

## What you need to know about what's sprayed on our forests

Glyphosate-based herbicides are broad-spectrum weedkillers and the most widely used herbicide in the world. They are used in agriculture, silviculture, recreational areas and on lawns. They are sold under countless trade names including Roundup, Vision, Vision Max.

Glyphosate, the active ingredient in the herbicide, works by inhibiting an enzyme which is essential for the formation of aromatic aminoacids in plants. Because this specific biologic pathway operates only in plants and microorganisms, glyphosate was thought to be a low or negligible risk for humans and wildlife.

Glyphosate require other chemicals such as adjuvants (agents that enhance chemical effects) and surfactants (wetting agents) to move the compound across cell membranes, to enhance or potentiate its action, to provide chemical stability and possibly to allow it to bioaccumulate. These are called 'inert' ingredients because they were thought to have little or no toxic effect. Any pesticide formulation, including herbicides, can contain more than a dozen so-called inert ingredients, none of which are on the product label and none, until recently, have been evaluated for their toxicity.

Regulatory approval for glyphosate was granted more than 20 years ago. Approval was based on a limited evaluation of the active ingredient only and not on the inert ingredients or the entire formulation (active + inert ingredients).

For decades Health Canada has said there were no human health effects from glyphosate if used properly.

On February 2, 2010, Health Canada announced the Pest Management Regulatory Agency was re-evaluating glyphosate and polyethoxylated tallow amines (POEAs), one of the adjuvant ingredients that is part of the product formulation. Health Canada's decision follows an earlier decision by the US Environmental Protection Agency to re-evaluate glyphosate. The Canadian review is expected to conclude by 2014.

The re-evaluation is the result of a large and growing number of scientific studies that have reported genotoxic, teratogenic, cytotoxic, hormonal (endocrine-disrupting) and/or enzymatic effects of glyphosate and associated adjuvants in a wide range of species including humans.

In the first eight months of 2010 alone, more than 70 peer-reviewed scientific studies have examined the ecological consequences in terrestrial and aquatic systems from using glyphosate-based herbicides and their biochemical interaction in mammals (including human), birds, fishes, crustaceans, worms, amphibians, bacteria and target and non-target plants. Majority of studies report adverse effects associated with exposure to low doses of glyphosate-based herbicides.

Glyphosate alone or in combination with the inert ingredients have been found to be toxic to human cells and can disrupt human enzymes that are responsible for hormone production. A 2009 French study found that, at low concentrations such as those measured in food, glyphosate and its adjuvant (POEA) damaged human umbilical, embryonic and placental cells.

Glyphosate-based herbicides have been linked to birth defects associated with the skull and brain such as facial deformations and partial or complete absence of parts of the brain and a 2010 study has shown glyphosate had a direct effect on the development of the neural crest which develops into parts of the nervous system, bones and hormone producing cells in vertebrate embryos.

### References

Benachour N, Seralini GE. 2009. Glyphosate formulations induce apoptosis and necrosis in human umbilical, embryonic, and placental cells. *Chemical Research in Toxicology* 22(1):97-105.

Gasnier C, Dumont C, Benachour N, et al. 2009. Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines. *Toxicology* 262, 184–191.

Mañas F, Peralta L, Raviolo J, et al. 2009a. Genotoxicity of AMPA [aminomethylphosphonic acid], the environmental metabolite of glyphosate, assessed by the Comet assay and cytogenetic tests. *Ecotoxicology and Environmental Safety* 72, 834–837.

Paganelli A, Gnazzo V, Acosta H, et al. 2010. Glyphosate-based herbicides produce teratogenic effects on vertebrates by impairing retinoic acid signaling. *Chemical Research in Toxicology* published ahead of print

Relyea RA, Jones KD. 2009. The toxicity of Roundup Original Max to 13 species of larval amphibians. *Environmental Toxicology and Chemistry* 28(9)2004-2008.

**Enzyme** - a protein that increases the rate of a biochemical reaction. Enzyme production is governed by a cell's gene.  
**Genotoxic** - a chemical or agent that damages cellular DNA, resulting in mutations or cancer.  
**Teratogenic** - a chemical or agent that causes malformation of an embryo or fetus  
**Cytotoxic** - a chemical or agent that affects cell development