

# Toxicological Profiles

Product: ROUNDUP

Active ingredient: **GLYPHOSATE** 41%

Other ingredients: 59% includes: polyethoxethyleneamine (POEA) and isopropylamine (amount undisclosed); identity of remaining ingredients withheld by manufacture as trade secrets.

Type: HERBICIDE (Systemic)

Mode of Action: Inhibits enzymatic activity of a process specific to plants; other enzyme systems in plants and animals are also affected by glyphosate (Heitanen 1983).

*Of pesticides used during 1994, glyphosate was #7 for overall total pounds of active ingredient applied in California. Of the total glyphosate used in the state, 10% was used in grape production, yet grapes were the number one crop associated with glyphosate-related illnesses from 1984 to 1990 (Pease 1993).*

## Toxicology

In California agriculture, Roundup's active ingredient, glyphosate, ranked 3rd for reported pesticide related **skin and eye acute illnesses**, 15th for reported **systemic and respiratory acute illnesses** and 3rd for reported pesticide related acute illnesses of any kind from 1984 to 1990. It was ranked 8th in acute illnesses per million pounds applied (ibid).

Roundup **inhibits enzymes involved in the detoxification of chemicals in the body**. Test animals exposed to glyphosate showed depressed function of cytochrome P450 and two other enzymes which are vital to the body's processing of toxicants (Heitanen 1983). At least two enzymatic steps are involved in the processing of toxicants in the liver of humans; the first involves cytochrome P450 enzymes and the second involves glutathione S transferases (GSTs). People who do not possess certain GSTs due to genetic variation (estimated at approximately 50% of the Caucasian population; others unknown), may have a greater risk of some types of cancer (Perera 1996).

U.S. EPA recently reclassified glyphosate as a Group E chemical, meaning that evidence exists that the compound is not a human carcinogen. Yet studies submitted to the California Department of Pesticide Regulation indicate **possible adverse cancer effects**, with rare tumor formation in the kidneys and adrenal cortex of test animals. Other studies found an increase of testicular tumors, thyroid cancer in females, and a rare kidney tumor (U.S.EPA 1982;1983;1985;1991).

Metabolites and breakdown products of glyphosate include the known carcinogen formaldehyde (Lund 1986). Formaldehyde is listed as a **carcinogen** by California's Office of Environmental Health Hazard Assessment under Proposition 65. It also causes gene **mutations** and is a **reproductive toxicant** (MBOC 1995).

N-nitrosoglyphosate, a contaminant of glyphosate, is a member of a chemical family of which approximately 75% are known **carcinogens** (Lijinsky 1974; Sittig 1980).

Glyphosate is a **severe eye irritant**. Symptoms of exposure include eye and **skin irritation**, which is sometimes severe and can persist for months (Temple and Smith 1992).

A study of humans documented a greater incidence of impaired lung function, throat irritation, coughing and breathlessness in workers exposed to dust of flax treated with Roundup, as compared to those exposed to untreated flax dust (Jamison 1986).

A low dose exposure study in experimental animals demonstrated salivary gland abnormalities related to changes in adrenalin levels. Changes were also observed in the kidney, liver, and thymus (U.S. Department of Health and Human Services).

An unknown percentage of Roundup's formulation is composed of polyethoxethyleneamine (POEA), a surfactant added to enhance the performance of glyphosate. POEA is **three times as acutely toxic** as glyphosate (Sawada 1988), is irritating to eyes and skin, and causes gastrointestinal problems (Monsanto 1992). POEA is contaminated by 1,4 dioxane during the manufacturing process (NCAP 1990). U.S.EPA regards 1,4 dioxane as a **probable human carcinogen**. California's Office of Environmental Health Hazard Assessment recognizes 1,4 dioxane as a carcinogen under Proposition 65.

In animal tests, a mixture of glyphosate and POEA caused cardiac arrest (UNEP/WHO/ILO 1994). The amount of Roundup — which is a combination of glyphosate and POEA — required to kill rats is about 1/3 of a lethal dose of either compound applied separately (Martinez 1990,1991), suggesting that **synergism** of the two chemicals may enhance toxicity.

Another portion of Roundup's formula is composed of isopropylamine, a neutralizing agent. It is extremely **destructive to tissue of the mucous membranes and upper respiratory tract** (Sigma Chemical 1994).

## Environmental Fate and Effects

Glyphosate is a candidate for evaluation as a **toxic air contaminant** by the California Department of Pesticide Regulation. Formaldehyde, one of glyphosate's breakdown products, is listed as a toxic air contaminant (DPR 1994).

Between 14% and 78% of glyphosate applied as a ground spray **drifts off-site** (Freedman 1990, 1991). It has been documented to affect plants as far as 131 feet away, and residues have been detected 1,312 feet downwind (Marrs 1993; Yates 1978).

Glyphosate is highly persistent in soil, taking from 24 to 249 days for one-half of it to transform or biodegrade (Lappe 1996).

Glyphosate has been found in **surface water** as the result of agricultural run-off (Frank 1990; Edwards 1980) and in **ground water** (U.S.EPA 1992).

Roundup is **highly toxic to fish and aquatic organisms** (Product label). Juvenile fish are particularly sensitive to the toxic effects of Roundup. Physical and chemical factors such as temperature, pH and solute concentration in aquatic ecosystems influence the acute toxicity of glyphosate to aquatic organisms (Caltrans 1991).

Glyphosate was shown in one study to **inhibit the growth of mycorrhizal fungi**, organisms which are essential to ecosystems and enhance plant survival (Sidhu 1990).

Acute toxicity to mammals, birds, and bees is low, but no information is available regarding long term effects of glyphosate to these organisms. No data is available regarding the toxicity of glyphosate to soil invertebrates, reptiles or amphibians (Caltrans 1991).

## Fraud and Profit

Laboratories contracted by the manufacturer to conduct toxicological analysis on glyphosate have twice been documented as **falsifying data** for these tests (U.S. Congress 1984; EPA 1994).

Public perception of Roundup has largely been shaped by high profile advertising campaigns of its manufacturer, Monsanto, which has a high economic stake in its continued use. According to The Wall Street Journal (1/2/96), Roundup accounts for one half of Monsanto's earnings. Monsanto advertises that Roundup can be used, "where pets and kids play" and that it, "breaks down into natural materials when its work is done." But in 1996 the New York Attorney General fined Monsanto \$50,000 for these **false claims** and extracted a promise from Monsanto to never again advertise in the state that Roundup is safe.