

E X T O X N E T

Extension Toxicology Network

A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis. Major support and funding was provided by the USDA/Extension Service/National Agricultural Pesticide Impact Assessment Program.

Pesticide
Information
Profile

Glyphosate

Publication Date: 5/94

TRADE OR OTHER NAMES

Trade names for products containing glyphosate include Roundup, Rodeo, and Pondmaster. It may be used in formulations with other herbicides.

INTRODUCTION

Glyphosate is a broad-spectrum, non-selective systemic herbicide. It is useful on essentially all annual and perennial plants including grasses, sedges, broad-leaved weeds and woody plants. It can be used on non-cropland and among a great variety of crops.

Glyphosate is usually formulated as an isopropylamine salt. While it can be described as an organophosphorus compound, glyphosate is not an organophosphate ester but a phosphanoglycine, and it does not inhibit cholinesterase activity.

Glyphosate is a general use pesticide.

TOXICOLOGICAL EFFECTS

Acute Toxicity

Glyphosate is a moderately toxic herbicide and carries the signal word WARNING on the label. Even though the LD50 values show the compound to be relatively non-toxic it can cause significant eye irritation. The toxicity of the technical product (glyphosate) and the formulated product (Roundup) is nearly the same. The acute oral LD50 in the rat is 5,600 mg/kg. Other oral LD50 values for glyphosate are 1,538 to greater than 10,000 mg/kg for mice, rabbits mg/kg, and goats ([1](#), [5](#)).

In a number of human volunteers, patch tests produced no visible skin changes or sensitization.

Chronic Toxicity

Subchronic and chronic tests with glyphosate have been conducted with rats, dogs, mice, and rabbits in studies lasting from 21 days to two years. With few exceptions there were no treatment-related gross (easily observable) or cellular changes ([5](#)). In a chronic feeding study with rats, no

toxic effects were observed in rats given doses as high as 31 mg/kg/day, the highest dose tested. No toxic effects were observed in a chronic feeding study with dogs fed up to 500 mg/kg/day, the highest dose tested ([8](#)). Mice fed glyphosate for 90 days exhibited reduced body weight gains. The lifetime administration of very high amounts of glyphosate produced only a slight reduction of body weight and some microscopic liver and kidney changes. Blood chemistry, cellular components, and organ function were not affected even at the highest doses.

Hens fed massive amounts over three days and again 21 days later showed no nerve related effects.

Reproductive Effects

Most of the field and laboratory evidence shows that glyphosate produces no reproductive changes in test animals. It is unlikely that the compound would produce any reproductive effects in humans.

Teratogenic Effects

In a teratology study with rabbits, the maternal NOEL was 175 mg/kg/day and no developmental toxicity was observed in the fetuses at the highest dose tested (350 mg/kg/day) ([8](#)).

Rats given doses up to 3,500 mg/kg on days 6 to 19 of pregnancy had offspring with no teratogenic effects, but other toxic effects were observed in both the mothers and the fetuses. No toxic effects to the fetuses occurred at 1,000 mg/kg/day.

Mutagenic Effects

The compound does not cause mutations in microbes. The tests on eight different kinds of bacterial strains and on yeast cells were all negative. The compound poses little mutagenic risk to humans ([6](#)).

Carcinogenic Effects

Rats and dogs and mice fed glyphosate over a wide range of doses showed no cancer related effects directly due to the compound ([4](#)). EPA has stated that there is sufficient evidence to conclude that glyphosate is not carcinogenic in humans ([8](#)).

Organ Toxicity

Glyphosate caused no changes in the rate of body weight gain, in blood, nor in kidneys or liver. The studies were conducted at doses up to 500 mg/kg ([3](#)).

Fate in Humans and Animals

Glyphosate is poorly absorbed from the digestive tract and is largely excreted unchanged by mammals. Ten days after treatment there were only minute amounts in the tissues of rats fed glyphosate for three weeks ([3](#)).

Cows, chickens, and pigs fed small amounts had undetectable levels (less than 0.05 ppm) in muscle tissue and fat. Levels in milk and eggs were also undetectable (less than 0.025 ppm). Nearly all glyphosate residues were rapidly eliminated by fish that had been exposed for 10 to 14

days once these fish were transferred to glyphosate-free water. Glyphosate has no significant potential to accumulate in animal tissue ([9](#)).

ECOLOGICAL EFFECTS

Glyphosate is only slightly toxic to wild birds. The LC50 in both mallards and bobwhite quail is greater than 4,500 ppm. The bioaccumulation factor in chicken muscle, fat, eggs, and liver was as low as 1/10,000 ([4](#)).

Glyphosate is practically non-toxic to fish. However, Roundup was more toxic to fish than was glyphosate. In rainbow trout, for instance, the 96-hour LC50 was 8.3 mg/l with Roundup and 38 ppm with glyphosate. The LC50 for glyphosate was 120 mg/l for bluegill sunfish. An additive used in the Roundup formulation (modified tallow amine used as a surfactant) is apparently more toxic to fish than many common surfactants. For this reason, the formulation for use in aquatic situations (Rodeo) omits this ingredient. The surfactant is used to allow the compound to readily dissolve in solution and to keep the compound from balling up on the leaf surface.

There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms. Glyphosate is relatively non-toxic to honeybees. Its oral and dermal LD50 is greater than 0.1 mg/ bee ([7](#)).

ENVIRONMENTAL FATE

Glyphosate is highly adsorbed on most soils especially those with high organic content. The compound is so strongly attracted to the soil that little is expected to leach from the applied area. Microbes are primarily responsible for the breakdown of the product. The time it takes for half of the product to break down ranges from 1 to 174 days. Because glyphosate is so tightly bound to the soil, little is transferred by rain or irrigation water. One estimate showed less than two percent of the applied chemical lost to runoff ([4](#)). The herbicide could move when attached to soil particles in erosion run-off. Photodecomposition plays only a minor role in environmental breakdown.

In water, glyphosate is strongly adsorbed to suspended organic and mineral matter and is broken down primarily by microorganisms also. Its half-life in pond water ranges from 12 days to 10 weeks.

Glyphosate may be extensively metabolized by some plants while remaining intact in others ([2](#)). Once in the plant tissue, the chemical is translocated throughout the plant, including to the roots.

Exposure Guidelines:

NOEL (rabbit): 175 mg/kg/day
HA: 0.7 mg/l (lifetime)
ADI: 0.03 mg/kg (EPA)
0.3 mg/kg (WHO)
LEL: 300 mg/kg/day (rabbit)

Physical Properties:

CAS #: 1071-83-6

Chemical name:	N-(phosphonomethyl) glycine
Chemical class/use:	Phosphanoglycine herbicide
Solubility in water:	900,000 mg/l
Solubility in other solvents:	insoluble in common organics
Melting Point:	200 degrees C
Vapor Pressure:	negligible (Monsanto)
Dissociation values:	2.27 (pKa)
Partition Coefficient:	0.17 x 10 to the minus 2 power at 20 ppm; 0.6 x 10 to the minus 3 power at 100 ppm

BASIC MANUFACTURER

Monsanto Company
800 N. Lindbergh Blvd.
St. Louis, MO 63167
Telephone: 314/694-1000
Emergency: 314/694-4000

Review by Basic Manufacturer:

Comments solicited: November, 1992
Comments received: November, 1992

REFERENCES

1. National Library of Medicine (1992). Hazardous Substances Databank. TOXNET, Medlars Management Section, Bethesda, MD.
2. Grossbard, E. and D. Atkinson, Editors (1985). The Herbicide Glyphosate, Butterworths, Boston, MA.
3. U.S. Environmental Protection Agency (1987). Health Advisory, Office of Drinking Water.
4. Forest Service (1984). Pesticide Background Statements, Vol. I Herbicides. United States Dept. of Agriculture, Agriculture Handbook No. 633.
5. Monsanto Company (1985). Toxicology of Glyphosate and Roundup Herbicide, Department of Medicine and Environmental Health, St. Louis, MO.
6. Stevens, James T. and Darrell D. Sumner. 1991. Herbicides in Handbook of Pesticide Toxicology Volume 3, Cases of Pesticides. Wayland J. Hayes and Edward R. Law editors. Academic Press, NY.
7. The Agrochemicals handbook. 1991. The Royal Society of Chemistry, Cambridge, England.
8. U.S. Environmental Protection Agency (1992). Pesticide Tolerance for Glyphosate. Federal Register 57 (49): 8739-40.
9. Malik, J., G. Barry and G. Kishore. 1989. Minireview: The herbicide glyphosate. BioFactors 2 (1): 17-25.