

As illustrated above, relative solubility corresponds to actual water solubility values. Therefore, if a herbicide is very soluble in water, it dissolves readily but can easily move with rainwater as runoff. It can also be carried through soil water movement and become a potential groundwater contaminant. If a herbicide has extremely low solubility it tends to stick to soil, reducing possible adverse non-target effects.

### Soil Adsorption

The ability of a compound to bind to soil particles is called soil adsorption. Most soil particles such as clay and organic matter are negatively charged and tend to repel negative and attract positive charges—much like a magnet. Sands are often neutral in their charges, therefore, they do not attract or repel charged compounds.

### Anionic Herbicides

Anionic, or negatively charged herbicides, show low adsorption to negatively charged soil particles such as organic matter and clay and generally leach readily out of the soil. For example, 2,4-D in the anionic form, is actually repelled by clays and organic matter.

### Cationic Herbicides

Cationic, or positively charged herbicides, are generally tightly adsorbed to negatively charged clay soils but less so in organic soils. For example, paraquat and diquat are positively charged and are adsorbed irreversibly by negatively charged expanding type clays.

### Nonionic

Nonionic, or neutrally charged herbicides, adsorb primarily through weak physical bonds to soil particles. The degree of adsorption is generally related to water solubility. The nonionic type herbicides are the largest category of herbicides.

### Vapor pressure

Vapor pressure (or volatility) is the measure of the intramolecular bonding forces of a compound and is usually expressed as mm Hg (mercury) at 25° C, Table 2. Compounds possessing weak intramolecular forces readily volatilize and can easily change from a solid or liquid form to a gaseous form at room

temperature. Volatility is highly dependent on temperature, moisture, soil texture, and the properties of a specific herbicide, and is extremely important in determining how a particular herbicide can be used. For example, compounds with high volatility such as trifluralin must be applied to the soil and incorporated by watering-in to prevent loss through volatilization to the air.

Table 2. Vapor pressure as a degree of volatility

Vapor Pressure	Volatility
$10^{-1}$ to $10^{-4}$ mm Hg, 25 C	volatile (high)
$10^{-4}$ to $10^{-6}$ mm Hg, 25 C	intermediate (medium)
$>10^{-6}$ mm Hg, 25 C	nonvolatile (low)

### Persistence

Persistence is a measure of how long a compound remains in the soil and can be identified in two ways, longevity and half-life. **Longevity** refers to the amount of time a particular pesticide remains phytotoxic to a sensitive species and is described in terms of "carry over," or residual effects. **Half-life** is a more absolute measure of persistence and is the time it takes for half of the applied pesticide to degrade. For example, if a herbicide's half-life is 30 days, half of the chemical will be left after 30 days, one-quarter after 60 days, one-eighth after 90 days and so on.

### Toxicity

Toxicity is the inherent capacity of a substance to cause injury or death. A commonly used measure of toxicity is **LD<sub>50</sub>**. LD<sub>50</sub> is the dose required to kill 50 percent of a population of test animals and is usually expressed in the weight of the chemical per unit of animal body weight (mg/kg or ppm). A chemical with a small LD<sub>50</sub> (e.g., 5 mg/kg) is extremely toxic while a chemical with a larger LD<sub>50</sub> (e.g., 1000 to 5000 mg/kg) is not as toxic (Table 3). **LC<sub>50</sub>** is the concentration that will kill 50 percent of the test animals and is usually expressed in parts per million (ppm). Terms expressing intake by animal or human tissue are acute oral, acute dermal and chronic toxicity. **Acute oral** refers to a single dose taken by mouth while **acute dermal** refers to a single dose applied directly to the skin. **Chronic** toxicity occurs over a long period of time, either continuously or intermittently and is used to describe ongoing