



## CLASSIFYING FUNGICIDES BY CHEMICAL GROUPS

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Have you ever wondered whether there is any systematic way of fitting various fungicides into categories that would be helpful in seeing their relationships, and helping to keep track of them? In other words, is there a "taxonomy" for them?

The answer is "Yes, there is!" Like any other taxonomic system, not everyone agrees with any one classification. Also, the language of the chemists is foreign to most of us, and sometimes they find several ways to describe the same compound.

The classification I've indicated below is one we use in class on the campus. While it is somewhat arbitrary, it provides a skeleton upon which the flesh of fungicides can be attached and studied. It tells you, among other things, which ones are inorganic or organic, and of the latter, which have primarily systemic or non-systemic properties to them. They also happen to be organized more or less according to their date of origin. As a turf person, you might find it interesting to see which groups have one or more prod-

ucts important to you. And the outline provides a point of discussion about several of the chemicals, a topic I plan to come back to in succeeding articles. At that time, we'll discuss the strengths and problems with the various groups, thinking particularly about such issues as their current registration, re-registration problems, possible environmental and toxicological concerns, and other important pieces of information about them.

### A classification of fungicides

#### Inorganic compounds:

1. Sulfur
2. Copper
3. Mercury, inorganic (Organic mercuries including alkyl formulation, such as Ceresan and Panogen, and phenyl mercury compounds)
4. Cadmium, chromium and other heavy metals

#### Organic compounds that act primarily as protectants, or surface compounds:

1. Dithiocarbamates
  - a. dimethyldithiocarbamates, as thiram, ferbam, ziram and metam-sodium (Vapam)
  - b. ethylenebisdithiocarbamates (EBDC's), as zineb, maneb, mancozeb and metiram (Polyram)
2. Dicarboximides (sulfenimides), ad captan, folpet (Phaltan), and captafol (Difolatan)
3. Substituted aromatics, as hexachlorobenzene, pentachlorophenol (PCP, Penta), pentachloronitrobenzene (PCNB, Terraclor), chlorothalonil (Bravo, Daconil), dicloran (Botran)
4. Dinitrophenols, as dinocap (Karathane)
5. Quinones, as dichlone
6. Aliphatic nitrogens as dodine (Cyprex)
7. Triazines, as anilazine (Dyrene)
8. Thiazoles, as ethazole (Terrazole, Truban, Koban) and TCMTB (Busan-72)
9. Organotin, as fentin hydroxide (Du-Ter)
10. Antibiotics, as cycloheximide (Antidione) and strep-

#### tomycin (Agri-strep)

11. Fumigants, as chloropicrin, methyl bromide, and methylisothiocyanate (Vorlex)
12. Organic acids, as propionic, phosphoric and other acids
13. Other

#### Systemic fungicides

1. Oxathiins, as carboxin (Vitavax) and oxycarboxin (Plantvax)
2. Benzimidazoles, as benomyl (Benlate, Tersan 1991), thiabendazole (Mertect, Arbotect), ethyl thiophanate (Cleary's 3336) and methyl thiophanate (Topsin M, Fungo 50)
3. Demethylation inhibitors (Ergosterol biosynthesis inhibitors) ("sterol inhibitors")
  - a. Pyrimidines, as ethirimol (Milcurb) and fenarimol (Rubigan)
  - b. Triazoles, as triademefon (Bayleton, Tilt, Banner)
  - c. Piperazine, as triforine (Funginex)
  - d. imidazoles, as imazalil and prochloraz
  - e. Morpholine, as dodemorph (Milban) (several others not yet registered)
4. Phenylamides (acylinines), as metalaxyl (Subdue, Ridomil, Apron)
5. Imides ("new" dicarboximides), as iprodione (Rovral, Chipco 26019), vinclozolin (Ronilan, Vorlan, Ornalin), and procymidone
6. Forestyl AI (Aliette)