

# GLYPHOSATE

## Overview

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Glyphosate is a widely used [non-selective herbicide](#) and is the active ingredient in various commercial formulations, most famously as the active ingredient in Roundup manufactured by the Monsanto Company. [John E. Franz](#) in 1970, discovered the glyphosate class of herbicides while working as research chemist for Monsanto. It was first registered in 1974 and was reregistered in 1993 for use on a variety of weeds in both agricultural and residential settings. Pure glyphosate is not highly toxic, but when it is mixed with other ingredients, most often a surfactant which are chemicals that help glyphosate penetrate plant cells as it is to form [Roundup](#), negative health effects have been observed ([#De Roos, et al, 2005](#)). For instance, a recent study has shown that glyphosate is toxic to human placental cells and that [Roundup](#) is "always more toxic than its active ingredient (glyphosate)" and that the formulation "depends on its formulation and several are more toxic than the glyphosate itself" ([#Richard, et al, 2005](#) and [#Watts and Mcfarlane, 1999](#)).

## Chemical Description

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Glyphosate is an organic acid that consists of a glycine moiety and a phosphonomethyl moiety. Technical grade glyphosate is an odorless white crystalline powder. It is usually mixed with other ingredients - surfactants - and its properties are changed upon its application. See the list of [inert ingredients](#) it is combined with.

**Table 1. Physical and chemical properties of glyphosate from [#INCHEM, 1994](#)**

Physical state: crystalline powder
Color: white
Odor: none

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Melting point: 184.5 °C, decomposition at 187 °C
Specific gravity (density): 1.704 @ 20 °C
Vapor pressure: < 1 x 10 <sup>-5</sup> Pa @ 25 °C
Solubility in water: 10 100 mg/litre @ 20 °C
Flammability: not flammable
Explosiveness: not explosive

## Uses

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Glyphosate is the most commonly used [pesticide](#) in the world with the latest estimate (2001 use) putting its usage at 85-90 million pounds worldwide and 38-48 million pounds in the United States annually ([Usage, 2007](#) and [Cox, 1998](#)). It is post-emergent, systemic, and non-selective [herbicide](#) used on a myriad of plants including annual and perennial plants of all types and in both commercial, residential, and agricultural settings ([#EXTOXNET, 1996](#) and [#INCHEM, 1994](#)). The major formulation is Roundup in which glyphosate is formulated as the isopropylamine salt as it is in additional 52 other formulations ([#INCHEM, 1994](#) and [#RED, 1993](#)). The isopropylamine salt specifically is used to control broad leaf plants in agricultural and residential settings ([#INCHEM, 1994](#)).

Trade Names
Glialka
Roundup
Sting
Rodeo

Trade Names
Spasor
Muster
Tumbleweed
Sonic
Glifonox
Glycel
Rondo

## Formulation

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Glyphosate is in its pure form an acid, but it is most commonly used as the isopropylamine salt and is generally distributed in conjunction with water-soluble concentrates and powders ([#EXTOXNET, 2006](#)).

## Glyphosate and Inert Ingredients

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Inert Ingredients in Glyphosate Products from <a href="#">#Cox, 1998</a>
* ammonium sulfate
* benzisothiazolone
* 3-iodo-2-propynyl butylcarbamate (IPBC)
* isobutane
* methyl pyrrolidinone
* pelargonic acid
* polyethoxylated tallowamine (POEA)

### Inert Ingredients in Glyphosate Products from #Cox, 1998

\* potassium hydroxide

\* sodium sulfite

\* sorbic acid

\* Isopropylamine|

\* Roundup

Glyphosate and Roundup are another example of the problem that allows companies to only label the "active" ingredient while referring to the remainder of the ingredients as "Inert". This is because glyphosate alone is less toxic than when it is combined with a surfactant, which are only listed as "inert" inert ingredients, giving a false impression of the compounds actual toxicity (#Cox, 1998).

## Health Effects

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Glyphosphate is marketed as benign but laboratory testing have discovered some negative health effects in short-term, long-term, carcinogenicity, and reproductive systems (#Cox, 1998). Additionally, the glyphosate-containing product Roundup has been known to be used in suicide ases in Japan and consumption of it results in Symptoms included intestinal pain, vomiting, excess fluid in the lungs, pneumonia, clouding of consciousness, and destruction of red blood cells (#Cox, 1998). It should be noted that glyphosate is not thought to be the cause of the health effects rather the surfactant POEA.

Pure glyphosphate is relatively nontoxic and categorized as a Category III (low oral and dermal toxicity) (#RED, 1993). But, the toxicity increases as it is combined with other ingredients especially the serfactant polyethoxethyleneamine and isopropylamine (#Watts and Mcfarlane, 1999). It is classified as a Category III relatively low toxicity. Short term exposure to glyphosate can cause breathing difficulties, loss of muscle control, and convulsions (#Watts and Mcfarlane, 1999). There is not sufficient information to qualify it as a carcinogen, developmental toxicant, teratogen, or mutagen, but there is some evidence that glyphosate has some of these properties

(#EXTOXNET, 1994). However, the EPA classifies glyphosate as a Group E Oncogen (evidence of non-carcinogenicity in humans) because based on "a lack of convincing evidence of carcinogenicity in adequate studies with two animal species, rat, and mouse (#RED, 1993).

Glyphosate-containing products are toxic to animals and humans and some symptoms include eye and skin irritation, headache, nausea, numbness, elevated blood pressure, and heart palpitations (#Cox, 1998). Some glyphosate-containing products are Toxicity Category I and II (acutely toxic) for eye and skin irritation (#RED, 1993).

## Exposure

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Exposure to glyphosate is expected based on its widespread use in Roundup (#EPA, 1993).

## Environmental Effects

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### Persistence and Mobility

The persistence of glyphosate varies widely but it does bind strongly to soil and not thought to leach into groundwater (#Cox, 1998 and #RED, 1993). Its half-life is estimated to be 47 days which makes it "moderately persistent" (#EXTOXNET, 1994). It is broken down in soil by microbes into carbon dioxide.

It does have the possibility to contaminate surface waters because of its use pattern and by binding to soil runoff (#RED, 1993). Several contaminations have been documented (#Cox, 1998):

- ♣ Surface water in in the Netherlands
- ♣ seven U.S. wells (one in Texas, six in Virginia)
- ♣ contaminated forest streams in Oregon and Washington
- ♣ contaminated streams near Puget Sound, Washington
- ♣ contaminated wells under electrical substations treated with glyphosate

### Effect on Non-target Organisms

From #INCHEM, 1994:

Glyphosate *"is moderately to slightly toxic to aquatic microorganisms, with EC50 (3-4 days) values of 1.2-7.8 mg/litre, and 7-day NOEC values of 0.3-34 mg/litre.*

*Formulations of glyphosate are slightly to highly toxic to aquatic microorganisms with 3-*

day EC50 values of 1.0 to > 55 mg product per litre."

It is "practically nontoxic" to fish but it is slightly toxic to wild birds ([#EXTOXNET, 1994](#)). Honeybees are not affected.

## Glyphosate Resistant Crops

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### Regulation

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Glyphosate is registered in the United States for use as a [herbicide](#) as well as in the rest of the world.

### Current Events

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*January 4, 2008*

- ♣ Monsanto Company, who makes the general use [herbicide](#) Roundup, reported 36% growth in sales. The jump is fueled by increased usage in Latin America. The increased use and corresponding windfall profits have a lot to do with expensive oil because the higher the price of oil, the more the need for alternative biofuels and the increased demand for [Herbicides](#) to protect those crops. Please see articles [here](#) and [here](#).

Source : <http://www.toxipedia.org/display/toxipedia/Glyphosate>