

# Pesticides



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# What are pesticides?

- Any substance or mixture of substances used for controlling, preventing, destroying, repelling, or mitigating pests.
- insecticides, herbicides, fungicides, bactericides, repellents, attractants



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# Pesticide modes of action

- Nervous system poisons
- Metabolic inhibitors
- Hormone mimics
- Physical poisons
- Repellents
- Attractants



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Not all pesticides are equally hazardous!

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Everyone wants to know  
How safe is this pesticide?



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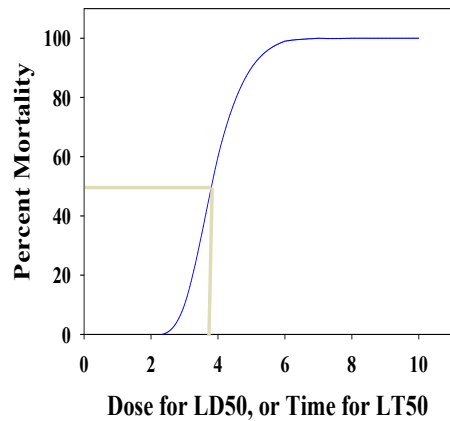
The dose  
makes the poison

- Paracelsus (1493-1541)
- “All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.”



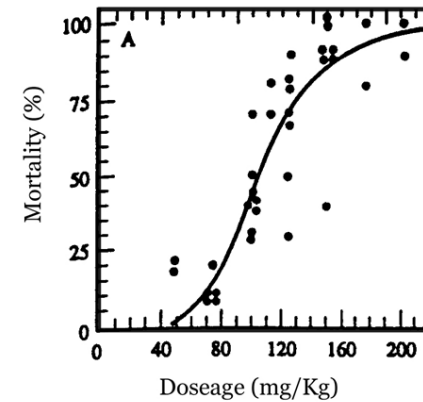
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## Dose-Response Curve



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## Dose-Response Curve



Real dose-response curve for DDT

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## Some terms



- **LD<sub>50</sub>** (Lethal Dose 50) - The amount of material needed to kill half of a test population
- **Mg/Kg** – The amount of toxin (in milligrams) per Kilogram of body weight of the test subject (equals parts per million)

## EPA Pesticide Toxicity Classes

Toxicity category	Extremely toxic I	Very toxic II	Moderately toxic III	Slightly toxic IV
Signal word	Danger	Warning	Caution	Caution
Oral LD <sub>50</sub> (mg/Kg)	0–50	51–500	501–5,000	> 5,000
Equivalent lethal dose for 150-lb person	< 1 tsp	1 tsp– 1 oz	1 oz–1 pt	1 pt–1 qt or more

**TOXICITY**  
By Caution... persons or persons under their...  
An applicator licensed by the state...  
at all times during introduction of fumigant...  
and initiation of the same procedure.

10.8 lb active ingredient per gallon (liquid in cylinder)  
EPA Reg. No. 62719-376  
Keep Out of Reach of Children  
**DANGER POISON**  
**PELIGRO**  
Si usted no entiende el etiqueto ni el manual de fumigación del...  
fumigante ProFume, busque a alguien para que se lo explique...  
detalle. (If you do not understand the label nor ProFume gas for...  
Fumigation Manual, find someone to explain it to you in detail.)

Precautionary Statements  
Harmful to Humans and Domestic Animals  
Causes Irreversible Eye Damage •  
Irritates Exposed Skin • May Be Fatal if Swallowed

**Herbicide**  
Registration of this Agrifluence 1422  
For selective postemergence grass weed control  
EPA Reg. No. 62719-357  
Keep Out of Reach of Children  
**WARNING AVISO**  
Si usted no entiende el etiqueto, busque a alguien para que se lo...  
explique o consulte al distribuidor. Si no puede entender el etiqueto, busque...  
alguno para que se lo explique en detalle.

Precautionary Statements  
Harmful to Humans and Domestic Animals

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EXTENSION

## Pesticide Safety



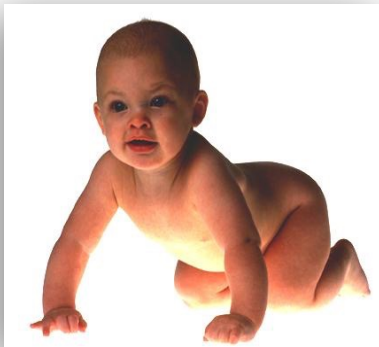
### Acute toxicity

Rapidly produced toxicity, usually resulting from a single exposure

### Chronic toxicity

Toxicity due to slow-action or long-term exposure to a poison

## Pesticide Safety



### Possible chronic effects:

- Carcinogenicity-cancer
- Mutagenicity-genetic mutation
- Teratogenicity-birth defect
- Oncogenicity-tumors
- Reproductive effects
- Delayed neurological effects

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## Tests required to register a pesticide

- Acute oral toxicity
- Acute dermal toxicity
- Acute inhalation
- Acute intraperitoneal
- Eye irritation
- Dermal photosensitization
- Acute delayed neurotoxicity
- 90-day rat feeding study
- 12-month dog feeding study
- 21 & 90-day dermal
- Lifetime rat feeding study
- Lifetime mouse feeding study
- Teratology (rat)
- Teratology (rabbit)
- Reproduction
- Excretion/metabolism & accumulation
- Antidote
- Mutagenicity



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It is impossible to provide experimental evidence that anything is **ABSOLUTELY** safe!

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Toxicity x Exposure =  
Hazard

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## Pesticide labeling



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## Pesticide labeling

- Most important source of information
- The label is the Law
- Read the label
  - before you buy/sell the product
  - before you use the product
  - before you dispose of the product

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## Common vs. trade names

- Trade name is a proprietary name used by a company (e.g., Sevin®)
- Common name is the generic name for the pesticide (e.g., carbaryl)
- Extension publications use common names
- The public looks for trade names : (



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## Label exercise

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**Bayer Advanced™ Tree & Shrub Insect Control Concentrate**

**Bayer CropScience**

**Tree & Shrub Insect Control Concentrate**

Our original 12-month insect control formula for trees. Just mix with water and pour over tree base for a full year of protection against devastating insects - even Emerald Ash Borers.

- Provides 12-month insect protection with one application
- Stops and prevents insect damage
- Easy-to-use - No spraying, just mix in a bucket or sprinkling can and pour

**Sizes and Labels:**

SIZE	32 oz.
COVERAGES	
PRODUCT LABEL	Click to download PDF
MSDS SHEET	Click to download PDF
502802A	
SIZE	1 Gallon
COVERAGES	
PRODUCT LABEL	Click to download PDF
MSDS SHEET	Click to download PDF
502805A	

Also Available In

**BAYER ADVANCED**

**12 Month Tree & Shrub Insect Control**

**CONCENTRATE**

**12 MONTH INSECT PROTECTION**

CONTROL INSECTS

12 meses de protección

• Kills insects & prevents new infestations

NO SPRAYING

MIX & POUR AT TREE BASE

KEEP OUT OF REACH OF CHILDREN CAUTION

NET CONTENTS 32 FL. OZ. (946ml)

Merit on

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## Parts of a Label

- Trade name
- Chemical name
- Common name
- Formulation type
- Allowed sites

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**12 Month Tree & Shrub Insect Control**

**CONCENTRATE**

This product provides 12-month systemic protection against damaging insects including Leafminers, Beetles, and Borers. Having beautiful trees and shrubs has never been easier.

**PRECAUTIONARY STATEMENTS**

**CAUTION: Hazards to Humans and Domestic Animals**

- Causes moderate eye irritation.
- Avoid contact with skin, eyes or clothing.
- Wash thoroughly with soap and water after handling.

**FIRST AID**

**IN CASE OF ACCIDENT...**

**IMMEDIATELY...**

- Call a poison control center or doctor immediately for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not induce vomiting unless told to do so by a poison control center or doctor.

**SWALLOWING**

- Hold eye open and rinse slowly and gently with water for 15 to 20 minutes.
- Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
- Call a poison control center or doctor for treatment advice.

**CONTACT WITH EYES**

**NOTE:** When calling poison control center, have this product label accessible. If seeking treatment at an emergency room or doctor's office, bring this product label to show medical personnel. You may call toll-free 1-877-229-7533 for medical emergency information. Active ingredient: 1.4% Imidacloprid (CAS # 136261-40-3).

**ENVIRONMENTAL HAZARDS**

- This pesticide is toxic to aquatic invertebrates. Do not apply directly to lakes, streams, rivers or ponds.
- Do not dump insect water into sewers or other bodies of water.
- Apply this product only as specified on this label.

**NOTICE:** Research and testing have determined that the "Directions For Use" are appropriate for the proper use of this product under expected conditions. The Bayer assumes responsibility for lack of performance or safety if not used according to the directions. Money Back Guarantee: If you are not satisfied with this product, we will gladly refund your original purchase price.

©2006 Bayer CropScience LP  
Bayer Advanced  
All Rights Reserved  
P.O. Box 12514, 21st Avenue Drive  
Research Triangle Park, NC 27709

EPA Reg. No. 72155-55  
EPA Est. No. Indicated by 2nd and 3rd digit of the batch number on this package.  
(01) = 3125-MG-1 (05) = 48276-1 (06) = 67572-GA-1 (08) = 5096-MG-1 (09) = 02102-46-001

Made in USA

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EXTENSION

## Parts of a Label

- Precautionary statement
- First aid
- Environmental statement
- EPA Registration number
- Directions for use
- Disposal instructions

**NO SPRAYING!**

**JUST MIX...**

**AND POUR...**

**PROTECTS ENTIRE TREE for up to 12 months!**

**FOR OUTDOOR RESIDENTIAL USE ONLY**

**READ THE LABEL FIRST!**

**QUICK FACTS**

- Provides 12-Month Insect Protection
- Rainproof Protection
- Easy-to-Use... Mix in Water and Pour Around Tree/Shrub

**KILLS**

Adelgids, Aphids, Bronze Birch Borers, Emerald Ash Borers, Leafminers, Scale and other listed pests

**COVERAGES**

Trees: 32" of distance around trees  
Shrubs: 5 (2 ft. tall)

**WHERE TO USE**

Outdoor trees and shrubs, including listed fruit and nut trees

**WHEN TO USE**

Once a year or when insects are present

**HOW MUCH TO USE**

Trees: 1 ounce per inch of distance around trunk  
Shrubs: 3 ounces per foot of height

**FOR QUESTIONS OR COMMENTS,** call toll-free 1-877-BayerAG (1-877-229-3724), or visit us on-line at [www.BayerAdvanced.com](http://www.BayerAdvanced.com)

**ACTIVE INGREDIENT:** Imidacloprid ..... 1.47%

**OTHER INGREDIENTS** ..... 98.53%

**Total** ..... 100.00%

Imidacloprid is the chemical name for Merit®

EPA Reg. No. 72155-55  
EPA Est. No. indicated by 2nd and 3rd digits of the batch number on this package.  
(01) = 3125-MG-1 (05) = 48276-1 (06) = 67572-GA-1 (08) = 5096-MG-1 (09) = 02102-46-001

358911 R4 6 01707342802 7

**DIRECTIONS FOR USE**

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. For best results, read and follow all label directions.

**BEFORE YOU USE**

Read and follow these directions when using:

- Do not apply near lakes, streams, rivers, or ponds.
- Do not apply to soils which are water-logged or saturated.
- Bucket or measuring utensils should not be used for any food or drinking water purposes after use with this product.

**HOW TO USE**

Determine the amount to use by measuring the distance around the tree trunk or height of the shrub. Pour the required amount into a bucket of water and empty the bucket around the base of the tree/shrub.

**FOR USE ON**

Outdoor trees and shrubs including listed fruit and nut trees:			
Apple	Mayhaw	Pecan	
Crabapple	Oriental Pear	Quince	
Loquat	Pear		

**CONTROLS**

Adelgids	Leafhoppers
Aphids	(including Glassy-winged Sharpshooter)
Roundheaded Borers (including Asian Longhorned Beetle and Eucalyptus Longhorned Borers)	Leafminers (including Birch Leafminers)
	Mealybugs
Flatheaded Borers (including Bronze Birch, Alder Borers and Emerald Ash Borer)	Pine Tip Moth Larvae
Japanese Beetles (adult)	Psyllids
Lacebugs	Root Weevil Larvae (including Black Vine Weevil)
Leaf Beetles (including Elm Leaf Beetles and Viburnum Leaf Beetles)	Royal Palm Bugs
	Sawfly Larvae
	Scalps (including Armored Scale (Suppression) and Soft Scale)
	Trips
	Whiteflies

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- Very little
- Can use on pests not listed only if the site of application is listed
- In most cases you can use *LOWER* rate than on the label

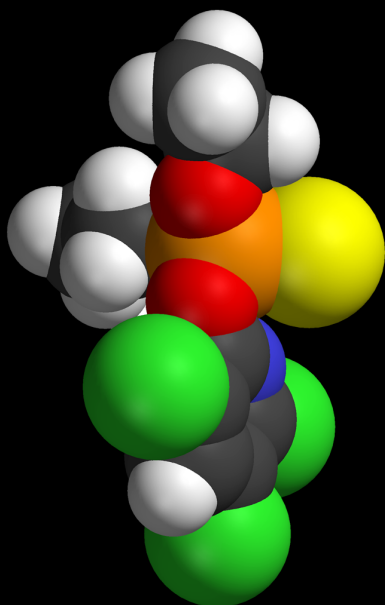
## Review of Pesticide signal words

- Caution
  - LD<sub>50</sub> greater than 500 mg/Kg
- Warning
  - LD<sub>50</sub> 50-500 mg/Kg
- Danger - Poison
  - LD<sub>50</sub> less than 50 mg/Kg



## Classifying insecticides by chemical class

- Organo-phosphates
- Carbamates
- Botanicals
- Pyrethroids
- Neo-nicotinoids
- Others



## Organophosphates

- Many formerly common pesticides
  - chlorpyrifos (Dursban)
  - diazinon
  - acephate (Orthene)
  - malathion
- Disappearing from market



## Botanicals

- Pesticides derived from plants
  - pyrethrins
  - neem extracts & oils
  - rotenone
  - Mint oils
  - citrus oils
  - clove oil
  - other essential oils



Neem seed

*Chrysanthemum cinerariifolium*  
*C. coccineum*

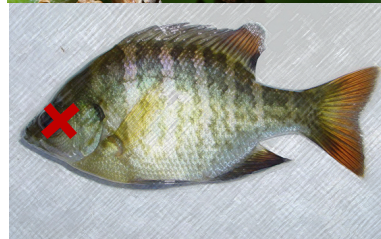


## Pyrethrins

- From ground-up flowerheads of pyrethrum daisies
- A natural combination of six compounds: pyrethrins I and II, jasmolin I and II, and cinerin I and II
- More uses approved than any other insecticide
- Usually includes a “synergist” to keep insects from detoxifying it

## Pyrethroids

- Synthetic chemicals based on pyrethrins chemistry
- Broad spectrum replacements for Dursban®, diazinon
- Low in toxicity to birds and mammals, but hazardous to fish in some settings



## Pyrethroids

- Recognize by suffixes: -thrin or -ate
- Examples:
  - Esfenvalerate
  - Permethrin
  - Bifenthrin
  - Cyfluthrin
  - Allethrin
  - Sumithrin
  - Others





## Neonicotinoids

- New class of systemic pesticides
  - imidacloprid (Bayer)
  - dinotefuran (Spectracide?)
- Effective against
  - Homoptera
  - Coleoptera (chewing, boring)
  - Thysanoptera
- Relatively low in mammalian, bird toxicity

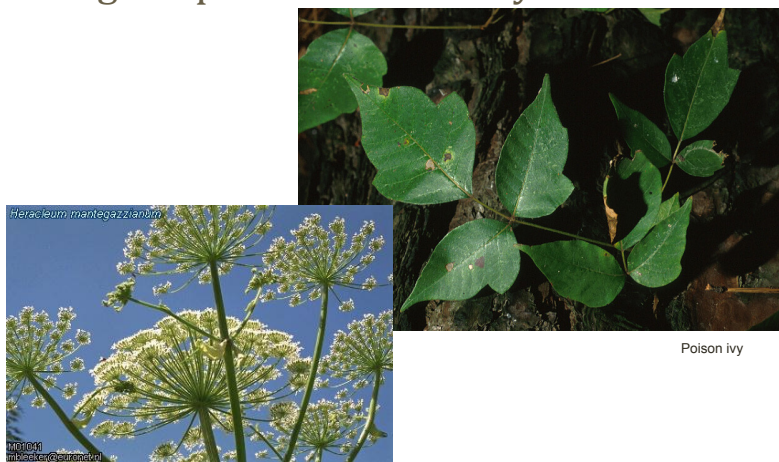


## Organic vs. synthetic

- “organic” pesticides include products derived from natural sources
- Synthetic pesticides are human-produced



## Are organic products inherently safe?

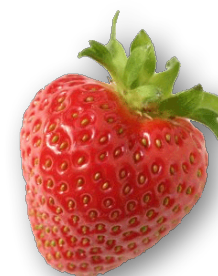


Poison ivy

Giant hogweed

## Even plants have carcinogens!

- Tobacco (leaf) - 7 carcinogens
- Strawberry (fruit) - 7 carcinogens
- Onion (bulb) - 6 carcinogens
- Tea (leaf) - 6 carcinogens
- Carrot (root) - 6 chemicals
- Cauliflower (leaf) - 5 chemicals
- Grapefruit (fruit) - 5 chemicals



Source: Phytochemical Database, USDA - ARS - NGRL  
<http://www.ars-grin.gov/duke/activity.html>



### Low impact pesticides

- Pesticides with minimal impact on people and on beneficial organisms, including beneficial insects

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### Low impact pesticides

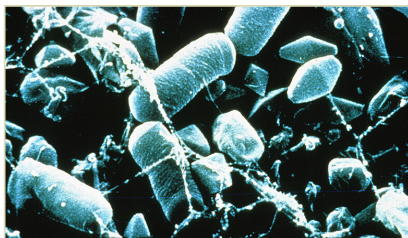
- Insecticidal soaps & oils
  - Kill small and soft-bodied insects and mites. Contact insecticide with short residue
  - Examples: Safer's soap, Sunspray Ultrafine Spray Oil, vegetable and neem oils



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### Low impact pesticides

- Microbe-derived
  - Consisting of, or derived from microbes. The best are low in toxicity to humans and non-pathogenic to non-target organisms.



- Examples: Bacillus thuringiensis products, spinosad

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### Low impact pesticides

- Baits
  - Mixture of an insecticide with some sort of food attractive to pest. Generally low percentage active ingredients make these relatively safe.
  - Examples: fire ant baits, containerized cockroach baits, granular ant, cockroach and cricket baits



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## Low impact pesticides

- Botanicals
  - Derived from plants. Although some active ingredients are toxic, generally formulated as a low percentage a.i. and degrade quickly in the environment.
  - Examples: pyrethrum, neem extract, essential oils, others...



## Low impact pesticides

- Insect growth regulators
  - Based on insect hormones unique to arthropods
  - Disrupts reproduction, molting, other growth processes
  - Excellent safety record
  - Products for fire ants, white grubs, fleas, others

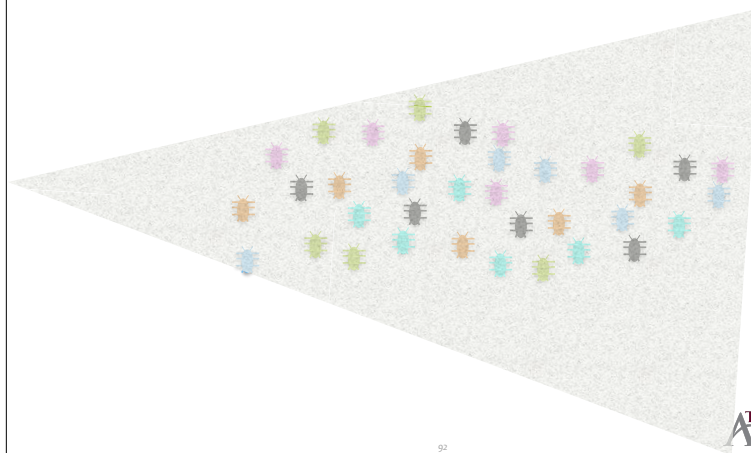


## Low impact pesticides

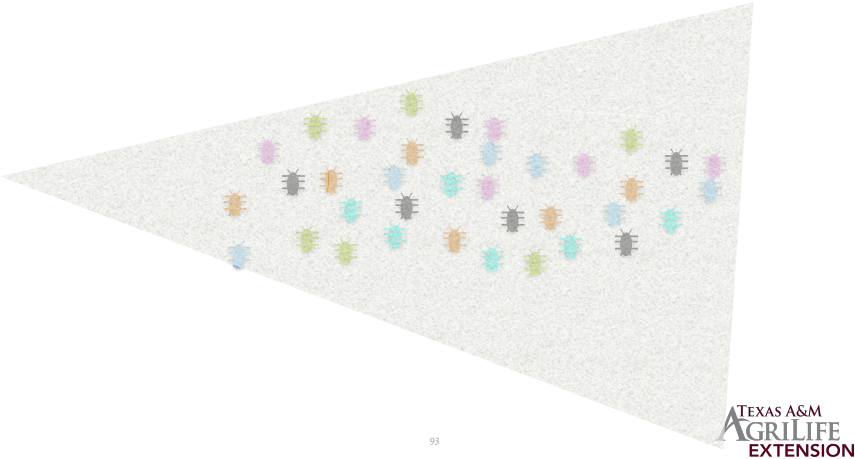
- Other low toxicity pesticides
  - Kill through physical or stomach poison action.
  - Generally non-toxic on skin.
  - Examples: silica aerogel, diatomaceous earth, boric acid and borate compounds, sulfur



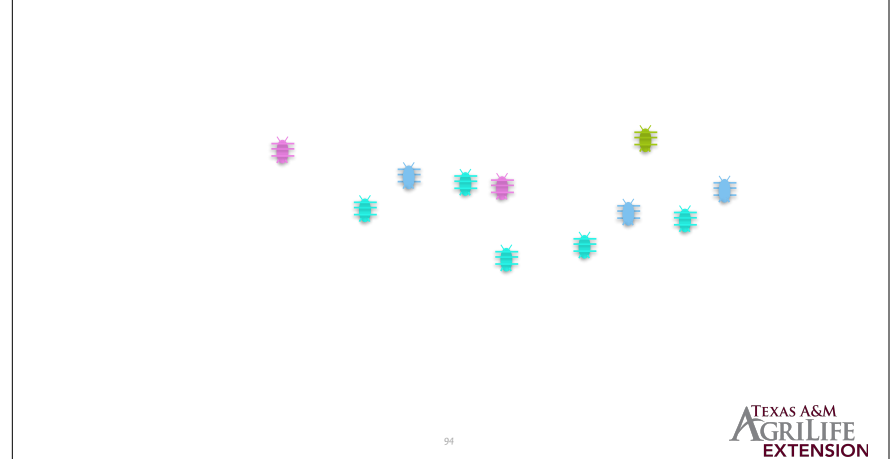
## Chemical Rotation



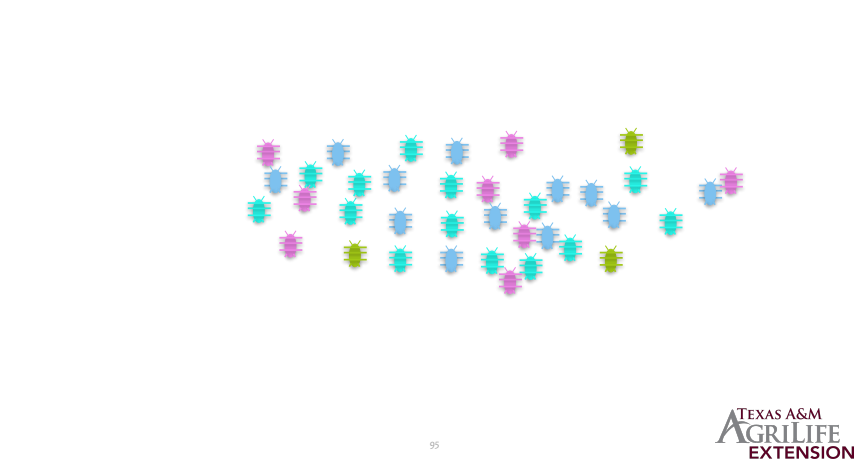
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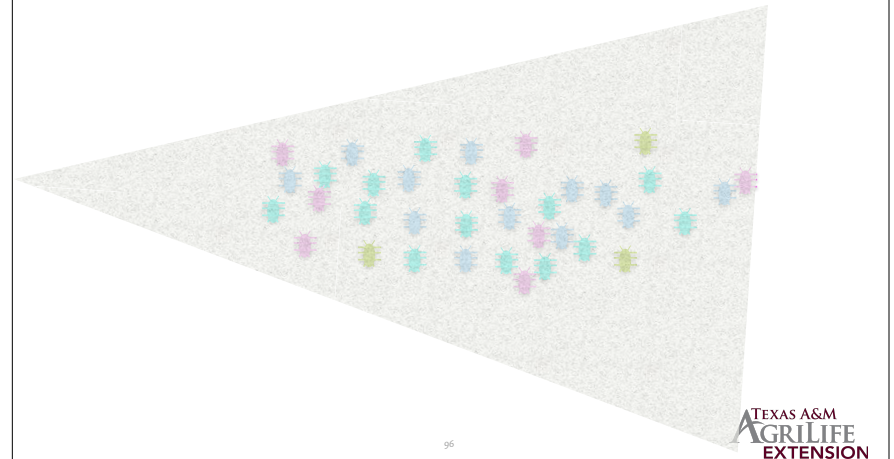
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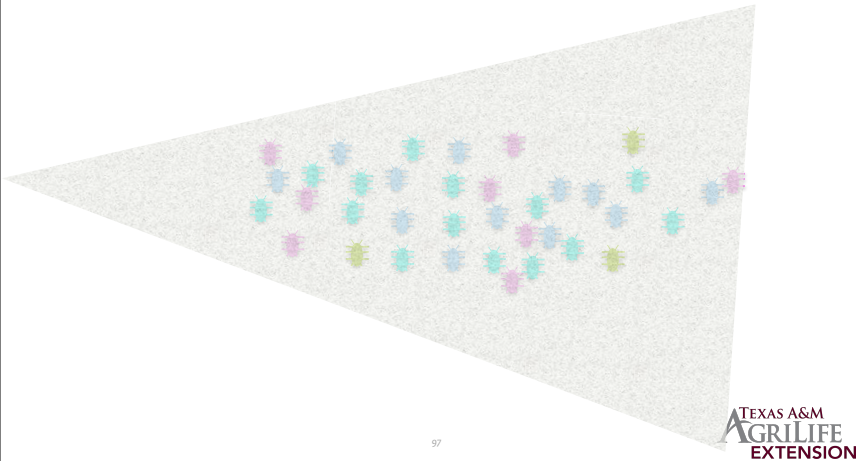
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## Chemical Rotation

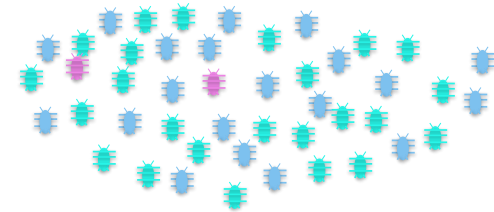


# Chemical Rotation



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# Chemical Rotation



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# Chemical Rotation

www.irac-online.org/modes-of-action/

HOME NEWS ABOUT TEAMS PESTS CROPS MODES OF ACTION TEST METHODS INDEX

## MODES OF ACTION

The IRAC Mode of Action (MoA) Classification is the definitive global authority on the target site of insecticides. It is the basis of MoA labeling of insecticides worldwide and is an essential tool for the development of insecticide resistance management (IRM) strategies. For more information please visit the [MoA Team](#) page, and should you wish you are welcome to [submit an active](#) for classification by the IRAC MoA Team.

The colour scheme below associates mode of action into broad categories based on the physiological functions affected, as an aid to understanding symptomatology, speed of action and other properties of the insecticides, and not for any resistance management purpose. Rotations for resistance management should be based only on the numbered mode of action groups.

■ Nerve & Muscle ■ Growth ■ Respiration ■ Midgut ■ Unknown or Non-Specific

Q FILTER BY MODE OF ACTION, CHEMICAL CLASS OR ACTIVE...

<b>1</b> ACETYLCHOLINESTERASE (ACHE) INHIBITORS A CARBAMATES B ORGANOPHOSPHATES	<b>2</b> GABA-GATED CHLORIDE CHANNEL BLOCKERS A CYCLODIENE ORGANOCYCLINES B PHENYLPYRAZOLES (FIPROLES)	<b>3</b> SODIUM CHANNEL MODULATORS A PYRETHROIDS, PYRETHRINS B DDT, METHOXYCHLOR
<b>4</b> NICOTINIC ACETYLCHOLINE RECEPTOR (NACHR) COMPETITIVE MODULATORS A NEDNICOTINOIDS B NICOTINE C SULFOXFLOR	<b>5</b> NICOTINIC ACETYLCHOLINE RECEPTOR (NACHR) ALLOSTERIC MODULATORS SPINOSYNS	<b>6</b> GLUTAMATE-GATED CHLORIDE CHANNEL (GLUCL) ALLOSTERIC MODULATORS AVERMECTINS, MILBEMYCINS
	<b>8</b> MISCELLANEOUS NON-SPECIFIC (MULTI-SITE) INHIBITORS A ALKYL-HALIDES	<b>9</b> MODULATORS OF CHORDOTONAL ORGANS B PYMETROZINE

# Management

Erfan Vafaie  
Extension Program Specialist, IPM  
erfan.vafaie@ag.tamu.edu  
(O) 903-834-6191  
[sixleggedaggie.com](http://sixleggedaggie.com)

