GLYPHOSATE-BASED HERBICIDES: Q & A May 2021

Glyphosate-based herbicides (GBHs) are a family of herbicide products with additives that can kill a broad spectrum of plants. Glyphosate (GLY), a systemic herbicide, was first registered by EPA in 1974 and is currently the most widely used herbicide in the world.

Q. How are these herbicides used in VT?
A. GBHs, such as Round-up® and Rodeo are used to control different weeds in different settings in Vermont such as:
* agricultural weed control in genetically modified corn and soy crops for the dairy industry;
* terminating cover crops in no-till practices;
* conventional corn and soy crops and vegetable growing;
* rights-of-way and substation vegetation management for electric utilities, railroads, highways near water;
* landscaping by homeowners.

Lack of data collection on some uses by individuals, farmers and commercial applicators makes it difficult to accurately estimate state-wide usage.

Q. How does the herbicide glyphosate work?
A. Glyphosate works by blocking a plant's ability to make certain proteins, known as the shikimic pathway. When this happens, the plant cannot grow, and it dies. For glyphosate to work, it must be applied to actively growing plants.

Q. How is glyphosate evaluated for risk to humans and the environment?
A. EPA evaluates the principal ingredient in a pesticide for short-term (acute) and longer-term (chronic) risks to humans and some animals, and its action in soil and water. Acute toxicity may be tested on the whole formulation; tests for chronic toxicity are done on the principal ingredient alone. One set of tests measures acute toxicity via the median lethal dose, "LD50", or the amount of chemical that makes 50% of the test subjects die. Generally an LD50 is expressed as milligrams of substance per kilogram of body weight. The lower the LD50, the more toxic the substance.

In addition, the Food Quality Protection Act of 1996 requires assessment of chemicals for endocrine disruption (EPA, n.d.). Endocrine (hormonal) systems control how animals develop, function, and reproduce, and can be disturbed by very small amounts of toxin (ACS, 2009). EPA has decided that glyphosate by itself is not an endocrine disruptor (EPA, 2021); however, European researchers have found that glyphosate-based herbicides (whole formulations) do cause endocrine disruption (Benachour et al, 2007; Defarge et al 2018).

EPA has not considered adverse effects of GBHs on the gut biome, which due to its biological similarity to plants, can be adversely affected by GBHs. A healthy gut biome is essential to help the immune system resist disease and detoxify environmental toxins, among other functions (Samsel A, Seneff S, 2017).

Risk of cancer has been a major focus of debate and testing. EPA denies that GLY (as a single chemical) causes cancer, while others find that repeated exposure to GBHs (formulations) can cause lymphomas (Zhang L,2019).

Q. Why is it important to distinguish GBHs from glyphosate (GLY)?
A. GLY is not applied to vegetation by itself. It is always used in a chemical mixture or formulation. The unidentified ingredients (considered "confidential business information") added to GLY in glyphosate-based herbicides may consist of 40%-98% of the herbicide product and can be more toxic than GLY itself. Only a portion of EPA's testing involves the whole mixture of a GBH. For example, Roundup Weathermax contains petroleum distillates, arsenic and chromium (Defarge, 2016). So it is important to refer to glyphosate-based herbicides (GBHs) or a product name like Roundup, rather than glyphosate when discussing the GBHs used all over Vermont.

Q. What does the Code of Federal Regulations say about pesticides and safety?
A. Pesticides cannot be represented as "safe" even if the products are *used according to the label required by EPA for the product.* The Federal Code of Rules *prohibits* representations that glyphosate is "safe when used as directed." [40 CFR 156.10 (a) (5) ix-x].

Q. What do Safety Data Sheets and Labels tell us about safety?
A. The Safety Data Sheet for Rodeo (DowAgroSciences, 2015) reports several possible adverse health effects; there is "no specific antidote" in case of ingestion of this compound. The Label for Rodeo states: It is impossible to eliminate all risks associated with use of this product (Corteva Agriscience, 2019). For whom, for what other organisms, in what time period is use of this pesticide safe?

Q. What are some long-term harms from using GBHs?
A. Some harmful effects include the following.

1. toxic to the gut biome (like plants biologically) in creatures from bees and fish to humans (Rueda-Ruzafa, L 2019).
2. disrupts hormone function in reproduction; reducing enzymes necessary for growth and development at 0.1ppb (Defarge N et al, 2016)
3. toxic to beneficial soil biota; promotes toxic biota and antibiotic resistance (Van Bruggen AHC et al, 2018)
4. toxic to fish, amphibians, mussels (Ayoola SO, 2008; Howe CM et al, 2004; Matozzo V et al, 2018)
5. likely to cause lymphomas in humans (Erickson M, 2008; Zhang L et al 2019)
6. can cause nausea, headaches, heart irregularities (Cox, C 2000).

Q. What does "half-life" of a chemical mean?
A. Half-life is the time it takes for a chemical to break down to half of its original strength; it will continue to breakdown more slowly into other substances known as "degradates".

Q. What happens to GBHs in the environment?
A. GLY can bind to some soils, but can be mobile in other soils. Its half-life can be between 2 and 197 days. The half life in soil for aminomethyl phosphonic acid (AMPA), its chief break-down product, is between 76 and 240 days (Battaglin WA et al 2005). Other breakdown products are ammonium and CO2. GLY and its degradate AMPA have been found in streams, rivers, lakes, groundwater, in snow melt and rain (Battaglin et al 2014). GLY is very soluble in water, making it difficult to detect and monitor.

Q. Can GLY reach groundwater?
A. In one study the half-life of GLY in silt clay loam soil was 19 days, and 14.5 days in sandy loam soil. AMPA was detected in the soils after 3 days. Risk of GLY contamination of groundwater was high over the long term in soils to which GLY could adhere and in soils where GLY remains partially broken down, like clay loam soil. But the release of some residues may increase the risk of contamination of groundwater regardless of the type of soil (Al-Rahab AJ, Schiavone, M, 2010). Research teams in the US have found GLY and AMPA in groundwater (Battaglin WA, 2014).

Q. Is there any problem with using GBHs near water?
A. GBHs add phosphorus (P) to soil which may already be saturated with P. GLY attached to soil particles can move into nearby water, contributing P to surface waters and feeding cyanobacteria blooms (Hébert MP et al, 2018; Saxton MA et al, 2011). Use in railroad rights-of-way and at highway guardrails near water can add more P to surface waters as it moves through loose rock and soil. Rodeo is approved for use near water, but 46.2% of the product is unknown.

Q. Do GBHs contribute to global climate change?
A. Yes, they degrade soil organisms that work to keep soil fertile and porous, produce CO2, kill non-target plants capable of incorporating CO2 in the soil; their manufacture, containers and transport also contribute to climate change.

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