

Other Herbicides

Many herbicides are now available for use in agriculture and for lawn and garden weed control. This chapter discusses herbicides other than the chlorophenoxy, nitrophenols and chlorophenols, arsenicals, and dipyridyls, which are the subjects of separate chapters. Many modern herbicides kill weeds selectively by impairing metabolic processes that are unique to plant life. For this reason, their systemic toxicities in mammals are generally low. Nonetheless, some herbicides pose a significant risk of poisoning if handled carelessly, and many are irritating to eyes, skin, and mucous membranes.

For several good reasons, all of the herbicides mentioned in this chapter should be handled and applied only with full attention to safety measures that minimize personal contact. Many formulations contain adjuvants (stabilizers, penetrants, surfactants) that may have significant irritating and toxic effects. A number of premixed formulations contain two or more active ingredients; the companion pesticides may be more toxic than the principal herbicide. Good hygienic practice should not be disregarded just because a pesticide is reported to have a high LD_{50} in laboratory rodents.

Health professionals who may need to assess the consequences of prior exposure should understand the fate of these compounds after absorption by humans. The water-soluble herbicides are not retained in body tissues for long periods, as were the old lipophilic organochlorine insecticides, such as DDT. Most are excreted, mainly in the urine, within one to four days.

Toxicology

The table on the following pages lists the more commonly used herbicides not discussed elsewhere in this manual. The rat acute oral LD_{50} is given as a rough index of potential lethal toxicity. (If several values are reported by various sources, the lowest is recorded here.) The adverse effect information is drawn from many sources, including product labels, textbooks, published case histories, and some unpublished reports. The listing cannot be considered inclusive, either of herbicide products or of effects.

TOXICITY OF COMMON HERBICIDES

Chemical Class	Generic Name	Proprietary Names	Acute Oral LD ₅₀ mg/kg	Known or Suspected Adverse Effects
Acetamides	metolachlor	Dual, Pennant, others	2,780	Irritating to eyes and skin.
Aliphatic acids	trichloroacetic acid	TCA	5,000	Irritating to skin, eyes, and respiratory tract.
	dichloropropionic acid (dalapon)	Dalapon, Revenge	970	
Anilides	alachlor	Lasso, Alanox	1,800	Mild irritant.
	propachlor	Ramrod, Bexton, Prolex	710	Dermal irritant and sensitizer.
	propanil	DPA, Chem Rice, Propanex, Riselect, Stam, Stampede	>2,500	Irritating to skin, eyes, and respiratory tract.
Benzamide	pronamide	Kerb, Rapier	8,350	Moderately irritating to eyes
Benzoic, anisic acid derivatives	trichlorobenzoic acid	TCBA, Tribac, 2,3,6-TBA	1,500	Moderately irritating to skin and respiratory tract.
	dicamba	Banvel	2,700	
Benzonitriles	dichlobenil	Casoron, Dyclomec, Barrier	>4,460	Minimal toxic, irritant effects
Benzothiadiazinone dioxide	bentazone	Basagran	>1,000	Irritating to eyes and respiratory tract.
Carbamates and Thiocarbamates (herbicidal)	asulam	Asulox	>5,000	Some are irritating to eyes, skin, and respiratory tract, particularly in concentrated form. Some may be weak inhibitors of cholinesterase.
	terbucarb	Azac, Azar	>34,000	
	butylate	Sutan	3,500	
	cycloate	Ro-Neet	2,000	
	pebulate	Tillam, PEBC	921	
	vernolate	Vernam	1,800	
	EPTC	Eptam, Eradicane	1,630	
	diallate	Di-allate	395	
	triallate	Far-go	1,675	
thiobencarb	Bolero, Saturn	1,300		

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Chemical Class	Generic Name	Proprietary Names	Acute Oral LD ₅₀ mg/kg	Known or Suspected Adverse Effects
Carbanilates	chlorpropham	Sprout-Nip Chloro-IPC	3,800	Skin irritants. May generate methemoglobin at high dosage.
Chloropyridinyl	triclopyr	Garlon, Turflon	630	Irritating to skin and eyes.
Cyclohexenone derivative	sethoxydim	Poast	3,125	Irritating to skin and eyes.
Dinitroamino-benzene derivative	butralin	Amex Tamex	12,600 >5,000	May be moderately irritating. These herbicides do not uncouple oxidative phosphorylation or generate methemoglobin.
	pendimethalin	Prowl, Stomp, Accotab, Herbodox, Go-Go-San, Wax Up	2,250	
	oryzalin	Surflan, Dirimal	>10,000	
Fluorodinitro-toluidine compounds	benfluralin	Benefin, Balan, Balfin, Quilan	>10,000	May be mildly irritating. These herbicides do not uncouple oxidative phosphorylation or generate methemoglobin.
	dinitramine	Cobex	3,000	
	ethalfuralin	Sonalan	>10,000	
	fluchloralin	Basalin	1,550	
	profluralin	Tolban	1,808	
	trifluralin	Treflan	>10,000	
Isoxazolidinone	clomazone	Command	1,369	May be moderately irritating.
Nicotinic acid isopropylamine derivative	imazapyr	Arsenal	>5,000	Irritating to eyes and skin. Does not contain arsenic.
Oxadiazolinone	oxadiazon	Ronstar	>3,500	Minimal toxic and irritant effects.
Phosphonates	glyphosate	Roundup, Glyfonox	4,300	Irritating to eyes, skin, and upper respiratory tract.
	fosamine ammonium	Krenite	>5,000	Irritating to eyes, skin, and upper respiratory tract.

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Chemical Class	Generic Name	Proprietary Names	Acute Oral LD ₅₀ mg/kg	Known or Suspected Adverse Effects
Phthalates	chlorthaldimethyl	Dachthal, DCPA	>10,000	Moderately irritating to eyes.
	endothall	Aquathol	51	Free acid is highly toxic. Irritating to skin, eyes and respiratory tract. See Chapter 18.
Picolinic acid compound	picloram	Tordon, Pinene	8,200	Irritating to skin, eyes, and respiratory tract. Low systemic toxicity.
Triazines	ametryn	Ametrex, Evik, Gesapax	1,750	Systemic toxicity is unlikely unless large amounts have been ingested. Some triazines are moderately irritating to the eyes, skin, and respiratory tract.
	atrazine	Aatrex, Atranex, Crisazina	1,780	
	cyanazine	Bladex, Fortrol	288	
	desmetryn	Semeron	1,390	
	metribuzin	Sencor, Lexone, Sencoral, Sencorex	1,100	
	prometryn	Caparol, Gesagard, Prometrex	5,235	
	propazine	Milo-Pro, Primatol, Prozinex	>7,000	
	simazine	Gesatop, Princep, Caliber 90	>5,000	
	terbuthylazine	Gardoprim, Primatol M	2,000	
	tertutryn	Ternit, Prebane, Terbutrex	2,500	
prometon	Gesafram 50	2,980	This particular formulation of prometon is strongly irritating to eyes, skin, and respiratory tract.	
	Pramitol 25E			
Triazole	amitrole, aminotriazole	Amerol, Azolan, Azole, Weedazol	>10,000	Minimal systemic toxicity. Slight irritant effect.

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Chemical Class	Generic Name	Proprietary Names	Acute Oral LD₅₀ mg/kg	Known or Suspected Adverse Effects
Uracils	bromacil	Hyvar	5,200	Irritant to skin, eyes, and respiratory tract. Moderately irritating.
	lenacil	Venzar	>11,000	
	terabacil	Sinbar	>5,000	
Urea derivatives	chlorimuron ethyl	Classic	>4,000	Systemic toxicity is unlikely unless large amounts have been ingested. Many substituted ureas are irritating to eyes, skin, and mucous membranes.
	chlorotoluron	Dicuran, Tolurex	>10,000	
	diuron	Cekiuron, Crisuron, Dailon, Direx, Diurex, Diuron, Karmex, Unidron, Vonduron	>5,000	
	flumeturon	Cotoran, cottonex	8,900	
	isoproturon	Alon, Arelon, IP50, Tolkan	1,826	
	linuron	Afalon, Linex, Linorox, Linurex, Lorox, Sarclex	1,500	
	methabenzthiazuron	Tribunil	5,000	
	metobromuron	Pattonex	2,000	
	metoxuron	Deftor, Dosaflo, Purivel, Sulerex	3,200	
	monolinuron	Aresin	2,100	
	monuron	Monuron	3,600	
	neburon	Granurex, Neburex	>11,000	
	siduron	Tupersan	>7,500	
	sulfemeturon-methyl	Oust	>5,000	
tebuthiuron	Spike, Tebusan	644		

Confirmation of Poisoning

Although there are analytical methods for residues of many of the herbicides mentioned in this chapter and for some of the mammalian metabolites generated from them, these procedures are not generally available to confirm human absorption of the chemicals. Exposure must be determined from a recent history of occupational contact or accidental or deliberate ingestion.

Treatment

1. Skin decontamination. Skin contamination should be treated promptly by washing with soap and water. Contamination of the eyes should be treated immediately by prolonged flushing of the eyes with large amounts of clean water. If dermal or ocular irritation persists, medical attention should be obtained without delay. See Chapter 2.

2. Gastrointestinal decontamination. Ingestions of these herbicides are likely to be followed by vomiting and diarrhea due to their irritant properties. Management depends on: (1) the best estimate of the quantity ingested, (2) time elapsed since ingestion, and (3) the clinical status of the subject.

Activated charcoal is probably effective in limiting irritant effects and reducing absorption of most or all of these herbicides. Aluminum hydroxide antacids may be useful in neutralizing the irritant actions of more acidic agents. Sorbitol should be given to induce catharsis if bowel sounds are present and if spontaneous diarrhea has not already commenced. Dehydration and electrolyte disturbances may be severe enough to require oral or intravenous fluids.

There are no specific antidotes for poisoning by these herbicides. In the case of suicidal ingestions, particularly, the possibility must always be kept in mind that multiple toxic substances may have been swallowed.

If large amounts of herbicide have been ingested and the patient is seen within an hour of the ingestion, gastrointestinal decontamination should be considered, as outlined in Chapter 2.

If the amount of ingested herbicides was small, if effective emesis has already occurred, or if treatment is delayed, administer activated charcoal and sorbitol by mouth.

3. Intravenous fluids. If serious dehydration and electrolyte depletion have occurred as a result of vomiting and diarrhea, monitor blood electrolytes and fluid balance and administer intravenous infusions of glucose, normal saline, Ringer's solution, or Ringer's lactate to restore extracellular fluid volume and electrolytes. Follow this with oral nutrients as soon as fluids can be retained.

4. Supportive measures are ordinarily sufficient for successful management of excessive exposures to these herbicides (endothall is an exception—see Chapter 18, p. 187). If the patient's condition deteriorates in spite of good supportive care, the operation of an alternative or additional toxicant should be suspected.