

Garden Chemicals and Their Application

A **fungicide** is a substance that destroys or inhibits the growth of fungi. It may be an **eradicant**, applied to a plant, plant part, or the environment as a curative treatment to destroy fungi established within a given area or plant; or preferably it may be a **protectant**, applied to protect a plant or plant part from infection by killing, or inhibiting the development of, fungal spores of mycelium that may arrive at the infection court. A **bactericide** is a substance that destroys or inhibits bacteria and nematicide for nematodes. Among the more recent bactericides are antibiotics, products of other living organisms. They also have value against certain fungi. There are few **virocides**, which are toxic or poisonous to viruses.

A **pesticide** is any chemical that is used to kill pests, especially insects and rodents.

An **insecticide** is an agent used to kill insects.

A **disinfectant** is an agent that frees a plant or plant part from infection by destroying the pathogen established within it. A disinfectant kills or inactivates organisms present on the surface of the plant or plant part or in the immediate environment. Chemicals for seed treatment can be either eradicants or protectants, but most of them are disinfectants, in that they kill organisms on the surface of the seed rather than those within. In common usage, however, they are called disinfectants.

A **nematicide** is, of course, a chemical that kills nematodes in the soil or in the plant. Most nematicides are **fumigants**, chemical toxicants that act in volatile form.

Not so long ago the chemicals on the garden medicine shelf consisted of copper and sulfur for protectants, lime sulfur as an eradicant, mercuric chloride as a disinfectant, and formalin and carbon bisulfide as fumigants. You sometimes got plant injury; you did not always get the best

possible control, but at least you did not have to be an organic chemist. Now we have the following classes of fungicides:

Inorganic	Organic
Sulfur	Dithiocarbamates
Copper	Thiazoles
Salts	Triazines
	Substituted
	Aromatics
	Dicarboximides
	Dinitrophenols
	Quinones
	Antibiotics
	Organotins
	Aliphatic
	Nitrogens
	Benzimidazoles
	Sterol Inhibitors
	Strobilurins

The search for new fungicides goes on, with hundreds of synthetic organic compounds being screened each year. This screening is often a cooperative venture between manufacturers, state experiment stations, and the U.S. Department of Agriculture. After safety precautions for the operator and the environment, and the effectiveness of a compound for certain diseases have been determined, the chief question is whether the material is **phytotoxic**, that is, injurious to plants, at concentrations required for control. Phytotoxicity is an elusive factor, not to be pinned down in a few tests. It varies not only with the kind of plant but with the particular variety, the amount of moisture in the soil when the spray is applied, the temperature, whether or not the application is followed by rain or high humidity, the section of the country, and the compatibility of the chemical with spreaders or wetting agents, as well as with other fungicides or insecticides. Coordinated tests with new materials in many different states are extremely valuable. Some compounds give rather uniform results over the country; others vary widely with climatic conditions.

The 1947 Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) provides that all fungicides must be registered with the U.S. Department of Agriculture before being marketed. Materials highly toxic to humans must be prominently marked, instructions given for avoiding injury to plants or animals, the toxicant chemical named, and the percentage of active and inactive ingredients given. All labels submitted for registration must be accompanied by proof that the claims for performance are valid.

In 1954, Public Law 518, known as the Miller Bill, was passed, providing for tolerances. A tolerance is the legal limit of a poisonous residue, expressed in parts per million (ppm), that may remain on an edible product at the time it is distributed for consumption. In 1958, The Food Additives Amendment was passed, which also controls pesticides residues in processed foods. It included the Delaney clause, which states that any chemical found to be a carcinogen in laboratory animals may not appear in a human food, a zero tolerance. In 1959, the FIFRA was amended to include nematicides, plant growth regulators,

defoliant, and desiccants as pesticides. Since that time, poisons and repellents used against all classes of animals (from invertebrates to mammals) have been brought into the approval process.

FIFRA was further amended in 1972 as the Federal Environmental Pesticide Control Act (FEPCA), making violations by growers, applicators, or dealers subject to heavy fines and/or imprisonment. All pesticides had been classified into either general-use or restricted-use categories by October 1977, with anyone applying restricted pesticides required to be state-certified. Pesticide manufacturing plants are to be registered and government-inspected. All pesticide products must be registered whether shipped in interstate or intrastate commerce. Other provisions are of various degrees of importance to concerned persons or companies.

Additional modifications were made in FIFRA in 1989. The modifications specifically will (1) accelerate re-registration of older pesticides (those registered prior to November 1984) and impose fees on chemical manufacturers for re-registration; (2) essentially eliminate indemnification payments to those holding inventories of suspended or canceled pesticides, except farmers and certain end users; and (3) shift part of the burden for storage and disposal of banned pesticides from the government to the manufacturer. The 1989 FIFRA also empowers the Environmental Protection Agency (EPA) to change regulations on how applicators handle, rinse, and dispose of pesticide containers. The Worker Protection Standard (WPS), passed in 1992, required labels to carry re-entry intervals (REI) and personal protection equipment for certain end-uses. Labels having both WPS and non-WPS uses are required to have recommendation for PPE and REI for both categories.

In 1996, the Food Quality Protection Act (FQPA) was passed, requiring a 10 year review process of all currently registered pesticides based on a risk cap of aggregate exposure, in other words all possible ways people, particularly children, can come into contact with pesticides whether through residues on food or backyard applications. Part of FQPA determined that an acceptable level of risk is a reasonable certainty of no harm, essentially eliminating the Delaney Clause from 1958. The FQPA also provided for accelerated registrations of safer pesticides, such as biological control organisms or active ingredients with the potential for minimal environmental impact.

The federal government considers these to be minimum pesticide regulations. Any state may choose to establish more rigid pesticide regulations within its boundaries than those legislated by the federal government, and some have done so. Some states require notification to be posted prior to commercial pesticide application including chemicals used. Thus, pesticide applicators must be familiar with individual state pesticide regulations as well as federal pesticide regulations.

Consumers, therefore, are well protected against fraud, but they must be willing to read the fine print on labels if they are to choose intelligently from the bewildering array of proprietary compounds on dealers' shelves. In the following pages there are lists of available products, cross-referenced by product name and the common name of active ingredients. In many cases, several product names may exist for the same active ingredient; those readily available to consumers may not be listed so pay particular attention to

the name of the active ingredient present on the available products. Consumers must also read the fine print and follow directions exactly if their homegrown vegetables are to be as safe for consumption as those from commercial growers who have to comply with the law in the matter of residues.

Even if you follow exactly the directions for dosage given on the label, you may have some plant injury under your particular combination of soil, weather, and kinds of plants. Keep a notebook. Put down the date you sprayed, the dosage used, the approximate temperature and humidity, whether it was cloudy or sunny, in a period of drought or prolonged wet weather. Go around later and check for burning; for leaf spotting and defoliation from the spray or from failure to control the disease; for leaf curling or stunting; for too much unsightly residue. Note which varieties can take the spray and which cannot.

The following alphabetical list includes chemicals now commercially available, a few that are rather outmoded but still found in textbooks, a few that were marketed in the past but have now been discontinued, and a few that will probably be marketed before this text is published. By that time there will be many more that should have been included, for the search for better chemicals is unending. There will also be more that will be discontinued. The list presented herein must be considered only as a guide. Exclusive reliance must be placed on directions and information supplied by the manufacturer or by agricultural specialists, agents, or advisors. **Be sure to read the label.** Because so many of the new compounds have long, complex chemical names, they have been given short common names by the American Standards Association. Such common names are listed first in the following listing. Frequently, however, the trade name is used as a common name; trade names are listed in parenthesis following the common names. The Crop Protection Handbook, which is published each year by Meister Publishing Co., 37841 Euclid Ave., Willoughby, OH, 44094, gives an up-to-date listing of pesticides. Vance Publishing publishes the Turf and Ornamental Reference and the Crop Protection Reference (Greenbook).

As always, read and follow label directions carefully. If unsure whether a listed product is registered in your area, contact local, state, and federal authorities.

In the following lists, the common chemical name is given first, in bold, followed by trade names available for professional growers of agricultural, turf and ornamental crops and products available for consumers. Then there is a brief description of target pathogens.