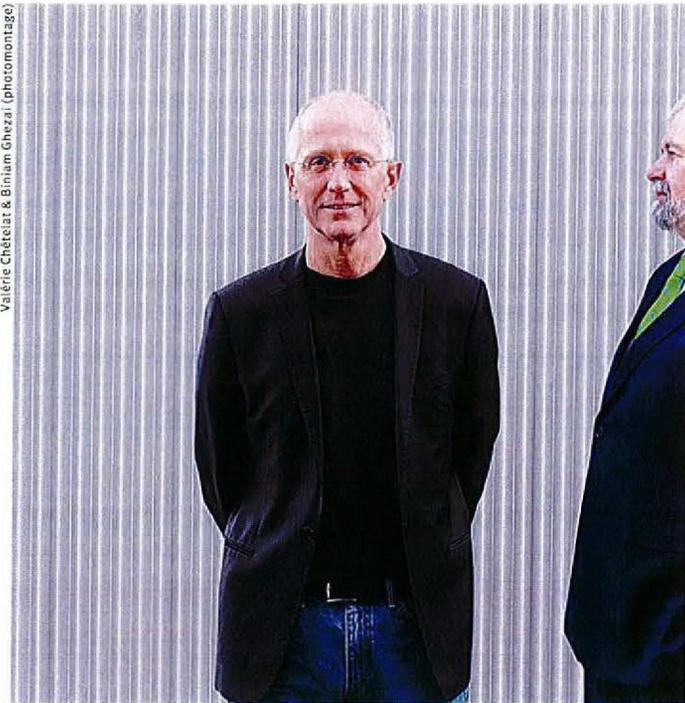


# Is glyphosate carcinogenic?

Glyphosate is the world's most widely used herbicide. While it's important in controlling weeds, its possible effects on humans are hotly debated among scientists.

Valérie Chételat & Biniam Ghezal (photomontage)



## Yes

says the environmental health researcher Christopher Portier

**H**ow strong is the evidence that humans are more likely to get cancer when widely exposed to glyphosate? This question centres on three issues: finding evidence in humans, finding evidence in laboratory animals and finding evidence of a molecular mechanism by which glyphosate might cause cancer.

Some 26 cancer studies have been carried out on humans who have been exposed to glyphosate formulations. Most of them found no connection. Nine of these studies examined non-Hodgkin lymphoma. Four case-control studies, when pooled, showed there to be an association between this cancer and glyphosate, as did two other case-control studies. The studies of higher quality adjusted for multiple exposures to other pesticides but still demonstrated an association, with the length of exposure increasing the strength of the association. However, these studies had certain limitations that made it impossible to rule out bias or other confounding factors. The conclusion we must draw is that glyphosate formulations are associated with non-Hodgkin lymphoma in humans, but there is only limited evidence of causality.

Five laboratory studies were carried out on mice, and nine on rats. All five of the mouse studies displayed increased tumour growth in at least one site. Three studies showed growth in kidney tumours, which rarely occur in mice; two studies showed an increase in hemangiosarcomas (a cancer arising in the blood vessels); and two studies also showed growth in malignant lymphomas. With the exception of growth in a few non-malignant tumours, none of the rat studies showed any effect. The conclusion is that glyphosate causes various tumours in laboratory mice.

“There is evidence of a mechanism by which glyphosate causes cancer”.

Christopher Portier

As to the molecular mechanism, publicly available data demonstrates that glyphosate and glyphosate formulations cause DNA damage in human and animal cells as well as in laboratory animals, but so far not

in bacterial cells. In two studies, glyphosate formulations also induced DNA damage in the blood cells of exposed humans. In human and other cells, glyphosate and glyphosate formulations have been shown to induce free oxygen radicals that are capable of damaging DNA. The conclusion is that there is indeed evidence of a mechanism by which glyphosate causes cancer.

From all this information, it is reasonable to conclude that, at sufficient levels of exposure, glyphosate and glyphosate formulations are probably carcinogenic to humans.

Christopher Portier is the former Director of the US National Institute of Environmental Health. He lives in Switzerland and wrote the 'Open letter: Review of the Carcinogenicity of Glyphosate by EFSA and BfR' to the European Commission that was signed by 95 scientists from around the world.

Dewayne Johnson v. Monsanto Company

Defendant's Exhibit 2931

Case No: CGC-16-550128

exhibitmaker.com



# No

says Jose Tarazona  
from the European  
Food Safety Authority

**T**he European Food Safety Authority (EFSA) has recently reviewed the toxicological profile of glyphosate and proposed new toxicological reference values for risk assessment. The EFSA did not confirm the recent classification of glyphosate as probably carcinogenic by the International Agency for Research on Cancer (IARC).

The IARC considered there to be “limited evidence in humans” for an association between glyphosate and non-Hodgkin lymphoma, while for the EFSA the evidence was insufficient to support such a classification. As the evidence from studies in humans alone had been insufficient for concluding that glyphosate is carcinogenic, the assessment of evidence in laboratory animals was key, and led to the different conclusions of the two bodies.

Significant trends in reports on industry-sponsored studies have been observed by the IARC. The EFSA searched the recent, large database of animal carcinogenicity studies in its entirety, but found no significant differences between control and treatment groups in the studies that were valid. Reviewing the biological relevance

of the incidences observed, the EFSA noted that the statistical trends were the result of bias, driven by secondary toxicity at excessively high doses, or chance results not related to glyphosate treatment.

“The lab results don't show a dose-response”.

Jose Tarazona

It is well known that excessive toxicity can affect the carcinogenic responses in bioassays. Such toxicity can cause effects such as cell death with associated regenerative cell proliferation. This can lead to tumour development as a secondary consequence, and is unrelated to the intrinsic potential of the substance to cause tumours at lower, less toxic doses.

The observed incidences were within the historical range observed in untreated animals. The laboratory results did not show a dose-response, and remain unconfirmed by equivalent studies at similar or higher doses. Therefore, besides the

absence of statistically significant differences with the concurrent controls, the observed tumour incidences also lacked biological relevance.

The EFSA also concluded that glyphosate is unlikely to cause DNA damage, as has been confirmed by a large number of studies showing no effect. However, effects were reported for glyphosate formulations containing other ingredients, and the EFSA's assessment of a surfactant frequently used in these formulations revealed some concerns. This led the EFSA to recommend carrying out further assessments regarding the possibility of DNA damage being caused by formulated products.

Jose Tarazona is the Head of the Pesticides Unit at the European Food Safety Authority (EFSA) and vice-chairman of the EU Scientific Committee on Health and Environmental Risks.