



**Friends of  
the Earth  
Europe**



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## **Glyphosate – Media Briefing Reasons for concern**

**Glyphosate is the world's best-selling weed killer. Now tests have found traces in human urine. This briefing asks why.**

## Table of Contents

- 3** What is glyphosate?
- 3** Where is it used?
- 4** Testing for glyphosate
- 4** Health concerns
- 5** Environmental concerns
- 6** Concerns about the approval process
- 7** Friends of the Earth Europe's demands

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## Glyphosate – Reasons for Concern

### Introduction

Glyphosate is the world's best-selling weed killer and one of the most widely used herbicides in Europe. It is used extensively in farming, in parks and public spaces, on railway lines and in gardens. It is also crucial for growing genetically modified (GM) crops, many of which are modified to withstand glyphosate.

Recent studies have raised concerns about the safety of glyphosate, with concerns particularly focused on its effect on human health, particularly on the hormone system, and its impact on the wider environment. The safety of glyphosate was due to be reassessed in the European Union in 2012, but the EU postponed the review until 2015.

Now tests have shown that glyphosate is present in the human body. Friends of the Earth Europe commissioned an independent laboratory in Germany to test urine samples from people in 18 countries for glyphosate. The results showed that traces of the chemical were found in samples from all countries, with 44 per cent of samples found to contain glyphosate on average.

### What is glyphosate?

Glyphosate (N-(phosphonomethyl)glycine) is a systemic, broad-spectrum herbicide, that works by blocking an enzyme used to make protein in plants. This means it is toxic to any plant that has not been genetically modified to resist it. Glyphosate's weed-killing properties were patented by Monsanto in the 1970s and the company's Roundup® brand became a top-seller. Glyphosate weed killers also contain other ingredients, including surfactants to improve take up by the plant.

Monsanto is responsible for around half of all the glyphosate weed killers sold worldwide, with a number of other companies, including Syngenta, BASF, Bayer and Dow, marketing their own glyphosate products. A substantial share of Monsanto's market comes from farmers who are obliged to use Roundup Ready herbicide on Roundup Ready GM crops.

### Where is it used?

Glyphosate is widely used by farmers to clear weeds from fields before planting, or before seeds have germinated. It is also sometimes sprayed on to cereal crops, oilseed rape, maize and sunflowers ahead of harvesting to dry out the crops. This is known as desiccation. Glyphosate is the most commonly used herbicide on UK arable farms, and is used on 39% of agricultural land in Germany.

Outside of Europe, glyphosate is also used for GM crops, with some 85% of GM crops modified to resist this herbicide. In the United States, almost half of all crop land was planted with Monsanto's Roundup Ready crops in 2012, and the majority of soy imported to Europe from Latin America for animal feed is Roundup resistant. There are currently 14 applications to grow GM glyphosate resistant crops in Europe awaiting approval. Evidence shows that the use of glyphosate, as well as other herbicides, increases dramatically if Roundup resistant GM crops are grown.

Glyphosate is also used for weed control in vineyards, olive groves and fruit orchards and commonly used in gardens, in parks, public spaces and on railway lines. Globally, some 650,000 tonnes of glyphosate products were used in 2011 – and use has been predicted to double by 2017. If more GM crops are approved in the EU, levels of use could increase by as much as 800%<sup>1</sup>

## Testing for glyphosate

There is currently very little testing for glyphosate by public authorities, despite its widespread use. Authorities in Europe do not test for glyphosate in humans, and tests on food are infrequent.

Because of this lack of public data, Friends of the Earth Europe tested urine samples from volunteers in 18 countries across Europe. The results showed traces of glyphosate in samples from all countries. This has raised serious concerns about the presence of glyphosate in the human body, as well as questions about exposure to the other chemicals used with glyphosate.

Friends of the Earth wants to know where this glyphosate has come from and what it is doing to our bodies and to the wider environment. We want to know why governments are not monitoring for glyphosate exposure. Why isn't our food routinely tested to ensure that it does not contain glyphosate? What steps, if any, are being taken to reduce our exposure?

## Health concerns

Data from animal experiments suggest that when glyphosate is consumed, 15-30% of it is absorbed into the body<sup>2</sup>. It can be found in blood and body tissues<sup>3</sup>, and has been shown to be able to cross the placenta during pregnancy<sup>4</sup>. A small proportion may break down into aminomethylphosphonic acid (AMPA). Evidence suggests that one per cent of glyphosate remains in the body a week after exposure<sup>5</sup>. Because glyphosate is so widely used, most people are exposed to it on a regular basis.

Glyphosate-based herbicides have varying levels of toxicity, but can be fatal in humans<sup>6</sup>. At lower doses, they have been shown to be toxic to human cell cultures, including embryonic and placental cells<sup>7</sup>. AMPA has been found to be more toxic to humans than glyphosate<sup>8</sup>.

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<sup>1</sup> Benbrook CM (2012) Glyphosate tolerant crops in the EU: a forecast of impacts on herbicide use. Greenpeace International

<sup>2</sup> Williams GM, Kroes R & Munro IC (2000) Safety Evaluation and Risk Assessment of the Herbicide Roundup and Its Active Ingredient, Glyphosate, for Humans Regulatory Toxicology and Pharmacology Vol 31 pp 117–165

<sup>3</sup> Anadon A et al. (2009) Toxicokinetics of glyphosate and its metabolite aminomethyl phosphonic acid in rats. *Toxicology Letters* Vol.190 pp 91–95.

<sup>4</sup> Poulsen MS, Rytting E, Mose T, Knudsen LE (2009) Modeling placental transport: correlation of in vitro BeWo cell permeability and ex vivo human placental perfusion *Toxicology In Vitro* 23:1380–1386.

<sup>5</sup> Brewster DW, Warren J & Hopkins WE (1991) Metabolism of glyphosate in Sprague–Dawley rats: tissue distribution, identification, and quantitation of glyphosate-derived materials following a single oral dose. *Fundamental & Applied Toxicology*. Vol 17 pp43–51.

<sup>6</sup> Lee H-L and Guo H-R (2011). The Hemodynamic Effects of the Formulation of Glyphosate-Surfactant Herbicides, in *Herbicides, Theory and Applications* Prof. M Larramendy (Ed.) ISBN: 978-953-307-975-2 Available at [www.intechopen.com](http://www.intechopen.com)

<sup>7</sup> Benachour N & GE Seralini (2009) Glyphosate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells *Chemical Research in Toxicology* Vol 22 pp 97–105

<sup>8</sup> Benachour N & GE Seralini (2009) *ibid*

There is also evidence that glyphosate may disrupt the human endocrine system, which can cause irreversible effects at particular life stages, such as during pregnancy. Studies on rats have shown damage to testosterone levels in male offspring<sup>9</sup>, while studies on cell cultures found that glyphosate blocks receptors for male sex hormones<sup>10</sup>, and that it inhibits production of oestrogen<sup>11</sup>. If glyphosate does affect the human hormone system, exposure to any level could pose a potential threat to health.

In soy-growing areas of South America, where levels of glyphosate exposure are likely to be much higher than in Europe, there have been reports of increases in birth defects. One study in Paraguay found that the babies of women living within one kilometre of fields sprayed with glyphosate were more than twice as likely to have birth defects<sup>12</sup>. Lab-based studies have shown malformations in frog and chicken embryos exposed to glyphosate-based herbicides<sup>13</sup>.

Glyphosate and AMPA have both been shown to be “genotoxic” – that is they interfere with a cell’s ability to accurately copy DNA and reproduce, leading to potential genetic mutations and an increased risk of cancer<sup>14</sup>. In Ecuador and Colombia, where glyphosate herbicides have been used to control cocaine production, studies have found genetic damage and increased rates of miscarriage during the spraying period<sup>15</sup>,<sup>16</sup>. In the soy-growing Chaco district of Argentina, cancer rates have increased fourfold in the last decade<sup>17</sup>.

## Environmental concerns

Because glyphosate is designed to kill plants, it can have a detrimental effect on wildlife, reducing farmland biodiversity and destroying food supplies for birds and insects. Trials in the UK looking at the impact of GM-herbicide resistant crops on biodiversity found that crops treated with glyphosate herbicides were likely to have an adverse impact on farmland birds<sup>18</sup>.

As well as directly affecting plants, glyphosate has been found to leach out of soils into rivers, streams and groundwater<sup>19</sup>. Water contamination poses a threat to aquatic life and there is evidence from studies in North America that herbicides containing glyphosate may

<sup>9</sup> Dallegrove E et al (2007) Pre- and postnatal toxicity of the commercial glyphosate formulation in Wistar rats *Archives of Toxicology* Vol 81 pp 665–673

<sup>10</sup> Gasnier C et al (2009) Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines *Toxicology* Vol 262 pp 184-191

<sup>11</sup> Richard S et al (2005) Differential effects of glyphosate and Roundup on human placental cells and aromatase. *Environmental Health Perspectives* Vol 113 pp716–720

<sup>12</sup> Benítez-Leite S, Macchi ML & Acosta M (2009) Malformaciones congénitas asociadas a agrotóxicos [Congenital malformations associated with toxic agricultural chemicals]. *Archivos de Pediatría del Uruguay* Vol 80 pp237-247.

<sup>13</sup> Paganelli A et al (2010) Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling *Chemical Research in Toxicology* Vol 23 pp 1586-1595

<sup>14</sup> Hoeijmakers JHJ (2001) Genome maintenance mechanisms for preventing cancer *Nature* Vol 411 pp 366-374

<sup>15</sup> Paz-y-Mino C et al (2007) Evaluation of DNA damage in an Ecuadorian population exposed to glyphosate *Genetics and Molecular Biology* Vol 30 pp 456-460

<sup>16</sup> Bolognesi C et al (2009) Biomonitoring of Genotoxic Risk in Agricultural Workers from Five Colombian Regions: Association to Occupational Exposure to Glyphosate *Journal of Toxicology and Environmental Health, Part A* Vol 72 pp 986-997

<sup>17</sup> López SL et al (2012) Pesticides Used in South American GMO-Based Agriculture: A Review of Their Effects on Humans and Animal Models. *Advances in Molecular Toxicology* Vol. 6 pp. 41-75

<sup>18</sup> Heard MS, Hawes C, Champion GT, Clark SJ, Firbank LG, Haughton AJ, Parish AM, Perry JN, Rothery P, Scott RJ, Skellern MP, Squire GR & Hill MO. 2003a. Weeds in fields with contrasting conventional and genetically modified herbicide-tolerant crop – I. Effects on abundance and diversity. *Philosophical Transactions of The Royal Society London B* 358: 1819-1832.

<sup>19</sup> Vereecken, H. (2005) Mobility and leaching of the glyphosate: a review. *Pesticide Management Science* Vol. 61 pp 1139-1151.

be toxic to frogs and toads<sup>20</sup>. This is of particular concern as one in three species of amphibian is threatened with extinction. Liver cells in carp have been found to be damaged by exposure to glyphosate herbicides<sup>21</sup>.

Glyphosate also affects soil chemistry. While in some soils, glyphosate binds to soil particles, making it inert, in some soil types it remains active and is broken down by soil microbes, affecting the biological and chemical processes around plant roots, including the ability of the plant to fix nitrogen<sup>22</sup>, resulting in the need for increased levels of nitrate fertilisers.

### Concerns about the approval process

Glyphosate was approved for EU-wide use in 2002 but the European regulatory agencies did not carry out their own safety testing, relying instead on data provided by the manufacturers. Most of this data came from industry studies, not from peer-reviewed science, and the original data are not available for independent scrutiny.

The approval process was led by the German authorities and the German Federal Office for Consumer Protection and Food Safety (BVL) is responsible for reauthorisation. When Monsanto applied to renew approval in 2010, the European Commission agreed to extend the existing approval by three years to 2015 to allow the company more time to prepare its application.

The process sets a level for “acceptable daily intake” (ADI), which for glyphosate is currently 0.3mg per kilogram of body weight. This is higher than the level recommended by some manufacturers of between 0.05mg/kg and 0.15mg/kg. An independent scientific review in 2012 suggested a level of 0.025mg/kg<sup>23</sup>.

The EU approval process only looks at studies on glyphosate, and not the actual formulation of the herbicide, ie what is used by farmers and gardeners. Some studies have suggested that the other ingredients may combine with glyphosate to increase its toxicity<sup>24</sup>. Researchers have warned that the focus on glyphosate underestimates the potential hazards<sup>25</sup>.

The 2002 approval process for glyphosate did not consider whether it could disrupt human hormone and reproductive systems. This has to be considered under the new rules. Endocrine experts have said a more precautionary approach is needed.

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<sup>20</sup> Relyea RA. 2005. The impact of insecticides and herbicides on the biodiversity and productivity of aquatic communities. *Ecological Applications*, 15: 618–627, and Relyea RA. 2005. The lethal impact of roundup on aquatic and terrestrial amphibians, *Ecological Applications* 15: 1118–1124.

<sup>21</sup> Szarek J, Siwicki A, Andrzejewska A, Terech-Majewska E & Banaszekiewicz T. 2000. Effects of the herbicide Roundup on the ultrastructural pattern of hepatocytes in carp (*Cyprinus carpio*), *Marine Environmental Research* 50: 263-266.

<sup>22</sup> Kremer RJ & Means NE. 2009. Glyphosate and glyphosate-resistant crop interactions with rhizosphere microorganisms. *European Journal of Agronomy* 31: 153-161.

<sup>23</sup> Antoniou M et al. (2012) Teratogenic Effects of Glyphosate-Based Herbicides: Divergence of Regulatory Decisions from Scientific Evidence. *Journal of Environmental and Analytical Toxicology* S4:006. doi:10.4172/2161-0525.S4-006

<sup>24</sup> For example: Song H-Y et al (2012) In Vitro Cytotoxic Effect of Glyphosate Mixture Containing Surfactants *Journal of Korean Medical Science* Vol 27 pp 711-715

<sup>25</sup> Benachour N et al (2007) Time- and Dose-Dependent Effects of Roundup on Human Embryonic and Placental Cells *Archives of Environmental Contamination and Toxicology* 10.1007/s00244-006-0154-8

## Friends of the Earth Europe's demands

Friends of the Earth believes that there is sufficient evidence suggesting environmental and health impacts from glyphosate to warrant concern. Given our test results have shown that glyphosate is present in humans, we want to know how the glyphosate found in human urine samples has entered the body and what the impacts of persistent exposure to low levels of glyphosate might be. What happens to the glyphosate that remains in the body?

### Friends of the Earth demands that:

- The EU and national governments start a monitoring programme for glyphosate in food and feed, including imported animal feed crops such as GM soy. Levels of glyphosate (and its breakdown product AMPA) in the environment should also be monitored, covering aquatic systems and soil. These monitoring programmes should be comprehensive and the results should be made available to the public without delay.
- National governments must introduce a glyphosate reduction programme and desiccation (spraying crops shortly before the harvest) should be banned without delay. All other uses for glyphosate should be evaluated by 2015, existing maximum residue limits (MRLs) should be re-evaluated, and there must be no further increases in the MRLs.
- No glyphosate resistant genetically modified crops should be authorized in the EU.
- All food processors and retailers should minimise their customers' exposure to glyphosate residues by specifying glyphosate-free products from their suppliers. They should extend their internal pesticides monitoring programme and include glyphosate in their regular testing.



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## **Friends of the Earth Europe**

### Member Groups

Austria	Global 2000
Belgium (Wallonia & Brussels)	Les Amis de la Terre
Belgium (Flanders & Brussels)	Friends of the Earth
Bulgaria	Za Zemiata
Croatia	Zelena Akcija
Cyprus	Friends of the Earth
Czech Republic	Hnutí Duha
Denmark	NOAH
England, Wales & Northern Ireland	Friends of the Earth
Estonia	Eesti Roheline Liikumine
Finland	Maan Ystävät Ry
France	Les Amis de la Terre
Georgia	Sakhartvelos Mtsvaneta Modzraoba
Germany	Bund für Umwelt und Naturschutz Deutschland (BUND)
Hungary	Magyar Természetvédők Szövetsége
Ireland	Friends of the Earth
Italy	Amici della Terra
Latvia	Latvijas Zemes Draugi
Lithuania	Lietuvos Žaliųjų Judėjimas
Luxembourg	Mouvement Ecologique
Macedonia	Dvizhenje na Ekologistite na Makedonija
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**Friends of the Earth Europe** campaigns for sustainable and just societies and for the protection of the environment, unites more than 30 national organisations with thousands of local groups and is part of the world's largest grassroots environmental network, Friends of the Earth International.