that they can take appropriate action to try to avoid exposure. Parents may want to remove children from the area. Pet owners may want to remove their pets. People may want to close windows or turn off units that circulate outside air to the indoor environment.

Beyond Pesticides is a national, grassroots, membership organization that represents community-based organizations and a range of people seeking to improve protections from pesticides and promote alternative pest management strategies that reduce or eliminate a reliance on toxic pesticides. Our membership spans the 50 states, the District of Columbia, and groups around the world. We are submitting this statement on behalf of our supporters in Michigan.

While Beyond Pesticides works with communities across the United States to adopt land and mosquito management practices not reliant on toxic pesticides and knows that there are cost-effective alternatives, people have a right to be notified when they will be exposed to pesticides..

Background on the health effects of pesticides

Beyond Pesticides reviews the latest scientific analysis regarding commonly used toxic pesticides on public and private spaces (See attachment for more information on "Health Effects of 40 Commonly Used Lawn Pesticides; also see Gateway on Pesticide Hazards and Safe Pest Management, and Pesticide-Induced Diseases Database). SB 645 would allow individuals to add themselves to the Pesticide Notification Registry without a physician recommendation, includes mosquito spraying to the list of pesticides subject to notification, and expands the radius for public notification to 500 feet of the property being sprayed.

Pesticides are an umbrella term that includes herbicides, insecticides, fungicides, and other biocides. Each category of pesticide has the potential to cause significant harm to human health and the wider environment (See Appendix A and B for more information). Herbicides, such as glyphosate (and its formulated products (Roundup) and 2,4-D, both widely used on turf and lawns, can also be tracked indoors where they settle in dust, air and on surfaces and may remain in carpets, resulting in long-term exposures.[1,2] In these environments, exposure may increase the risk of developing asthma, exacerbate a previous asthmatic condition, or even trigger asthma attacks by increasing bronchial hyper-responsiveness.[3] This is especially important as infants crawling behavior and proximity to the floor account for a greater potential than adults for dermal and inhalation exposure to contaminants on carpets, floors, lawns, and soil.[4]

---

[1] Nishioka, M., et al. 1996. Measuring lawn transport of lawn-applied herbicide acids from turf. Env Science Technology, 30:3313-3320.

[2] Nishioka, M., et al. 2001. "Distribution of 2,4-D in Air and on Surfaces Inside Residences. Environmental Health Perspectives 109(11).

[3] Hernández, AF., Parrón, T. and Alarcón, R. 2011. Pesticides and asthma. Curr Opin Allergy Clin Immunol.11(2):90-6.

[4] Bearer, CF. 2000. The special and unique vulnerability of children to environmental hazards. Neurotoxicology 21: 925-934; and Fenske, R., et al. 1990. Potential Exposure and Health Risks of Infants following Indoor Residential Pesticide Applications. Am J. Public Health. 80:689-693.

Insecticides pose similar concerns to public health. Synthetic pyrethroids, a class of neurotoxic chemicals commonly used on lawns and landscapes, have been repeatedly linked by peer-reviewed studies to neurological issues such as learning disabilities in children. A 2015 study by Cincinnati Children's Hospital Medical Center found a strong association between urinary concentrations of synthetic pyrethroids and the development of ADHD, primarily in boys (aged 8 to 15). Any concentrations found above the level of detection corresponded to a three-fold increase in the chance of developing ADHD, when compared to boys without detectable levels.[5]

Fungicide use results in significant risks to community health, particularly for the most sensitive, such as young children and the elderly. The use of a certain class of fungicides, the strobilurins, has been linked in peer-reviewed research to the development of autism in children and Alzheimer's in older adults.[6] Drug-resistant fungal infections are on the rise, and many researchers indicate the use of fungicides is likely playing a role.[7]

While the effects of different pesticide types can be delineated, a significant body of research finds that pesticide use in general is hazardous to health. A study published in the *Journal of the National Cancer Institute* finds that household and garden pesticide use, in general, can increase the risk of childhood leukemia as much as seven-fold.[8] Women who are exposed to pesticides in homes and yards are more than two times more likely to give birth to children with neural tube defects than those who do not use pesticides, according to one study.[9] A meta-analysis investigating years of previous research on residential pesticide use and childhood leukemia finds associations with exposure during pregnancy. [10]

Limitations in the regulations governing pesticides use

EPA has undergone a severe reduction in programmatic work and adequate scientific assessment over the last several decades. This is an urgent problem, given that the state regulatory system (Michigan Department of Agriculture and Rural Development) relies almost exclusively on the underlying scientific determinations of EPA when it registers pesticides in the state.

---

[5] Wagner-Schuman, et al. 2015. Association of pyrethroid pesticide exposure with attention-deficit/hyperactivity disorder in a nationally representative sample of U.S. children. Environmental Health 14, 44. https://ehjournal.biomedcentral.com/articles/10.1186/s12940-015-0030-y.

[6] Pearson et al. 2016. Identification of chemicals that mimic transcriptional changes associated with autism, brain aging and neurodegeneration. *Nature Communications* **volume 7**, Article number: 11173 https://www.nature.com/articles/ncomms11173.

[7] Richtel, Matt and Jacobs, Andrew. 2019. A Mysterious Infection, Spanning the Globe in a Climate of Secrecy https://www.nytimes.com/2019/04/06/health/drug-resistant-candida-auris.html

[8] Lowengart, R. et al. 1987. Childhood Leukemia and Parent's Occupational and Home Exposures. Journal of the National Cancer Institute. 79:39.

[9]Brender, JD., et al. 2010. Maternal Pesticide Exposure and Neural Tube Defects in Mexican Americans. Ann Epidemiol. 20(1):16-22.

[10] Turner, M.C., et al. 2010. Residential pesticides and childhood leukemia: a systematic review and meta-analysis. Environ Health Perspect 118(1):33-41.

In recent years, there as been a reversal by federal regulators, which sheds light on a deeper problem that calls for local action on all pesticides in the absence of federal and state protections:

- PFAS contamination and the fact that pesticides have been shown in some cases to be contaminated with PFAS tells a story of inadequate regulation that calls for a precautionary approach to toxic chemical use that you have the power to effect.
- When EPA reversed a decision in 2015 to ban the use of the insecticide chlorpyrifos, which is a neurological toxicant that damages children's brains, it took over five years to get EPA to act.[11]
- That set the tone for the agency's decision to take no action on the weed killer glyphosate/Roundup, despite the independent science and the World Health Organization's 2015 finding on its cancer-causing properties, and other science on it causing liver and kidney damage and endocrine disrupting effects.[12]
- EPA, in recent years, further weakened protections for 23 synthetic pyrethroid insecticides. Pyrethroids are a common class of neurotoxic insecticides that have been repeatedly linked by peer-reviewed studies to neurological issues such as learning disabilities in children.[13] The agency allowed a three-fold increase in exposure to the chemical, when the data indicates that children are more susceptible to the impacts of toxic pesticides.[14]
- U.S. regulators at the U.S. Department of Agriculture were influenced by representatives of Bayer to pressure a United Nations Task Force to drop any reference of "fungicides" or "crops" from a document intended to counter the rising number of drug-resistant fungal infections.

Given all pesticides' hazards and widespread use, full notification is especially important.

Conclusion

In light of the hazardous nature of pesticides and a weakened regulatory, it is important that the state of Michigan provide all residents with the right to notification of all pesticide use under SB 645. To this end, we urge that the Committee **amend the bill text to remove "other than a general-use pesticide**" (from 1994 PA 451, 324.8316b(1) Pesticide notification registry; notification requirements; exclusions; definitions) so that the notification provision applies to all pesticides, including general use pesticides.

Thank you for consideration of our comments.

---

[11] Levin, Sam. 2019. Trump Administration won't ban pesticide tied to childhood rain damage. The Guardian. https://www.theguardian.com/us-news/2019/jul/18/epa-chlorpyrifos-ban-children-brain-damage-trump.

[12] International Agency for Research on Cancer. 2015. Monograph on Glyphosate. https://monographs.iarc.fr/wp-content/uploads/2018/06/mono112-10.pdf.

[13] Dalsager, L. et al. Maternal urinary concentrations of pyrethroid and chlorpyrifos metabolites and attention deficit hyperactivity disorder (ADHD) symptoms in 2-4-year-old children from the Odense Child Cohort. Environmental Research, 10 Jun 2019, 176:108533.

[14] Jacobs, Andrew. 2020. Emails Show How Pesticide Industry Influenced U.S. Position in Health Talks. New York Times. https://www.nytimes.com/2020/09/24/health/pesticides-drug-resistance-trump-anifungals.html.

Appendix A. Key Areas of Concern with Toxic Pesticides

BEYOND PESTICIDES
701 E Street, SE ■ Washington DC 20003
202-543-5450 phone ■ 202-543-4791 fax
info@beyondpesticides.org ■ www.beyondpesticides.org

Pesticide-Induced Diseases

The scientific literature documents elevated rates of chronic diseases among people exposed to pesticides, with increasing numbers of studies associated with both specific illnesses and a range of illnesses. Beyond Pesticides' Pesticide-Induced Diseases Database[29] documents over 750 studies linked to human health effects. Of which, there are 359 studies on cancer; 107 studies on sexual and reproductive dysfunction; 102 studies on Parkinson's disease; 87 studies on learning and developmental disorders; 33 studies on birth defects; 32 studies on asthma; 18 studies on diabetes; and 12 studies on Alzheimer's disease.

The studies in the database show that our current approach to restricting pesticide use through risk assessment-based mitigation measures is not working. This failed human experiment must be ended. The warnings of those who have expressed concerns about risk assessment, such as U.S. Environmental Protection Agency (EPA) Administrator under Presidents Nixon and Reagan, William Ruckelshaus, have been borne out by three decades of use and study. Mr. Ruckelshaus in 1984 said, "We should remember that risk assessment data can be like the captured spy: If you torture it long enough, it will tell you anything you want to know." EPA's risk assessment fails to look at chemical mixtures, synergistic effects, certain health endpoints (such as endocrine disruption), disproportionate effects to vulnerable population groups, and regular noncompliance with product label directions. These deficiencies contribute to its severe limitations in defining real world poisoning, as captured by epidemiologic studies in the database.

<u>Children's Vulnerability</u>

Children face unique dangers from pesticide exposure. The National Academy of Sciences reports that children are more susceptible to chemicals than adults and estimates that 50% of lifetime pesticide exposures occur during the first five years of life.[30] In fact, studies show children's developing organs create "early windows of great vulnerability" during which

[29] Beyond Pesticides. 2020. Pesticide Induced Diseases Database. http://www.beyondpesticides.org/resources/pesticide-induced-diseases-database/overview.
[30] National Research Council, National Academy of Sciences. 1993. Pesticides in the Diets of Infants and Children, National Academy Press, Washington, DC: 184-185.

exposure to pesticides can cause great damage.[31] For example, according to researchers at the University of California-Berkeley School of Public Health, exposure to pesticides while in the womb increases the odds that a child will have attention deficit hyperactivity disorder (ADHD).[32] Likewise, Cincinnati Children's Hospital Medical Center found a strong association between urinary concentrations of pyrethroids, a commonly used lawn care pesticide, and the development of ADHD, primarily in boys (aged 8 to 15). Any concentrations found above the level of detection corresponded to a three-fold increase in the chance of developing ADHD, when compared to boys without detectable levels.[33]

As EPA points out in its document, *Pesticides and Their Impact on Children: Key Facts and Talking Points*:[34]

- "Due to key differences in physiology and behavior, children are more susceptible to environmental hazards than adults."
- "Children spend more time outdoors on grass, playing fields, and play equipment where pesticides may be present."
- "Children's hand-to-mouth contact is more frequent, exposing them to toxins through ingestion."

In 2012, the American Academy of Pediatrics (AAP) released a landmark policy statement, *Pesticide Exposure in Children*, on the effects of pesticide exposure in children, acknowledging the risks to children from both acute and chronic effects.[35] AAP's statement notes that, "Children encounter pesticides daily and have unique susceptibilities to their potential toxicity." The report discusses how kids are exposed to pesticides every day in air, food, dust, and soil. Children also frequently come into contact with pesticide residue on pets and treated lawns, gardens, and indoor spaces.

Pesticides, such as glyphosate and its formulated products (Roundup) and 2,4-D, both widely used on turf and lawns, can be tracked indoors resulting in long-term exposures. Scientific studies show that pesticides, like 2,4-D, that are applied to lawns drift and are tracked indoors where they settle in dust, air and on surfaces and may remain in carpets.[36,37] Pesticides in these

---

[31] Landrigan, P.J., L Claudio, SB Markowitz, et al. 1999. "Pesticides and inner-city children: exposures, risks, and prevention." Environmental Health Perspectives 107 (Suppl 3): 431-437.

[32] Marks AR, Harley K, Bradman A, Kogut K, Barr DB, Johnson C, et al. 2010. Organophosphate Pesticide Exposure and Attention in Young Mexican-American Children: The CHAMACOS Study. Environ Health Perspect 118:1768-1774.

[33] Wagner-Schuman, et al. 2015. Association of pyrethroid pesticide exposure with attention-deficit/hyperactivity disorder in a nationally representative sample of U.S. children. Environmental Health 14, 44. https://ehjournal.biomedcentral.com/articles/10.1186/s12940-015-0030-y

[34] See: https://www.epa.gov/sites/production/files/2015-12/documents/pest-impact-hsstaff.pdf.

[35] Roberts JR, Karr CJ; Council On Environmental Health. 2012. Pesticide exposure in children. Pediatrics. 2012 Dec; 130(6):e1765-88.

[36] Nishioka, M., et al. 1996. Measuring lawn transport of lawn-applied herbicide acids from turf. Env Science Technology, 30:3313-3320.

[37] Nishioka, M., et al. 2001. "Distribution of 2,4-D in Air and on Surfaces Inside Residences. Environmental Health Perspectives 109(11).

environments may increase the risk of developing asthma, exacerbate a previous asthmatic condition, or even trigger asthma attacks by increasing bronchial hyper-responsiveness.[38] This is especially important as infants crawling behavior and proximity to the floor account for a greater potential than adults for dermal and inhalation exposure to contaminants on carpets, floors, lawns, and soil.[39]

A study published in the Journal of the National Cancer Institute finds that household and garden pesticide use can increase the risk of childhood leukemia as much as seven-fold.[40] Similarly, a 2010 meta-analysis on residential pesticide use and childhood leukemia finds an association with exposure during pregnancy, as well as to insecticides and herbicides. An association is also found for exposure to insecticides during childhood.[41]

Prenatal exposures to pesticides can also have long-lasting impacts on infants and children. Herbicides, like glyphosate, can adversely affect embryonic, placental and umbilical cord cells, and can impact fetal development. Preconception exposures to glyphosate were found to moderately increase the risk for spontaneous abortions in mothers exposed to glyphosate products.[42] One 2010 analysis observed that women who use pesticides in their homes or yards were two times more likely to have offspring with neural tube defects than women who did not use pesticides.[43] Studies also find that pesticides, like 2,4-D, can also pass from mother to child through umbilical cord blood and breast milk.[44,45]

Biomonitoring testing has also documented pesticide residues in children. Residues of lawn pesticides, like 2,4-D and mecoprop, were found in 15 percent of children tested, ages three to seven, whose parents had recently applied the lawn chemicals. Breakdown products of organophosphate insecticides were present in 98.7 percent of children tested.[46] In one study, children in areas where glyphosate is routinely applied were found to have detectable concentrations in their urine.[47] While glyphosate is excreted quickly from the body, it was

[38] Hernández, AF., Parrón, T. and Alarcón, R. 2011. Pesticides and asthma. Curr Opin Allergy Clin Immunol.11(2):90-6.
[39] Bearer, CF. 2000. The special and unique vulnerability of children to environmental hazards. Neurotoxicology 21: 925-934; and Fenske, R., et al. 1990. Potential Exposure and Health Risks of Infants following Indoor Residential Pesticide Applications. Am J. Public Health. 80:689-693.
[40] Lowengart, R. et al. 1987. Childhood Leukemia and Parent's Occupational and Home Exposures. Journal of the National Cancer Institute. 79:39.
[41] Turner, M.C., et al. 2010. Residential pesticides and childhood leukemia: a systematic review and meta-analysis. Environ Health Perspect 118(1):33-41.
[42] Arbuckle, T. E., Lin, Z., & Mery, L. S. (2001). An Exploratory Analysis of the Effect of Pesticide Exposure on the Risk of Spontaneous Abortion in an Ontario Farm Population. Environ Health Perspect, 109, 851–857.
[43]Brender, JD., et al. 2010. Maternal Pesticide Exposure and Neural Tube Defects in Mexican Americans. Ann Epidemiol. 20(1):16-22.
[44] Pohl, HR., et al. 2000. Breast-feeding exposure of infants to selected pesticides. Toxicol Ind Health. 16:65-77.
[45] Sturtz, N., et al. 2000. Detection of 2,4-dichlorophenoxyacetic acid (2,4-D) residues in neonates breast-fed by 2,4-D exposed dams. Neurotoxicology 21(1-2): 147-54.
[46] Valcke, Mathieu, et al. 2004. Characterization of exposure to pesticides used in average residential homes with children ages 3 to 7 in Quebec. National Institute of Public Health, Québec.
[47] Acquavella, J. F., et al. (2004). Glyphosate Biomonitoring for Farmers and Their Families: Results from the Farm Family Exposure Study. Environ Health Perspect. 112(3), 321-326.

concluded, “a part may be retained or conjugated with other compounds that can stimulate biochemical and physiological responses.” A 2002 study finds children born to parents exposed to glyphosate show a higher incidence of attention deficit disorder and hyperactivity.[48]

Pesticides and Pets

Studies find that dogs exposed to herbicide-treated lawns and gardens can double their chance of developing canine lymphoma (1) and may increase the risk of bladder cancer in certain breeds by four to seven times (2).

(1) Scottish Terriers exposed to pesticide-treated lawns and gardens are more likely to develop transitional cell carcinoma of the bladder, a type of cancer.[49]
(2) “Statistically significant” increase in the risk of canine malignant lymphoma in dogs when exposed to herbicides, particularly 2,4-D, commonly used on lawns and in “weed and feed” products.[50]

Appendix B. The Failure of EPA’s Regulatory System

Pesticides are, by their very nature, poisons. The Federal Insecticide Fungicide and Rodenticide Act (FIFRA), the law governing pesticide registration and use in the U.S., relies on a risk-benefit assessment, which allows the use of pesticides with known hazards based on the judgment that certain levels of risk are acceptable. However, EPA, which performs risk assessments, assumes that a pesticide would not be marketed if there were no benefits to using it and therefore no risk/benefit analysis is conducted or evaluated by the agency "up front." Registration of a pesticide by EPA does not guarantee that the chemical is “safe,” particularly for vulnerable populations such as pregnant mothers, children, pets, and those with chemical sensitivities. Below are examples of concern within the pesticide registration process. These factors should give pause to lawmakers tasked with protecting public and environmental health, and supports action to prohibit toxic pesticides and, in so doing, encourage alternatives.

Conditional Registration. EPA will often approve the use of a pesticide without all of the necessary data required to fully register the chemical and will assign it a "conditional" registration. The agency assumes that while it waits for additional data the product would not cause adverse impacts that would prevent an eventual full registration. A recent report (2013) from the Government Accountability Office, entitled *EPA Should Take Steps to improve Its Oversight of Conditional Registrations,*[52] strongly criticizes this process, citing poor internal

[48] Cox C. 2004. Journal of Pesticide Reform. Vol. 24 (4) citing: Garry, V.F. et al. 2002. “Birth defects, season of conception, and sex of children born to pesticide applicators living in the Red River Valley of Minnesota.” Environ. Health Persp. 110 (Suppl. 3):441-449.
[49] Hayes, H. et al., 1991. “Case-control study of canine malignant lymphoma: positive association with dog owner’s use of 2,4-D acid herbicides,” Journal of the National Cancer Institute, 83(17):1226.
[50] Glickman, Lawrence, et al. 2004. "Herbicide exposure and the risk of transitional cell carcinoma of the urinary bladder in Scottish Terriers," Journal of the American Veterinary Medical Association 224(8):1290-1297.
[52] Government Accountability Office. August 2013. EPA Should Take Steps to Improve Its Oversight of Conditional Registrations. GAO-13-145. http://www.gao.gov/products/GAO-13-145.

management of data requirements, constituting an "internal control weakness." The report states, "The extent to which EPA ensures that companies submit additional required data and EPA reviews these data is unknown. Specifically, EPA does not have a reliable system, such as an automated data system, to track key information related to conditional registrations, including whether companies have submitted additional data within required time frames." However, these recommendations do not go far enough. Pesticides without all the data required for a full understanding of human and environmental toxicity should not be allowed on the market. Several historic examples exist of pesticides that have been restricted or canceled due to health or environmental risks decades after first registration. Chlorpyrifos, an organophosphate insecticide, which is associated with numerous adverse health effects, including reproductive and neurotoxic effects, had its residential uses canceled in 2001. Others, like propoxur, diazinon, carbaryl, aldicarb, carbofuran, and most recently endosulfan, have seen their uses restricted or canceled after years on the market due to unreasonable human and environmental effects. Recently, a product manufactured by DuPont, Imprelis, with the active ingredient aminocyclopyrachlor, was removed from the market only two years after EPA approval under conditional registration.[53] Marketed as a broadleaf weed killer, Imprelis was found to damage and kill trees. However, in EPA's registration of the chemical, the agency noted, "In accordance with FIFRA Section 3(c)(7)(C), the Agency believes that the conditional registration of aminocyclopyrachlor will not cause any unreasonable adverse effects to human health or to the environment and that the use of the pesticide is in the public's interest; and is therefore granting the conditional registration."[54]

Failure to test or disclose inert ingredients. Despite their innocuous name, inert ingredients in pesticide formulations are neither chemically, biologically, or toxicologically inert; in fact they can be just as toxic as the active ingredient. Quite often, inert ingredients constitute over 95% of the pesticide product. In general, inert ingredients are minimally evaluated, even though many are known to state, federal, and international agencies to be hazardous to human health. For example, until October 23, 2014,[55] creosols, chemicals listed as hazardous waste under Superfund regulations and considered possible human carcinogens by EPA,[56] were allowed in pesticide formulations without any disclosure requirement. EPA recently took action to remove cresols and 71 other inert ingredients from inclusion in pesticide formulations as a result of petitions from health and consumer groups. However, numerous hazardous inerts remain. For example, a 2009 study, entitled *Glyphosate Formulations Induce Apoptosis and Necrosis in*

[53] Environmental Protection Agency. June 2012. Imprelis and Investigation of Damage to Trees. http://www.epa.gov/pesticides/regulating/imprelis.html.

[54] Environmental Protection Agency. August 2010. Registration of the New Active Ingredient Aminocyclopyrachlor for Use on Non-Crop Areas, Sod Farms, Turf, and Residential Lawns. http://www.regulations.gov/contentStreamer?objectId=0900006480b405d8&disposition=attachment&contentType=pdf.

[55] Environmental Protection Agency. October 2014. EPA Proposes to Remove 72 Chemicals from Approved Pesticide Inert Ingredient List. http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/3397554fa65588d685257d7a0061a300!OpenDocument.

[56] Environmental Protectin Agency. October 2013. Cresol/Cresylic Acid. http://www.epa.gov/ttnatw01/hlthef/cresols.html.

Human Umbilical, Embryonic, and Placental Cells,[57] found that an inert ingredient in formulations of the weed killer Roundup (glyphosate), polyethoxlated tallowamine (POEA), is more toxic to human cells than the active ingredient glyphosate, and, in fact, amplifies the toxicity of the product – an effect not tested or accounted for by the pesticide registration process. A 2014 study, *Major pesticides are more toxic to human cells than their declared active principle*, found inert ingredients had the potential to magnify the effects of active ingredients by 1,000-fold.

Pesticide manufacturers argue against the disclosure of inert ingredients on pesticide product labels, maintaining that this information is proprietary. Limited review of inert ingredients in pesticide products highlights a significant flaw with the regulatory process. Rather than adopt a precautionary approach when it comes to chemicals with unknown toxicity, EPA allows uncertainties and relies on flawed risk assessments that do not adequately address exposure and hazard. Then, when data becomes available on hazards, these pesticides, both active ingredients and inerts, have already left a toxic trail on the environment and people's well-being.

Label Restrictions Inadequate. From a public health perspective, an inadequate regulatory system results in a pesticide product label that is also inadequate, failing to restrict use or convey hazard information. While a resident may be able to glean some acute toxicity data, chronic or long-term effects will not be found on products' labels. Despite certain pesticides being linked to health endpoints, such as exacerbation of asthma,[58] learning disabilities,[59] or behavioral disorders,[60] this information is not disclosed on the label. Furthermore, data gaps for certain health endpoints are also not disclosed.

Mixtures and Synergism. In addition to gaps in testing inert ingredients and their mixture with active ingredients in pesticide products, there is an absence of review of the health and environmental impacts of pesticides used in combination. A study by Warren Porter, PhD., professor of zoology and environmental toxicology at the University of Wisconsin, Madison, examined the effect of fetal exposures to a mixture of 2,4-D, mecoprop, and dicamba exposure —frequently used together in lawn products like Weed B Gone Max and Trillion— on the mother's ability to successfully bring young to birth and weaning.[61] A 2011 study, entitled

---

[57] Benachour and Seralini. 2009. Glyposate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells. *Chemical Research and Toxicology.* *http://pubs.acs.org/doi/abs/10.1021/tx800218n*.

[58] Hernandez et al. 2011. Pesticides and Asthma. *Current opinion in allergy and clinical immunology*. http://www.ncbi.nlm.nih.gov/pubmed/21368619.

[59] Horton et al. 2011. Impact of Prenatal Exposure to Piperonyl Butoxide and Permethrin on 36-Month Neurodevelopment. *Pediatrics*. http://www.ncbi.nlm.nih.gov/pubmed/21300677.

[60] Furlong et al. 2014. Prenatal exposure to organophosphate pesticides and reciprocal social behavior in childhood.

[61] Cavieres MF, Jaeger J, Porter W. Developmental toxicity of a commercial herbicide mixture in mice: I. Effects on embryo implantation and litter size. Environmental Health Perspectives. 2002;110(11):1081-1085.

Additivity of pyrethroid actions on sodium influx in cerebrocotorial neurons in primary culture,[62] finds that the combined mixture's effect is equal to the sum of the effects of individual pyrethoids. This equates to a cumulative toxic loading for exposed individuals. Similarly, researchers looked at the cumulative impact the numerous pesticides that may be found in honey bee hives in the 2014 paper *Four Common Pesticides, Their Mixtures and a Formulation Solvent in the Hive Environment Have High Oral Toxicity to Honey Bee Larvae*.[63] The findings of the study send no mixed messages —pesticides, whether looked at individually, in different combinations, or even broken down into their allegedly inert component parts have serious consequences on the bee larvae survival rates. The synergistic effects in most combinations of the pesticides amplify these mortality rates around the four-day mark.

Research by Tyrone Hayes, PhD, professor of integrative biology at UC Berkeley has compared the impact of exposure to realistic combinations of small concentrations of pesticides on frogs, finding that frog tadpoles exposed to mixtures of pesticides took longer to metamorphose to adults and were smaller at metamorphosis than those exposed to single pesticides, with consequences for frog survival. The study revealed that "estimating ecological risk and the impact of pesticides on amphibians using studies that examine only single pesticides at high concentrations may lead to gross underestimations of the role of pesticides in amphibian declines."[64]

[62] Cao et al. 2011. Additivity of Pyrethroid Actions on Sodium Influx in Cerebrocortical Neurons in Primary Culture. *Environmental Health Perspectives. http://ehp.niehs.nih.gov/1003394/*.
[63] Zhu et al. 2014. Four Common Pesticides, Their Mixtures and a Formulation Solvent in the Hive Environment Have High Oral Toxicity to Honey Bee Larvae. PLOS One. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0077547.
[64] Hayes TB, Case P, Chui S, et al. Pesticide Mixtures, Endocrine Disruption, and Amphibian Declines: Are We Underestimating the Impact? *Environmental Health Perspectives*. 2006;114(Suppl 1):40-50. doi:10.1289/ehp.8051.

Appendix C

40 Common Lawn and Landscape Chemicals

Pesticides for aesthetic purposes are widely used on lawns, landscapes, parks, playing fields, and open space by the general public, city/town/county governments, and commercial companies. Many of these chemicals harm health and the environment with both immediate and long-term effects. The "40 Most Commonly Used Lawn and Landscape Pesticides" factsheets make the science on pesticide hazardous to people, pets, and the environment accessible and easy to understand. When used with information on organic land management practices (see Lawns and Landscape webpage and ManageSafe), land managers can adopt a healthy approach to lawn and land- scape care.

Using the Tables

Empty cells in the factsheets may refer to either (i) insufficient data or (ii) a determination, based on currently available data, that the chemical is relatively nontoxic. The key following the chart includes information on how to interpret the categorization of specific compounds. The analysis supporting the adverse health and environmental effects identified in the factsheets are based on toxicity determinations in government reviews and university studies and databases. More in-depth information on the specific chemicals is available on the Gateway on Pesticide Hazards and Safe Pest Management. The factsheets and Gateway are organized by active ingredients in pesticides products (trade names; for example, glyphosate is the active ingredient in the product Roundup™), so identify the active ingredients in the product(s) of concern by searching the web for the product label or company information and then find that active ingredient in the factsheets or the Gateway.

Chemical Exposure and Underlying Conditions

Acute and chronic exposure to chemicals like pesticides can cause a range of harmful effects. Even use in accordance with the pesticide product label directions can cause or promote:

- Cancer
- Neurotoxicity/Developmental and Learning Disabilities
- Reproductive and Birth Defects
- Respiratory Illnesses
- Endocrine/Immune Disruption
- Skin irritation/headaches/disorientation

Additionally, exposure to these toxic pesticides can weaken the body's immune response to illnesses and initiate or promote underlying conditions and vulnerabilities—like respiratory issues such as asthma or endocrine disruption problems like diabetes.

The onset of the coronavirus pandemic in late 2019 further demonstrates (in even more jarring form) the harsh reality of pesticide exposure—as we learn that those with comorbidities are more vulnerable to the virus, resulting in disproportionate impact in essential workers and those with underlying conditions. With COVID-19 plaguing global health, it is especially important to eliminate exposure to toxic chemicals that pose the same health hazard or elevate pre-existing health conditions. Most pesticides (including disinfectants), similar to COVID-19, act on the respiratory system, exacerbating adverse inflammatory responses, and impair the immune and nervous systems. Therefore, a serious cumulative and in some cases synergistic effect may occur between the disease and toxic chemicals, worsening disease outcomes. (See Beyond Pesticides' webpage on Safer Disinfectants and Sanitizers, Pesticide-Induced Diseases Database, and Gateway on Pesticide Hazards and Safe Pest Management.)

Organic Land Management

While chemical land management focuses on treating problems caused by conventional management practices and chemical use, the organic approach is a preventive system that addresses root causes. In this context, unwanted organisms (pests, including insects and weeds) are the symptoms of a problem caused by poor soil health and management practices.

The key to a healthy lawn is healthy soil and proper mowing, watering, fertilizing and other cultural practices. Healthy soil contains high organic content and is teeming with biological life. Healthy soil supports the development of healthy and resilient turf and landscapes that naturally manage weeds, insects, and fungal diseases.

Furthermore, organic land management represents an economically viable approach for individual homeowners, landscapers, local parks departments, and school districts committed to the adoption of practices that protect health and the environment. (See Beyond Pesticides' Cost Comparison Document.)

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[v]	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[7]
Imazapyr	Suggestive[7,8]				X[7]	X[2]	
Isoxaben	X[3]				X[2]		Possible[21]
MCPA	Possible[3]	X[6]	X[2]	X[2]	X[11]	X[1]	
Mecoprop (MCPP)*	Possible[3]	X[6]	X[2]	X[1]	X[9]	X[1]	X[1]
Oxadiazon	X[3]	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[9]	X[2]	X[2]
Prodiamine	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[18]	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 ß						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	**21**	**24**	**28**	**39**	**33**	**18**	**Totals**

Please see following page for notes, key, description, and citations.

HEALTH EFFECTS OF 40 COMMONLY USED LAWN PESTICIDES

Key

* 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.

ß 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 informa-tion 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.beyond pesticides.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.

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 orReproductive Toxicity.* Office of Environmental Health Hazard Assessment. https://oehha.ca.gov/media/downloads/proposition-65/p65chemicalslistsinglelisttable2021p.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]

ENVIRONMENTAL EFFECTS OF 40 COMMONLY USED LAWN PESTICIDES

	Environmental Effects					
	Detected in Groundwater	Potential Leacher	Toxic to Birds	Toxic to Fish/ Aquatic Organisms	Toxic to Bees	Toxic to Mammals
Herbicides						
2,4-D*	X[1,2,3,4,7]	X[3,4]	X[1,2,3,11]	X[1,2,3,11]	X[1,11]	X[3,4,12]
Atrazine[¥]	X[1]	X[1]	Possible[10]	X[1]		
Benfluralin	X[7]		X[3,11]	X[3,11]	X[5,11]	
Bensulide			X[3]	X[3]	X[3]	
Clopyralid	X[2,7]	X[2,11]	X[11]	X[11]	X[11]	
Dicamba	X[2,7]	X[1,2,3]	X[10,11]	X[1,2,3,11]	X[5,10,11]	
Diquat Dibromide		X[5]	X[1,3,11]	X[1,3,11]	X[5,11]	X[1]
Dithiopyr				X[5,6,11]	X[5,11]	
Fluazipop-p-butyl				X[1,4,6,11]	X[1,4]	
Glyphosate*	X[8]	X[5]	X[1,3,11]	X[1,2,11]	X[11]	X[4]
Imazapyr	X[2]	X[2,3]		X[2,5,11]	X[5,11]	
Isoxaben		X[11]	X[11]	X[3,11]	X[11]	
MCPA	X[4,7]	X[1,4,11]	X[1,3,11]	X[1,3,11]	X[5]	X[3]
Mecoprop (MCPP)*	X[4]	X[1,2,3,11]	X[3,11]	X[2]	X[11]	X[3]
Oxadiazon			Possible[3]	X[3]	Possible[3]	
Oxyfluorfen				X[1]		Possible[3]
Pendimethalin*	X[3,7]		X[1,3,11]	X[1,3,11]	X[5,11]	X[3]
Prodiamine		X[3]		X[3]		
Sulfentrazone			Possible[3]	X[13]		X[3]α
Triclopyr	X[2,7]	X[1,2,3,11]	X[2,3,11]	X[2,3,11]	X[5,11]	
Trifluralin*	X[4,7]			X[3,11]	X[5,11,12]	
Insecticides						
Abamectin/ Avermectin B1				X[1,3]	X[1,3]	X[3]
Acephate		X[1]	X[1,3,10,11]	X[3,11]	X[1,3,10,11]	X[3]
Bifenthrin*†			X[1,10,11]	X[1,10,11]	X[1,10,11]	X[1,4]
Carbaryl	X[1,3,7]	X[11]	X[2,11]	X[1,2,3,11]	X[1,2,3,11]	X[3,11]
Cyfluthrin†			Possible[14]	X[1]	X[1]	
Deltamethrin†				X[1]	X[1]	
Fipronil	X[7]	X[5,11]	X[2,4,10,11]	X[2,4,10,11]	X[2,4,10,11]	X[4]
Imidacloprid ‡	X[7]	X[1,2,10,11]	X[1,2,11]	X[1,2,11]	X[1,2,10,11]	
Malathion*	X[1,2,3,7]	X[1,3,5]	X[1,2,3,10,11]	X[1,2,3,10,11]	X[1,3,10,11]	X[3]
Permethrin*†	X[2,7]			X[1,2,3,11]	X[1,2,3,11]	
Trichlorfon		X[1,3,11]	X[1,3,11]	X[1,3,11]	X[1,11]	X[4]//
Fungicides						
Azoxystrobin	X[9]	X[3,4,11]	X[11]	X[3,11]	X[11]	
Chlorothalonil	X[2]	X[1]	X[3]	X[1]		Possible[3]α
Metalaxyl			Possible[14]			
Myclobutanil	X[7]			X[5]		
Propiconazole	X[7]	X[3]		X[3,11]	X[5,11]	X[11]
Sulfur[6]		X[1]	X[11]	X[11]	X[11]	
Thiophanate methyl		X[3]		X[3,11]	X[11]	
Ziram		X[3,4]	X[1,3,11]	X[1,3,11]	X[11]	X[3]
Totals	**21**	**24**	**28**	**39**	**33**	**18**

Please see following page for notes, key, description, and citations.

ENVIRONMENTAL EFFECTS OF 40 COMMONLY USED LAWN PESTICIDES

Key

* 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.

// Based on in-vitro mammalian cell study.

α Dietary Exposure

¥ Atrazine has residential uses in Southeast United States.

ß Least Toxic

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 column labeled "Potential to Leach" refers to a chemical's potential to move into deeper soil layers and eventually into groundwater. The column labeled "Toxic to Mammals" refers to conclusions based on evidence from studies done on non-human mammals.

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.

Citations

1. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Available at: http://extoxnet.orst.edu/pips/ghindex.html.
2. Northwest Coalition for Alternatives to Pesticides (NCAP), Pesticide Factsheets. Available at: http://www.pesticide.org/get-the-facts/pesticide-factsheets.
3. U.S. EPA, Office of Prevention, Pesticides and Toxic Substances, Reregistration Eligibility Decisions (REDs), Interim REDS (iREDs) and RED Factsheets. Available at: http://www.epa.gov/pesticides/reregistration/status.htm.
4. National Library of Medicine. TOXNET Hazardous Substances Database. Available at: http://toxnet.nlm.nih.gov/cgi-bin/sis/ htmlgen?HSDB.
5. Pesticide Action Network Pesticide Database. Available at: http://www.pesticideinfo.org.
6. Fluoride Action Alert Pesticide Project Factsheets. Available at: http://www.fluoridealert.org/f-pesticides.htm.
7. U.S. Geological Survey, Water Quality in Principal Aquifers of the United States, 1991–2010. 2015. Available at: http://pubs.usgs.gov/circ/1360.
8. Battaglin, W.A., M.T. Meyer, K.M. Kuivila, and J.E. Dietze. Glyphosate and Its Degradation Product AMPA Occur Frequently and Widely in U.S. Soils, Surface Water, Groundwater, and Precipitation. Journal of the American Water Resources Association (JAWRA) 50(2): 275-290. 2014. Available at: http://onlinelibrary.wiley.com/doi/10.1111/jawr.12159/abstract.
9. U.S. Geological Survey. Occurrence of Fungicides and Other Pesticides in Surface. Water, Groundwater, and Sediment from Three Targeted-Use Areas in the United States. 2013. Available at: http://www.sciencedirect.com/science/article/pii/S0045653512005218.
10. National Pesticide Information Center (NCPIC). Available at: http://npic.orst.edu/index.html.
11. University of Hertfordshire. PPDB: Pesticide Properties Database. Available at: http://sitem.herts.ac.uk/aeru/ppdb/en.
12. U.S. Forest Service. Human Health and Ecological Risk Assessment. Available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml.
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. Mineau, P., A. Baril, B.T. Collins , J. Duffe, G. Joerman, R. Luttik. 2001. Reference values for comparing the acute toxicity of pesticides to birds. Reviews of Environmental Contamination and Toxicology 170:13-74. https://training.fws.gov/resources/course-resources/pesticides/Terrestrial%20Effects/2001_Acute%20toxicity%20reference%20values.pdf. [National Wildlife Research Centre, Canadian Wildlife Service, Environment Canada]