



## Glyphosate: Health Controversy, Benefits and Continuing Debate

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### Introduction

At a time when alternative facts and fake news are making detectives out of all of us, we probably shouldn't be surprised that conflicting opinions invade our lives as gardeners as well. Glyphosate, the active ingredient in the world's most widely used weed killers, including Monsanto's Roundup, has long been regarded by government agencies including the US Environmental Protection Agency (EPA), as economical, broadly effective, low-toxicity and environmentally benign. In 2015 however, glyphosate was classified as "probably carcinogenic to humans" by the World Health Organization's International Agency for Research on Cancer (IARC). This classification conflicts with the EPA's stated opinion that glyphosate is "not likely to be carcinogenic to humans". Since the IARC's departure from the prevailing governmental posture on the chemical, there has been a proliferation of conflicting opinions on where the truth lies. Let's try to sort the arguments out in layman's terms.

### How it works

Glyphosate is applied to leaves and stems and translocates throughout the plant, concentrating in meristem tissue. It blocks the shikimic acid pathway,



preventing plants from making certain amino acids required to produce proteins, needed for growth. Exposure leads to stunted growth, loss of green coloration, leaf wrinkling/malformation, tissue death and plant death generally in 7-21 days.

The absence of this pathway in mammals is the basis for low toxicity claims in humans. Humans and other animals must get these amino acids from their diets since they can't produce them.

The National Pesticide Information Center notes that glyphosate doesn't easily pass through skin. If ingested, it passes quickly without change. It may cause eye/skin and nose/throat irritation and can be toxic if ingested intentionally in very large quantities. This is unsurprising and typical of many commonly used items like aspirin and

table salt, for example. It further notes conflicting studies on whether glyphosate exposure increases cancer rates in humans, including a possible association with Non-Hodgkin Lymphoma, and notes that developmental and reproductive issues have been observed in rats at high doses.

Environmentally, Glyphosate binds to soil, minimizing runoff issues. It is broken down by microbial action with a half-life averaging about 47 days.

## History

Glyphosate was patented by Monsanto in 1974 and is the active ingredient in their Roundup herbicide. Today glyphosate is used in many competing herbicide products. Its use as a weed control product took off in the 1990s when Monsanto introduced GMO crops that are resistant to it. Today these crops include corn, soybeans, sugar beets, canola and cotton. Glyphosate is used as a pre-planting treatment and as a maintenance treatment during the growing season. Less well known is its use as a desiccant, sprayed on wheat crops. The practice is to spray Roundup or a similar product on wheat to dry the plants up a couple of weeks prior to harvest. This makes the harvest more uniform and easier on harvesting machinery. There is some dispute about how widespread this practice is in the US. Overall use of glyphosate herbicide products in the US is in excess of 100 million pounds annually.



## The IARC Position

On March 20, 2015, IARC published an opinion that called glyphosate “Probably carcinogenic to humans”. The studies were an analysis of published and peer reviewed reports, of mostly agricultural exposures in the US, Canada and Sweden performed after 2001. It also reanalyzed EPA studies of tumors in lab mice. According

to IARC, the EPA originally classified these results as possibly carcinogenic to humans (1985), but then later reclassified them as presenting “evidence of non-carcinogenicity in humans” (1991) after a review of the tissue slides by an independent panel of expert pathologists. The IARC analysis of this data led to a conclusion of “sufficient evidence of carcinogenicity” that they became a part of the “probably carcinogenic to humans” position noted above.

## The EPA Position

In December 2017, the EPA released a “draft” human health risk assessment for glyphosate, concluding that it is “not likely to be carcinogenic to humans” and found “no other meaningful risks to human health” when used according to published directions. The EPA assessment is based on published information plus manufacturer data that is normally withheld from public view to protect proprietary information. While Monsanto offered to provide this data to IARC, they declined to utilize it. The EPA conclusion agrees with virtually every major regulatory body in the world, (IARC, not a regulatory body, excepted) and includes the latest observations of enrollees in the Agricultural Health Study, a collaboration of EPA, National Cancer Institute, National Institute of Environmental Health Sciences and the National Institute for Occupational Safety and Health. It is the largest ever pesticide study with over 50,000 farmers in North Carolina and Iowa participating over 25+ years. A November 2017 published study update cited “No association apparent between glyphosate and ...Non-Hodgkin Lymphoma. There was some evidence of AML (acute myeloid leukemia) among the highest exposed group that requires confirmation.” The EPA draft assessment does state that “there is potential for effects on birds, mammals, and terrestrial and aquatic plants”. A “final” opinion is due from EPA in 2019.

## Opinions from Other World Regulatory and Advisory Organizations

In March 2015, the European Chemicals Agency (ECHA), the main driver of European Union chemicals regulation, released a report that concluded that there is “no evidence linking glyphosate to cancer in humans, based on the available information” and that “glyphosate should not be classed as a “substance that causes genetic damage or disrupts reproduction”.

The same conclusions were reached by the European Food Safety Authority, national authorities in Canada, Japan, Australia and New Zealand, and the Joint Food and Agriculture Organization/World Health Organization on Pesticide Residues. This makes the IARC the only agency with a divergent view.

## The Conflict Continues

The IARC position has been undermined by a Reuters journalist who managed to get a copy of the draft report and found 10 significant instances where evidence of non-carcinogenicity of glyphosate in animals were edited out and were replaced with neutral or countervailing statements.

On the flip side, there is reporting that a key EPA official involved in the agency's cancer assessment has a cozy and maybe compromised relationship with Monsanto. There is current court action underway involving hundreds of lawsuits of alleged non-Hodgkin lymphoma sufferers brought by farmers and farm workers. There are also published reports by academic researchers noting correlations between glyphosate exposure and shortened gestational lengths in pregnant women as well as the coincident rise of glyphosate use with the increase of autism since the 1990s. There are no direct causal relationships established, but they add to the emotion around the topic.

Complicating matters is the fact that the cited reports address glyphosate without considering the effects of other chemicals in the herbicide formulation, which need not be identified on the product label. For example, there is evidence that the surfactant in Roundup is toxic to aquatic plant species so glyphosate-based products containing that surfactant are not approved for aquatic weed control. In addition, conventional farmers handle many different chemicals throughout their lifetime. It is difficult to effectively isolate glyphosate's impacts from the many other variables that could affect the study participants' health.

And finally, after 20 plus years of heavy use, there are an increasing number of weeds, 24 species at last count, that are glyphosate resistant. At some point this becomes a major issue for both weed control and the crops that the herbicide has been mated with. What then?

## Sorting It Out

An important distinction between IARC and EPA positions is that IARC assesses Hazard. EPA assesses Risk. Hazard means that glyphosate, in this case, is capable of causing cancer under some circumstances. IARC does not determine safe/unsafe exposure levels or attempt to quantify risks. Risk attempts to quantify impact based on level of exposure. The EPA "not likely to be carcinogenic" position is based on use per manufacturer directions.

From a user viewpoint, glyphosate-based herbicides are low toxicity compared to other chemical weed control options. It has had a positive impact in the growth of no-till farming, reducing erosion, runoff and topsoil depletion. It has also helped increase food production in a food short world, while helping control growers' costs.

On the flip side, there are credible individuals and environmental organizations that hold the opinion that glyphosate may be a human carcinogen. Regardless, it is unsettling to know that we unavoidably ingest glyphosate residues in our food and at a minimum, pass it through our bodies. The Non-Hodgkin lymphoma and AML claims by high exposure farm workers are a definite concern, even if their exposure is a lot higher than for us home gardeners.

Then there is the symbiotic relationship between glyphosate, GMO crops and Monsanto's heavy dependence on their related acceptance by society. There is certainly reason for caution in accepting Monsanto's advocacy given their stake in the outcome.

## Organic Alternatives

Based on my research, there doesn't seem to be another chemical herbicide that matches glyphosate's combination of effectiveness and low toxicity. So, as chemical weed killers go, it is hard to improve on.



There are several organic post-emergence herbicides available for home use. They include acetic acid-based products containing 10-20% acidity vs the 5-7% content of the white vinegar in our kitchens. Other products contain mixtures of plant oils, acetic or other acids, or other chemicals. The products most widely used by organically minded professionals are plant oil mixtures. Clove oil is the basis for many with citric and cinnamon oils also part of different recipes. All these options are contact herbicides. They will burn down above ground plant parts but underground parts like rhizomes, bulbs and roots are unaffected and require repeated applications for control. In addition, acetic acid and the oils have strong scents which some may find objectionable. Ironically, the risk to skin and eyes from contact may be higher with these products than with glyphosate. Many advisors recommend these alternatives for smaller weed control requirements, for example on a patio or pool area.



*Corn gluten can be a practical preemergence weed control product*

If your need is for preemergence weed control, corn gluten meal may be used on turf and certain other areas. It is a byproduct of corn milling and inhibits germination of crabgrass and certain other weeds. It requires metered application and moisture management, and lasts about 5 or 6 weeks. However, tests indicate that chemical herbicides like pendimethalin are more effective than corn gluten.

## Cultural Alternatives

Beyond hand weeding and boiling water, there are a couple of non-herbicidal practices worth mentioning. Using a propane torch to burn weeds, actually to heat them to kill cell function, can be an effective contact weed control method. Obviously, care to prevent the spread of fire beyond the weeds under attack is very important. Specialty weed torches have flames that are nearly invisible and it is not hard to imagine inadvertently lighting

up a wooden fence post, or dead plant material among the weeds. Again, the method does not kill the roots of offending plants, only the above ground portion.

For a contained area, solarization is an option. This involves tilling the area to be cleared of weeds and covering it with a sheet of plastic for six weeks in summer. This will raise the soil temperature enough to kill weed seed.

### ***So What About Roundup™?***

The IARC opinion lacks the specificity to be of much value, beyond stoking fear. The EPA draft is more substantial and the “not likely to be carcinogenic” characterization is a relatively high bar. However it isn’t conclusive and the many outstanding claims of negative health impacts will keep the debate going.

The occasional, proper use of glyphosate products by home gardeners doesn’t generate unacceptable risks of toxicity, carcinogenicity or environmental harm, as long as users follow directions for mixing and use. The large scale use of these chemicals in commercial farming does however cause concern for farm workers, the environment and the public at large. Gut level discomfort with the widespread use of glyphosate products on commercial crops and its hidden presence in our food, is understandable in spite of the official view that it is not likely to harm human health. It is this large scale commercial dependence on glyphosate, and other chemical pesticides and fertilizers that is most troubling.

What does the home gardener do? Aspire to gardening using integrated pest management or organic techniques. Turn to glyphosate and other chemicals, minimally, when there is no effective alternative. Follow directions for mixing and use. Understand that virtually all conventionally grown produce and processed foods may contain trace levels of pesticides such as glyphosate and that the EPA



*Always read the label!  
The label is the law.*

has determined that these amounts don’t pose a health risk. And while conventionally grown produce is equally nutritious, organic produce will be closer to chemical free.

And stay tuned. This story is a long way from over...

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