

## TOXICITY OF HERBICIDES

Toxicity is the capacity of a substance to produce injury. Toxic effects may be immediate (acute) or accumulative (chronic), depending upon the exposure duration, the dose, and the herbicide. The toxicity of a substance varies with the animal species, age, sex, and nutritional status and with the route of exposure—through the stomach (orally), the lungs (by inhalation), or the skin (dermally). The skin and eyes are also subject to irritation caused by chemicals.

### HUMAN TOXICITY OF HERBICIDES

Pesticide manufacturers are required to conduct acute, subacute, and chronic toxicity tests, including tests for mutagenicity, teratogenicity, and carcinogenicity. The usual expression of acute toxicity is  $LD_{50}$ , which is the average lethal dose in milligrams per body weight in kilograms (mg/kg) required to kill 50 percent of a test population. Toxicity tests are conducted on experimental animals, such as white rats, mice, and rabbits.

To make mg/kg more meaningful, the following factors are given to convert mg/kg to ounces per pound (oz/lb) for a 100-pound person and a 187-pound person:

$$\text{mg/kg} \times 0.0016 = \text{oz}/100 \text{ lb}$$

$$\text{mg/kg} \times 0.0030 = \text{oz}/187 \text{ lb}$$

Because toxicity depends upon body weight, the amount of chemical considered lethal for a child is less than the amount for an adult. And conversely, it takes more to kill a large animal than a small one.

The categories of toxicity are given in Table 1. The herbicide label indicates the extent of toxicity by the

signal word(s) it carries. The signal word on the label applies to the most serious method or route of exposure. For example, if an herbicide has an acute oral  $LD_{50}$  of 368 (which triggers the signal word “Warning”) and an acute dermal  $LD_{50}$  of > 2,000 (which triggers “Caution”) and is severely and irreversibly corrosive to the eyes (which warrants “Danger”), then the label signal word is “Danger.”

#### DANGER-POISON

Herbicides with the active ingredient endothall or paraquat carry the signal word “Danger” plus a skull and crossbones. Endothall is available in liquid form as Aquathol K and Hydrothol 191. Paraquat is available as Gramoxone Inteon.

These herbicide labels carry the following precautions: The user is advised to wear goggles or a face shield, rubber gloves, and a rubber apron when working with concentrates and to avoid breathing spray mists.

#### DANGER-CORROSIVE

The signal words “Danger-Corrosive” indicate the risk of irreversible eye or skin burns. This warning is usually accompanied by a recommendation that the user wear goggles or a face shield, especially when handling concentrates. The label also may call for wearing rubber gloves and an apron when handling or mixing concentrates or adjusting equipment. The first-aid statement states, “In case of contact with eyes, immediately flush eyes with plenty of water for at least 15 minutes and **get medical attention promptly.**” If the contact is with the skin, the label calls for washing with plenty of water. If skin irrita-

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*The information in this chapter is provided for educational purposes only. Product trade names have been used for clarity, but reference to trade names does not imply endorsement by the University of Illinois; discrimination is not intended against any product. The reader is urged to exercise caution in making purchases or evaluating product information.*

*Label registrations can change at any time. Thus the recommendations in this chapter may become invalid. The user must read carefully the entire, most recent label and follow all directions and restrictions. Purchase only enough pesticide for the current growing season.*

**Table 1. Toxicity categories of herbicides**

Toxicity category	Label signal words	Skin effects	Acute oral LD <sub>50</sub> (mg/kg)	Acute dermal LD <sub>50</sub> (mg/kg)	Acute inhalation LC <sub>50</sub> * (mg/L)
I. High	Danger–Poison	corrosive	≤ 50	≤ 200	≤ 0.2
II. Moderate	Warning	severe irritation at 72 hours	50–500	200–2,000	0.2–2
III. Low	Caution	moderate irritation at 72 hours	500–5,000	2,000–20,000	2–20
IV. Very low	Caution	mild irritation at 72 hours	> 5,000	> 20,000	> 20

\*LC<sub>50</sub> = concentration of pesticide, in milligrams per liter of air space, required to kill 50 percent of a test population.

tion occurs, medical attention should be sought. Herbicides in this category are listed in Table 2.

#### WARNING

“Warning” is the signal word used for herbicides containing an active ingredient that is moderately toxic through oral, dermal, or inhalation exposure. The labels state, under “Hazardous to Humans,” “May be fatal or harmful if swallowed, inhaled, or absorbed through the skin.” The following herbicides contain such a warning:

#### BROMOXYNIL

Buctril 2EC, Buctril + atrazine, Moxy, etc.

#### DIQUAT

Reward, Weedtrine-D

#### GLUFOSINATE

Liberty

“Warning” also appears as a signal word for herbicides with label statements indicating that they can cause eye or skin irritation or burns or may be harmful if swallowed, inhaled, or absorbed through the skin. Herbicides in this category are listed in Table 3.

Most of these herbicide labels state, “Do not get into eyes or on skin.” If skin or eye contact occurs, the labels advise washing the contacted areas thoroughly for 15 minutes and calling a physician in case of eye contact. All herbicide labels must include a section describing the appropriate personal protective equipment that should be worn by applicators and handlers.

Any herbicide that does not have a “Danger” or “Warning” signal word has “Caution” on the label. “Caution” indicates that the product has low oral, dermal, and inhalation toxicity and has little or no irritability to either the eyes or the skin.

**Table 2. Herbicides labeled with the signal words “Danger–Corrosive” or “Danger–Poison”**

Trade name	Common name
Aquathol	endothall
Assure II	quizalofop
Butoxone 200	2,4-DB amine
Butyrac 200	2,4-DB amine
Cimarron Max	metsulfuron + dicamba + 2,4-D
Cobra	lactofen
Confront	triclopyr + clopyralid
Curtail	clopyralid + 2,4-D
Devrinol 2E	napropamide
Garlon 3A	triclopyramine
Gramoxone Inteon	paraquat
Hydrothol 191	endothall
IntRRo	alachlor
Laddok S-12	bentazon + atrazine
Many	2,4-D amine
MCPA Amine	MCPA
Reflex	fomesafen
Shotgun	atrazine + 2,4-D
Sonalan (HFP or 10G)	ethalfluralin
Storm	acifluorfen + bentazon
Ultra Blazer	acifluorfen
Velpar L	hexazinone
Weedone 638	2,4-D acid + ester

**Table 3. Herbicides labeled with the signal word “Warning”**

Trade name	Common name
Alanap-L	naptalam
Banvel, Sterling	dicamba
Buctril, Moxy, Bromox, etc.	bromoxynil
Camix	S-metolachlor + mesotrione
Define DF	flufenacet
Extreme	imazethapyr + glyphosate
Flexstar	fomesafen
G-Max Lite	dimethenamid-P + atrazine
Goal	oxyfluorfen
Harness	acetochlor + safener
Hornet WDG	flumetsulam + clopyralid
Liberty	glufosinate
Lightning	imazethapyr + imazapyr
MCPA esters	MCPA
Outlook	dimethenamid-P
Poast	sethoxydim
Pramitol	prometon
Pursuit DG	imazethapyr
Resource	flumiclorac
Reward, Weedtrine-D	diquat
Ronstar	oxadiazon
Select, Select Max	clethodim
Starane	fluroxypyr
Super Brush	2,4-D + dicamba + dichlorprop
Surpass	acetochlor

## ENVIRONMENTAL TOXICITY OF HERBICIDES

The “Environmental Hazards” section of the label includes statements regarding toxicity to fish and wildlife, and the user is urged to be especially careful in this regard. Herbicides that state they are toxic to fish or wildlife contain the active ingredient bromoxynil, propachlor, or others:

### BROMOXYNIL

Buctril 2EC, Moxy, Bromox, etc.  
Buctril + atrazine

### OTHERS

Goal (oxyfluorfen)  
Gramoxone Inteon (paraquat)  
Reward, Weedtrine-D (diquat)

Some herbicide labels carry the statement “Toxic to Fish.” These include certain esters of phenoxy and pyridinoxy-phenoxy herbicides, the dinitroaniline herbicides, and miscellaneous others. All herbicide labels warn the user to keep the product out of lakes and streams.

### DINITROANILINES (DNAs)

Balan (benefin)  
Prowl, Pendimax (pendimethalin)  
Sonalan, Curbit (ethalfluralin)  
Many (trifluralin)

### DNA MIXES

Pursuit Plus (pendimethalin + imazethapyr)

### OXY-PHENOXY ESTERS

Fusilade DX 2EC (fluazifop)  
Fusion 2.56EC (fluazifop + fenoxaprop)

### PHENOXY ESTERS

(There are many phenoxy herbicide products.)  
Crossbow 3EC  
Esteron 99  
Garlon 4E  
MCPA ester  
Patron 170

Other herbicides, such as **Aim** (carfentrazone), contain warnings stating that they are very toxic to algae and moderately toxic to fish. The potential for contaminating groundwater with pesticides has prompted the addition of groundwater statements on several pesticide labels, especially for products containing atrazine, simazine, flufenacet, dimethenamid, acetochlor, alachlor, metolachlor, or metribuzin. Table 4 lists herbicides carrying label statements cautioning the user to handle the herbicides in a manner that minimizes the potential for groundwater contamination.

**Table 4. Herbicides carrying label statements about groundwater contamination**

Trade name	Common name	Trade name	Common name
2,4-D Amine (many)	2,4-D Amine	Keystone, Keystone LA	acetochlor + atrazine
AAtrex, Atrazine	atrazine	Krovar	bromacil + diuron
Authority MTZ	sufentrazone + metribuzin	Laddok S-12	atrazine + bentazon
Balance Pro	isoxaflutole	Lightning	imazethapyr + imazapyr
Banvel	dicamba	Lumax, Lexar	S-metolachlor + atrazine + mesotrione
Basagran	bentazon	Marksman	dicamba + atrazine
Bicep II Magnum, Bicep Lite II Magnum	S-metolachlor + atrazine	Micro-Tech	alachlor
Boundary	S-metolachlor + metribuzin	Northstar	primisulfuron + dicamba
Breakfree	acetochlor	Outlook	dimethenamid-P
Breakfree ATZ	acetochlor + atrazine	Paramount	quinclorac
Buctril + atrazine	bromoxynil + atrazine	Pathway	picloram + 2,4-D
Camix	S-metolachlor + mesotrione	Prefix	S-metolachlor + fomesafen
Celebrity Plus	nicosulfuron + dicamba + diflufenzopyr	Princep	simazine
Clarity	dicamba	Python	flumetsulam
Define	flufenacet	Radius	flufenacet + isoxaflutole
Degree	acetochlor	Sencor	metribuzin
Degree Xtra	acetochlor + atrazine	Sequence	S-metolachlor + glyphosate
Distinct, Status	dicamba + diflufenzopyr	Shotgun	atrazine + 2,4-D
Dual II Magnum	S-metolachlor	Sim-Trol	simazine
Expert	S-metolachlor + atrazine + glyphosate	Sonic, Authority First	cloransulam + sulfentrazone
FieldMaster	acetochlor + atrazine + glyphosate	Spartan	sulfentrazone
FirstRate	cloransulam	Spirit	primisulfuron + prosulfuron
FulTime	acetochlor + atrazine	Steadfast ATZ	nicosulfuron + rimsulfuron + atrazine
G-Max Lite, Guardsman Max	dimethenamid-P + atrazine	Stinger	clopyralid
Halex GT	S-metolachlor + glyphosate + mesotrione	Storm	bentazon + acifluorfen
Harness	acetochlor	SureStart	acetochlor + flumetsulam + clopyralid
Harness Xtra	acetochlor + atrazine	Surpass	acetochlor
Hornet WDG	flumetsulam + clopyralid	TopNotch	acetochlor
Hyvar X, XL	bromacil	Tordon 101	acetochlor
IntRRo	alachlor	Tordon K	picloram + 2,4-D
		Tordon RTU	picloram
		Ultra Blazer	picloram + 2,4-D
		Yukon	acifluorfen

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