

Herbicides: How Toxic Are They?¹

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An herbicide is any agent used to bring about plant death. Although everything from salt to soap has been used for this purpose, herbicides are primarily synthetic chemicals manufactured for use in the agriculture, industrial, and ornamental and turf industries. For many years, these products have been seen as toxins that poison plants and are equally harmful to the applicator. To compound this issue, organically produced food is becoming more popular because it is pesticide-free and is seen as being healthier. These factors have led to a prevalence of opinion that pesticides are bad for the environment and harmful to humans.

Although there have been pesticides that were toxic and dangerous to handle, most of these products are no longer used and have been replaced by newer chemistry. Pesticides now must go through rigorous testing by the U.S. Environmental Protection Agency (EPA) before they can be sold. This has led to many herbicides that possess little or no mammalian toxicity and are less harmful than many everyday household products (Table 1). Surprisingly, household chemicals that many of us store under the kitchen sink pose more risk to the handler than herbicides.

A common way to document toxicity is by oral LD₅₀ values. LD₅₀ is the amount of chemical required to provide a “lethal dose” to 50% of the test population. LD₅₀ is measured in mg of chemical administered per kg of body weight. Therefore,

an oral LD₅₀ of 500 means that 500 mg of chemical was needed to obtain lethality in a 1 kg subject (rabbit). The lower the LD₅₀ value, the less chemical that is required to reach lethality. A chemical with an LD₅₀ of 10 mg/kg is more acutely toxic than one with an LD₅₀ of 100 mg/kg.

Table 1 demonstrates that herbicides often have higher LD₅₀ values than many commonly used or consumed products. Why is this? Why are chemicals that are so effective on plant species not equally harmful to humans? The reason is two-fold. First, herbicides target highly specific biological or biochemical processes within plants, such as photosynthesis and production of branch-chain amino acids. However, mammals (humans included) do not photosynthesize or produce branch-chain amino acids. Therefore, herbicides that target photosynthesis or branch-chain amino acid production have no place to bind in our bodies and have very little impact. Secondly, since these herbicides do not bind in our bodies, they are often excreted in urine within 24 hours of the dose. This flushing of the herbicide does not allow concentrations to build up to toxic levels within the body. This in no way means that it is safe to intentionally ingest herbicides, but the fact is that our bodies are well equipped to safely dispose of accidental exposure to many common herbicides.

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Use herbicides safely. Read and follow directions on the manufacturer's label.

Table 1. Comparison of oral LD₅₀ values for commonly used herbicides and consumer goods.

Herbicide	LD ₅₀	Common consumer chemicals	LD ₅₀
Paraquat (Gramoxone)	~100	Nicotine	9
Triclopyr	630	Caffeine	192
2,4-D	666	Bleach	192
Pendimethalin (Prowl)	1050	Tylenol	338
Atrazine	3090	Household ammonia (10%)	350
Glyphosate (Roundup)	4900	Codeine	427
Imazaquin (Image)	>5000	Table salt	3000

What about Agent Orange?

Agent Orange was an herbicide product containing equal parts 2,4-D and 2,4,5-T. These herbicides were used extensively in the Vietnam War to defoliate jungles in an attempt to expose troop movement. However, many veterans came forward after the war with illnesses ranging from a multitude of cancers to various respiratory diseases. It was speculated that Agent Orange was to blame for these disorders.

After numerous governmental inquiries, it was found that the herbicides 2,4-D and 2,4,5-T were not responsible for the human health effects of Agent Orange. Rather, Agent Orange was inadvertently contaminated with dioxin, a potent and known carcinogen. Dioxin was an unanticipated by-product of the 2,4,5-T synthesis process. Although synthesis processes have been developed that allow 2,4,5-T to be produced without dioxin contamination, these procedures were not employed to fulfill this specific contract. Consequently, the production of 2,4,5-T has been totally banned by the United States and numerous other countries.

Conclusion

It must be noted that some herbicides are harmful. Herbicides such as paraquat and endothal have “Danger” signal words on the label and must be handled with great care. Therefore, it is important that **all** herbicides be handled carefully and in a manner consistent with their labeling. Just because some herbicides are less toxic than table salt does not mean that any herbicides should be handled carelessly. But on the other hand, using a herbicide in accordance with the product label will not often result in personal injury or cause for alarm.

Additional Information

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