

Widely used herbicide linked to cancer

As the World Health Organization's research arm declares glyphosate a probable carcinogen, *Nature* looks at the evidence.

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Glyphosate, a chemical found in Monsanto's 'Roundup' herbicide product, has been declared "probably carcinogenic to humans".

The cancer-research arm of the World Health Organization last week [announced](#) that glyphosate, the world's most widely used herbicide, is probably carcinogenic to humans.¹ But the assessment, by the International Agency for Research on Cancer (IARC) in Lyon, France, has been followed by an immediate backlash from industry groups.

On 23 March, Robb Fraley, chief technology officer at the agrochemical company Monsanto in St Louis, Missouri, which sells much of the world's glyphosate, accused the IARC of "cherry picking" data. "We are outraged with this assessment," he said in a [statement](#). *Nature* explains the controversy.

What does the IARC report say?

The IARC regularly reviews the carcinogenicity of industrial chemicals, foodstuffs and even jobs. On 20 March, a panel of international experts convened by the agency reported the findings of a review of five agricultural chemicals in a class known as organophosphates. A summary of the study was published in *The Lancet Oncology*¹.

Two of the pesticides — tetrachlorvinphos and parathion — were rated as "possibly carcinogenic to humans", or category 2B. Three — malathion, diazinon and glyphosate — were rated as "probably carcinogenic to humans", labelled category 2A.

Why should I care about glyphosate?

Glyphosate is the world's most widely produced herbicide, by volume. It is used extensively in agriculture and is also found in garden products in many countries. The chemical is an ingredient in Monsanto's weedkiller product Roundup, and glyphosate has become more popular with the increasing market share of crops that are genetically engineered to be tolerant to the herbicide.

What evidence is there for a link between glyphosate and cancer?

The IARC review notes that there is limited evidence for a link to cancer in humans. Although several studies have shown that people who work with the herbicide seem to be at increased risk of a cancer type called non-Hodgkin lymphoma, the report notes that a

separate huge US study, the [Agricultural Health Study](#), found no link to non-Hodgkin lymphomas. That study followed thousands of farmers and looked at whether they had increased risk of cancer.

But other evidence, including from animal studies, led the IARC to its 'probably carcinogenic' classification. Glyphosate has been linked to tumours in mice and rats — and there is also what the IARC classifies as 'mechanistic evidence', such as DNA damage to human cells from exposure to glyphosate.

Kathryn Guyton, a senior toxicologist in the monographs programme at the IARC and one of the authors of the study, says, "In the case of glyphosate, because the evidence in experimental animals was sufficient and the evidence in humans was limited, that would put the agent into group 2A."

But not everyone agrees?

An industry group of agrochemical companies called the [Glyphosate Task Force](#) said that the agency's evaluation "demonstrates serious deficiencies in terms of methodological approach and the overall conclusion is inconsistent with the results of all regulatory reviews concerning glyphosate's safety profile".

Monsanto — a member of the task force — said that relevant scientific data that showed no risk was excluded from the review, and the IARC "purposefully disregarded dozens of scientific studies", specifically genetic toxicity studies.

But Guyton strongly defends the IARC process and insists that there is a set of clear rules that lays out which studies can be considered by the experts convened by the IARC. These are broadly limited to peer-reviewed publications and government reports, leading to the rejection of a number of industry-submitted studies.

Some academic scientists have sounded notes of caution over the IARC report. Oliver Jones, an analytical chemist at RMIT University in Melbourne, [told the Science Media Centre in London](#): "IARC evaluations are usually very good, but to me the evidence cited here appears a bit thin." He added: "From a personal perspective, I am a vegetarian so I eat a lot of vegetables and I'm not worried by this report."

Doesn't just about everything cause cancer if you look hard enough?

The IARC [classifies](#) compounds on a scale of decreasing certainty: group 1 is for agents that are definitely carcinogenic to humans; 2A, probably carcinogenic to humans; 2B, possibly carcinogenic to humans; 3, not classifiable; and 4, probably not carcinogenic to humans.

Monsanto said in its statement, "IARC has classified numerous everyday items in Category 2 including coffee, [cell phones](#), aloe vera extract and pickled vegetables, as well as professions such as a barber and fry cook."

But the IARC classified most of these items at the less dangerous 2B level, whereas glyphosate is in the 'probably carcinogenic' 2A category. Of Monsanto's list, only emissions from high-temperature frying and the occupational exposure experienced as a barber are rated as 2A.

What happens next?

It is not part of the IARC's process to quantify any increased risk of cancer due to a chemical, or to recommend a safe exposure level, although its studies can be influential. Rather, regulatory agencies around the world will have to decide what to do with the agency's finding. The US Environmental Protection Agency is currently conducting a [formal review](#) of the safety of glyphosate (which it does not consider carcinogenic in humans) and said that it would give "full consideration" to the IARC study.

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References

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1. Guyton, K. Z. et al. *Lancet Oncol.* [http://dx.doi.org/10.1016/S1470-2045\(15\)70134-8](http://dx.doi.org/10.1016/S1470-2045(15)70134-8) (2015).