



Questions and Answers about Glyphosate

Basics

Why do farmers need to control weeds with herbicides?

Plant pests and weeds have presented a challenge to farmers ever since people began to cultivate crops. Many weed species can easily destroy half of an entire harvest. The common couch grass for instance, a frequent invader of cereal fields in Europe, can reduce yields up to 60%.

Chemical weed-control methods have always been seen as an attractive solution because they are relatively cost-effective and easy to use, so herbicides have played a key role in our production of food, feed, and fibre over the last 60 years.

What is glyphosate?

Glyphosate, or N-(phosphonomethyl)glycine, is one of the world's most widely used broad-spectrum herbicides and accounts for around 25% of the global herbicide market. Glyphosate was first introduced in 1974 under the trade name "Roundup" and has since been marketed as the active ingredient of hundreds of plant protection products around the world.

How does glyphosate work?

Glyphosate prevents the synthesis of certain crucial amino acids by blocking the the shikimic acid pathway at the growing points of a plant. Without these amino acids, the plant cannot metabolize and create new growth. Weeds must, therefore, be in the active growth phase in order for glyphosate to work. This is why farmers predominately apply glyphosate when weed species are already shooting but crop seeds have not yet begun to germinate. These "post-harvest treatments" were the first type of glyphosate application and are still the most commonly used management practice in Europe. The shikimic acid pathway exists only in plants, fungi and bacteria, so the toxicity to animals is low.

How is glyphosate used?

Glyphosate is used to control a variety of plants in agriculture and gardening, on grasslands and in aquatic environments. In most European countries glyphosate herbicides are predominately applied after harvest to prevent weeds infesting winter crops (pre-planting) or after sowing before the new crop plants emerge (post planting pre-emergence). In some countries such as the UK, glyphosate is also used before the harvest to control weeds (pre-harvest) and to speed up the maturation process of crops (dessication). Crops managed with these pre-harvest methods include oilseed rape and cereals. However, the time, amount and method of application of glyphosate products vary across the EU depending on the crop and the target weed species.



What crop types are managed with glyphosate?

Glyphosate containing products are used as foliar sprays to manage weeds in a wide range of arable crops. The major crops managed with glyphosate in Europe include cereals, vineyards, olives, citrus and nuts for grassland renovation. However, these after harvest treatments generally include all crops. In Germany eight out of ten oilseed rape fields are for instance treated with glyphosate herbicides.

Is glyphosate only used in agriculture?

Although the main global market for glyphosate is agriculture, glyphosate is also used to improve visibility and manage weed growth on non-cultivated areas such as railway tracks and verges. Non-crop uses also include weed control in the amenity, forestry and in aquatic environments. In addition, glyphosate products are used by many gardeners. Another, minor but important use of glyphosate is the control of invasive weed species, such as Japanese Knotweed, which threaten the survival of native plants.

Since when are glyphosate based herbicides used?

The molecule “glyphosate” was patented by Monsanto in the early 1970s as the active ingredient in the herbicide Roundup®. Since its patent expiration in 2000, glyphosate has been marketed by various companies and several hundred plant protection products containing glyphosate are currently registered in Europe for use on croplands.

Benefits

Why is glyphosate so important for European agriculture?

Several European countries, including Germany, use glyphosate herbicides on almost half of their total crop area. Recent case studies conducted by researchers in Germany and the UK predict that losing glyphosate would have a considerable effect on crop production costs and would also have an impact on the international trade in several European winter crops and sugar. Food prices would increase and the EU's share of the global agricultural market would decrease if glyphosate use was restricted. In fact, it is estimated that crop yields for farmers would be reduced by 5% to 40%, depending on the region, and diminish the global market share of several EU crops if glyphosate was no longer available.

A limitation in the availability for farmers of glyphosate is also predicted to have potential implications for land use, biodiversity, greenhouse gas emissions and water quality. By using glyphosate for weed control, farmers in Europe have been able to forgo or significantly reduce traditional ploughing methods. Conventional plough tillage is an energy-intensive process that releases tonnes of carbon dioxide into the atmosphere from the soil. If farmers are forced to fall back



on these weed-control methods, CO₂ emissions and fossil fuel consumption in Europe are predicted to more than double, while soil erosion could increase six times over.

What are the benefits for farmers to use glyphosate herbicides?

For farmers, glyphosate herbicides provide simple, flexible and cost-effective weed control as glyphosate helps to remove perennial weeds for several years. Unlike several other herbicides which act on either monocotyledons or dicotyledons, glyphosate is effective on all weeds, providing broad-spectrum control. Applying glyphosate before the new crop is planted has the potential to produce 30%-60% higher harvests for many of Europe's major crops, depending on the weed population and other conditions. Glyphosate also breaks the "green bridge", removing weeds that might otherwise act as an intermediate host for parasites and other disease vectors when young crops are emerging.

Its effectiveness as a broad-spectrum herbicide has ultimately reduced the use of ploughing as a means of controlling weeds, which exposes fertile topsoil to water and wind erosion. Some studies have estimated that ploughing approaches are approximately twice as costly and time consuming as chemical weed control.

Are there ecological benefits to use glyphosate?

By chemically controlling a broad spectrum of weeds and their entire root systems, glyphosate has eliminated or reduced the need for ploughing the soils. These reduced tillage practises allow farmers to plant crop seeds directly into stubble fields.

A large proportion of Europe's cultivated land is prone to soil erosion, and minimal soil disturbance practices are sustainable alternatives that help to protect the soil from degradation and reduce greenhouse gas emissions and energy consumption. Several important crops in Europe, including maize and sugar beet, are predominantly managed with these practices in combination with glyphosate. This makes glyphosate a popular tool for many farmers that decide to pursue these soil conservation practices.

Safety

How is it ensured that herbicides are safe for humans and the environment?

Plant protection products also come into contact with farmers, food and the environment. To ensure they pose no unreasonable risk, comprehensive risk assessment procedures are prescribed by law. In the European Union and in most other countries worldwide, no plant protection product can be used unless it has been confirmed that it poses no unreasonable risk to the health of consumers, farmers, local residents and by-standers and that it does not cause unacceptable effects on the environment.

Companies wanting to register herbicide products for use in the EU must apply to the relevant national authority. The application has to include information on comprehensive scientific analyses that have examined:



Glyphosate Facts

Transparency on safety aspects and use of glyphosate-containing herbicides in Europe

- the identity and physical /chemical properties of the active ingredient;
- its fate and behaviour in the environment;
- possible effects on the environment, non-target animals, -plants and microorganisms (ecotoxicology);
- possible effects on mammals (toxicology);
- residues in crops, food and feed and suitable analytical methods for the detection of residues.

Active ingredients, such as glyphosate, are first approved at EU level including an evaluation by the European Food Safety Authority. If they are found to be without any unacceptable risk to people or the environment, these substances are included in the EU list of approved active ingredients. This approval is valid for a maximum period of 10 years but can be subject to conditions and reviewed at any time and is renewable.

All evaluations of glyphosate by regulatory authorities have so far concluded that glyphosate does not pose any unacceptable risk to human health, the environment or non-target animals and plants. The fact that glyphosate binds strongly to soil and that it degrades rapidly in soil and water are significant factors in its favourable safety profile. Glyphosate's overall low toxicity and its good safety profile are major benefits which have contributed to the widespread use of glyphosate based plant protection products.

Frequently asked questions about the safety of glyphosate

Does glyphosate pose risks to human health?

Glyphosate is one of the most widely used active ingredients in herbicides designed to prevent unwanted plant growth in cultivated crops.

Glyphosate works by blocking a metabolic pathway which is essential for the plant's growth. This pathway is present in all plants, but does not exist in animals, which makes glyphosate a very effective broad-spectrum herbicide and contributes to its low toxicity in animals.

Numerous health assessments conducted by public authorities over the past 40 years have consistently concluded that glyphosate does not pose any unacceptable risk to human health. However, a controversial debate concerning the assessment of glyphosate health risks has emerged, largely as a result of a recent publication entitled "Roundup And Birth Defects: Is the Public Being Kept in the Dark?" released by the non-governmental organisation Earth Open Source. The report expresses criticisms of a number of toxicological evaluations and risk assessments conducted by official authorities in recent decades. In particular, it refers to some studies that reported developmental toxicity in *in vitro* tests with isolated chicken and frog embryos and human cell lines.

Public authorities have found these *in vitro* studies to be of only very limited use for regulatory decisions, as they do not take into account the realistic exposure conditions that apply to animals and humans, nor the physiological barriers (absorption, metabolism and excretion) that limit exposure.

According to international guidelines, substances must be tested in *in vivo* feeding experiments with intact animals, which is consistent with real exposure conditions. *In vitro* studies, in which substances



are artificially administered directly to embryos (by mixing them into the culture medium or through injection), do not conform to international guidelines and authorities consider them to be less reliable and less relevant for human risk assessments than studies in intact animals.

The in vitro studies also typically used the weed control product as a whole, rather than just the active substance. Therefore, it cannot be determined if any observed effects are due to the active ingredient glyphosate or another substance included in the herbicide formulation.

Do typical agricultural applications of glyphosate harm frog populations?

In recent years, media headlines such as "Popular herbicide kills tadpoles " have fuelled a public debate about the potential risks of glyphosate for ecosystems. The media attention was generated in larger part by a study on frogs which claimed to link the application of glyphosate to a widespread decline in amphibians. The study was however not based on an agricultural application scenario and unrealistically high dosages were applied in the experiments which are extremely unlikely to occur in natural wetlands.

Many scientific studies have tested whether glyphosate-based formulations could potentially damage natural frog population. Even in the worst case of an unintentional overspray directly into water, no acute effects were observed.

Surfactants: A threat to fish and frogs?

Surfactants are found in many everyday products such as shampoos, toothpaste, and detergents. Many different classes of surfactants are used to improve the efficiency of plant protection products, including glyphosate products.

Over the last few years there have been allegations of side effects of polyethoxylated alkyl amine surfactants to fish and frogs. Although these allegations have not been completely scientifically substantiated these issues continue to be raised in some EU Member States. Consequently Germany has decided to selectively phase out certain products containing tallow amine-based surfactants.

However, so far only laboratory experiments with very high dosages have shown any negative impacts on frogs and their larval stages (tadpoles), and these exceedingly high doses and durations of exposure are very unlikely to occur in real-life scenarios. Thus, a surfactant such as the polyethoxylated tallow amine contained in glyphosate-based formulations is unlikely to be threat to fish or frogs when used according to defined agronomic practices.

Bees at risk?

Honeybees and other insects play a pivotal role in agriculture because many crops are not wind-pollinated but depend on pollinating insects. In addition, spiders and insects such as beetles and wasps feed on small herbivorous insects, which make them important biological pest control agents.

There has been much discussion about whether herbicides could harm important pollinators and other beneficial arthropods. Glyphosate and glyphosate-based formulations have been extensively tested in the laboratory and in the field to study their potential impact on insects. The overall



conclusion from these studies is that glyphosate-based formulations will not harm beneficial insect populations at field exposure levels.

Scientists found that honeybees and their brood were not affected by glyphosate or by glyphosate-based formulations. Nor were these products found to have any impact on beneficial arthropods such as ground predators (spiders and beetles). Several laboratory tests have suggested that glyphosate formulations could be harmful to some plant-dwelling species (e.g. parasitic wasps and predatory mites). However, these effects were only observed on artificial substrates such as glass and are not observed under more realistic conditions.

Does glyphosate impair water quality?

Glyphosate, the active ingredient of a diverse range of herbicide products, is unlikely to leach into groundwater, since it binds tightly to soils typically used in agriculture. The same applies to AMPA, the main degradation product of glyphosate. This has been confirmed by a large number of European monitoring studies: glyphosate and AMPA are rarely found in groundwater and usually only under exceptional circumstances, for example in very porous soil prone to rapid and uneven movement of water, or groundwater in direct contact with surface water.

Glyphosate and AMPA may reach surface water through run-off, drainage, spray drift and occasionally as a result of bad agricultural practices. Although the presence of these substances is more widespread in surface water than in groundwater, levels in surface water rarely exceed the threshold of environmental concern.

The presence of glyphosate and AMPA in surface and ground water does not pose a threat to human health. Glyphosate and AMPA are easily removed from raw water by conventional drinking water treatment methods (which include sand filtration and chlorination). In addition, according to the World Health Organization (WHO), the observed concentrations in environmental waters are several orders of magnitude lower than the permitted safety threshold. The WHO concludes that the establishment of a numerical guideline value for glyphosate is not deemed necessary. The occasional incidence of glyphosate and/or AMPA in drinking water would not represent a hazard to human health.