MONSANTO

***Backgrounder***
**Glyphosate and Reproductive Toxicology**
Updated November 2014

Regulatory authorities and independent experts around the world agree that glyphosate does not cause adverse reproductive effects in adults or birth defects in offspring of these adults exposed to glyphosate, even at very high doses. This conclusion is based on multiple studies in laboratory animals that have been conducted to examine the potential for such effects. These include studies in which laboratory animals, their offspring and the next generation of offspring have been examined for adverse effects.

An international panel of renowned toxicologists reviewed the extensive data for glyphosate (Williams et al., 2000). They concluded that the normal use of the original Roundup herbicide[1] "does not result in adverse effects on development, reproduction, or endocrine systems in humans and other mammals. A review of epidemiologic literature of non-cancer endpoints and glyphosate found no evidence of a causal relationship between glyphosate exposures and adverse reproductive outcomes or malformations (Mink *et al*., 2011).In a recent review of epidemiological and animal reports, as well as studies on mechanisms of action related to possible developmental and reproductive effects of glyphosate the authors found no consistent effects of glyphosate exposure on reproductive health or the developing offspring. Furthermore, no plausible mechanisms of action for such effects were identified (Williams *et al*., 2012).

The World Health Organization (WHO 2004), the U.S. Environmental Protection Agency (US EPA 1993) and the European Commission (2002) also have reviewed the data and concluded that the use of glyphosate according to label directions would not result in adverse reproductive or developmental problems or birth defects.

The U.S. EPA has evaluated glyphosate data according to parameters established by the Food Quality Protection Act of 1996, which required special consideration of potential effects of pesticide use on children. The U.S. EPA (2014) concluded that "There is a reasonable certainty that no harm will result to the general population, and to infants and children from aggregate exposure to glyphosate residues."

The following in vivo (live animal) toxicology studies have been conducted and reviewed by regulatory authorities, other scientific bodies and independent experts:

**Three-Generation Rat Reproduction:** Male and female rats were fed glyphosate at dosages of 0, 3, 10, and 30 mg/kg/day everyday throughout the production of three successive generations. No adverse treatment-related effects on reproduction were observed. Likewise, there were no other adverse effects as determined by gross and microscopic pathology examinations.

**Two-Generation Rat Reproduction:** Male and female rats were fed glyphosate at dose levels of 0, 2000, 10,000 and 30,000 parts per million (ppm; equivalent to approximately 0, 100, 500 and 1500 mg/kg body weight/day) everyday throughout the production of two successive generations. It was concluded that reduced body weights and soft stools occurred at 30,000 ppm (a very high dose representing approximately 3 percent of the diet). Glyphosate did not affect the ability of rats to mate, conceive, carry or

[1] "Roundup" refers to the original single active ingredient Roundup herbicide formulation (also known as MON 2139).

deliver normal offspring at any dose and no treatment-related effects were seen at 10,000 ppm (1 percent of diet) and below.

**Developmental Toxicity**

**Rats:** No birth defects were observed in the offspring of pregnant rats given glyphosate by gavage at dose levels of 0, 300, 1000, and 3,500 mg/kg/day on days 6 through 19 of gestation. Only the highest dose caused adverse effects in the parent. No adverse effects were seen in either the parent or the offspring at 1,000 mg/kg/day.

**Rabbits:** No birth defects were observed in the offspring of pregnant rabbits given glyphosate by gavage at dose levels of 0, 75, 175 and 350 mg/kg/day on days 6 through 27 of gestation. Only the highest dose caused adverse effects in the parent.

In addition, four expert developmental toxicologist reviewed seven unpublished rabbit and six unpublished rat developmental toxicology studies and concluded there was no toxicological evidence for a potential risk for increased cardiovascular defects as a result of glyphosate exposure during pregnancy (Kimmel *et al*., 2013).

**Wildlife studies:**

In reproduction studies with bobwhite quail and mallard ducks, glyphosate was fed to male and female birds at dietary concentrations of 0, 50, 200 and 1,000 ppm for 16-17 weeks. There was no effect on reproductive success in either species at any dose tested.

In a chronic fathead minnow study, fish were exposed to glyphosate concentrations of 0.7, 2.8, 7.0. 13.0 and 25.7 mg/l for 255 days. No treatment-related effects were reported on the survival, growth and egg production of first generation fish or on hatchability, survival and growth of second-generation eggs and fry.

In summary, the results of these studies indicate that glyphosate does not produce birth defects and is not a reproductive toxin.

**References**


European Commission (2002) Report for the Active Substance Glyphosate, Directive 6511/VI/99, Jan. 21. http://ec.europa.eu/food/plant/protection/evaluation/existactive/list1_glyphosate_en.pdf

Kimmel GL, Kimmel CA, Williams AL, DeSesso JM (2013) Evaluation of developmental toxicity studies of glyphosate with attention to cardiovascular development. Crit Rev Toxicol, 2013; 43(2): 79–95.

Mink PJ, Mandel JS, Lundin JI, Sceurman BK. (2011). Epidemiologic studies of glyphosate and non-cancer health outcomes: a review. Regul Toxicol Pharmacol, 61, 172–84.

U.S. EPA (1993) Reregistration Eligibility Decision: Glyphosate. EAP-738-F-93-011, September 1993, Environmental Protection Agency, Washington, DC.
http://www.epa.gov/oppsrrd1/REDs/old_reds/glyphosate.pdf

U.S. EPA (2013) Glyphosate; Pesticide Tolerances. Final Rule; Environmental Protection Agency. Federal Register 78(84): 25396-25401. http://www.gpo.gov/fdsys/pkg/FR-2013-05-01/pdf/2013-10316.pdf

Williams AL, Watson RE, DeSesso JM. (2012). Developmental and reproductive outcomes in humans and animals after glyphosate exposure: a critical analysis. J Toxicol Environ Health, Pt B, 15, 39–96.

Williams GM, Kroes R, Munro IC (2000) Safety evaluation and risk assessment of the herbicide Roundup and its active ingredient, glyphosate, for humans. Reg Toxicol Pharmacol 31(2):117-165. http://dx.doi.org/10.1006/rtph.1999.1371

JMPR. (2004) Pesticide Residues in Food -- 2004. Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues. FAO Plant Production and Protection Paper, 178.