UNIVERSITY OF FLORIDA
EXTENSION
Institute of Food and Agricultural Sciences

Hillsborough County Florida

Hillsborough County
Cooperative Extension Service
5339 County Rd 579
Seffner, Fl., 33584-3334
813-744-5519
Fax 813-744-5776
http://prohort.ifas.ufl.edu/

How Insecticides Work

Dave Palmer - Extension Agent I - Hillsborough Extension Service 03/99

Almost everyone knows that insecticides kill insects. Very few people understand how they work. In slightly scientific terms, how they work is called the "mode of action." Most insecticides affect one of the following biological systems.

The Nervous System - Most traditional insecticides attack the nervous system of insects. There are two main parts of the nervous system: the nerve fibers (also called axons), which carry small electrical impulses, and the synapse, the microscopic gap between nerve fibers. Because each nerve fiber ends at a synapse, the nerve impulse must be carried across the synapse chemically. The pesticides that attack the synapse are called synaptic poisons. The chemicals that attack the nerve fiber itself are called axonic poisons. Some chemicals and classes of chemicals that affect the nervous system of insects (and humans) are:

- Organophosphates (synaptic poison)
- Carbamates (synaptic poison)
- Pyrthroids - synthetic pyrethrins (axonic poison)
- Avermectins (axonic poison)
- Imidacloprid (synaptic poison)
- Fipronil (axonic poison)

Energy Production - These chemicals significantly slow the production of energy that an insect needs to survive. The insects "run out of gas" and can even die standing on their feet. Many new chemicals with this mode of action are under development. Only a few are currently in use. These chemicals come in several "classes" or types:

- Amidinohydrazone
  - Hydramethylnon
    - Amdro® - ant bait
    - Siege Gel Bait® - insect? bait
    - Combat® - insect bait
- Halogenated alkyl sulphonamide
  - Sulfluramid
    - Raid Max® - ant bait
  - Sulfluryl fluoride - fumigant
- Pyrrole
- Thiourea
- Quinazoline

Cuticle Production - Insects wear their skeleton on the outside of their body. It's called an exoskeleton and chitin is a major component of the exoskeleton. Chemicals called chitin synthesis inhibitors, or CSI's, slow or stop the production of chitin. Without chitin, the insect cannot molt (shed it's exoskeleton and re-grow a new one) and will soon die. These chemicals are very target-specific, so they help preserve beneficial insect populations. One type of CSI is:

Benzoyphenyl Urea

Lufenuron (Program®) Used for flea control on pets
Diflubenzuron (Dimilin®) Used against fly larvae in manure
Hexaflumuron (Sentricon®) Used in termite bait stations

Endocrine System - Insect growth regulators, or IGR's, act on the hormone or endocrine system of insects. Juvenile hormones keep insects from molting (shedding their exoskeleton) until the insect reaches the proper state of maturity. IGR's fool the insect's body. They don't allow the insect to molt at the proper time, keeping the insect from maturing and reproducing. IGR's are used in very small amounts and are not very toxic to humans and other mammals. These chemicals are also very target-specific, so they preserve beneficial insect populations. Some of these IGR's are:

hydroprene
methoprene
pyriproxyfen
fenoxycarb

Water Balance - Insects have a thin waxy coating over their exoskeleton to prevent water loss. Diatomaceous earth and Silica aerogels absorb the waxy coating, resulting in rapid water loss and eventual death. Boric acid also disrupts water loss in insects but the exact mechanism is not known.

Boric Acid
Diatomaceous Earth
Silica Aerogels

How Do Insects Become Resistant to Chemicals?

When the same insecticide or related insecticides are used again and again in the same area against the same pest, the pest may become "resistant" to the insecticides. The only way to prevent resistance is to alternate chemicals, that is, rotate between chemicals that are completely unrelated or that have different modes of action. For example, don't switch between **carbamates** and **organophosphates** because these chemical families have similar modes of action. Treat **carbamates** and **organophophates** as a single family and use **botanicals** or **pyrethrins** as your alternate - you can control the pest and reduce the chances that the pest will build resistance. (Sources: *"Managing Resistance: Insecticides" Grounds Maintenance Magazine, Oct. '98,* and *"Pests in and Around the Florida Home" Koehler, Short & Kern, 3rd Ed.,* *University of Florida, 1998, SP-134*)

Pesticide Groups or "Families"

Carbamates
Aldicarb (Temik)
Bendiocarb (Ficam, Turcam)
Carbaryl (Sevin)
Fenoxycarb (Award)
Methomyl
Propoxur
Lindane
Methoxychlor
Pentacholrphenol

Organophospates
Acephate (Orthene, Velocity,Pinpoint)
Azinphos
Chlorpyrifos (Dursban)
Coumaphos
DDVP/Dichlorvo
Diazinon (Diazinon, Evict)
Dimethoate (Cygon)
Disulfoton (Dysiston)
Ethion
Ethoprop (Mocap)
Fenamiphos (Nemicure)
Fenthion
Fonofos
Isofenphos (Oftanol)
Malathion
Methidathion
Methyl Parathion
Mevinphos/Phosdrin
Naled Parathion
Phorate
Phosmet
Propetamphos
Temephos
Terbufos
Trichlorfon (Dylox, Larva-Lur, Grub Control)

(Sources: Extoxnet (Extension Toxicology Network) notebook, 1994)

Chlorinated Hydrocarbons
Chlorodane
Chlorobenzilate
Dienochlor
Dicofol (Kelthane)
Endosulfan
Heptachlor
Lindane

Halogenated Hydrocarbons
Ethylene Dibromide
Methyl Bromide

Pyrethroid
Bifenthrin (Talstar)
Cyfluthrin (Tempo)
Cypermethrin (Demon, Cynoff)
Deltamethrin (DeltaGard)
Lambda-cyhaolthrin (Battle, Scimitar)
Permethrin (Astro, Dragnet, Flee, Prelude, Perm-x)
Pyrethrin (Exciter)
Resmethrin

Botanicals / Biologicals / Others
Allethrin
Bacillus thuringiensis aizawai (bacteria)(Xen Tari)
Bacillus thuringiensis kurstaki (bacteria) (Bt, Dipel, Thuricide)
Beauveria bassiana (fungus) (Naturalis-T)
Boric Acid
Esfenvalerate
Fenvalerate
Fipronil (Chipco Choice)
Fluvalinate
Halofenozide (Mach 2)
Heterorhabditis bacteriophora (Cruiser)
Hydramethylnon (Amdro, Seige)
Imidacloprid (Merit)
Myrothecium verrucaria (DiTerra-WDG)
Potassium salts of fatty acids (M-Pede)
Rotenone
Spinosad (Conserve SC)

To rotate chemicals properly, treat the caramates and organophosphates as ONE family, use no more than twice, then rotate to either pyrethroids or botanicals, use no more than twice, and rotate back.