Appendix A: Pesticide Toxicities

This Appendix contains more detailed information about pesticide toxicities, supplementing information provided in Chapter 6, Health and Safety.

LD$_{50}$ and LC$_{50}$

Pesticide toxicity is determined by testing a range of doses of the chemical on animals. A common method used for comparing the acute toxicity of pesticides is determining the LD$_{50}$, or the dose that kills 50 percent of test animals under standard conditions. It is usually expressed in milligrams of chemical to kilograms of the animal's body weight (or mg/kg). When the chemical is fed to the animals, the resulting number is called the oral LD$_{50}$; when the animal's skin is exposed, the resulting number is called a dermal LD$_{50}$.

Example: Pesticide A has been fed to female white rats to test its toxicity. The acute oral LD$_{50}$ for Pesticide A is 42 mg/kg in this animal population. This means that when rats eat a dose of 42 milligrams of Pesticide A for every kilogram of their body weight, it will kill half of them.

When pesticides are sprayed into the air or mixed into water, the chemical dose is diluted, so another measure of toxicity is the LC$_{50}$, the concentration of chemical in air or water that kills 50 percent of test animals that inhale the air or swim in the water. The LC$_{50}$ can be expressed in parts per million (ppm) or milligrams of chemical to liters of water or air (mg/l).

The lower the LD$_{50}$ or LC$_{50}$, the more toxic the chemical. Federal laws classify the most toxic pesticides as legal poisons if it has any one of the following:

- An acute oral LD$_{50}$ of 50 mg/kg; or
- An acute dermal LD$_{50}$ of 200 mg/kg; or
- An acute inhalation LC$_{50}$ less than 0.2 mg/l.

Any product with these toxicity levels has the potential to kill humans with very small amounts, as little as a few drops taken by mouth.
The LD$_{50}$ and LC$_{50}$ have limitations because they measure only one toxic effect—death. They do not give any indication of what dose may lead to other less serious, acute systemic effects or to other, possibly equally serious, contact effects or delayed systemic effects. Also, they do not translate directly to humans because our body systems are slightly different from those of test animals (rats, mice, etc.). Lastly, the LD$_{50}$ and LC$_{50}$ are measures of a single exposure, not the potential buildup of effects resulting from multiple exposures.

The lower the LD$_{50}$ value of a pesticide, the less it takes to kill 50 percent of the population of test animals. Therefore, the lower the LD$_{50}$, the greater the toxicity of the chemical.

Some pesticides produce acute toxic effects because of their corrosive or irritant properties. These can result in respiratory, skin, or eye irritation or damage. Some can cause severe burns or permanent blindness. Chemicals with these irritant or corrosive properties need to be used with extra care.

Fungicides, herbicides, and some insecticides pose contact injury concerns. Manufacturers list non-lethal systemic and contact effects in addition to the signal word. Systemic and contact acute toxicity concerns are indicated by the signal words and further explained in the “Precautionary Statements” portion of the product label under the “Hazards to Humans and Domestic Animals” section.

The EPA and the manufacturer take into account both systemic and contact toxicity measures in assigning the product’s signal word and toxicity category. These are assigned on the basis of the greatest concern, be it oral, dermal, or inhalation systemic effects, or skin, eyes, or respiratory tract contact effects.

**Signal Words**

Pesticide labels are required to have specific signal words on the label to flag to pesticide users the level of toxicity of the formulated product. There are four distinct signal words found on pesticide labels:

**DANGER—POISON, DANGER, WARNING, and CAUTION.**

Signal words are also found on other chemical products used around work and home, such as paint, oven cleaner, dish soap, antifreeze, and window cleaner, to name a few. Signal words are based on the toxicity of the product. Depending on their toxicity, products are categorized into several classes of hazard. Some very low toxicity products (Hazard Class IV) are not required to have a signal word.
Danger—Poison: Pesticides classified as highly toxic (Hazard Class I) with acute oral LD$_{50}$ values from a trace to 50 mg/kg must have the signal words DANGER and POISON (in red letters) and a skull and crossbones symbol prominently displayed on the package label. The lethal toxicity may be based on oral, dermal, or inhalation exposure. PELIGRO, the Spanish word for DANGER, must also appear on the labels of highly toxic chemicals. As little as a few drops of a DANGER—POISON material taken orally could be fatal to a 150-pound person.

Danger: Some highly toxic (Hazard Class I) pesticide products carry the signal word DANGER (without the word “poison” or the skull and crossbones symbol) because of their potential to cause acute contact injury. DANGER indicates the potential for permanent or severe damage to skin, eyes, or lungs. These contact effects are more dangerous than the acute systemic toxicity (LD$_{50}$) of the product. Several carry warnings of concern about their causing irreversible eye damage at low exposures.

Warning: A pesticide product considered moderately toxic (Hazard Class II) must have the signal words WARNING and AVISO (Spanish) on its label. If the concern is due to systemic toxicity, the acute oral LD$_{50}$ values range from 50 to 500 mg/kg; 1 teaspoonful to 1 ounce (2 tablespoons) of this material could be fatal to a 150-pound person. The concern could also be due to contact injury to skin, eyes, or respiratory tract. The WARNING signal word alone does not indicate whether the concern is systemic or contact or both.

Caution: Pesticide products classified as slightly toxic (Hazard Class III) are required to have the signal word CAUTION on the pesticide label. Acute toxicity may be systemic or contact in nature. If systemic, the acute oral LD$_{50}$ values are between 500 mg/kg and 5,000 mg/kg. Contact effects are generally irritation of eyes, skin, or respiratory tract. Consult the precautionary statements that follow the signal word on the label to learn about the product’s contact or systemic hazard to humans. Pesticides classified very low toxicity to almost nontoxic (Hazard Class IV) are not required to carry a signal word on the label, though many choose to have the signal word CAUTION on the label.
<table>
<thead>
<tr>
<th>Toxicity Level</th>
<th>Oral LD$_{50}$ (mg/kg)</th>
<th>Dermal LD$_{50}$ (mg/kg)</th>
<th>Inhalation LC$_{50}$ (mg/l)</th>
<th>Toxicity Concern</th>
<th>Signal Word</th>
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</thead>
<tbody>
<tr>
<td>Highly toxic</td>
<td>Trace to 50</td>
<td>Trace to 200</td>
<td>Trace to 0.2</td>
<td>Severe systemic toxicity in oral, dermal, inhalation exposure</td>
<td>Danger-Poison, with skull and crossbones, printed in red</td>
</tr>
<tr>
<td>Highly toxic</td>
<td></td>
<td></td>
<td></td>
<td>Severe contact toxicity in eye, skin, and respiratory exposure</td>
<td>Danger</td>
</tr>
<tr>
<td>Moderately toxic</td>
<td>50 to 500</td>
<td>200 to 2,000</td>
<td>0.2 to 2.0</td>
<td>Systemic and/or contact toxicity in moderate doses</td>
<td>Warning</td>
</tr>
<tr>
<td>Slightly toxic</td>
<td>500 to 5,000</td>
<td>2,000 to 20,000</td>
<td>2 to 20</td>
<td>Systemic and/or contact toxicity in large doses</td>
<td>Caution</td>
</tr>
<tr>
<td>Rarely toxic</td>
<td>Greater than 5,000</td>
<td>Greater than 20,000</td>
<td>Greater than 20</td>
<td>Slight systemic and/or contact toxicity</td>
<td>Caution or no signal word</td>
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