Chapter 6

Classification and Properties of Commercial Insecticides and Acaricides

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In this section, we provide an overview of the different classes of insecticides and acaricides available for pest management programs. These compounds are grouped according to their mechanisms of action and then organized according to their chemical class. Examples of each class are described in greater depth to illustrate the specific properties of members of the class without attempting to be comprehensive in the coverage of all members of the group. As a quick reference, Table 1 at the end of this chapter lists common names of many insecticides, and groups them into their respective chemical families and action mechanisms. This table was prepared by the Insecticide Resistance Action Committee (IRAC), and updates can be found at http://www.irac-online.org.

Certain chemical properties are outlined for these compounds because they provide important information about their biological and environmental behavior. The volatility (measured as vapor pressure) indicates the rate at which a compound may dissipate from surfaces into the ambient air and also whether it is likely to have a vapor phase action in controlling pests.

Water solubility is an important factor governing whether a compound will have systemic action in plants and also its ability to leach down through soils to reach groundwater. The logP value is the logarithm of the octanol/water partition coefficient. This indicates the preference of the compound for oily (lipid) environments compared with water. A logP value of 0 indicates an equal preference for oily and watery phases. Higher values indicate a greater preference for lipid and such compounds would be termed lipophilic. Values <0, which are rare among insecticides, indicate a preference for water. This value governs such factors as the rate of uptake from water by aquatic species, the distribution and retention within the body of living organisms, and the strength of binding to soil colloids such as clays and organic matter that influence the probability of leaching to groundwater and of entering surface runoff attached to soil colloid. Susceptibility to hydrolysis and photodegradation greatly affect the general stability in the environment and also the persistence and length of effective control on the leaf surface.

The Chemical Abstracts Registry Number (CAS RN) is provided as a widely accepted and compound-specific indicator for literature searching. We have provided only general details about biochemical mechanisms of action because these are covered in greater detail in chapter 5.

In addition to text descriptions of the various chemical families, we also provide color-coded figures of selected molecules to give the reader a visual translation of chemical nomenclature with the chemical structure and highlighted features of the insecticide molecule as described in the text. For example, Fig. 4 describes the indeno–oxadiazine insecticide family, with the representative molecule being indoxacarb. In the aforementioned figure the phrase "indeno" is colored red, which matches the red portion (moiety) of indoxacarb, known as an indene; whereas the phrase "oxadiazine" is colored blue, which in turn matches the blue moiety of indoxacarb, which is an oxadiazine group.

Neurotoxic Insecticides

Voltage-Dependent Sodium Channels—Activators and Blockers

Two groups of compounds affect voltage-dependent sodium channels, the pyrethroids and the oxadiazines. Though attacking the same general target, they act at different sites in different ways and thus do not have a common site of action, which is significant for purposes of resistance management. Some chlorinated hydrocarbons such as DDT and methoxychlor also act on these channels in a way that is indistinguishable from the pyrethroids. This explains the site of action-related cross-resistance between DDT and pyrethroids that is often observed. However, these organochlorine compounds have little continuing use in the United States and are not discussed further here.

Pyrethroids. The pyrethroids have a long and distinguished history. The forerunners of the class are the pyrethrins, natural compounds produced by a chrysanthemum-like plant *Tanacetum* (previously *Chrysanthemum* and *Pyrethrum) cinerariaefolium*. Crude preparations from the flowers have been used to control insects for many centuries, probably first in China. Powdered flowers, and more refined pyrethrum extracts, are still used today, particu-