Chapter 1

GENERAL INFORMATION

Pesticides can be grouped in a number of ways; by mode of action, by target pest or by chemical family. The **General Information** chapter in the **Applicator Core Manual** gives additional information on grouping by target pest and mode of action.

Pesticides are often complex chemical formulations. They are built around a number of core chemical structures or building blocks. Chemists have grouped these core structures into chemical families. Pesticides in the same chemical family often have similar properties (e.g., poisoning symptoms, persistence in the environment). Knowing the chemical family provides an idea of the health and environmental risks. This helps you to make sound decisions and choose the least hazardous pesticide. Knowing the family also helps you to choose the proper personal protective equipment and identify needed safeguards to protect the environment.

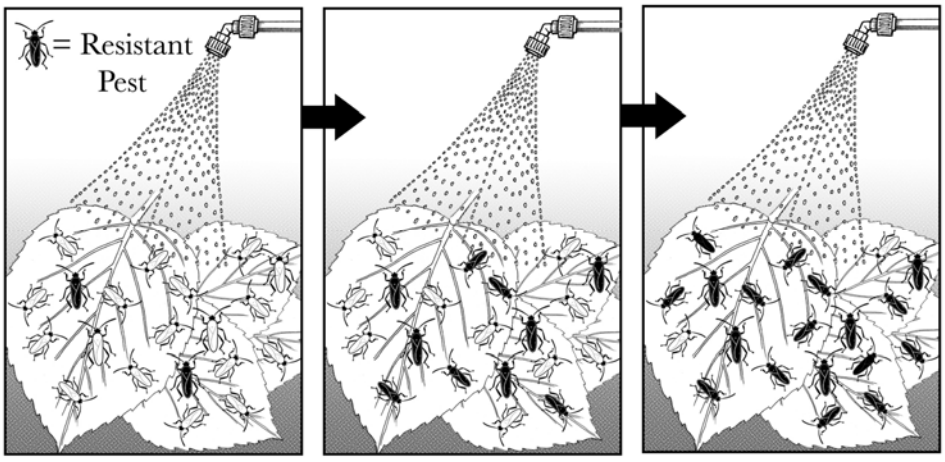

Figure 1-1: Pest resistance increases with repeated exposure to products from the same chemical family.

Pesticides in the same family are likely to control pests in the same way. Repeated use of pesticides that control pests in the same way increases the risk of pesticide resistance. For example, repeated use of an insecticide in one chemical family can speed insect resistance to other insecticides in the same family. Using pesticides from more than one chemical family reduces risk of pesticide resistance developing. This extends the useful life of each product. When pesticides are used in an Integrated Pest Management (IPM) program, care is taken to alternate pesticides of different chemical families.

Pesticide applicators must know which chemical family a given pesticide belongs to. This chapter looks at how a number of chemical families of pesticides are used in the landscape industry.

Learning Objectives

Completing this chapter will help you to:

- **Know the properties of chemical families used in the landscape industry**
- **Make informed choices to manage health and environmental risks.**

Chemical Families

Most pesticide active ingredients are either inorganic or organic carbon-based. Inorganic pesticides do not contain carbon and are often derived from mineral ores (copper, sulphur) or their salts (e.g., copper sulphate, sodium chlorate, ferrous sulphate). Most pesticides that have carbon in their chemical structure are made from petroleum-based compounds. Pesticides made from plants are called "botanicals" or "botanical pesticides".

Organic carbon-based pesticides are grouped into families with similar molecular structures. Products in the same chemical family often have similar first aid, clean-up, and safe handling procedures. Pesticides within a group often have similar properties and modes of action in controlling pests.

The most common pesticide groups used for pest control in the landscape industry are given in **Tables 1-1**., **1- 2 and 1-3.**

Herbicides

Table 1-1: List of herbicides within the various chemical families.

Chemical Family	*Common Name*
Benzoic Acid	dicamba
Bipyridylium	diquat, paraquat
Piclorinic Acid	triclopyr, picloram
Phenoxy	2,4-D, 2,4-DB 2,4-D + diclorprop, MCPA, MCPB + MCPA
Thiocarbamates (Carbamates)	triallate, EPTAC, butylate
Triazines	atrazine, metribuzin, hexazinone, simazine
Ureas	linuron, diuron, tebuthiuron
Miscellaneaous	glyphosate, difenzoquat

Insecticides

Table 1-2: List of insecticides within the various chemical families.

Chemical Family	*Common Name*
Carbamates	aldicarb, carbaryl, methomyl, pirimicarb
Petroleum-based products	dormant oils
Organophoshates	azinphos-methyl, diazinon, dimethoate, malathion, methamidaphos, methidathion, trichlorfon
Organochlorines	chlorpyrifos, endosulfan
Pyrethroids	cypermethrin, deltamethrin, permethrin

Fungicides

Table 1-3: List of fungicides within the various chemical families.

Chemical Family	*Common Name*
Dithiocarbamates (Carbamates)	maneb, mancozeb, thiophanate-methyl, metiram, propamocarb, chlorothalonil, thiram
Dicarboximides	iprodione and vinclozolin.
Benzimidazoles	benomyl

Herbicide Families

Common herbicide families/groups used in the landscape include:

- **Synthetic Auxins -** These herbicides are plant growth regulators. They interfere with growth of new stems and leaves. This leads to twisting and malformation in target weeds. The synthetic auxins include:
    - **Phenoxy Herbicides -** Grass species are resistant to this group of herbicides. These selective herbicides are often used in turfgrass to

manage broadleaf weeds. This group includes 2,4-D, MCPA, and mecoprop. They have low to moderate toxicity.

- **Benzoic acid family -** This family includes dicamba. Dicamba is often used to control broadleaf weeds in turf. It is often combined with 2,4-D and MCPA.

- **Phosphate Synthesis Inhibitors -** This group of herbicides inhibits the synthesis of an enzyme in the phosphate production cycle. The herbicide glyphosate is included in this group. Glyphosate is used to control both broadleaf and grass weeds.

- **Bipyridylium Herbicides -** Bipyridylium herbicides are the most toxic herbicides used in landscape applications. They can irritate the skin and mucous membranes in the eyes, mouth, and lungs. Examples include diquat and paraquat.

Insecticide Families

Common insecticide families/groups used in the landscape include:

- **Organophosphates (OPs) -** Organophosphate insecticides act by inhibiting the cholinesterase enzyme. This enzyme is used in nerve function. A number of insecticides in this family are used to control a wide range of landscape insect pests. These products tend to have a short persistence in the soil. Common examples are listed in **Table 1-1**. These include phorate, malathion, diazinon, and dimethoate.

- **Carbamates** - The carbamate group includes insecticides, fungicides, and herbicides. Most have a short persistence in the environment. Like organophosphates, carbamate insecticides inhibit cholinesterase. Carbamates have moderate to high toxicity. Common examples include aldicarb, carbaryl, carbofuran, methomyl, and pirimicarb.

- **Petroleum-based Products -** Some petroleum-based products are registered as pesticides (e.g., dormant oils, summer oils). They act by suffocating pests.

- **Botanical Pesticides -** Botanical pesticides are used to control insects, spiders, and mites. They are rapidly degrading contact pesticides. Botanical pesticides (e.g. natural pyrethroids) are derived from plants. Pyrethrum is the most common of the natural pyrethroid group. Pyrethrum is extracted from the flower heads of the chrysanthemum plant. It is a mixture of four compounds with similar chemical structures. These compounds act by

disrupting the nerve impulse as it travels down the nerve cell. If the nerve impulse is disrupted, muscles are quickly paralysed. The manufacturer often adds piperonyl butoxide to increase pesticide effectiveness. Pyrethrum is listed on pesticide product labels as the active ingredient "pyrethrins".

- **Synthetic Botanical Insecticides -** Synthetic pyrethroids (e.g., resmethrin and permethrin) are used as contact or stomach insecticides. They are man-made equivalents of natural pyrethrums. They show similar pesticidal characteristics. Piperonyl butoxide is often added to enhance effectiveness. Applications are made to foliage when pests appear.

- **Microbial Insecticides -** Microbial insecticides are insecticides that have been commercially developed from naturally-occurring microorganisms. Bt *(Bacillus thuringiensis)* is an example. These persticides only act on very specific groups of pests. Correct identification of the pest is necessary to obtain effective control.

Both natural pyrethrins and synthetic pyrethroids are toxic to fish and other aquatic organisms. Care should be taken not to apply these pesticides, or to clean application equipment near bodies of water.

Fungicide Families

Common fungicide families or groups used in the landscape include the following foliar sprays:

- **Dithiocarbamates -** Dithiocarbamate fungicides are non-selective, protectant fungicides. Examples include mancozeb, thiram and metiram (a non-systemic fungicide used for mildew and apple scab).

- **Dicarboximides -** Dicarboximide fungicides are protectants. These pesticides affect fungal cell division and disrupt fungus growth. Examples include iprodione and vinclozolin.

- **Benzimidazoles -** Benzimidazole fungicides are systemic fungicides. These fungicides inhibit tubulin formation (an essential part of fungal growth). Examples include benomyl, thiophanate methyl and thiabendazole.

- **Inorganic Fungicides -** Inorganic fungicides are non-selective, protectant fungicides. Examples include sulphur and copper.

Note: Terms such as protectant, non-selective, systemic and contact pesticides are defined in the **General Information chapter of the Applicator Core Manual.**

Chemical Additives

Common chemical additives found in pesticides used in the landscape industry include:

- Aromatic hydrocarbons
- Petroleum products and distillates
- Polymerized butanes (in sticky pastes)

These materials serve a number of functions. They can help make the pesticide more effective, extend its shelf life, or improve its handling. However, they can also make the formulated pesticide more toxic or flammable than the active ingredient is by itself.

Hazardous chemical additives found in the pesticide formulation are listed on the Material Safety Data Sheet. The label also gives information on any concerns related to chemical additives.

Summary

Pesticides are grouped into families according to chemical structure. Pesticides within the same chemical family often have similar properties. Knowing the chemical family of pesticides allows an applicator to make informed choices on protective clothing. It also allows you to decide what measures are needed to protect the environment. Alternating pesticides from different chemical families reduces the risk of pesticide resistance

Self-test Questions

Answers are provided in Appendix A of this manual.

1. Which chemical families of insecticides are cholinesterase inhibitors?

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2. List two (2) common herbicides in the phenoxy herbicide family.

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3. Which chemical family is derived from plants and what is the most common example?

_____

4. What chemical is often added to pyrethrum to increase its effectiveness?

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5. Both synthetic pyrethroids and natural pyrethrum are derived from flowers. **True or False**?

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