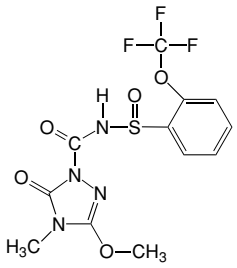
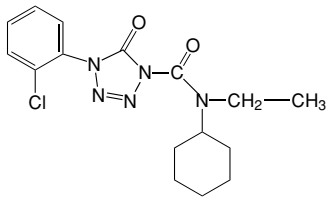
FLUCARBAZONE (Everest®)



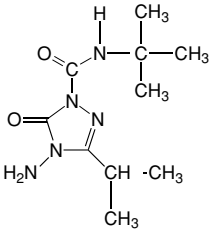
4,5-dihydro-3-methoxy-4-methyl-5-oxo-*N*-[2-(trifluoromethoxy)phenylsulfonyl]-1*H*-1,2,4-triazole-1-carboxamide

FENTRAZAMIDE (Lecs®)



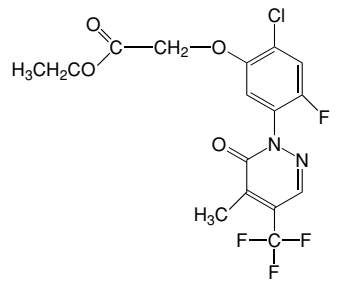
4-(2-chlorophenyl)-*N*-cyclohexyl-*N*-ethyl-4,5-dihydro-5-oxo-1*H*-tetrazole-1-carboxamide

AMICARBAZONE (Dinamic®)



4-amino-*N*-*tert*-butyl-4,5-dihydro-3-isopropyl-5-oxo-1*H*-1,2,4-triazole-1-carboxamide

FLUFENPYR-ETHYL (Axiom®)



acetic acid,[2-chloro-4-fluoro-5-[5-methyl-6-oxo-4-(trifluromethyl)-1(6*H*)-pyridazingyl]phenoxy]-ethylester

Sulfonylamino-carbonyl-triazolinones: The two new entrants in this class are flucarbazone (Everest®) and propoxycarbazone (Attribute®, Olympus®) each of which exist as sodium salts. Each of these products are used in small grains to control grassy annual and some broadleaf weeds. Flucarbazone is registered on wheat in Canada and the U.S. Both products are inhibitors of acetolactate synthetase like the sulfonylureas.

Tetrazolinones: Fentrazamide (Lecs®) is structurally reminiscent of the amide and chloroacetamid herbicides and is the only member of this class. It is a low toxicity material which is used to control barnyardgrass and annual sedges in rice in Japan and Korea. Like many of the amide and chloroacetamides it acts by inhibiting very long chain fatty acid synthesis.

Triazolinones: Amicarbazone (Dinamic®) is used to control broadleaf weeds in corn and soybeans and perhaps sugarcane outside the U.S. It is an inhibitor of photosystem II.

Unclassified or Miscellaneous: Three herbicides have recently appeared that do not fit any particular established structural class. These are flufenpyr-ethyl (Axiom®), oxaziclomefone (Homerun®, Patful®) and benzobicyclon (Showace®). Flufenpyr-ethyl is in development for use on potatoes and wheat. It is a PPO inhibitor. Oxoziclomefone and benzobicyclon are both for use on rice in Japan. Their modes of action are not yet known.

Soaps

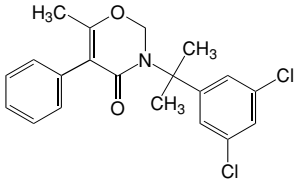
The principal value of soaps is in their capacity to reduce the surface tension of water, thus causing the guard cells surrounding the stomata to collapse. These in turn close or clog the stomata, the oxygen:carbon dioxide-exchange organs of the plants, causing death to the surrounding cells.

Soaps are the alkali salts of fatty acids. Both soft soaps (potassium salts) and the hard soaps (sodium salts) are water soluble, but only the soft soaps are herbicidal. Overall, the most efficacious fatty acid salts are those near the carbon chain length of lauric acid (C_{12}), which include caproic (C_{10}), myristic (C_{14}), palmitic (C_{16}) and stearic acids (C_{18}). Thus the *molecular formula* of lauric acid potassium soap (potassium laurate) would be:

$$C_{11}H_{23}COOK$$

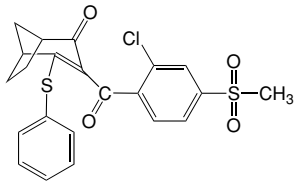
In the late-1980s the first soft soap herbicides were registered. The two major manufacturers are the Ringer Corporation, which produces Safer® Moss & Algae Killer, and the Mycogen Corporation, which produces DeMoss® Moss/Algaecide, and Sharpshooter® Herbicide, all aimed primarily toward the home yard and turf market.

OXAZICLOMEFONE (Homerun®, Patful®)



3-[1-(3.5-dichlorophenyl)-1-methylethyl]-3,4-dihydro-6-methyl-5-phenyl-2*H*-1,3-oxazin-4-one

BENZOBICYCLON (Showace®)



3-(2-chloro-4-mesylbenzoyl)-2-phenylthiobicyclo[3.2.1]oct-2-en-4-one

Petroleum Oils

The earliest organic herbicides were the petroleum oils, which are a complex mixture of long-chain hydrocarbons. They include alkanes, alkenes and often alicyclics and aromatics, produced by distillation and refinement of crude oils. The petroleum oils exert their lethal effect by penetrating and disrupting plasma membranes, which is enhanced by temperature and direct sunlight. Because of EPA's and many local and state governments' regulations to halt the release of hydrocarbons into the atmosphere, petroleum oils are no longer prominently used as herbicides though they are sometimes used as adjuvants in herbicide formulations.

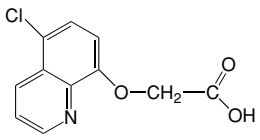
Herbicide Safeners

It has been known for many years that mixing certain substances with herbicides before application will impart a protective or safening effect on selected crops without substantively affecting weed control. Few were widely used before the last decade or so, however, in recent years the search for such substances has increased as producers have sought incremental performance and market advantages for their products.

Herbicide safeners are a rather diverse collection of compounds and many, though not all, appear to impart their effects by enhancing the metabolism of the herbicide by the monocotyledonous crops on which the herbicide is used. A general review of such compounds is beyond the scope of this book. We will, however, mention a few prominent representatives.

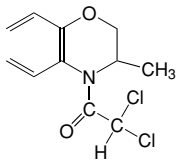
Cloquintocet-mexyl is used with clodinafop-propargyl in Discover® Herbicide to safen the active ingredient on wheat. This safener/herbicide combination was first registered in the U.S. in 2000. Benoxacor, registered in 1997, increased the tolerance of s-metolachlor (and metolachlor) to corn. Dichlormid increases corn tolerance to thiocarbamate herbicides. Fenchlorazole-ethyl synergizes the activity of fenoxyprop-ethyl in susceptible species including wheat where the main action is to reduce phytotoxicity and growth retardation. Similarly, mefenpyr-diethyl safens fenoxyprop-P-ethyl in small grains. Fluxofenim and oxabetrinil both safen sorghum from metolachlor injury when applied as a seed treatment, particularly when metolachlor is used in combination with a triazine herbicide. Furilazole is a herbicide safener designed for a wide range of herbicides on cereals, corn and rice. Finally, isoxadifen-ethyl, a safener for corn, appeared in 2002.

CLOQUINTOCET-MEXYL



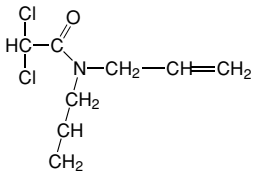
(5-chloroquinolin-8-yloxy)acetic acid

BENOXACOR



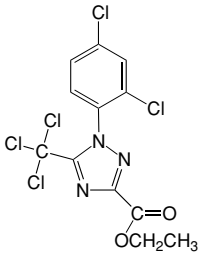
(*RS*)-4-dichloroacetyl-3,4-dihydro-3-methyl-2*H*-1,4-benzoxazine

DICHLORMID



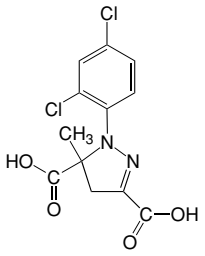
N,*N*-diallyl-2,2-dichloroacetamide 1-methylhexyl (5-chloroquinolin-8-yloxy)acetic acid

FENCHLORAZOLE-ETHYL



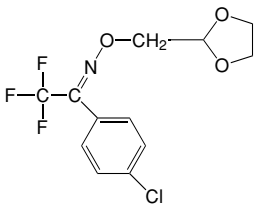
ethyl 1-(2,4-dichlorophenyl)-5-(trichloromethyl)-1*H*-1,2,4-triazole-3-carboxylate

MEFENPYR-DIETHYL



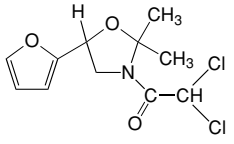
(*RS*)-1-(2,4-dichlorophenyl)-5-methyl-2-pyrazoline-3,5-dicarboxylic acid

FLUXOFENIM



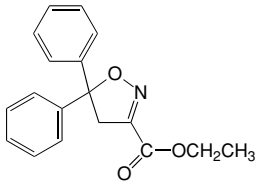
4'-chloro-2,2,2-trifluoroacetophenone *O*-1.3-dioxolan-2-ylmethyloxime

FURILAZOLE



(*RS*)-3-dichloroacetyl-5-(2-furanyl)-2,2-dimethyloxazolidine

ISOXADIFEN-ETHYL



ethyl 4,5-dihydro-5,5-diphenyl-1,2-oxazole-3-carboxylate