

# **IARC Monograph: Evaluation of Carcinogenic Risk to Humans**

## **GLYPHOSATE**

**Category: Group 2A- Probable Human Carcinogen based on limited evidence in humans and sufficient evidence in experimental animals.**

### **1. Exposure Data**

Glyphosate has both occupational and residential uses.

### **2. Evidence in Humans: Limited**

The Work Group (WG) evaluated 7 reports on the Agricultural Health (AHS) cohort study and 21 reports from 13 independent case-control studies regarding the associations with glyphosate.

- Two large case-control studies from the U.S (De Roos *et al.*, 2003) and Canada (McDuffie *et al.*, 2001) and two case-control studies from Sweden (Hardell *et al.*, 2002 and Eriksson *et al.*, 2008) all reported a positive and statistically significant association for Non-Hodgkin lymphoma (NHL) and glyphosate exposure.
- Subtype specific analyses in a Swedish case-control study indicated positive associations for total NHL as well lymphoma subtypes (B-cell lymphoma, lymphocytic lymphoma).
- The increased risk persisted in the studies that adjusted for exposure to other pesticides.

### **3. Evidence in Experimental Animals: Sufficient**

The WG evaluated a total of 10 studies: two dietary feeding studies in mice; five dietary feeding studies in rats; one study of the technical material via drinking water; another drinking water study with a commercial formulation; and one initiation-promotion study by subcutaneous injection.

- In one study with mice, there was a positive trend in the incidence of renal tubule adenoma or carcinoma (combined) in male mice. There were no significant findings in the females. Renal tubule carcinoma is a rare tumor in this strain (CD-1) mice.
- In the second study with mice, there was a positive trend in the incidence of hemangiosarcomas in male mice. There were no significant findings in the female mice.
- Two studies in rats showed a significant increase in the incidence of pancreatic islet cell adenomas in male rats. There were no significant findings in the female rats.
- A commercial formulation of glyphosate was found to be a skin-tumor promoter in the initiation-promotion study.

### **4. Mechanistic and other relevant data**

The WG concluded that the available mechanistic data provide support for carcinogenicity findings and that these effects can operate in humans.

- Genotoxicity – strong evidence for both the technical and formulated products;
- Oxidative stress – strong evidence for glyphosate and commercial formulations ;
- Receptor mediated effects – weak evidence
- Cell proliferation – weak evidence

- Immune system - weak evidence