PI-133

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Herbicides: How Toxic Are They?[1]

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A 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 lead 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there have been pesticides that were toxic and dangerous to handle, most of these products are no longer used and have been replaced by newer chemistry.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 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 LD_{50} values. LD_{50} is the amount of chemical required to provide a "lethal dose" to 50% of the test population. LD_{50} is measured in mg of chemical administered per kg of body weight. Therefore, an oral LD_{50} of 500 means that 500 mg of chemical were needed to obtain lethality in a 1 kg subject (rabbit). The lower the LD_{50} value, the less chemical that is required to reach lethality. A chemical with an LD_{50} of 10 mg/kg is more acutely toxic than one with an LD_{50} of 100 mg/kg.

Table 1 demonstrates that herbicides often have higher LD_{50} 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.

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

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 within the body to toxic levels. 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.

What about Agent Orange?

Agent Orange was a herbicide product containing equal parts 2,4-D and 2,4,5-T. These herbicides were used extensively in the Vietnam War to defoliate the 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 has been learned 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 byproduct 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 US and numerous other countries. For a detailed discussion of this subject, see http://www.nap.edu/catalog/11242.html#orgs.

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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Table 1. Comparison of oral LD_{50} values for commonly used herbicides and consumer goods.

Herbicide	LD_{50} [1]	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