

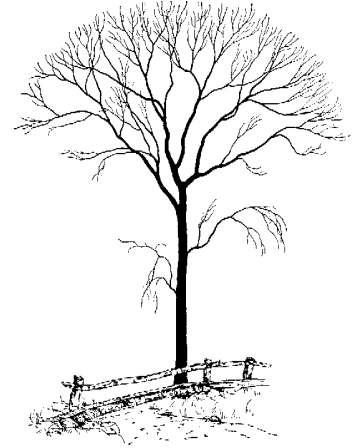
Glyphosate *N*-(phosphonomethyl)glycine

General

Glyphosate is the active ingredient in Monsanto's Roundup™, and many other agricultural, forestry, and residential herbicides with the products names Rodeo™ and Pondmaster™, etc. It is a broad spectrum, non-selective systemic herbicide.

How It Works

Amazingly, the mode of action of glyphosate is not known. There is considerable research that points the potential that the pesticide inhibits the shikimic acid pathway, which prevents plants from synthesizing three aromatic amino acids. It has also been shown to inhibit the enzyme EPSP synthase¹ and a host of other enzymes in specific plant species.



Inert Ingredients

Commercial glyphosate is composed of a myriad of other chemicals all with the purpose of making the herbicide more easy to use. These products are generally not placed on the label. Estimates are that over 99% of the product is composed of these inert products, of which little research has been conducted.

Health Effects

The toxicity of glyphosate alone is much less than the toxicity of commercial glyphosate used by consumers, due to the so-called "inert" ingredients in the commercial formulation. For example the surfactant polyethoxylated tallowamine has an acute lethal dose three times that of glyphosate alone and destroys red blood cells. Yet toxicity studies used to regulate the product only examine the "active" ingredient only and not the formulation.

Acute symptoms of glyphosate exposure include, destruction of red blood cells, lung dysfunction, low blood pressure, kidney damage, erosion of gastrointestinal tract, dizziness, fever, and nausea.^{2,3,4}

A study of Ontario farmers, found that those using glyphosate had an increase of miscarriages and premature births within their family.⁵ Also, glyphosate has been shown to disrupt hormones that regulate oestrogen synthesis, important reproductive hormones that have also been shown to have a role in bone growth and testicular function.

Examinations of the effects of Roundup™ on human lymphocytes have shown an increase in the frequency of sister chromatid exchanges, genetic exchanges during cell division resulting in point mutations.^{6,7}

Environmental Effects

Glyphosate has been shown to kill beneficial insects including parasitoid wasps, lacewings and ladybugs.⁸ Other insect populations have been drastically reduced by glyphosate populations, which negatively impacts on birds and small insect-eating mammals.⁹ These changes in plant communities impact birds' sources of food, shelter and nest support.

Glyphosate in its commercial form is 20 to 70 times more toxic to fish than glyphosate alone¹⁰. It is also increasingly toxic at higher temperatures. This is significant when one considers that glyphosate is a defoliant and the lack of plant cover increases the temperature of waterways. Sublethal effects on fish include erratic swimming, gill damage, and changes in liver structure.^{11,12}

Glyphosate also impacts non-target plant species in several important ways. In low doses it decreases both the number of seeds germinating and the seedling weight as compared to untreated plants.¹³ It also affects the ability of bacteria located on the nodules of leguminous plants to perform nitrogen fixation, an essential process converting nitrogen from an unusable form to a compound that is able to be used by the plant. Studies have shown that at typically application rates, glyphosate inhibits up to 70% of nitrogen fixation.¹⁴

Corn and soybeans, are some of the crops that have been genetically modified with genes that convey resistance to the herbicide Roundup™. There exist numerous other health, environmental and economic issues with these products. *For information on genetically modified, glyphosate resistant crops see Sierra Club of Canada's fact sheets on Genetically Modified Organisms.*

Conclusions

Glyphosate is a herbicide that is constantly lauded as benign. These affirmations are based on studies examining the active ingredient only. In the field, our lawns, our communities, however a different result has emerged. Glyphosate has caused a host of acute and chronic effects ranging from red blood cell destruction to increased propensity for miscarriages. The effects on wildlife, from fish to birds and also non-target species have been observed at doses lower than the application rates suggested.

Resources

¹ Franz, J.E., M.K. Mao, and J.A. Sikorski. 1997. Glyphosate: A unique global herbicide. ACS Monograph 189. Washington, D.C.: American Chemical Society.

² Sawada, Y., et al. 1988. Probable toxicity of surface-active agent in commercial herbicide containing glyphosate. *Lancet* 1(8580):299.

³ Tominack, R.L. et al. 1991. Taiwan National Poison Center: Survey of glyphosate-surfactant herbicide ingestions. *Clin. Toxicol.* 29(1):91-109.

⁴ Talbot, A.R. et al. 1991. Acute poisoning with a glyphosate-surfactant herbicide ("Roundup"): A review of 93 cases. *Human Exp. Toxicol.* 10:1-8.

⁵ Savitz, D.A. et al. 1997. Male pesticide exposure and pregnancy outcome. *Am. J. Epidemiol.* 146: 1025-1036.

⁶ Vigfusson, N.V. and E.R. Vyse. 1980. The effect of the pesticides, Dexon, Captan, and Roundup on sister-chromatid exchanges in human lymphocytes in vitro. *Mut. Res.* 79:53-57.

⁷ Bolognesi, C. et al. 1995. Mutagenicity testing of nine herbicides and pesticides currently used in agriculture. *Environ. Mol. Mutagen.* 25:148-153.

⁸ Hassan, S.A. et al. Results of the fourth joint pesticide testing programme carried out by the IOBC/WPRS working group "Pesticides and Beneficial Organisms". *J. Appl. Ent.* 105:321-329.

⁹ Santillo, D.J., D.M. Leslie, and P.W. Brown. 1989. Responses of small mammals and habitat to glyphosate application

¹⁰ Folmar, L.C., H.O. Sanders, and A.M. Julin. 1979. Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates. *Arch. Environ. Contam. Toxicol.* 33:355-361.

¹¹ Liong, P.C., W.P. Hamzah, and V. Murugan. 1988. Toxicity of some pesticides towards freshwater fishes. *Malaysian Agric. J.* 54(3):147-156.

¹² Neskovic, N.K. et al. 1996. Biochemical and histopathological effects of glyphosate on carp, *Cyprinus carpio* L. *Bull. Environ. Toxicol. Chem.* 56:295-302.

¹³ Locke, D., J.A. Landivar, and D. Moseley. 1995. The effects of rate and timing of glyphosate applications on defoliation efficiency, regrowth inhibition, lint yield, fiber quality and seed quality. *Proc. Beltwide Cotton Conf. National Cotton Council of America*: 1088-1090.

¹⁴ Eberback, P.L. and L.A. Douglas 1983. Persistence of glyphosate in a sandy loam. *Soil Biol. Biochem.* 15(4):485-487.