# Chemical Factsheet

## Glyphosate

### General Information

- Fact Sheet: bp-fact-glyosphate.082017.pdf
- Product Names:
  **Ranger Pro** (Bayer CropScience)
  **Roundup** (Monsanto)
  **Polado** (Monsanto)
  **Accord** (Monsanto)
  **Clearout** (Albaugh)
  **Departure** (Syngenta)
  **Extreme** (BASF) formulated with Imazethapyr
  **Backdraft** (BASF) formulated with Imazaquin
  **Rage** (FMC) formulated with Carentrazone-ethyl
  **Ortho Season-Long Grass & Weed Killer** (Scotts)
  **Knockout** (Libertas)
  **Cornerstone** (Winfield)
  **Rodeo** (Monsanto)
- Chemical Class: Phosphanoglycine herbicide
- Uses: Non selective herbicide, or at low rates a plant growth regulator
- Alternatives: Organic agriculture, Organic land managment
- Beyond Pesticides rating: Toxic

### Health and Environmental Effects

*See citations at end of document.*

- Cancer: Yes (**1**, **2**, **3**)
- Endocrine Disruption: Yes (**4**)
- Reproductive Effects: Yes (**5**, **6**)
- Neurotoxicity: Yes (**7**)
- Kidney/Liver Damage: Yes (**4**)
- Sensitizer/ Irritant: Yes (**6**)
- Birth/Developmental: Yes (**8**)
- Detected in Groundwater: Yes (**9**)
- Potential Leacher: Possible (**10**)
- Toxic to Birds: Yes (**11**)
- Toxic to Fish/Aquatic Organisms: Yes (**12**)
- Toxic to Bees: Yes (**13**, **14**)

### Residential Uses as Found in the ManageSafe™ Database

- Dandelions
- Annual Bluegrass
- Clover
- Ground Ivy

- Japanese Knotweed
- Chickweed

## Additional Information

- Regulatory Status:
    - EPA's Glyphosate Background and Updates
    - Draft Human Health and Ecological Risk Assessments for Glyphosate
    - Code of Federal Regulations: Glyphosate Tolerances
    - EPA Withdraws Glyphosate Interim Decision (September 2022)
    - Interim Registration Review Decision and Responses to Public Comments for Glyphosate (2020)
    - Beyond Pesticides' Draft Human Health and Ecological Risk Assessments for Glyphosate comments (04/2018)
    - Draft Human Health and Ecological Risk Assessments for Glyphosate (2017)
    - Revised Glyphosate Issue Paper: Evaluation of Carcinogenic Potential (2017)
    - Beyond Pesticides' Evaluation of the Carcinogenic Potential comments (10/2016)
    - Glyphosate Listed Effective July 7, 2017, as Known to the State of California to Cause Cancer (OEHHA, 2017)
    - Beyond Pesticides' Notice of Intent to List (California) comments (10/2015)
    - Beyond Pesticides' Enlist Duo registration comments (12/2016)
    - EPA Meeting Materials for the December 13-16, 2016 Scientific Advisory Panel on the Carcinogenic Potential of Glyphosate
    - Registration of Enlist Duo (EPA, 2014)
    - FInal work plan for Glyphosate Registration review (2009)
    - EPA Reregistration Eligibility Decision (RED) signed (9/1993)
- Supporting information:
    - Daily News Blog
    - Report- Glyphosate: Unsafe on Any Plate
    - Beyond Pesticides' letter to EPA calling for residue testing (12/2015)
    - Agricultural Uses of Antibiotics Escalate Bacterial Resistance (Pesticides and You, Winter 2016-2017)
    - Asthma, Children and Pesticides (Beyond Pesticides)
    - Children & Lawn Chemicals Don't Mix (Beyond Pesticides)
    - GMO Factsheet (Beyond Pesticides)
    - NCAP Glyphosate Factsheet (Northwest Coalition for Alternatives to Pesticides)
    - PAN Pesticides Database: Glyphosate (Pesticide Action Network)
    - EPA Technical Factsheet
- Studies [compiled from the Pesticide-Induced Diseases Database]
    - Exposure to Glyphosate-Based Herbicides and Risk for Non-Hodgkin Lymphoma: A Meta-Analysis and Supporting Evidence. Zhang, L., Rana, I., Taioli, E., Shaffer, R.M. and Sheppard, L., 2019. Mutation Research/Reviews in Mutation Research.
    - Multiomics reveal non-alcoholic fatty liver disease in rats following chronic exposure to an ultra-low dose of Roundup herbicide. Mesnage, R, Renney, G, Seralini, GE, et al. 2017. Scientific Reports 7, Article number: 39328
    - Glyphosate pathways to modern diseases V: Amino acid analogue of glycine in diverse proteins. Samsel, A, Seneff, S. 2016. J Biological Physics and Chemistry.16:9-46
    - IARC Classification of Glyphosate as a "probable" carcinogen (2015).
      Read the Daily News Blog
    - Transcriptome profile analysis reflects rat liver and kidney damage following chronic ultra-low dose Roundup exposure. Mesnage, R, Arno, M, Contanzo, M et al., 2015.

Environmental Health 14:70.
- Glyphosate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells. Benachour, et al. 2009. Chem. Res. Toxicol. 22 (1), pp 97–105.
- Do Pesticides Affect Learning Behavior? The neuro-endocrine-immune connection. Porter, Warren. 2004. Pesticides and You (Beyond Pesticides)
- A Case–Control Study of Non-Hodgkin Lymphoma and Exposure to Pesticides Journal of the American Cancer Society, 1999.
- Glyphosate formulations induce apoptosis and necrosis in human umbilical, embryonic, and placental cells. Benachour N, Séralini GE. Chemical Research in Toxicology. 2009 Jan;22(1):97-105
- Top 15 Farmworker Poison
- A comparison of temporal trends in United States autism prevalence to trends in suspected environmental factors.. Nevison, CD. 2014. Environ Health.13:73.
- An assessment of the acute dietary exposure to glyphosate using deterministic and probabilistic methods.. Stephenson CL, Harris CA, Clarke R. 2018. Food Addit Contam Part A Chem Anal Control Expo Risk Assess. 35(2):258-272
- An exploratory analysis of the effect of pesticide exposure on the risk of spontaneous abortion in an Ontario farm population.. Arbuckle,TE, Lin, Z and Mery, LS. 2001. Environ Health Perspect. 109(8): 851–857.
- Assessment of Glyphosate Induced Epigenetic Transgenerational Inheritance of Pathologies and Sperm Epimutations: Generational Toxicology. Kubsad, D., Nilsson, E.E., King, S.E., Sadler-Riggleman, I., Beck, D. and Skinner, M.K., 2019. Scientific reports, 9(1), pp.1-17.
- Prenatal and infant exposure to ambient pesticides and autism spectrum disorder in children: population based case-control study. von Ehrenstein, et al. 2019. BMJ 2019;364:l962
- Biomonitoring of Danish school children and mothers including biomarkers of PBDE and glyphosate.. Knudsen LE, Hansen PW, Mizrak S, Hansen HK, Mørck TA, et al. 2017. Rev Environ Health. 32(3):279-290
- Birth defects, season of conception, and sex of children born to pesticide applicators living in the Red River Valley of Minnesota, USA.. Garry, V.F. et al. 2002. Environ. Health Persp. 110 (Suppl. 3):441-449
- Characterising glyphosate exposures among amenity horticulturists using multiple spot urine samples.. Connolly A, Basinas I, Jones K, Galea KS, et al. 2018. Int J Hyg Environ Health. 221(7):1012-1022
- Combined effects of repeated administration of Bretmont Wipeout (glyphosate) and Ultrazin (atrazine) on testosterone, oxidative stress and sperm quality of Wistar rats.. Abarikwu SO, Akiri OF, et al. 2015. Toxicol Mech Methods.25(1):70-80.
- Cytotoxicity on human cells of Cry1Ab and Cry1Ac Bt insecticidal toxins alone or with a glyphosate-based herbicide. . Mesnage, R., Clair, E., Gress, S., Then, C., Székács, A. and Séralini, G.E., 2013. Journal of Applied Toxicology, 33(7), pp.695-699.
- Differential Effects of Glyphosate and Roundup on Human Placental Cells and Aromatase. Richard S., et al. 2005. Environmental Health Perspectives, 113(6).
- Early-life chemical exposures and risk of metabolic syndrome.. De Long NE, Holloway AC. 2017. Diabetes Metab Syndr Obes. 10:101-109.
- Effects of melatonin in rats in the initial third stage of pregnancy exposed to sub-lethal doses of herbicides.. Almeida LL, Teixeira ÁAC, Soares AF, Cunha FMD, et al. Acta Histochem. 119(3):220-227.
- Environmental and health effects of the herbicide glyphosate.. Van Bruggen AHC, He MM, Shin K, Mai V, Jeong KC, Finckh MR, Morris JG Jr. 2018. Sci Total Environ. 16-617:255-268
- Glyphosate poisoning - a case report. Kunapareddy, T. and Kalisetty, S., 2021. Journal of

Postgraduate Medicine.
- Cellular injury leading to oxidative stress in acute poisoning with potassium permanganate/oxalic acid, paraquat, and glyphosate surfactant herbicide. Wijerathna, T.M., Mohamed, F., Gawarammana, I.B., Wunnapuk, K., Dissanayake, D.M., Shihana, F. and Buckley, N.A., 2020. Environmental toxicology and pharmacology, 80, p.103510.
- Evaluation of estrogen receptor alpha activation by glyphosate-based herbicide constituents.. Mesnage R, Phedonos A, Biserni M, et al. 2017. Food Chem Toxicol. 108(Pt A):30-42.
- Exposure to Glyphosate-Based Herbicides and Risk for Non-Hodgkin Lymphoma: A Meta-Analysis and Supporting Evidence. . Zhang, L., Rana, I., Taioli, E., Shaffer, R.M. and Sheppard, L., 2019. Mutation Research/Reviews in Mutation Research.
- Exposure to pesticides as risk factor for non-Hodgkin's lymphoma and hairy cell leukemia: pooled analysis of two Swedish case-control studies.. Hardell, L., et al. 2002. Leuk Lymphoma 43(5):1043-1049
- Facts and Fallacies in the Debate on Glyphosate Toxicity.. Mesnage R, Antoniou MN. 2017. Front Public Health. 5:316
- Glyphosate and adverse pregnancy outcomes, a systematic review of observational studies. de Araujo JS, Delgado IF, Paumgartten FJ. 2016. BMC Public Health. 16:472
- Glyphosate and Paraquat in Maternal and Fetal Serums in Thai Women. Kongtip P, Nankongnab N, Phupancharoensuk R, et al. 2017. J Agromedicine. 22(3):282-289.
- Glyphosate biomonitoring for farmers and their families: results from the Farm Family Exposure Study.. Acquavella, J, F. et al. 2004. Environ Health Perspect; 112(3): 321–326
- Glyphosate exposure exacerbates the dopaminergic neurotoxicity in the mouse brain after repeated administration of MPTP. Pu, Y., Chang, L., Qu, Y., Wang, S., Tan, Y., Wang, X., Zhang, J. and Hashimoto, K., 2020. Neuroscience Letters, p.135032.
- Glyphosate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells. Benachour, N., et al. 2009. Chemical Research in Toxicology, 22(1)
- Glyphosate has limited short-term effects on commensal bacterial community composition in the gut environment due to sufficient aromatic amino acid levels.. Nielsen LN, Roager HM, Casas ME, Frandsen HL, et al. 2018. Environ Pollut. 233:364-376
- Glyphosate impairs male offspring reproductive development by disrupting gonadotropin expression.. Romano MA, Romano RM, Santos LD, et al. 2012. Arch Toxicol. 86(4):663-73
- Glyphosate in German adults - Time trend (2001 to 2015) of human exposure to a widely used herbicide.. Conrad A, Schröter-Kermani C, Hoppe HW, Rüther M, Pieper S, Kolossa-Gehring M. 2017. Int J Hyg Environ Health. 220(1):8-16
- Glyphosate induces human breast cancer cells growth via estrogen receptors.. Thongprakaisang S, Thiantanawat A, Rangkadilok N, et al. 2013. Food Chem Toxicol.59:129-36
- Glyphosate pathways to modern diseases V: Amino acid analogue of glycine in diverse proteins. Samsel, A. and Seneff, S., 2016. J Biol Phys Chem, 16(6), pp.9-46.
- Glyphosate Residues in Groundwater, Drinking Water and Urine of Subsistence Farmers from Intensive Agriculture Localities: A Survey in Hopelchén, Campeche, Mexico. Rendon-von Osten J, Dzul-Caamal R. 2017. Int J Environ Res Public Health. 14(6). pii: E595.
- Glyphosate toxicity and carcinogenicity: a review of the scientific basis of the European Union assessment and its differences with IARC.. Tarazona JV, Court-Marques D, Tiramani M, et al. 2017. Arch Toxicol. 91(8):2723-2743.
- Glyphosate Use and Cancer Incidence in the Agricultural Health Study. Andreotti G, Koutros S, Hofmann JN, Sandler DP, Lubin JH, et al. 2017. J Natl Cancer Inst. doi: 10.1093/jnci/djx233.
- Glyphosate, pathways to modern diseases II: Celiac sprue and gluten intolerance. Samsel, A. and Seneff, S., 2013. Interdisciplinary toxicology, 6(4), pp.159-184.

- [Integrative assessment of multiple pesticides as risk factors for non-Hodgkin's lymphoma among men]. De Roos, A.J., et al. 2003. Occupational and Environmental Medicine 60(9):e11
- [Is it time to reassess current safety standards for glyphosate-based herbicides?]. Vandenberg LN, Blumberg B, Antoniou MN, Benbrook CM, Carroll L, Colborn T, et al. 2017. J Epidemiol Community Health. 71(6):613-618
- [Can Glyphosate-Based Herbicides Contribute to Sustainable Agriculture?]. Krimsky, S. Sustainability, 13(4), p.2337.
- [Classification of the glyphosate target enzyme (5-enolpyruvylshikimate-3-phosphate synthase) for assessing sensitivity of organisms to the herbicide ]. Leino, L., Tall, T., Helander, M., Saloniemi, I., Saikkonen, K., Ruuskanen, S. and Puigbò, P. Journal of Hazardous Materials, 408, p.124556.
- [Indirect Effects of the Herbicide Glyphosate on Plant, Animal and Human Health Through its Effects on Microbial Communities]. Van Bruggen, A.H., Finckh, M.R., He, M., Ritsema, C.J., Harkes, P., Knuth, D. and Geissen, V. Frontiers in Environmental Science, 9.
- [Pesticides applied to crops and amyotrophic lateral sclerosis risk in the U.S]. Andrew, A., Zhou, J., Gui, J., Harrison, A., Shi, X., Li, M., Guetti, B., Nathan, R., Tischbein, M., Pioro, E.P. and Stommel, E. NeuroToxicology, 87, pp.128-135.
- [Impacts of dietary exposure to pesticides on faecal microbiome metabolism in adult twins] . Mesnage, R., Bowyer, R.C., El Balkhi, S., Saint-Marcoux, F., Gardere, A., Ducarmon, Q.R., Geelen, A.R., Zwittink, R.D., Tsoukalas, D., Sarandi, E. and Paramera, E.I., Environmental Health, 21(1), pp.1-14.
- [Oxidative stress of glyphosate, AMPA and metabolites of pyrethroids and chlorpyrifos pesticides among primary school children in Cyprus]. Makris, K.C., Efthymiou, N., Konstantinou, C., Anastasi, E., Schoeters, G., Kolossa-Gehring, M. and Katsonouri, A., Environmental Research, 212, p.113316.
- [Glyphosate impairs collective thermoregulation in bumblebees. ]. Weidenmüller, A., Meltzer, A., Neupert, S., Schwarz, A. and Kleineidam, C. Science, 376(6597), pp.1122-1126.
- [Glyphosate-Based Herbicides Alter the Reproductive Morphology of Rosa acicularis (Prickly Rose)]. Golt, A.R. and Wood, L.J. Frontiers in Plant Science, p.1184.
- [Roundup causes embryonic development failure and alters metabolic pathways and gut microbiota functionality in non-target species]. Suppa, A., Kvist, J., Li, X., Dhandapani, V., Almulla, H., Tian, A.Y., Kissane, S., Zhou, J., Perotti, A., Mangelson, H. and Langford, K., 2020. Microbiome, 8(1), pp.1-15.
- [Roundup and glyphosate’s impact on GABA to elicit extended proconvulsant behavior in Caenorhabditis elegans]. Naraine, A.S., Aker, R., Sweeney, I., Kalvey, M., Surtel, A., Shanbhag, V. and Dawson-Scully, K. Scientific Reports, 12(1), pp.1-11.
- [Perinatal exposure to a glyphosate pesticide formulation induces offspring liver damage]. Rieg, C.E.H., Cattani, D., Naspolini, N.F., Cenci, V.H., Cavalli, V.L.D.L.O., Jacques, A.V., Nascimento, M.V.P.D.S., Dalmarco, E.M., De Moraes, A.C.R., Santos-Silva, M.C. and Silva, F.R.M.B., 2022. Toxicology and Applied Pharmacology, 454, p.116245.
- [Glyphosate exposure in early pregnancy and reduced fetal growth: a prospective observational study of high-risk pregnancies]. Gerona, R.R., Reiter, J.L., Zakharevich, I., Proctor, C., Ying, J., Mesnage, R., Antoniou, M. and Winchester, P.D., 2022. Environmental Health, 21(1), pp.1-12.
- [Glyphosate and glyphosate-based herbicides (GBHs) induce phenotypic imipenem resistance in Pseudomonas aeruginosa]. Háhn, J., Kriszt, B., Tóth, G., Jiang, D., Fekete, M., Szabó, I., Göbölös, B., Urbányi, B., Szoboszlay, S. and Kaszab, E., 2022. Scientific Reports, 12(1), pp.1-11.
- [Amine Volatilization from Herbicide Salts: Implications for Herbicide Formulations and

Atmospheric Chemistry. Sharkey, S.M., Hartig, A.M., Dang, A.J., Chatterjee, A., Williams, B.J. and Parker, K.M., 2022. Environmental Science & Technology.

- Association of Lifetime Exposure to Glyphosate and Aminomethylphosphonic Acid (AMPA) with Liver Inflammation and Metabolic Syndrome at Young Adulthood: Findings from the CHAMACOS Study. Eskenazi, B., Gunier, R.B., Rauch, S., Kogut, K., Perito, E.R., Mendez, X., Limbach, C., Holland, N., Bradman, A., Harley, K.G. and Mills, P.J., 2023. Environmental Health Perspectives, 131(3), p.037001.
- Occurrence and exposure assessment of glyphosate in the environment and its impact on human beings. Muñoz, J.P., Silva-Pavez, E., Carrillo-Beltrán, D. and Calaf, G.M., 2023. Environmental Research, p.116201.
- Low-dose glyphosate exposure alters gut microbiota composition and modulates gut homeostasis. Lehman, P.C., Cady, N., Ghimire, S., Shahi, S.K., Shrode, R.L., Lehmler, H.J. and Mangalam, A.K., 2023. Environmental toxicology and pharmacology, 100, p.104149.
- The effects of glyphosate, pure or in herbicide formulation, on bumble bees and their gut microbial communities. Motta, E.V. and Moran, N.A., 2023. Science of The Total Environment, 872, p.162102.
- Individual and joint effects of glyphosate and cypermethrin formulations on two human cell lines. Coalova, I., March, H., de Molina, M.D.C.R. and Chaufan, G., 2023. Toxicology and Applied Pharmacology, 461, p.116398.
- Maternal exposure to a glyphosate-based herbicide impairs placental development through endoplasmic reticulum stress in mice. Liu, M., Lu, S., Yang, C., Zhang, D., Zhu, J., Yin, J., Zhao, H., Yang, B. and Kuang, H., 2023. Food and Chemical Toxicology, 173, p.113640.
- Human serum lipidomics analysis revealed glyphosate may lead to lipid metabolism disorders and health risks. Zhang, F., Zhang, Q., Liu, X., Gao, M., Li, X., Wang, Y., Chang, Y., Zhang, X., Huo, Z., Zhang, L. and Shan, J., 2023. Environment International, 171, p.107682.
- Glyphosate-based formulation affects Tetragonisca angustula worker’s locomotion, behavior and biology. Prado, I.S., da Rocha, A.A., Silva, L.A. and Gonzalez, V.C., 2023. Ecotoxicology, 32(4), pp.513-524.
- Mammary Gland Development in Male Rats Perinatally Exposed to Propiconazole, Glyphosate, or their Mixture. . Gomez, A.L., Altamirano, G.A., Alcaraz, M.R., Montemurro, M., Schierano-Marotti, G., Oddi, S.L., Culzoni, M.J., Muñoz-de-Toro, M., Bosquiazzo, V.L. and Kass, L., 2023. Environmental Toxicology and Pharmacology, p.104184.
- Association between glyphosate exposure and cognitive function, depression, and neurological diseases in a representative sample of US adults: NHANES 2013–2014 analysis. Hsiao, C.C., Yang, A.M., Wang, C. and Lin, C.Y., 2023. NHANES 2013–2014 analysis. Environmental Research, p.116860.
- Mapping the key characteristics of carcinogens for glyphosate and its formulations: A systematic review. Rana, I., Nguyen, P.K., Rigutto, G., Louie, A., Lee, J., Smith, M.T. and Zhang, L., 2023. Chemosphere, p.139572.
- Glyphosate impairs aversive learning in bumblebees. Nouvian, M., Foster, J.J. and Weidenmüller, A., 2023. Science of the Total Environment, 898, p.165527.
- Assessment of the impact of glyphosate and 2,4-D herbicides on the kidney injury and transcriptome changes in obese mice fed a Western diet.. Romualdo, G.R., de Souza, J.L.H., Valente, L.C. and Barbisan, L.F., 2023. Toxicology Letters, 385, pp.1-11.
- Occurrence of pesticide residues in indoor dust of farmworker households across Europe and Argentina.. Navarro, I., de la Torre, A., Sanz, P., Baldi, I., Harkes, P., Huerta-Lwanga, E., Nørgaard, T., Glavan, M., Pasković, I., Pasković, M.P. and Abrantes, N., 2023. Science of The Total Environment, p.167797.
- Association of glyphosate exposure with multiple adverse outcomes and potential

mediators.. Li, W., Lei, D., Huang, G., Tang, N., Lu, P., Jiang, L., Lv, J., Lin, Y., Xu, F. and Qin, Y.J., 2023. Chemosphere, p.140477.

- Pesticides: An alarming detriment to health and the environment. Kaur R;Choudhary D;Bali S;Bandral SS;Singh V;Ahmad MA;Rani N;Singh TG;Chandrasekaran B; Pesticides: An alarming detrimental to health and environment, The Science of the total environment. Available at: https://www.pubmed.ncbi.nlm.nih.gov/38232846/
- Evaluation of the scientific quality of studies concerning genotoxic properties of glyphosate. Nersesyan, A. and Knasmueller, S. (no date) 'Evaluation of the scientific quality of studies concerning genotoxic properties of glyphosate', Glyphosate EFSA studies SK & AN [Preprint]. Available at: https://usrtk.org/wp-content/uploads/2021/06/Evaluation_25.03.21-with-signatures.pdf.
- Modeling pesticides and ecotoxicological risk assessment in an intermittent river using SWAT. Centanni, M. et al. (2024) Modeling pesticides and ecotoxicological risk assessment in an intermittent river using Swat, Scientific Reports. Available at: https://www.nature.com/articles/s41598-024-56991-6#Sec14.
- Glyphosate presence in human sperm: First report and positive correlation with oxidative stress in an infertile French population. Vasseur, C. et al. (2024) Glyphosate presence in human sperm: First report and positive correlation with oxidative stress in an infertile French population, Ecotoxicology and Environmental Safety. Available at: https://www.sciencedirect.com/science/article/pii/S014765132400486X.
- Genome-wide transcriptional responses of Escherichia coli to glyphosate, a potent inhibitor of the shikimate pathway enzyme 5-enolpyruvylshikimate-3-phosphate synthase. Lu, W. et al. (2012) Genome-wide transcriptional responses of escherichia coli to glyphosate, a potent inhibitor of the shikimate pathway enzyme 5-enolpyruvylshikimate-3-phosphate synthase, Molecular BioSystems. Available at: https://pubmed.ncbi.nlm.nih.gov/23247721/.
- Major Pesticides Are More Toxic to Human Cells Than Their Declared Active Principles. Mesnage, R. et al. (2014) Major pesticides are more toxic to human cells than their declared active principles, BioMed Research International. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3955666/.
- Aquatic toxicity of glyphosate-based formulations: comparison between different organisms and the effects of environmental factors. Tsui, M. and Chu, L. (2003) Aquatic toxicity of glyphosate-based formulations: Comparison between different organisms and the effects of environmental factors, Chemosphere. Available at: https://pubmed.ncbi.nlm.nih.gov/12821000/.
- Assessing the ecological impact of pesticides/herbicides on algal communities: A comprehensive review. Narayanan, N. et al. (2024) Assessing the ecological impact of pesticides/herbicides on algal communities: A comprehensive review, Aquatic Toxicology. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0166445X24000225?via%3Dihub.
- A Comprehensive Review on Pesticide Residues in Human Urine. Hakme, E., Poulsen, M. and Lassen, A. (2024) A Comprehensive Review on Pesticide Residues in Human Urine, Journal of Agricultural and Food Chemistry. Available at: https://pubs.acs.org/doi/abs/10.1021/acs.jafc.4c02705.
- The impact and toxicity of glyphosate and glyphosate-based herbicides on health and immunity. Peillex, C. and Pelletier, M. (2020) The impact and toxicity of glyphosate and glyphosate-based herbicides on health and immunity, Journal of Immunotoxicology. Available at: https://www.tandfonline.com/doi/full/10.1080/1547691X.2020.1804492.
- Tannic acid inhibits pain mediators, inflammation and oxidative stress in mice exposed to glyphosate-based herbicide. Abolarin, P.O. and Owoyele, B.V. (2024) Tannic acid inhibits pain mediators, inflammation and oxidative stress in mice exposed to glyphosate-based

herbicide, Environmental Analysis Health and Toxicology. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11294660/.

- Glyphosate infiltrates the brain and increases pro-inflammatory cytokine TNFα: implications for neurodegenerative disorders. Winstone, J.K. et al. (2022) Glyphosate infiltrates the brain and increases pro-inflammatory cytokine TNFA: Implications for neurodegenerative disorders, Journal of Neuroinflammation. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9331154/.
- Influence of Pesticides Contamination on Microbial Population of Selected Farmlands. Uneze, D.P., Kugbenu, G.J. and Obire, O. (2024) Influence of pesticides contamination on microbial population of selected farmlands, British Journal of Environmental Sciences. Available at: https://eajournals.org/bjes/vol12-issue-5-2024/influence-of-pesticides-contamination-on-microbial-population-of-selected-farmlands/.
- Exposure to agricultural pesticides and wheezing among 5–12-year-old children in the Imperial Valley, CA, USA. Ornelas Van Horne, Y. et al. (2024) Exposure to agricultural pesticides and wheezing among 5–12-year-old children in the Imperial Valley, CA, USA, Environmental Epidemiology. Available at: https://journals.lww.com/environepidem/fulltext/2024/10000/exposure_to_agricultural_pesticides_and_wheezing.2.as
- Relationship between farming practices, soil macrofauna and litter decomposition in organic versus conventional banana agroecosystems. Jaouhari, M., Damour, G. and Coulis, M. (2024) Relationship between farming practices, soil macrofauna and litter decomposition in organic versus conventional banana agroecosystems, Applied Soil Ecology. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0929139324004281.
- Glyphosate formulations cause mortality and diverse sublethal defects during embryonic development of the amphibian Xenopus laevis. Flach, H. et al. (2024) Glyphosate formulations cause mortality and diverse sublethal defects during embryonic development of the amphibian Xenopus laevis, Chemosphere. Available at: https://www.sciencedirect.com/science/article/pii/S0045653524025244.
- Common use herbicides increase wetland greenhouse gas emissions. Cornish, C.M. et al. (2024) Common use herbicides increase wetland greenhouse gas emissions, Science of The Total Environment. Available at: https://www.sciencedirect.com/science/article/pii/S0048969724030286.
- Pesticides and prostate cancer incidence and mortality: An environment-wide association study. Soerensen, S. et al. (2024) Pesticides and prostate cancer incidence and mortality: An environment-wide association study, Cancer. Available at: https://acsjournals.onlinelibrary.wiley.com/doi/10.1002/cncr.35572.
- Assessment of lethal and sublethal effects of imidacloprid, ethion, and glyphosate on aversive conditioning, motility, and lifespan in honey bees (Apis mellifera L.). Sahar Delkash-Roudsari, Ana M. Chicas-Mosier, Seyed Hossein Goldansaz, Khalil Talebi-Jahromi, Ahmad Ashouri, Charles I. Abramson, Assessment of lethal and sublethal effects of imidacloprid, ethion, and glyphosate on aversive conditioning, motility, and lifespan in honey bees (Apis mellifera L.), Ecotoxicology and Environmental Safety, Volume 204, 2020, 111108, ISSN 0147-6513, https://doi.org/10.1016/j.ecoenv.2020.111108.
- Impaired associative learning after chronic exposure to pesticides in young adult honey bees. Carolina Mengoni Goñalons, Walter M. Farina; Impaired associative learning after chronic exposure to pesticides in young adult honey bees. J Exp Biol 1 April 2018; 221 (7): jeb176644. doi: https://doi.org/10.1242/jeb.176644
- Exposure to multiple pesticides and neurobehavioral outcomes among smallholder farmers in Uganda. Samuel Fuhrimann, Andrea Farnham, Philipp Staudacher, Aggrey

Atuhaire, Tiziana Manfioletti, Charles B. Niwagaba, Sarah Namirembe, Jonathan Mugweri, Mirko S. Winkler, Lutzen Portengen, Hans Kromhout, Ana M. Mora, Exposure to multiple pesticides and neurobehavioral outcomes among smallholder farmers in Uganda, Environment International, Volume 152, 2021, 106477, ISSN 0160-4120, https://doi.org/10.1016/j.envint.2021.106477.

- Impact of Endocrine Disrupting Pesticide Use on Obesity: A Systematic Review. Pérez-Bermejo, M. et al. (2024) Impact of Endocrine Disrupting Pesticide Use on Obesity: A Systematic Review, Biomedicines. Available at: https://www.mdpi.com/2227-9059/12/12/2677.
- Spatial distribution of agricultural pesticide use and predicted wetland exposure in the Canadian Prairie Pothole Region. Malaj, E., Liber, K. and Morrissey, C. (2020) Spatial distribution of agricultural pesticide use and predicted wetland exposure in the Canadian Prairie Pothole Region, Science of The Total Environment. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0048969719347564.
- Beyond the field: How pesticide drift endangers biodiversity. Albaseer, S. et al. (2024) Beyond the field: How pesticide drift endangers biodiversity, Environmental Pollution. Available at: https://www.sciencedirect.com/science/article/pii/S0269749124022437.
- Milkweed loss in agricultural fields because of herbicide use: effect on the monarch butterfly population. Pleasants, J. and Oberhauser, K. (2012) Milkweed loss in agricultural fields because of herbicide use: effect on the monarch butterfly population, Insect Conservation and Diversity. Available at: https://resjournals.onlinelibrary.wiley.com/doi/abs/10.1111/j.1752-4598.2012.00196.x.
- Response of Wine Grape Cultivars to Simulated Drift Rates of 2,4-D, Dicamba, and Glyphosate, and 2,4-D or Dicamba Plus Glyphosate. Mohseni-Moghadam, M. et al. (2017) Response of Wine Grape Cultivars to Simulated Drift Rates of 2,4-D, Dicamba, and Glyphosate, and 2,4-D or Dicamba Plus Glyphosate, Weed Technology. Available at: https://www.cambridge.org/core/journals/weed-technology/article/response-of-wine-grape-cultivars-to-simulated-drift-rates-of-24d-dicamba-and-glyphosate-and-24d-or-dicamba-plus-glyphosate/1BAD9A48DD98F8896E56C6823A2EE4A4.
- Immune response of Brazilian farmers exposed to multiple pesticides . Jacobsen-Pereira, C.H. et al. (2020) 'Immune response of Brazilian farmers exposed to multiple pesticides', Ecotoxicology and Environmental Safety, 202, p. 110912. doi:10.1016/j.ecoenv.2020.110912.
- Determination of glyphosate in breast milk of lactating women in a rural area from Paraná state, Brazil. Camiccia, M. et al. (2022) 'Determination of glyphosate in breast milk of lactating women in a rural area from Paraná State, Brazil', Brazilian Journal of Medical and Biological Research, 55. doi:10.1590/1414-431x2022e12194.
- Brief research report pesticide occupational exposure leads to significant inflammatory changes in normal mammary breast tissue . da Silva, R.G. et al. (2023) 'Brief research report pesticide occupational exposure leads to significant inflammatory changes in normal mammary breast tissue', Frontiers in Public Health, 11. doi:10.3389/fpubh.2023.1229422.
- Toxicity of pesticides toward human immune cells U-937 and HL-60. Barbasz, A. et al. (2020) 'Toxicity of pesticides toward human immune cells U-937 and HL-60', Journal of Environmental Science and Health, Part B, 55(8), pp. 719–725. doi:10.1080/03601234.2020.1777059.
- Pesticide-Induced Inflammation at a Glance. Lopes-Ferreira, M. et al. (2023) 'Pesticide-induced inflammation at a glance', Toxics, 11(11), p. 896. doi:10.3390/toxics11110896.
- Genotoxicity evaluation of 2,4-D, dicamba and glyphosate alone or in combination with cell reporter assays for DNA damage, oxidative stress and unfolded protein response . Mesnage, R. et al. (2021) 'Genotoxicity evaluation of 2,4-D, dicamba and glyphosate

alone or in combination with cell reporter assays for DNA damage, oxidative stress and unfolded protein response', Food and Chemical Toxicology, 157, p. 112601. doi:10.1016/j.fct.2021.112601.

- Glyphosate-based herbicides at low doses affect canonical pathways in estrogen positive and negative breast cancer cell lines . Stur, E. et al. (2019) 'Glyphosate-based herbicides at low doses affect canonical pathways in estrogen positive and negative breast cancer cell lines', PLOS ONE, 14(7). doi:10.1371/journal.pone.0219610.
- Recent pesticide exposure affects sleep: A cross-sectional study among smallholder farmers in Uganda. Samuel Fuhrimann, Iris van den Brenk, Aggrey Atuhaire, Ruth Mubeezi, Philipp Staudacher, Anke Huss, Hans Kromhout, Recent pesticide exposure affects sleep: A cross-sectional study among smallholder farmers in Uganda, Environment International, Volume 158, 2022, 106878, ISSN 0160-4120, https://doi.org/10.1016/j.envint.2021.106878. (https://www.sciencedirect.com/science/article/pii/S0160412021005031)
- Glyphosate exposure and GM seed rollout unequally reduced perinatal health. E. Reynier,& E. Rubin, Glyphosate exposure and GM seed rollout unequally reduced perinatal health, Proc. Natl. Acad. Sci. U.S.A. 122 (3) e2413013121, https://doi.org/10.1073/pnas.2413013121 (2025).
- Influence of microplastic addition on glyphosate decay and soil microbial activities in Chinese loess soil. Yang, X., Bento, C. P. M., Chen, H., Zhang, H., Xue, S., Lwanga, E. H., Zomer, P., Ritsema, C. J., & Geissen, V. (2018). Influence of microplastic addition on glyphosate decay and soil microbial activities in Chinese loess soil. Environmental pollution (Barking, Essex : 1987), 242(Pt A), 338–347. https://doi.org/10.1016/j.envpol.2018.07.006
- Hypothesis: glyphosate-based herbicides can increase risk of hematopoietic malignancies through extended persistence in bone. Benbrook, C. (2025) Hypothesis: glyphosate-based herbicides can increase risk of hematopoietic malignancies through extended persistence in bone, Environmental Sciences Europe. Available at: https://enveurope.springeropen.com/articles/10.1186/s12302-025-01057-1.
- Exploring the Joint Association Between Agrichemical Mixtures and Pediatric Cancer. Taiba, J. et al. (2025) Exploring the Joint Association Between Agrichemical Mixtures and Pediatric Cancer, GeoHealth. Available at: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2024GH001236.
- Urinary biomonitoring of glyphosate exposure among male farmers and nonfarmers in the Biomarkers of Exposure and Effect in Agriculture (BEEA) study. Chang, V. C., Ospina, M., Xie, S., Andreotti, G., Parks, C. G., Liu, D., Madrigal, J. M., Ward, M. H., Rothman, N., Silverman, D. T., Sandler, D. P., Friesen, M. C., Beane Freeman, L. E., Calafat, A. M., & Hofmann, J. N. (2024). Urinary biomonitoring of glyphosate exposure among male farmers and nonfarmers in the Biomarkers of Exposure and Effect in Agriculture (BEEA) study. Environment international, 187, 108644. https://doi.org/10.1016/j.envint.2024.108644
- The evidence of human exposure to glyphosate: a review. Gillezeau, C., van Gerwen, M., Shaffer, R.M. et al. The evidence of human exposure to glyphosate: a review. Environ Health 18, 2 (2019). https://doi.org/10.1186/s12940-018-0435-5
- Genotoxicity Assays Published since 2016 Shed New Light on the Oncogenic Potential of Glyphosate-Based Herbicides. Benbrook, C., Mesnage, R., & Sawyer, W. (2023). Genotoxicity Assays Published since 2016 Shed New Light on the Oncogenic Potential of Glyphosate-Based Herbicides. Agrochemicals, 2(1), 47-68. https://doi.org/10.3390/agrochemicals2010005
- How did the US EPA and IARC reach diametrically opposed conclusions on the genotoxicity of glyphosate-based herbicides?. Benbrook, C.M. How did the US EPA and IARC reach diametrically opposed conclusions on the genotoxicity of glyphosate-based

herbicides?. Environ Sci Eur 31, 2 (2019). https://doi.org/10.1186/s12302-018-0184-7

- A comprehensive analysis of the animal carcinogenicity data for glyphosate from chronic exposure rodent carcinogenicity studies. Portier, C.J. A comprehensive analysis of the animal carcinogenicity data for glyphosate from chronic exposure rodent carcinogenicity studies. Environ Health 19, 18 (2020). https://doi.org/10.1186/s12940-020-00574-1
- Glyphosate exposure and urinary oxidative stress biomarkers in the Agricultural Health Study. Vicky C Chang, Gabriella Andreotti, Maria Ospina, Christine G Parks, Danping Liu, Joseph J Shearer, Nathaniel Rothman, Debra T Silverman, Dale P Sandler, Antonia M Calafat, Laura E Beane Freeman, Jonathan N Hofmann, Glyphosate exposure and urinary oxidative stress biomarkers in the Agricultural Health Study, JNCI: Journal of the National Cancer Institute, Volume 115, Issue 4, April 2023, Pages 394–404, https://doi.org/10.1093/jnci/djac242
- Urinary Glyphosate Concentrations among Pregnant Participants in a Randomized, Crossover Trial of Organic and Conventional Diets. Hyland, C., Spivak, M., Sheppard, L., Lanphear, B. P., Antoniou, M., Ospina, M., Calafat, A. M., & Curl, C. L. (2023). Urinary Glyphosate Concentrations among Pregnant Participants in a Randomized, Crossover Trial of Organic and Conventional Diets. Environmental health perspectives, 131(7), 77005. https://doi.org/10.1289/EHP12155
- A Human Biomonitoring Study Assessing Glyphosate and Aminomethylphosphonic Acid (AMPA) Exposures among Farm and Non-Farm Families. Connolly, A., Koch, H. M., Bury, D., Koslitz, S., Kolossa-Gehring, M., Conrad, A., Murawski, A., McGrath, J. A., Leahy, M., Brüning, T., & Coggins, M. A. (2022). A Human Biomonitoring Study Assessing Glyphosate and Aminomethylphosphonic Acid (AMPA) Exposures among Farm and Non-Farm Families. Toxics, 10(11), 690. https://doi.org/10.3390/toxics10110690
- Quantification of glyphosate and other organophosphorus compounds in human urine via ion chromatography isotope dilution tandem mass spectrometry. Schütze, A., Morales-Agudelo, P., Vidal, M., Calafat, A. M., & Ospina, M. (2021). Quantification of glyphosate and other organophosphorus compounds in human urine via ion chromatography isotope dilution tandem mass spectrometry. Chemosphere, 274, 129427. https://doi.org/10.1016/j.chemosphere.2020.129427
- Glyphosate and AMPA in saliva and other traditional human matrices. New findings for less invasive biomonitoring to the exposure to pesticides. Filippi, Iohanna & Fernandez, Pilar & Grimalt, Joan & Butinof, Mariana & Amé, María & Muñoz, Sonia. (2023). Glyphosate and AMPA in saliva and other traditional human matrices. New findings for less invasive biomonitoring to the exposure to pesticides. Environmental Advances. 15. 100474. 10.1016/j.envadv.2023.100474.
- Determination of glyphosate and AMPA in blood and urine from humans: About 13 cases of acute intoxication. Zouaoui, K., Dulaurent, S., Gaulier, J. M., Moesch, C., & Lachâtre, G. (2013). Determination of glyphosate and AMPA in blood and urine from humans: about 13 cases of acute intoxication. Forensic science international, 226(1-3), e20–e25. https://doi.org/10.1016/j.forsciint.2012.12.010
- Prenatal Exposure to Glyphosate and Its Environmental Degradate, Aminomethylphosphonic Acid (AMPA), and Preterm Birth: A Nested Case–Control Study in the PROTECT Cohort (Puerto Rico). Silver, M. K., Fernandez, J., Tang, J., McDade, A., Sabino, J., Rosario, Z., Vélez Vega, C., Alshawabkeh, A., Cordero, J. F., & Meeker, J. D. (2021). Prenatal Exposure to Glyphosate and Its Environmental Degradate, Aminomethylphosphonic Acid (AMPA), and Preterm Birth: A Nested Case-Control Study in the PROTECT Cohort (Puerto Rico). Environmental health perspectives, 129(5), 57011. https://doi.org/10.1289/EHP7295
- The mechanism of DNA damage induced by Roundup 360 PLUS, glyphosate and AMPA in human peripheral blood mononuclear cells - genotoxic risk assessement. Woźniak, E.,

Sicińska, P., Michałowicz, J., Woźniak, K., Reszka, E., Huras, B., Zakrzewski, J., & Bukowska, B. (2018). The mechanism of DNA damage induced by Roundup 360 PLUS, glyphosate and AMPA in human peripheral blood mononuclear cells - genotoxic risk assessement. Food and chemical toxicology : an international journal published for the British Industrial Biological Research Association, 120, 510–522. https://doi.org/10.1016/j.fct.2018.07.035

- Occupational exposure to glyphosate and risk of lymphoma:results of an Italian multicenter case-control study. Meloni, F., Satta, G., Padoan, M. et al. Occupational exposure to glyphosate and risk of lymphoma:results of an Italian multicenter case-control study. Environ Health 20, 49 (2021). https://doi.org/10.1186/s12940-021-00729-8
- Leukemia in Sprague-Dawley Rats Exposed Long-term from Prenatal Life to Glyphosate and Glyphosate-Based Herbicides. Panzacchi, Simona & Tibaldi, Eva & Angelis, Luana & Falcioni, Laura & Gnudi, Federica & Iuliani, Martina & Manservigi, Marco & Manservisi, Fabiana & Manzoli, Isabella & Menghetti, Ilaria & Montella, Rita & Noferini, Roberta & Sgargi, Daria & Strollo, Valentina & Antoniou, Michael & Chen, Jia & Dinelli, Giovanni & Lorenzetti, Stefano & Mesnage, Robin & Mandrioli, Daniele. (2023). Leukemia in Sprague-Dawley Rats Exposed Long-term from Prenatal Life to Glyphosate and Glyphosate-Based Herbicides. 10.1101/2023.11.14.566013.
- A Review and Update with Perspective of Evidence that the Herbicide Glyphosate (Roundup) is a Cause of Non-Hodgkin Lymphoma. Weisenburger D. D. (2021). A Review and Update with Perspective of Evidence that the Herbicide Glyphosate (Roundup) is a Cause of Non-Hodgkin Lymphoma. Clinical lymphoma, myeloma & leukemia, 21(9), 621–630. https://doi.org/10.1016/j.clml.2021.04.009
- A cocktail of contaminants: how mixtures of pesticides at low concentrations affect aquatic communities. Relyea R. A. (2009). A cocktail of contaminants: how mixtures of pesticides at low concentrations affect aquatic communities. Oecologia, 159(2), 363–376. https://doi.org/10.1007/s00442-008-1213-9
- Glyphosate-based herbicide causes spermatogenesis disorder and spermatozoa damage of the Chinese mitten crab (Eriocheir sinensis) by affecting testes characteristic enzymes, antioxidant capacities and inducing apoptosis. Yang, X., Yu, X., Sun, N., Shi, X., Niu, C., Shi, A., & Cheng, Y. (2022). Glyphosate-based herbicide causes spermatogenesis disorder and spermatozoa damage of the Chinese mitten crab (Eriocheir sinensis) by affecting testes characteristic enzymes, antioxidant capacities and inducing apoptosis. Toxicology and applied pharmacology, 447, 116086. https://doi.org/10.1016/j.taap.2022.116086
- Perinatal Exposure to Glyphosate and a Glyphosate-Based Herbicide Affect Spermatogenesis in Mice. Pham, T. H., Derian, L., Kervarrec, C., Kernanec, P. Y., Jégou, B., Smagulova, F., & Gely-Pernot, A. (2019). Perinatal Exposure to Glyphosate and a Glyphosate-Based Herbicide Affect Spermatogenesis in Mice. Toxicological sciences : an official journal of the Society of Toxicology, 169(1), 260–271. https://doi.org/10.1093/toxsci/kfz039
- Glyphosate-induced liver and kidney dysfunction, oxidative stress, immunosuppression in Nile tilapia, but ginger showed a protection role. Abdelmagid, A.D., Said, A.M., Abd El-Gawad, E.A. et al. Glyphosate-induced liver and kidney dysfunction, oxidative stress, immunosuppression in Nile tilapia, but ginger showed a protection role. Vet Res Commun 47, 445–455 (2023). https://doi.org/10.1007/s11259-022-09961-0
- Alterations in blood parameters, DNA damage, oxidative stress and antioxidant enzymes and immune-related genes expression in Nile tilapia (Oreochromis niloticus) exposed to glyphosate-based herbicide. Acar, Ü., İnanan, B. E., Navruz, F. Z., & Yılmaz, S. (2021). Alterations in blood parameters, DNA damage, oxidative stress and antioxidant enzymes and immune-related genes expression in Nile tilapia (Oreochromis niloticus) exposed to glyphosate-based herbicide. Comparative biochemistry and physiology. Toxicology &

pharmacology : CBP, 249, 109147. https://doi.org/10.1016/j.cbpc.2021.109147
- Assessing pesticide residue occurrence and risks in the environment across Europe and Argentina. Alaoui, A., Christ, F., Abrantes, N., Silva, V., González, N., Gai, L., Harkes, P., Navarro, I., Torre, A., Martínez, M. Á., Norgaard, T., Vested, A., Schlünssen, V., Aparicio, V. C., Campos, I., Pasković, I., Pasković, M. P., Glavan, M., Ritsema, C., & Geissen, V. (2024). Assessing pesticide residue occurrence and risks in the environment across Europe and Argentina. Environmental pollution (Barking, Essex : 1987), 363(Pt 1), 125056. https://doi.org/10.1016/j.envpol.2024.125056
- Toxicity of atrazine, glyphosate, and quinclorac in bullfrog tadpoles exposed to concentrations below legal limits. Dornelles, M.F., Oliveira, G.T. Toxicity of atrazine, glyphosate, and quinclorac in bullfrog tadpoles exposed to concentrations below legal limits. Environ Sci Pollut Res 23, 1610–1620 (2016). https://doi.org/10.1007/s11356-015-5388-4
- Fate of pesticide residues in beer and its by-products. Hakme, E., Kallehauge Nielsen, I., Fermina Madsen, J., Storkehave, L. M., Skjold Elmelund Pedersen, M., Schulz, B. L., … Duedahl-Olesen, L. (2023). Fate of pesticide residues in beer and its by-products. Food Additives & Contaminants: Part A, 41(1), 45–59. https://doi.org/10.1080/19440049.2023.2282557
- Prenatal residential proximity to endocrine disrupting agricultural pesticides and menstrual cycle characteristics among Latina adolescents in California. Paul, J. et al. (2025) Prenatal residential proximity to endocrine disrupting agricultural pesticides and menstrual cycle characteristics among Latina adolescents in California, American Journal of Epidemiology. Available at: https://academic.oup.com/aje/advance-article/doi/10.1093/aje/kwaf059/8083004.
- Glyphosate Herbicide: Reproductive Outcomes and Multigenerational Effects. Milesi, M. M., Lorenz, V., Durando, M., Rossetti, M. F., & Varayoud, J. (2021). Glyphosate Herbicide: Reproductive Outcomes and Multigenerational Effects. Frontiers in endocrinology, 12, 672532. https://doi.org/10.3389/fendo.2021.672532
- Perinatal exposure to glyphosate or a glyphosate-based formulation disrupts hormonal and uterine milieu during the receptive state in rats. Lorenz, V., Pacini, G., Luque, E. H., Varayoud, J., & Milesi, M. M. (2020). Perinatal exposure to glyphosate or a glyphosate-based formulation disrupts hormonal and uterine milieu during the receptive state in rats. Food and chemical toxicology : an international journal published for the British Industrial Biological Research Association, 143, 111560. https://doi.org/10.1016/j.fct.2020.111560
- Molecular Basis for Endocrine Disruption by Pesticides Targeting Aromatase and Estrogen Receptor. Zhang, C., Schilirò, T., Gea, M., Bianchi, S., Spinello, A., Magistrato, A., Gilardi, G., & Di Nardo, G. (2020). Molecular Basis for Endocrine Disruption by Pesticides Targeting Aromatase and Estrogen Receptor. International journal of environmental research and public health, 17(16), 5664. https://doi.org/10.3390/ijerph17165664
- Impact of saflufenacil and glyphosate-based herbicides on the morphoanatomical and development of Enterolobium contortisiliquum (Vell.) Morong (Fabaceae): new insights into a non-target tropical tree species. de Araújo, H.H., Soares, G.D.D., Dias-Pereira, J. et al. Impact of saflufenacil and glyphosate-based herbicides on the morphoanatomical and development of Enterolobium contortisiliquum (Vell.) Morong (Fabaceae): new insights into a non-target tropical tree species. Environ Sci Pollut Res 31, 61254–61269 (2024). https://doi.org/10.1007/s11356-024-35223-4
- Adverse Effects of Pesticides on the Ovary: Evidence from Epidemiological and Toxicological Studies. Wang, L., Ma, X. and Liu, J. (2025) Adverse Effects of Pesticides on the Ovary: Evidence from Epidemiological and Toxicological Studies, Environment & Health. Available at: https://pubs.acs.org/doi/full/10.1021/envhealth.4c00243.
- Subchronic exposure to kalach 360 SL-induced endocrine disruption and ovary damage in

female rats. Hamdaoui, L., Naifar, M., Rahmouni, F., Harrabi, B., Ayadi, F., Sahnoun, Z., & Rebai, T. (2017). Subchronic exposure to kalach 360 SL-induced endocrine disruption and ovary damage in female rats. Archives of Physiology and Biochemistry, 124(1), 27–34. https://doi.org/10.1080/13813455.2017.1352606

- Effects of glyphosate on the ovarian function of pregnant mice, the secretion of hormones and the sex ratio of their fetuses. Ren, X., Li, R., Liu, J., Huang, K., Wu, S., Li, Y., & Li, C. (2018). Effects of glyphosate on the ovarian function of pregnant mice, the secretion of hormones and the sex ratio of their fetuses. Environmental pollution (Barking, Essex : 1987), 243(Pt B), 833–841. https://doi.org/10.1016/j.envpol.2018.09.049
- The toxic effects and possible mechanisms of glyphosate on mouse oocytes. Zhang, J. W., Xu, D. Q., & Feng, X. Z. (2019). The toxic effects and possible mechanisms of glyphosate on mouse oocytes. Chemosphere, 237, 124435. https://doi.org/10.1016/j.chemosphere.2019.124435
- Glyphosate and its formulation Roundup impair pig oocyte maturation. Spinaci, M., Nerozzi, C., Tamanini, C.l. et al. Glyphosate and its formulation Roundup impair pig oocyte maturation. Sci Rep 10, 12007 (2020). https://doi.org/10.1038/s41598-020-68813-6
- Evidence for direct effects of glyphosate on ovarian function: glyphosate influences steroidogenesis and proliferation of bovine granulosa but not theca cells in vitro. Perego, M. C., Schutz, L. F., Caloni, F., Cortinovis, C., Albonico, M., and Spicer, L. J. (2017) Evidence for direct effects of glyphosate on ovarian function: glyphosate influences steroidogenesis and proliferation of bovine granulosa but not theca cells in vitro. J. Appl. Toxicol., 37: 692–698. doi: 10.1002/jat.3417.
- Re-Evaluating the Use of Glyphosate-based Herbicides: Implications on Fertility. Stone, A. et al. (2025) Re-Evaluating the Use of Glyphosate-based Herbicides: Implications on Fertility, Reproductive Sciences. Available at: https://link.springer.com/article/10.1007/s43032-025-01834-6.
- Glyphosate and the key characteristics of an endocrine disruptor: A review. Muñoz, J. P., Bleak, T. C., & Calaf, G. M. (2021). Glyphosate and the key characteristics of an endocrine disruptor: A review. Chemosphere, 270, 128619. https://doi.org/10.1016/j.chemosphere.2020.128619
- Review: Mechanisms of Glyphosate and Glyphosate-Based Herbicides Action in Female and Male Fertility in Humans and Animal Models. Serra, L., Estienne, A., Vasseur, C., Froment, P., & Dupont, J. (2021). Review: Mechanisms of Glyphosate and Glyphosate-Based Herbicides Action in Female and Male Fertility in Humans and Animal Models. Cells, 10(11), 3079. https://doi.org/10.3390/cells10113079
- Effects of glyphosate exposure on sperm concentration in rodents: A systematic review and meta-analysis. Cai, W., Ji, Y., Song, X., Guo, H., Han, L., Zhang, F., Liu, X., Zhang, H., Zhu, B., & Xu, M. (2017). Effects of glyphosate exposure on sperm concentration in rodents: A systematic review and meta-analysis. Environmental toxicology and pharmacology, 55, 148–155. https://doi.org/10.1016/j.etap.2017.07.015
- Effect of glyphosate on reproductive organs in male rat. Dai, P., Hu, P., Tang, J., Li, Y., & Li, C. (2016). Effect of glyphosate on reproductive organs in male rat. Acta histochemica, 118(5), 519–526. https://doi.org/10.1016/j.acthis.2016.05.009
- Controversies on Endocrine and Reproductive Effects of Glyphosate and Glyphosate-Based Herbicides: A Mini-Review. de Araújo-Ramos AT, Passoni MT, Romano MA, Romano RM and Martino-Andrade AJ (2021) Controversies on Endocrine and Reproductive Effects of Glyphosate and Glyphosate-Based Herbicides: A Mini-Review. Front. Endocrinol. 12:627210. doi: 10.3389/fendo.2021.627210
- Glyphosate Induces Metaphase II Oocyte Deterioration and Embryo Damage by Zinc Depletion and Overproduction of Reactive Oxygen Species. Yahfoufi, Z. A., Bai, D., Khan, S. N., Chatzicharalampous, C., Kohan-Ghadr, H. R., Morris, R. T., & Abu-Soud, H. M. (2020).

Glyphosate Induces Metaphase II Oocyte Deterioration and Embryo Damage by Zinc Depletion and Overproduction of Reactive Oxygen Species. Toxicology, 439, 152466. https://doi.org/10.1016/j.tox.2020.152466

- Effects of glyphosate-based herbicide-contaminated diets on reproductive organ toxicity and hypothalamic-pituitary-ovarian axis hormones in weaned piglets. Fu, H., Gao, F., Wang, X., Tan, P., Qiu, S., Shi, B., & Shan, A. (2021). Effects of glyphosate-based herbicide-contaminated diets on reproductive organ toxicity and hypothalamic-pituitary-ovarian axis hormones in weaned piglets. Environmental pollution (Barking, Essex : 1987), 272, 115596. https://doi.org/10.1016/j.envpol.2020.115596
- Epigenetic disruption of estrogen receptor alpha is induced by a glyphosate-based herbicide in the preimplantation uterus of rats. Lorenz, V., Milesi, M. M., Schimpf, M. G., Luque, E. H., & Varayoud, J. (2019). Epigenetic disruption of estrogen receptor alpha is induced by a glyphosate-based herbicide in the preimplantation uterus of rats. Molecular and cellular endocrinology, 480, 133–141. https://doi.org/10.1016/j.mce.2018.10.022
- Perinatal exposure to a glyphosate-based herbicide impairs female reproductive outcomes and induces second-generation adverse effects in Wistar rats. Milesi, M.M., Lorenz, V., Pacini, G. et al. Perinatal exposure to a glyphosate-based herbicide impairs female reproductive outcomes and induces second-generation adverse effects in Wistar rats. Arch Toxicol 92, 2629–2643 (2018). https://doi.org/10.1007/s00204-018-2236-6
- Ovarian mitochondrial and oxidative stress proteins are altered by glyphosate exposure in mice. Ganesan, S., & Keating, A. F. (2020). Ovarian mitochondrial and oxidative stress proteins are altered by glyphosate exposure in mice. Toxicology and applied pharmacology, 402, 115116. https://doi.org/10.1016/j.taap.2020.115116
- Sub-chronic exposure to Kalach 360 SL, Glyphosate-based Herbicide, induced bone rarefaction in female Wistar rats. Hamdaoui, L., Oudadesse, H., Lefeuvre, B., Mahmoud, A., Naifer, M., Badraoui, R., Ayadi, F., & Rebai, T. (2020). Sub-chronic exposure to Kalach 360 SL, Glyphosate-based Herbicide, induced bone rarefaction in female Wistar rats. Toxicology, 436, 152412. https://doi.org/10.1016/j.tox.2020.152412
- Glyphosate-based herbicide enhances the uterine sensitivity to estradiol in rats. Guerrero Schimpf, M., Milesi, M. M., Luque, E. H., & Varayoud, J. (2018). Glyphosate-based herbicide enhances the uterine sensitivity to estradiol in rats. Journal of Endocrinology, 239(2), 197-213. https://doi.org/10.1530/JOE-18-0207
- Altered uterine angiogenesis in rats treated with a glyphosate-based herbicide. Ingaramo, P. I., Alarcón, R., Caglieris, M. L., Varayoud, J., Muñoz-de-Toro, M., & Luque, E. H. (2022). Altered uterine angiogenesis in rats treated with a glyphosate-based herbicide. Environmental pollution (Barking, Essex : 1987), 296, 118729. https://doi.org/10.1016/j.envpol.2021.118729
- Pesticide contamination in indoor home dust: A pilot study of non-occupational exposure in Argentina. Aparicio, Virginia & Kaseker, Jessica & Scheepers, Paul & Alaoui, Abdallah & Figueiredo, Daniel & Mol, H. & Silva, Vera & Harkes, Paula & dos Santos, Danilo & Geissen, Violette & Costa, José. (2025). Pesticide Contamination in Indoor Home Dust: A Pilot Study of Non-Occupational Exposure in Argentina. Environmental Pollution. 373. 126208. 10.1016/j.envpol.2025.126208.
- Parkinsonism after glycine-derivate exposure. Barbosa, E. R., Leiros da Costa, M. D., Bacheschi, L. A., Scaff, M., & Leite, C. C. (2001). Parkinsonism after glycine-derivate exposure. Movement disorders : official journal of the Movement Disorder Society, 16(3), 565–568. https://doi.org/10.1002/mds.1105
- Lethal, sublethal, and combined effects of pesticides on bees: A meta-analysis and new risk assessment tools. Tosi, S., Sfeir, C., Carnesecchi, E., vanEngelsdorp, D., & Chauzat, M. P. (2022). Lethal, sublethal, and combined effects of pesticides on bees: A meta-analysis and new risk assessment tools. The Science of the total environment, 844, 156857.

https://doi.org/10.1016/j.scitotenv.2022.156857

- The combination of microplastics and glyphosate affects the microbiome of soil inhabitant Enchytraeus crypticus. Yang, Huihui & Zheng, Guogang & Qin, Guoyan & Zhang, Qi & Zhang, Ziyao & Chen, Bingfeng & Lei, Chaotang & Liu, Meng & Cui, Rui & Sun, Liwei & Xia, Shengjie & Peijnenburg, Willie & Lu □□, Tao & Tang, Tao & Qian, Haifeng. (2025). The combination of microplastics and glyphosate affects the microbiome of soil inhabitant Enchytraeus crypticus. Journal of hazardous materials. 489. 137676. 10.1016/j.jhazmat.2025.137676.
- Assessing fire hazards of herbicides: Identifying toxic emissions from pesticide combustion. Przybysz, J. et al. (2025) Assessing fire hazards of herbicides: Identifying toxic emissions from pesticide combustion, Science of The Total Environment. Available at: https://www.sciencedirect.com/science/article/pii/S0048969725011829.
- Assessment of genetic damage levels in agricultural workers exposed to pesticides in Paraíba, Brazil. Carvalho-Gonçalves, L. et al. (2025) Assessment of genetic damage levels in agricultural workers exposed to pesticides in Paraíba, Brazil, Environmental Toxicology and Pharmacology. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1382668925000900.
- Recent trends in pesticides in crops: A critical review of the duality of risks-benefits and the Brazilian legislation issue. Souza, M. C. O., Cruz, J. C., Cesila, C. A., Gonzalez, N., Rocha, B. A., Adeyemi, J. A., Nadal, M., Domingo, J. L., & Barbosa, F. (2023). Recent trends in pesticides in crops: A critical review of the duality of risks-benefits and the Brazilian legislation issue. Environmental research, 228, 115811. https://doi.org/10.1016/j.envres.2023.115811
- In vitro genomic damage caused by glyphosate and its metabolite AMPA. Santovito, A., Nota, A., Pastorino, P., Gendusa, C., Mirone, E., Prearo, M., & Schleicherová, D. (2024). In vitro genomic damage caused by glyphosate and its metabolite AMPA. Chemosphere, 363, 142888. https://doi.org/10.1016/j.chemosphere.2024.142888
- Mapping pesticide-induced metabolic alterations in human gut bacteria. Chen, L. et al. (2025) Mapping pesticide-induced metabolic alterations in human gut bacteria, Nature Communications. Available at: https://www.nature.com/articles/s41467-025-59747-6.
- Glyphosate and aminomethylphosphonic acid metabolite (AMPA) modulate the phenotype of murine melanoma B16-F1 cells. Salgado Kiefer, Y. C. S., Ferreira, M. B., da Luz, J. Z., Filipak Neto, F., & Oliveira Ribeiro, C. A. (2024). Glyphosate and aminomethylphosphonic acid metabolite (AMPA) modulate the phenotype of murine melanoma B16-F1 cells. Environmental toxicology and pharmacology, 107, 104429. https://doi.org/10.1016/j.etap.2024.104429
- Preliminary Study of Pesticide Drift into the Maya Mountain Protected Areas of Belize. Kaiser, K. Preliminary Study of Pesticide Drift into the Maya Mountain Protected Areas of Belize. Bull Environ Contam Toxicol 86, 56–59 (2011). https://doi.org/10.1007/s00128-010-0167-x
- Carcinogenic effects of long-term exposure from prenatal life to glyphosate and glyphosate-based herbicides in Sprague–Dawley rats. Panzacchi, S., Tibaldi, E., De Angelis, L. et al. Carcinogenic effects of long-term exposure from prenatal life to glyphosate and glyphosate-based herbicides in Sprague–Dawley rats. Environ Health 24, 36 (2025). https://doi.org/10.1186/s12940-025-01187-2
- A wild bumble bee shows intraspecific differences in sensitivity to multiple pesticides. Tatarko, A. et al. (2025) A wild bumble bee shows intraspecific differences in sensitivity to multiple pesticides, Royal Society Open Science. Available at: https://royalsocietypublishing.org/doi/10.1098/rsos.250281.
- Review on the sublethal effects of pure and formulated glyphosate on bees: Emphasis on social bees. Battisti, L., Potrich, M., Lozano, E. R., dos Reis Martinez, C. B., & Sofia, S. H.

(2023). Review on the sublethal effects of pure and formulated glyphosate on bees: Emphasis on social bees. Journal of Applied Entomology, 147, 1–18. https://doi.org/10.1111/jen.13089

- Investigations of the Sensitivity of Ornamental, Fruit, and Nut Plant Species to Driftable Rates of 2,4-D and Dicamba. Dintelmann, Brian & Warmund, Michele & Bish, Mandy & Bradley, Kevin. (2019). Investigations of the Sensitivity of Ornamental, Fruit, and Nut Plant Species to Driftable Rates of 2,4-D and Dicamba. Weed Technology. 34. 1-35. 10.1017/wet.2019.118.
- Occurrence and distribution of glyphosate, polar pesticides and their metabolites in honeybees (Apis mellifera): a monitoring study in six different Italian regions. Gasparini, M. et al. (2025) Occurrence and distribution of glyphosate, polar pesticides and their metabolites in honeybees (Apis mellifera): a monitoring study in six different Italian regions, Environmental Advances. Available at: https://www.sciencedirect.com/science/article/pii/S2666765725000493.
- Glyphosate and its formulations Roundup Bioflow and RangerPro alter bacterial and fungal community composition in the rat caecum microbiome. Mesnage R, Panzacchi S, Bourne E, Mein CA, Perry MJ, Hu J, Chen J, Mandrioli D, Belpoggi F and Antoniou MN (2022) Glyphosate and its formulations Roundup Bioflow and RangerPro alter bacterial and fungal community composition in the rat caecum microbiome. Front. Microbiol. 13:888853. doi: 10.3389/fmicb.2022.888853
- Urinary pesticide biomarkers from adolescence to young adulthood in an agricultural setting in Ecuador: Study of secondary exposure to pesticides among children, adolescents, and adults (ESPINA) 2016 and 2022 examination data. Parajuli, R. et al. (2025) Urinary pesticide biomarkers from adolescence to young adulthood in an agricultural setting in Ecuador: Study of secondary exposure to pesticides among children, adolescents, and adults (ESPINA) 2016 and 2022 examination data, Data in Brief. Available at: https://www.sciencedirect.com/science/article/pii/S2352340925006067.
- Glyphosate in poultry production: health risks, toxicity, and environmental impact. Fathi, M. et al. (2025) Glyphosate in poultry production: health risks, toxicity, and environmental impact, World’s Poultry Science Journal. Available at: https://www.tandfonline.com/doi/full/10.1080/00439339.2025.2542410.
- Impact of feed glyphosate residues on broiler breeder egg production and egg hatchability. Foldager, L., Winters, J.F.M., Nørskov, N.P. et al. Impact of feed glyphosate residues on broiler breeder egg production and egg hatchability. Sci Rep 11, 19290 (2021). https://doi.org/10.1038/s41598-021-98962-1
- Detection of Glyphosate in Malformed Piglets. Krueger, Monika & Schrödl, Wieland & Pedersen, Ib. (2014). Detection of Glyphosate in Malformed Piglets. Journal of Environmental & Analytical Toxicology. 04. 10.4172/2161-0525.1000230.
- Effect of in ovo glyphosate injection on embryonic development, serum biochemistry, antioxidant status and histopathological changes in newly hatched chicks. Fathi, Mohamed Ahmed et al. “Effect of in ovo glyphosate injection on embryonic development, serum biochemistry, antioxidant status and histopathological changes in newly hatched chicks.” Journal of animal physiology and animal nutrition vol. 103,6 (2019): 1776-1784. doi:10.1111/jpn.13181
- Low-dose Roundup induces developmental toxicity in bovine preimplantation embryos in vitro. Cai, Wenyang et al. “Low-dose Roundup induces developmental toxicity in bovine preimplantation embryos in vitro.” Environmental science and pollution research international vol. 27,14 (2020): 16451-16459. doi:10.1007/s11356-020-08183-8
- Transcriptome profile analysis reflects rat liver and kidney damage following chronic ultra-low dose Roundup exposure. Mesnage, Robin et al. “Transcriptome profile analysis

reflects rat liver and kidney damage following chronic ultra-low dose Roundup exposure." Environmental health : a global access science source vol. 14 70. 25 Aug. 2015, doi:10.1186/s12940-015-0056-1

- Disruption of cytochrome P450 enzymes in the liver and small intestine in chicken embryos in ovo exposed to glyphosate. Fathi, Mohamed Ahmed et al. "Disruption of cytochrome P450 enzymes in the liver and small intestine in chicken embryos in ovo exposed to glyphosate." Environmental science and pollution research international vol. 27,14 (2020): 16865-16875. doi:10.1007/s11356-020-08269-3
- Chronic dietary exposure to a glyphosate-based herbicide in broiler hens has long-term impacts on the progeny metabolism. Estienne, Anthony et al. "Chronic dietary exposure to a glyphosate-based herbicide in broiler hens has long-term impacts on the progeny metabolism." Poultry science vol. 102,9 (2023): 102877. doi:10.1016/j.psj.2023.102877
- Involvement of glyphosate in disruption of biotransformation P450 enzymes and hepatic lipid metabolism in chicken. Fathi, Mohamed Ahmed et al. "Involvement of glyphosate in disruption of biotransformation P450 enzymes and hepatic lipid metabolism in chicken." Animal biotechnology vol. 34,9 (2023): 4957-4967. doi:10.1080/10495398.2023.2214601
- Glyphosate suppresses the antagonistic effect of Enterococcus spp. on Clostridium botulinum. Krüger, Monika et al. "Glyphosate suppresses the antagonistic effect of Enterococcus spp. on Clostridium botulinum." Anaerobe vol. 20 (2013): 74-8. doi:10.1016/j.anaerobe.2013.01.005
- The effect of glyphosate on potential pathogens and beneficial members of poultry microbiota in vitro. Shehata, Awad A et al. "The effect of glyphosate on potential pathogens and beneficial members of poultry microbiota in vitro." Current microbiology vol. 66,4 (2013): 350-8. doi:10.1007/s00284-012-0277-2
- The exposure in ovo to glyphosate on the integrity of intestinal epithelial tight junctions of chicks. Fathi, Mohamed A et al. "The exposure in ovo to glyphosate on the integrity of intestinal epithelial tight junctions of chicks." Journal of environmental science and health. Part. B, Pesticides, food contaminants, and agricultural wastes vol. 59,4 (2024): 183-191. doi:10.1080/03601234.2024.2319006
- Reproductive toxicity of roundup®-treated feed on broiler breeder roosters and the amelioration of these deleterious effects with inclusion of humic acids in feed. Jarrell, Zachery Ryan et al. "Reproductive toxicity of roundup®-treated feed on broiler breeder roosters and the amelioration of these deleterious effects with inclusion of humic acids in feed." Veterinary and animal science vol. 14 100215. 5 Nov. 2021, doi:10.1016/j.vas.2021.100215
- Glyphosate-based herbicides influence antioxidants, reproductive hormones and gut microbiome but not reproduction: A long-term experiment in an avian model. Ruuskanen, Suvi et al. "Glyphosate-based herbicides influence antioxidants, reproductive hormones and gut microbiome but not reproduction: A long-term experiment in an avian model." Environmental pollution (Barking, Essex : 1987) vol. 266,Pt 1 (2020): 115108. doi:10.1016/j.envpol.2020.115108
- Chronic Dietary Exposure of Roosters to a Glyphosate-Based Herbicide Increases Seminal Plasma Glyphosate and AMPA Concentrations, Alters Sperm Parameters, and Induces Metabolic Disorders in the Progeny. Serra L, Estienne A, Bourdon G, Ramé C, Chevaleyre C, Didier P, Chahnamian M, El Balkhi S, Froment P, Dupont J. Chronic Dietary Exposure of Roosters to a Glyphosate-Based Herbicide Increases Seminal Plasma Glyphosate and AMPA Concentrations, Alters Sperm Parameters, and Induces Metabolic Disorders in the Progeny. Toxics. 2021; 9(12):318. https://doi.org/10.3390/toxics9120318
- Investigating adverse effects of chronic dietary exposure to herbicide glyphosate on zootechnical characteristics and clinical, biochemical and immunological blood parameters in broiler chickens. Yildirim, Elena A et al. "Investigating adverse effects of

chronic dietary exposure to herbicide glyphosate on zootechnical characteristics and clinical, biochemical and immunological blood parameters in broiler chickens." Veterinary research communications vol. 48,1 (2024): 153-164. doi:10.1007/s11259-023-10195-x

- Toxicities of glyphosate- and cypermethrin-based pesticides are antagonic in the tenspotted livebearer fish (Cnesterodon decemmaculatus). Brodeur, Julie Céline et al. "Toxicities of glyphosate- and cypermethrin-based pesticides are antagonic in the tenspotted livebearer fish (Cnesterodon decemmaculatus)." Chemosphere vol. 155 (2016): 429-435. doi:10.1016/j.chemosphere.2016.04.075
- Assessment of cell death and genotoxic potential of glyphosate and cypermethrin formulations, individually and in combination, in HEp-2 cells. Coalova, Isis et al. "Assessment of cell death and genotoxic potential of glyphosate and cypermethrin formulations, individually and in combination, in HEp-2 cells." Environmental toxicology and pharmacology, vol. 119 104815. 2 Sep. 2025, doi:10.1016/j.etap.2025.104815
- Overview of human health effects related to glyphosate exposure. Galli FS, Mollari M, Tassinari V, Alimonti C, Ubaldi A, Cuva C and Marcoccia D (2024) Overview of human health effects related to glyphosate exposure. Front. Toxicol. 6:1474792. doi: 10.3389/ftox.2024.1474792
- Network toxicology reveals glyphosate mechanisms in kidney injury and cancer. Dong, Y. and Zhu, J. (2025) Network toxicology reveals glyphosate mechanisms in kidney injury and cancer, Scientific Reports. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC12375789/.
- Oxidative Stress and Metabolism: A Mechanistic Insight for Glyphosate Toxicology. Wang, Xiaojing et al. "Oxidative Stress and Metabolism: A Mechanistic Insight for Glyphosate Toxicology." Annual review of pharmacology and toxicology vol. 62 (2022): 617-639. doi:10.1146/annurev-pharmtox-020821-111552
- Pleiotropic Outcomes of Glyphosate Exposure: From Organ Damage to Effects on Inflammation, Cancer, Reproduction and Development. Marino, Marianna et al. "Pleiotropic Outcomes of Glyphosate Exposure: From Organ Damage to Effects on Inflammation, Cancer, Reproduction and Development." International journal of molecular sciences vol. 22,22 12606. 22 Nov. 2021, doi:10.3390/ijms222212606
- Binding interaction of glyphosate with glyphosate oxidoreductase and C-P lyase: Molecular docking and molecular dynamics simulation studies. Bhatt, Pankaj et al. "Binding interaction of glyphosate with glyphosate oxidoreductase and C-P lyase: Molecular docking and molecular dynamics simulation studies." Journal of hazardous materials vol. 409 (2021): 124927. doi:10.1016/j.jhazmat.2020.124927
- Use of human neuroblastoma SH-SY5Y cells to evaluate glyphosate-induced effects on oxidative stress, neuronal development and cell death signaling pathways. Martínez, María-Aránzazu et al. "Use of human neuroblastoma SH-SY5Y cells to evaluate glyphosate-induced effects on oxidative stress, neuronal development and cell death signaling pathways." Environment international vol. 135 (2020): 105414. doi:10.1016/j.envint.2019.105414
- Amyotrophic Lateral Sclerosis Pathoetiology and Pathophysiology: Roles of Astrocytes, Gut Microbiome, and Muscle Interactions via the Mitochondrial Melatonergic Pathway, with Disruption by Glyphosate-Based Herbicides. Anderson, George. "Amyotrophic Lateral Sclerosis Pathoetiology and Pathophysiology: Roles of Astrocytes, Gut Microbiome, and Muscle Interactions via the Mitochondrial Melatonergic Pathway, with Disruption by Glyphosate-Based Herbicides." International journal of molecular sciences vol. 24,1 587. 29 Dec. 2022, doi:10.3390/ijms24010587
- Characterization of glyphosate-induced cardiovascular toxicity and apoptosis in zebrafish. Lu, Jian et al. "Characterization of glyphosate-induced cardiovascular toxicity and apoptosis in zebrafish." The Science of the total environment vol. 851,Pt 2 (2022):

158308. doi:10.1016/j.scitotenv.2022.158308
- Pesticide residues in European agricultural soils – A hidden reality unfolded. Silva, Vera et al. "Pesticide residues in European agricultural soils - A hidden reality unfolded." The Science of the total environment vol. 653 (2019): 1532-1545. doi:10.1016/j.scitotenv.2018.10.441
- Long-Term Effects of Perinatal Exposure to a Glyphosate-Based Herbicide on Melatonin Levels and Oxidative Brain Damage in Adult Male Rats. Cattani, D., Pierozan, P., Zamoner, A., Brittebo, E., & Karlsson, O. (2023). Long-Term Effects of Perinatal Exposure to a Glyphosate-Based Herbicide on Melatonin Levels and Oxidative Brain Damage in Adult Male Rats. Antioxidants (Basel, Switzerland), 12(10), 1825. https://doi.org/10.3390/antiox12101825
- Urea Co-exposure Increases Glyphosate Toxicity in Earthworms: Evidence from Species with Distinct Sensitivities. Li, P. et al. (2025) Urea Co-exposure Increases Glyphosate Toxicity in Earthworms: Evidence from Species with Distinct Sensitivities, Environmental Science & Technology. Available at: https://pubs.acs.org/doi/abs/10.1021/acs.est.5c10842.
- Effects of glyphosate on earthworms: From fears to facts. de Lima E Silva, C., & Pelosi, C. (2024). Effects of glyphosate on earthworms: From fears to facts, Integrated Environmental Assessment and Management, Volume 20, Issue 5, 1 Pages 1330–1336, https://doi.org/10.1002/ieam.4873
- Glyphosate and urea co-exposure: Impacts on soil nitrogen cycling. Li, P., Zhai, W., Li, B., Guo, Q., Wang, Y., Gu, Y., Zheng, L., Zhao, F., Liu, X., Wang, P., & Liu, D. (2025). Glyphosate and urea co-exposure: Impacts on soil nitrogen cycling. Journal of hazardous materials, 492, 138150. https://doi.org/10.1016/j.jhazmat.2025.138150
- Microplastics modify the toxicity of glyphosate on Daphnia magna. Zocchi, M., & Sommaruga, R. (2019). Microplastics modify the toxicity of glyphosate on Daphnia magna. The Science of the total environment, 697, 134194. https://doi.org/10.1016/j.scitotenv.2019.134194
- Glyphosate-Based Herbicide Formulations and Their Relevant Active Ingredients Affect Soil Springtails Even Five Months after Application. Altmanninger, A., Brandmaier, V., Spangl, B., Gruber, E., Takács, E., Mörtl, M., Klátyik, S., Székács, A., & Zaller, J. G. (2023). Glyphosate-Based Herbicide Formulations and Their Relevant Active Ingredients Affect Soil Springtails Even Five Months after Application. Agriculture, 13(12), 2260. https://doi.org/10.3390/agriculture13122260
- Repeated annual glyphosate applications may impair beneficial soil microorganisms in temperate grassland. Druille, M., García-Parisi, P. A., Golluscio, R. A., Cavagnaro, F. P., & Omacini, M. (2016). Repeated annual glyphosate applications may impair beneficial soil microorganisms in temperate grassland. Agriculture, Ecosystems & Environment, 230, 184-190.
- Adverse impacts of Roundup on soil bacteria, soil chemistry and mycorrhizal fungi during restoration of a Colorado grassland. B de Mesquita, B, Schmidt, S, Suding, K and de Mesquita, B. (2023). Adverse impacts of Roundup on soil bacteria, soil chemistry and mycorrhizal fungi during restoration of a Colorado grassland. Applications in Soil Ecology, 185, 104778.
- Terrestrial ecotoxicity of glyphosate, its formulations, and co-formulants: evidence from 2010–2023. Klátyik, S., Simon, G., Oláh, M. et al. Terrestrial ecotoxicity of glyphosate, its formulations, and co-formulants: evidence from 2010–2023. Environ Sci Eur 35, 51 (2023). https://doi.org/10.1186/s12302-023-00758-9
- Glyphosate reduces the biodiversity of soil macrofauna and benefits exotic over native species in a tropical agroecosystem. El jaouhari, M., Damour, G., Tixier, P. and Coulis, M. (2023) Glyphosate reduces the biodiversity of soil macrofauna and benefits exotic over

native species in a tropical agroecosystem. Basic and Applied Ecology, 73, pp. 18-26.
- Hotspots of soil pollution: Possible glyphosate and aminomethylphosphonic acid risks on terrestrial ecosystems and human health. Ferreira, N.G.C., Alves da Silva, K., Guimarães, A.T.B. and de Oliveira, C.M.R. (2023). Hotspots of soil pollution: Possible glyphosate and aminomethylphosphonic acid risks on terrestrial ecosystems and human health. Environment International, 179.
- The combined toxicity effect of nanoplastics and glyphosate on Microcystis aeruginosa growth. Zhang, Q., Qu, Q., Lu, T., Ke, M., Zhu, Y., Zhang, M., Zhang, Z., Du, B., Pan, X., Sun, L. and Qian, H. (2018) 'The combined toxicity effect of nanoplastics and glyphosate on Microcystis aeruginosa growth', Environmental Pollution, 243, pp. 1106-1112. doi: 10.1016/j.envpol.2018.09.073.
- Long-term exposure to polyethylene microplastics and glyphosate interferes with the behavior, intestinal microbial homeostasis, and metabolites of the common carp (Cyprinus carpio L.). Chen, J., Rao, C., Yuan, R., Sun, D., Guo, S., Li, L., Yang, S., Qian, D., Lu, R., & Cao, X. (2022). Long-term exposure to polyethylene microplastics and glyphosate interferes with the behavior, intestinal microbial homeostasis, and metabolites of the common carp (Cyprinus carpio L.). The Science of the total environment, 814, 152681. https://doi.org/10.1016/j.scitotenv.2021.152681
- Insight into the confusion over surfactant co-formulants in glyphosate-based herbicides. Mesnage, R., Benbrook, C., & Antoniou, M. N. (2019). Insight into the confusion over surfactant co-formulants in glyphosate-based herbicides. Food and chemical toxicology : an international journal published for the British Industrial Biological Research Association, 128, 137–145. https://doi.org/10.1016/j.fct.2019.03.053
- The impact of glyphosate at regulatory “safe” levels on reproductive health: cellular and molecular disruptions on male germ line. Lombó, M. et al. (2025) The impact of glyphosate at regulatory “safe” levels on reproductive health: cellular and molecular disruptions on male germ line, Environment International. Available at: https://www.sciencedirect.com/science/article/pii/S0160412025002958.
- “Ashamed” to Put His Name to It: Monsanto, Industrial Bio-Test Laboratories, and the Use of Fraudulent Science, 1969–1985. David Rosner and Gerald Markowitz: “Ashamed” to Put His Name to It: Monsanto, Industrial Bio-Test Laboratories, and the Use of Fraudulent Science, 1969–1985. American Journal of Public Health 113, 661_666, https://doi.org/10.2105/AJPH.2023.307247
- Evaluation of carcinogenic potential of the herbicide glyphosate, drawing on tumor incidence data from fourteen chronic/carcinogenicity rodent studies. Greim, H., Saltmiras, D., Mostert, V., & Strupp, C. (2015). Evaluation of carcinogenic potential of the herbicide glyphosate, drawing on tumor incidence data from fourteen chronic/carcinogenicity rodent studies. Critical reviews in toxicology, 45(3), 185–208. https://doi.org/10.3109/10408444.2014.1003423
- Dietary exposure to pesticides in poultry: From semen quality to embryonic mortality and tissue accumulation. Napierkowska, S. et al. (2026) Dietary exposure to pesticides in poultry: From semen quality to embryonic mortality and tissue accumulation, Poultry Science. Available at: https://www.sciencedirect.com/science/article/pii/S0032579126000192.
- Chronic dietary exposure to a glyphosate-based herbicide results in reversible increase early embryo mortality in chicken. Estienne, A., Fréville, M., Bourdon, G., Ramé, C., Delaveau, J., Rat, C., Chahnamian, M., Brionne, A., Chartrin, P., Adriensen, H., Lecompte, F., Froment, P., & Dupont, J. (2022). Chronic dietary exposure to a glyphosate-based herbicide results in reversible increase early embryo mortality in chicken. Ecotoxicology and environmental safety, 241, 113741. https://doi.org/10.1016/j.ecoenv.2022.113741
- Hidden risks associated with occupational pesticide exposure in women with breast

cancer: High frequency of the Luminal B molecular subtype and occurrence of poor prognostic features. Cazagranda, I. et al. (2026) Hidden risks associated with occupational pesticide exposure in women with breast cancer: High frequency of the Luminal B molecular subtype and occurrence of poor prognostic features, PLOS ONE. Available at: https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0339471.

- Relationship between agrochemical compounds and mammary gland development and breast cancer. Kass, L., Gomez, A. L., & Altamirano, G. A. (2020). Relationship between agrochemical compounds and mammary gland development and breast cancer. Molecular and cellular endocrinology, 508, 110789. https://doi.org/10.1016/j.mce.2020.110789
- Alteration of estrogen-regulated gene expression in human cells induced by the agricultural and horticultural herbicide glyphosate. Hokanson R, Fudge R, Chowdhary R, Busbee D. Alteration of estrogen-regulated gene expression in human cells induced by the agricultural and horticultural herbicide glyphosate. Human & Experimental Toxicology. 2007;26(9):747-752. doi:10.1177/0960327107083453
- Exposure to Pesticides and Breast Cancer in an Agricultural Region in Brazil. Panis, C., Candiotto, L. Z. P., Gaboardi, S. C., Teixeira, G. T., Alves, F. M., da Silva, J. C., Scandolara, T. B., Rech, D., Gurzenda, S., Ponmattam, J., Ohm, J., Castro, M. C., & Lemos, B. (2024). Exposure to Pesticides and Breast Cancer in an Agricultural Region in Brazil. Environmental science & technology, 58(24), 10470–10481. https://doi.org/10.1021/acs.est.3c08695
- Pre-conceptional and prenatal exposure to pesticides and pediatric neuroblastoma. A meta-analysis of nine studies. Khan, A., Feulefack, J., & Sergi, C. M. (2022). Pre-conceptional and prenatal exposure to pesticides and pediatric neuroblastoma. A meta-analysis of nine studies. Environmental toxicology and pharmacology, 90, 103790. https://doi.org/10.1016/j.etap.2021.103790
- Parental Pesticide Exposure and Childhood Brain Cancer: A Systematic Review and Meta-Analysis Confirming the IARC/WHO Monographs on Some Organophosphate Insecticides and Herbicides. Feulefack, J., Khan, A., Forastiere, F., & Sergi, C. M. (2021). Parental Pesticide Exposure and Childhood Brain Cancer: A Systematic Review and Meta-Analysis Confirming the IARC/WHO Monographs on Some Organophosphate Insecticides and Herbicides. Children (Basel, Switzerland), 8(12), 1096. https://doi.org/10.3390/children8121096
- Emerging prospects and consequences of environmental neurotoxic pollutants in the vertebrate system. Shaw, R. et al. (2026) Emerging prospects and consequences of environmental neurotoxic pollutants in the vertebrate system, Discover Toxicology. Available at: https://link.springer.com/article/10.1007/s44339-025-00042-w.
- Epilithic biofilms as bioindicators of water contamination by pesticides in Protected Areas from Atlantic Forest. Mollmann, V. et al. (2026) Epilithic biofilms as bioindicators of water contamination by pesticides in Protected Areas from Atlantic Forest, Science of The Total Environment. Available at: https://www.sciencedirect.com/science/article/pii/S0048969726003177.
- Metabolome disruption of pregnant rats and their offspring resulting from repeated exposure to a pesticide mixture representative of environmental contamination in Brittany. Bonvallot N, Canlet C, Blas-Y-Estrada F, Gautier R, Tremblay-Franco M, Chevolleau S, et al. (2018) Metabolome disruption of pregnant rats and their offspring resulting from repeated exposure to a pesticide mixture representative of environmental contamination in Brittany. PLoS ONE 13(6): e0198448. https://doi.org/10.1371/journal.pone.0198448
- Cytotoxicity and Oxidative Stress Responses of Imidacloprid and Glyphosate in Human Prostate Epithelial WPM-Y.1 Cell Line. Abdel-Halim, Khaled Y., Osman, Safaa R., Cytotoxicity and Oxidative Stress Responses of Imidacloprid and Glyphosate in Human

Prostate Epithelial WPM-Y.1 Cell Line, Journal of Toxicology, 2020, 4364650, 12 pages, 2020. https://doi.org/10.1155/2020/4364650

- Global perspective of herbicide-resistant weeds. Heap I. (2014). Global perspective of herbicide-resistant weeds. Pest management science, 70(9), 1306–1315. https://doi.org/10.1002/ps.3696
- The Introduction of Thousands of Tonnes of Glyphosate in the food Chain-An Evaluation of Glyphosate Tolerant Soybeans. Bøhn, T., & Millstone, E. (2019). The Introduction of Thousands of Tonnes of Glyphosate in the food Chain-An Evaluation of Glyphosate Tolerant Soybeans. Foods (Basel, Switzerland), 8(12), 669. https://doi.org/10.3390/foods8120669
- Concerns over use of glyphosate-based herbicides and risks associated with exposures: a consensus statement. Myers, J. P., Antoniou, M. N., Blumberg, B., Carroll, L., Colborn, T., Everett, L. G., Hansen, M., Landrigan, P. J., Lanphear, B. P., Mesnage, R., Vandenberg, L. N., Vom Saal, F. S., Welshons, W. V., & Benbrook, C. M. (2016). Concerns over use of glyphosate-based herbicides and risks associated with exposures: a consensus statement. Environmental health : a global access science source, 15, 19. https://doi.org/10.1186/s12940-016-0117-0
- Glyphosate contamination in grains and foods: An overview. Xu, Jingwen & Smith, Shayna & Smith, Gordon & Wang, Weiqun & Li, Yonghui. (2019). Glyphosate Contamination in Grains and Foods: An Overview. Food Control. 106. 106710. 10.1016/j.foodcont.2019.106710.
- Pesticide exposure among organic and conventional smallholder farmers in Costa Rica and Uganda: biomarker evidence on exposure determinants. Petitpierre. A. et al. (2026). Pesticide exposure among organic and conventional smallholder farmers in Costa Rica and Uganda: biomarker evidence on exposure determinants, The Lancet Planetary Health. Available at: https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(25)00294-3/fulltext
- Toxicity of formulants and heavy metals in glyphosate-based herbicides and other pesticides. Defarge, N., Spiroux de Vendômois, J., & Séralini, G. E. (2017). Toxicity of formulants and heavy metals in glyphosate-based herbicides and other pesticides. Toxicology reports, 5, 156–163. https://doi.org/10.1016/j.toxrep.2017.12.025
- The effect of combinations of a glyphosate-based herbicide with various clinically used antibiotics on phenotypic traits of Gram-negative species from the ESKAPEE group. Zerrouki, H., Hamieh, A., Hadjadj, L. et al. The effect of combinations of a glyphosate-based herbicide with various clinically used antibiotics on phenotypic traits of Gram-negative species from the ESKAPEE group. Sci Rep 14, 21006 (2024). https://doi.org/10.1038/s41598-024-68968-6
- Glyphosate resistance as a potential driver for the dissemination of multidrug-resistant clinical strains. Knecht CA, Prack McCormick B, Álvarez VE, Gonzales Machuca A, Buzzola F, Fuchs J, Salgado P, Campos J, Müller JA, Quiroga MP and Centrón D (2026) Glyphosate resistance as a potential driver for the dissemination of multidrug-resistant clinical strains. Front. Microbiol. 17:1740431. doi: 10.3389/fmicb.2026.1740431
- Occurrence and fate of the herbicide glyphosate and its degradate aminomethylphosphonic acid in the atmosphere. Feng-chih Chang, Matt F Simcik, Paul D Capel, Occurrence and fate of the herbicide glyphosate and its degradate aminomethylphosphonic acid in the atmosphere, Environmental Toxicology and Chemistry, Volume 30, Issue 3, 1 March 2011, Pages 548–555, https://doi.org/10.1002/etc.431
- Glyphosate and atrazine in rainfall and soils in agroproductive areas of the pampas region in Argentina. Alonso, L. L., Demetrio, P. M., Agustina Etchegoyen, M., & Marino, D. J. (2018). Glyphosate and atrazine in rainfall and soils in agroproductive areas of the

pampas region in Argentina. The Science of the total environment, 645, 89–96. https://doi.org/10.1016/j.scitotenv.2018.07.134
- Pesticides in ambient air, influenced by surrounding land use and weather, pose a potential threat to biodiversity and humans. Zaller, J. G., Kruse-Plaß, M., Schlechtriemen, U., Gruber, E., Peer, M., Nadeem, I., Formayer, H., Hutter, H. P., & Landler, L. (2022). Pesticides in ambient air, influenced by surrounding land use and weather, pose a potential threat to biodiversity and humans. The Science of the total environment, 838(Pt 2), 156012. https://doi.org/10.1016/j.scitotenv.2022.156012

## Gateway Health and Environmental Effects Citations

1. International Agency for Research on Cancer, World Health Organization (IARC) category, the agent (mixture) is possibly carcinogenic to humans. November 2, 2018. http://monographs.iarc.fr/ENG/Classification/index.php

2. Northwest Coalition for Alternatives to Pesticides (NCAP), Pesticide Factsheets. http://www.pesticide.org/pesticide-factsheets.

3. Zhang, L., Rana, I., Taioli, E., Shaffer, R.M. and 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*. *Meta-analysis of every available published human study on NHL and glyphosate, including the most recently updated data from the ongoing U.S. Agricultural Health Study, published in 2018. Statistical analysis revealed a 41% increased risk of NHL resulting from high exposure to glyphosate-based herbicide.*

4. Beyond Pesticides ChemWatch Factsheets. (Cited under factsheets on Beyond Pesticides Gateway; see top of individual chemical page)

5. Frazier, L. and M.L. Hage. 2001. Reproductive Hazards of the Workplace. Europe: Wiley. Table 10: Partial List of Reproductive Toxins. https://web.archive.org/web/20100624221623/http://www.biosci.osu.edu/safety/CHP/Tables2001/Table10-11-00.pdf.

6. US EPA, Office of Prevention, Pesticides and Toxic Substances, Reregistration Eligibility Decisions (REDs), Interim REDS (iREDs) and RED Factsheets. https://archive.epa.gov/pesticides/reregistration/web/html/status.html.

7. Neto da Silva, K., Garbin Cappellaro, L., Ueda, C.N., Rodrigues, L., Pertile Remor, A., Martins, R.D.P., Latini, A. and Glaser, V., 2020. Glyphosate-based herbicide impairs energy metabolism and increases autophagy in C6 astroglioma cell line. *Journal of Toxicology and Environmental Health, Part A*, pp.1-15. https://www.tandfonline.com/doi/abs/10.1080/15287394.2020.1731897

8. Rappazzo, K.M., Warren, J.L., Davalos, A.D., Meyer, R.E., Sanders, A.P., Brownstein, N.C. and Luben, T.J., 2019. Maternal residential exposure to specific agricultural pesticide active ingredients and birth defects in a 2003–2005 North Carolina birth cohort. Birth defects research, 111(6), pp.312-323. https://onlinelibrary.wiley.com/doi/epdf/10.1002/bdr2.1448

9. Rendón-von Osten, J. and Dzul-Caamal, R., 2017. Glyphosate residues in groundwater, drinking water and urine of subsistence farmers from intensive agriculture localities: a survey in Hopelchén, Campeche, Mexico. International journal of environmental research and public health, 14(6), p.595. https://www.mdpi.com/1660-4601/14/6/595/htm

10. Agency for Toxic Substances and Disease Registry. ToxFAQs. http://www.atsdr.cdc.gov/toxfaqs/index.asp.

11. Hussain R, Ali F, Rafique A, Ghaffar A, Jabeen G, Rafay M, Liaqat S, Khan I, Malik R, Khan MK, Niaz M, Akram K and Masood A, 2019. Exposure to sub-acute concentrations of glyphosate induce clinicohematological, serum biochemical and genotoxic damage in adult cockerels. Pak Vet J, 39(2): 181-186. http://dx.doi.org/10.29261/pakvetj/2019.064

12. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. http://extoxnet.orst.edu/pips/ghindex.html

13. Ledoux, M.L., Hettiarachchy, N., Yu, X., Howard, L. and Lee, S.O., 2019. Penetration of glyphosate into the food supply and the incidental impact on the honey supply and bees. Food Control, p.106859. https://doi.org/10.1016/j.foodcont.2019.106859

14. Zgurzynski, M.I. and Lushington, G.H., 2019. Glyphosate Impact on Apis mellifera Navigation: A Combined Behavioral and Cheminformatics Study. *EC Pharmacology and Toxicology*, *7*, pp.806-824. https://www.ecronicon.com/ecpt/pdf/ECPT-07-00336.pdf

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