

# Periodic Graphics

A collaboration between C&EN and  
Andy Brunning, author of the popular  
graphics blog *Compound Interest*

More  
online

To see more of  
Brunning's work, go to  
**compoundchem.com**.  
To see all of C&EN's  
Periodic Graphics,  
visit **cenm.ag/  
periodicgraphics**.

## INSECTICIDES AND HOW THEY WORK

Farmers have used synthetic insecticides for decades to protect crops from pests. People also use some in their gardens and on pets. Here we look at some families of insecticides and how they work.

### INSECTICIDE EXPOSURE ROUTES



#### Systemic insecticides

Systemic insecticides are usually applied to the soil and spread through the entire plant. Insects ingest the insecticide when they eat the plant. These compounds can also work upon contact.



#### Contact insecticides

Contact insecticides kill insects when they come in direct contact with the molecules.

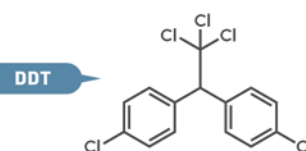


**PERIODIC  
GRAPHICS**

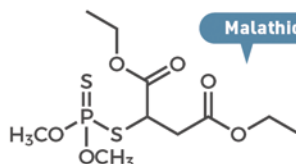
### SELECTED SYNTHETIC INSECTICIDE FAMILIES

#### Organochlorines

These affect either sodium or chloride channels in nerve cells. Many are now restricted or banned globally because they persist in the environment.



#### Malathion

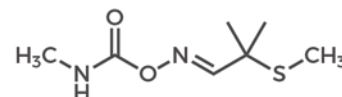


#### Organophosphates

These insecticides overstimulate the nervous system by irreversibly stopping the breakdown of acetylcholine. The compounds also affect humans and other animals, and their use is restricted.

#### Carbamates

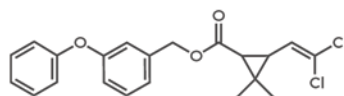
Like organophosphates, these molecules block the breakdown of acetylcholine. Unlike organophosphates, their effects are reversible, so they are less toxic to humans and animals.



#### Aldicarb

#### Pyrethroids

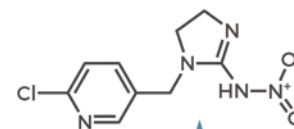
This class holds nerve cells' sodium channels open. They mimic pyrethrins, natural compounds in chrysanthemums. Pyrethroids don't harm humans and most mammals but are toxic to cats.



#### Permethrin

#### Neonicotinoids

These kill insects by binding to acetylcholine receptors, thereby overstimulating insects' nervous systems. Some research suggests that neonicotinoids may harm honeybees.



#### Imidacloprid



© C&EN 2022 Created by Andy Brunning for *Chemical & Engineering News*