Chapter 13 Integrated Pest Management and Pesticide Use

Janet A. Hurley, ACE, MPA

Senior Extension Program Specialist – IPM

Texas A&M AgriLife Extension

ja-hurley@tamu.edu

Learning Objectives

- What is IPM and why it’s important
- What are the principal steps of an IPM program
- What are pesticides
- Why it’s important to read and understand the label
- Types of chemical control used around the home

What is IPM?

Integrated Pest Management

A strategy that

- focuses on long-term suppression of pests
- uses a combination of the best control tactics
- minimizes pesticides' negative impact on people and the environment
- strives to be economical

How TDA Defines Integrated Pest Management (IPM)?

a pest management strategy that relies on multiple pest control tactics

including the judicious use of pesticides

informed by accurate identification and scientific knowledge of pests

reliable monitoring methods to assess pest presence

preventative measures to avoid pest infestations

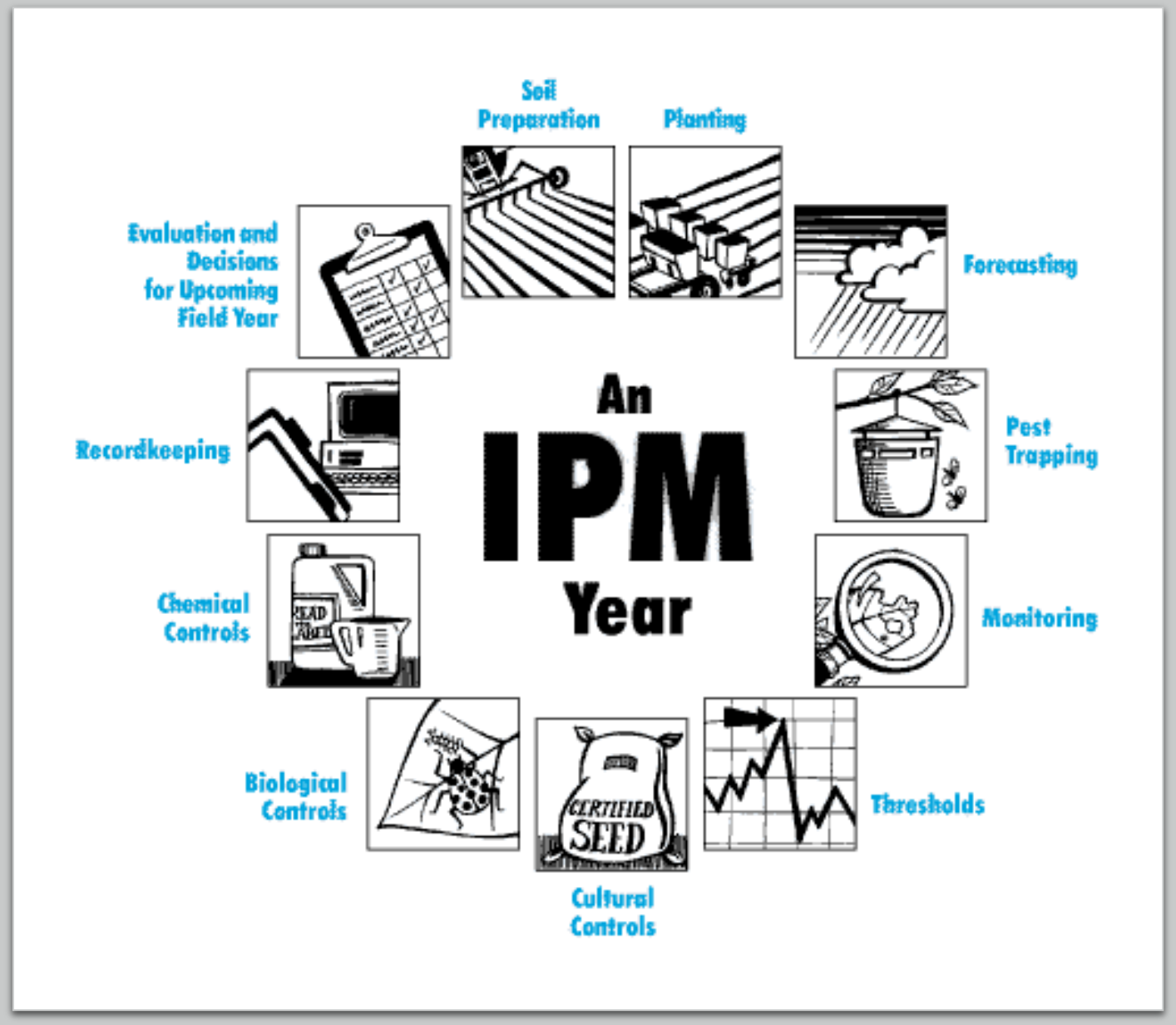
and thresholds to determine when corrective control measures are needed.

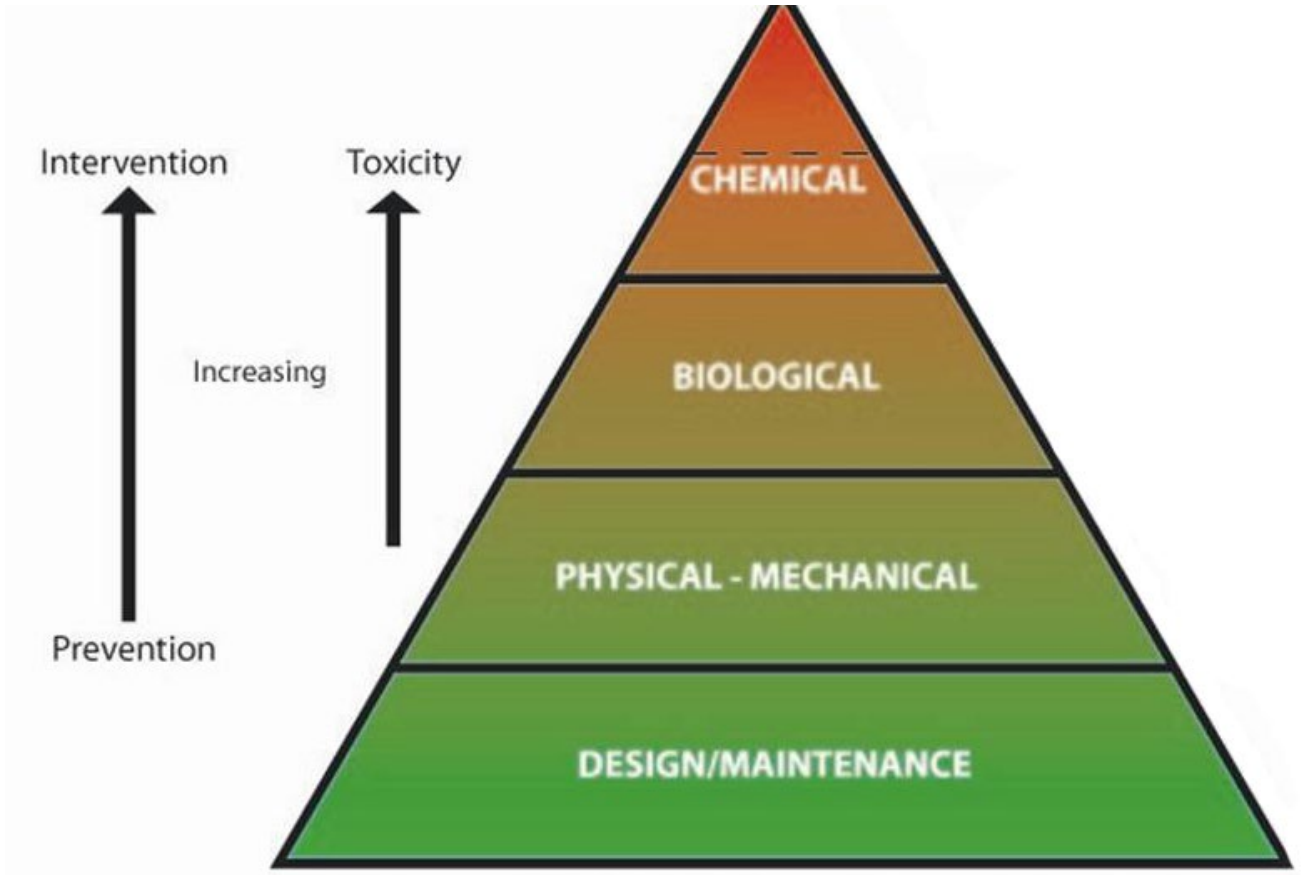
Practicing Green Landscaping

- Efficient watering
- Planting ornamentals & shrubs wisely
- Building healthy soil
- Limited use of insecticides and herbicides

Ingredients to an IPM Program

- Identify the problem
- Know the enemy
- Taking Action
- Evaluate your measures





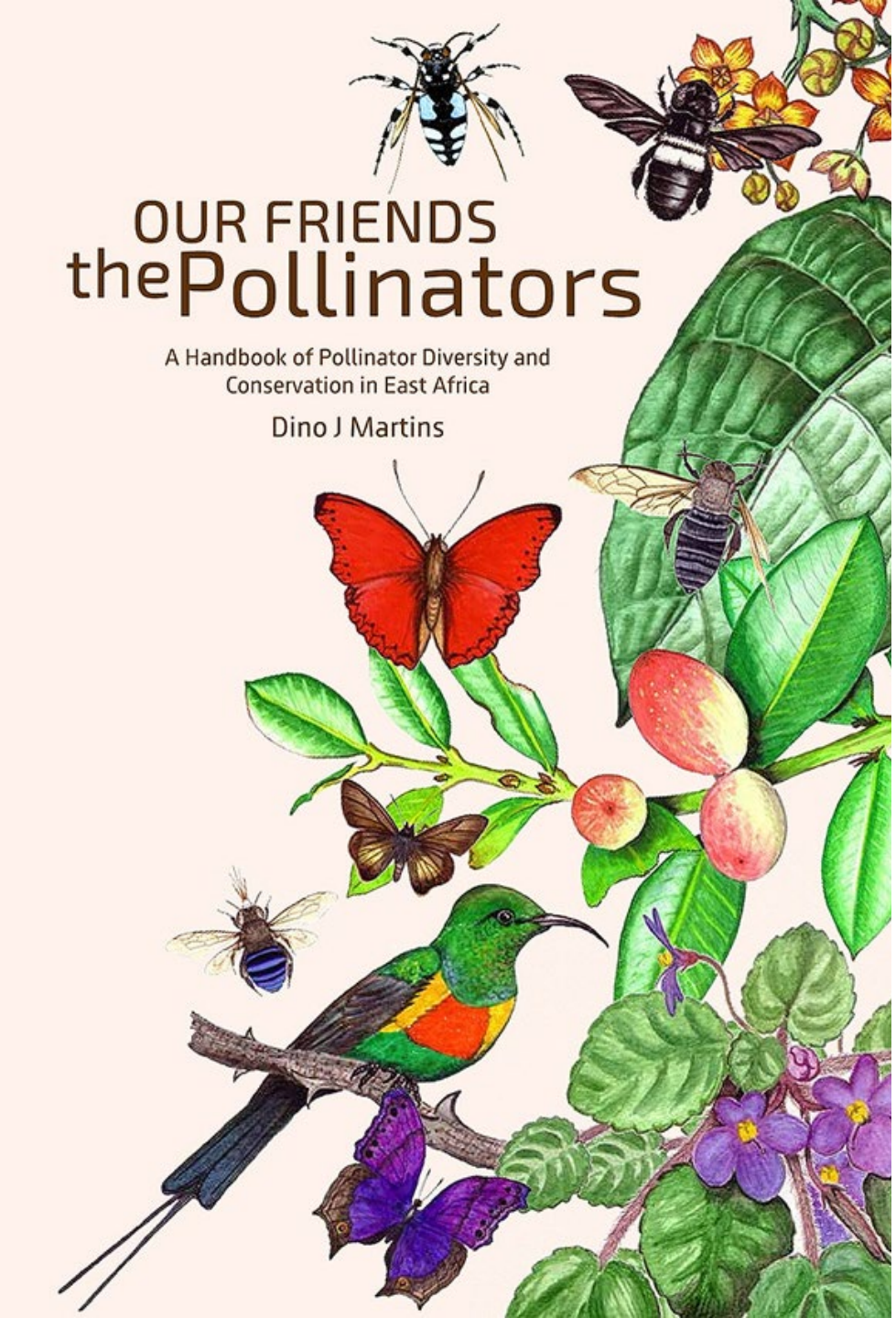
The IPM Pyramid

Identify the Problem

- Before you act, know what to act on
  - Plants under environmental stress
  - Is it a disease or insect
  - Is it temporary or on-going
  - Could the problem be?
    - Poor growing conditions
    - Too much moisture, not enough
    - Too much sun, not enough

Friend or Foe

- Beneficial insects' prey on harmful insects
- Examples:
  - Lady beetles
  - Fireflies
  - Green lacewings
  - Praying mantids
  - Spiders

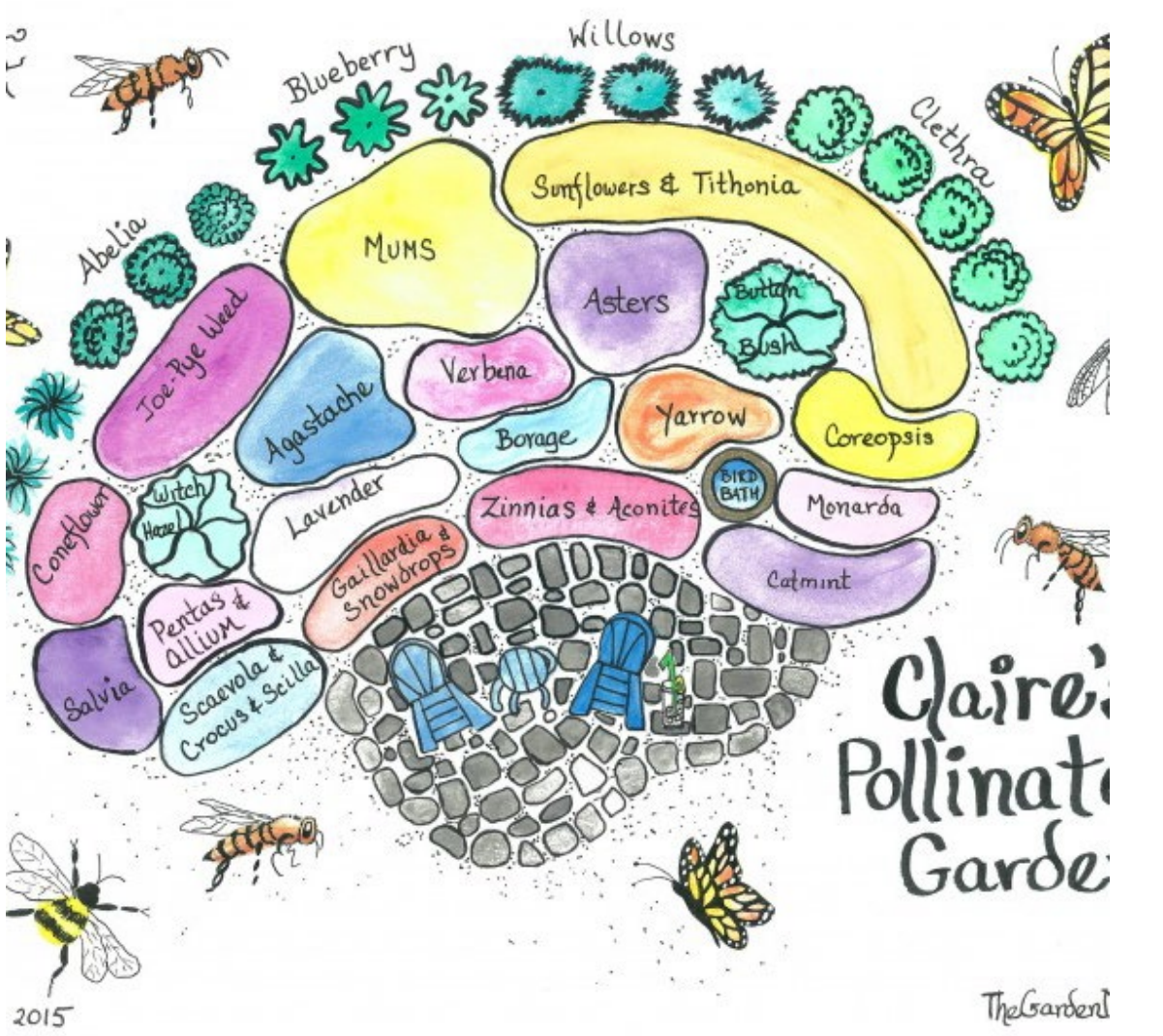


Beneficials need love too

- Pollinate your plants
- Decompose organic matter
- Chemicals can harm beneficial insects
- If in doubt, ask
  - Collect samples take to Extension office, gardening center, look up on internet or book
  - iNaturalist https://www.inaturalist.org/
  - Google Lens https://lens.google.com/
  - https://extensionentomology.tamu.edu/resources/insects/

Creating a Haven for Beneficials

- They need three things
- Food
  - Pollen and nectar
- Water
  - Keep it fresh – stagnant water attracts the wrong type
- Shelter
  - Growing the right plants



Keeping the bad pests out Control Measures

- Removal
- Barriers
- Repellants
- Traps
- Biological controls
- Least-toxic controls

Things to remember when you are in the garden

A good gardener always plants 3 seeds - one for the bugs, one for the weather and one for himself.

- Leo Aikman

One for blackbird, one for the crow, one for the cutworm, and one to grow.

- American saying

Removal

- 100% effective for species specific
- Must watch plants for signs of damage
- Can pick off or mash harmful insects
- Blast of water remove aphids
- Pruning shears remove tent caterpillars
- Uproot weeds that have spreading roots
- Use mechanical weed puller

Removal

Barriers

- Keep pests out of areas
  - Floating row covers
    - Lightweight, keep flying insects out – grasshoppers
  - Netting
    - Birds off, especially fruiting plants
  - Copper Slug Barrier
    - Slugs can’t cross copper use on pots, raised beds
  - Protective Collars
    - Good for new seedlings, young growth, remove

Barriers

Traps

- Attract target pests to capture
  - Sticky traps
    - Sticky surface, sometimes has smell
    - Mice, rats, roaches
  - Japanese beetle traps
    - Fermenting mush of fruit placed in trap
  - Slug and snail traps
  - Wasp and yellow jacket traps
    - Great for picnics or large gatherings


SureFire
PRODUCTS
ALL NEW!
DELUXE
YELLOWJACKET/WASP™
TRAP

Biological Controls

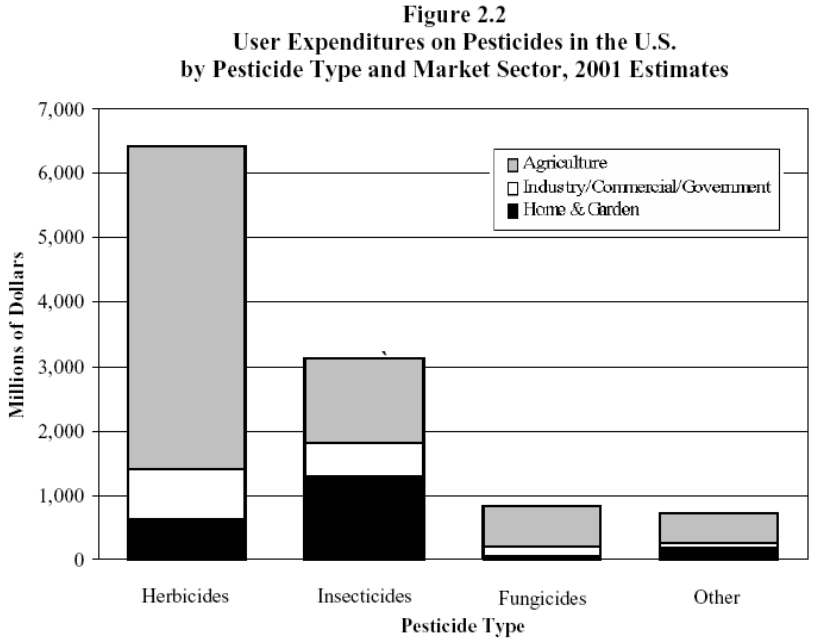
- Using living organisms to control pests
- Ladybugs
  - Aphids, soft body insects
- Lacewings
  - Aphids, scales, spider mites, soft body insects
- Predatory mites
  - Spider mites and other pest mites
- Trichogramma Wasps
  - Moth and butterfly eggs, some research on fire ants

Chemical Controls - Pesticides

- Any substance or mixture of substances designed to
  - control
  - prevent
  - destroy
  - repel
  - attract
  - or otherwise mitigate pests

Pesticide use in the U.S.

https://www.epa.gov/sites/production/files/2017-01/documents/pesticides-industry-sales-usage-2016_0.pdf



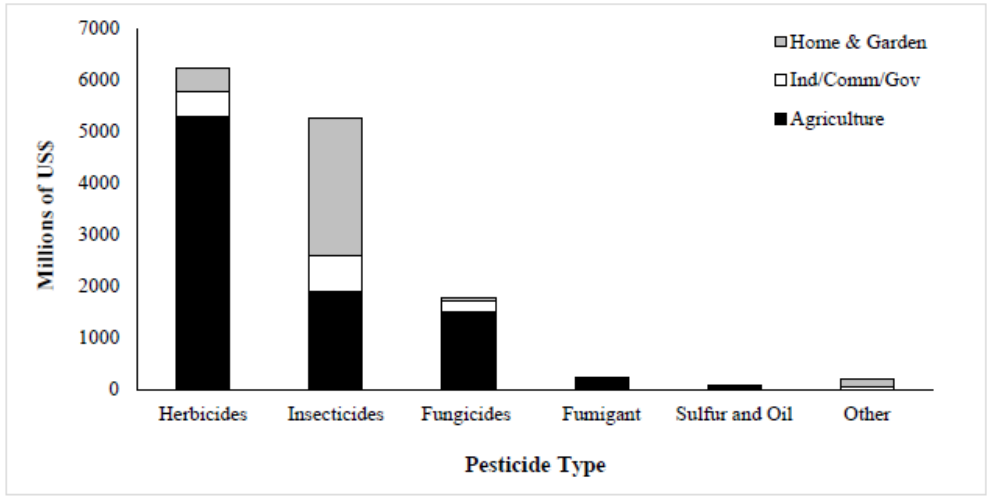


Figure 2.2. User Expenditures on Pesticides in the United States by Pesticide Type and Market Sector, 2012 Estimates

Pesticide use in the U.S.

2001

- $11 billion total sales ($3 billion insecticides)
- 15% of insecticide sales are structural, horticultural and government use
- 15 million lbs. per year in Industry/commercial/government sector

2012

- $14 billion in total sales and $13 billion in 2009
- 33% of insecticide sales are structural, horticultural and government use
- 48 million lbs. per year per year in industry/commercial/government sector
- 59 million lbs. for home and garden

How insecticides work: Modes of action

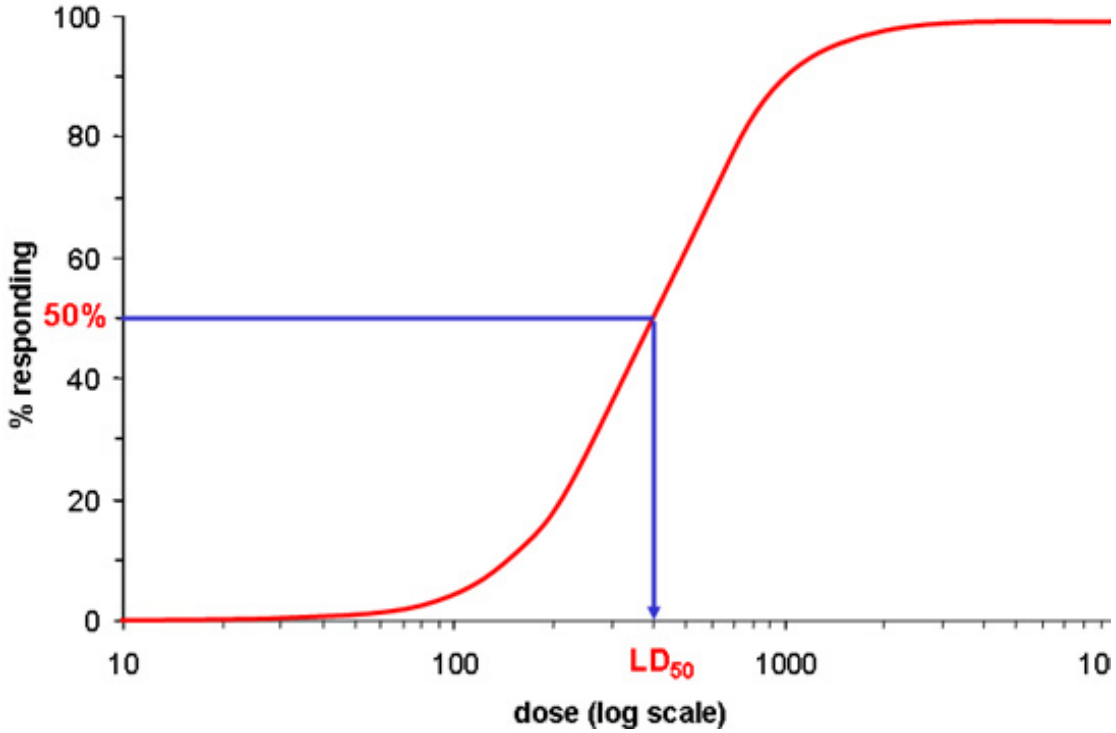
- Nervous system poisons
  - Acts on the nerve
- Metabolic inhibitors
  - Affect ability of target to process food
- Hormone mimics
  - Disrupt normal growth & reproduction
- Physical poisons
  - Physically damage insect
- Repellents & attractants
  - Attracts like sex pheromones used in traps to lure

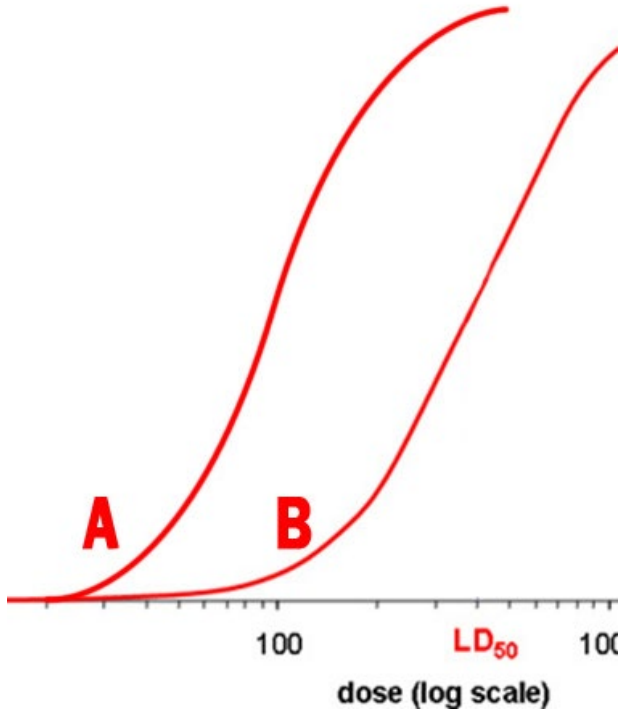
NOT ALL INSECTICIDES ARE EQUALLY HAZARDOUS!

IS THAT SAFE?

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.”





Dose-Response Curve

Some terms

- LD_{50} (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

	Extremely Toxic	Very Toxic	Moderately Toxic	Slightly Toxic
Toxicity Category	I	II	III	IV
Signal Word	Danger	Warning	Caution	Caution
Oral LD_{50} (mg/Kg)	0 – 50	50 – 500	500 – 5,000	> 5,000
Equivalent Lethal Dose for 150 lb human	Less than a teaspoon	Teaspoon to an ounce	Ounce to a Pint	Pint to a quart or more

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 la etiqueta ni el manual de fumigacion
fumigante ProFume, busque a alguien para que se la explique
tails. (If you do not understand the label nor ProFume gas
umigation Manual, find someone to explain it to you in deta

Precautionary Statements

Herbicide

*Trademark of Dow AgroSciences LLC

For selective postemergence grass weed control in rice

Active Ingredient(s):
cyhalofop: 2-[4-(4-cyano-2- fluorophenoxy)
phenoxy] propanoic acid,
butyl ester, (R) 29.6%
Inert Ingredients 70.4%
Total 100.0%

Contains 2.36 lb of active ingredient per gallon.
Contains petroleum distillates.

EPA Reg. No. 62719-557

Keep Out of Reach of Children

WARNING AVISO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

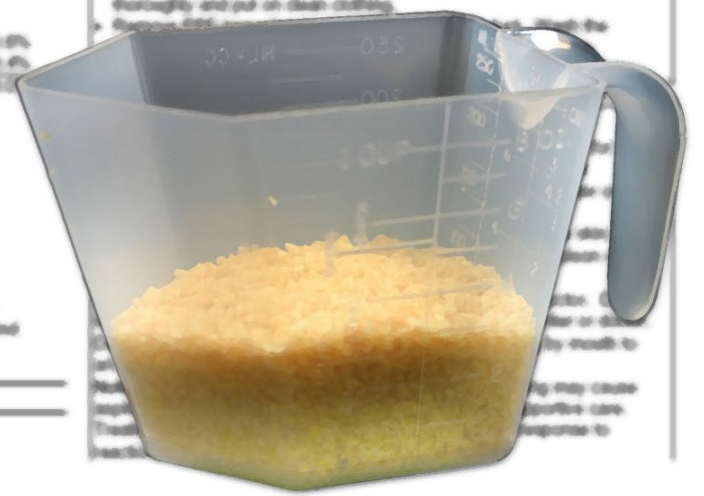
Hazards to Humans and Domestic Animals

application. When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d) (4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.



Pesticide Safety

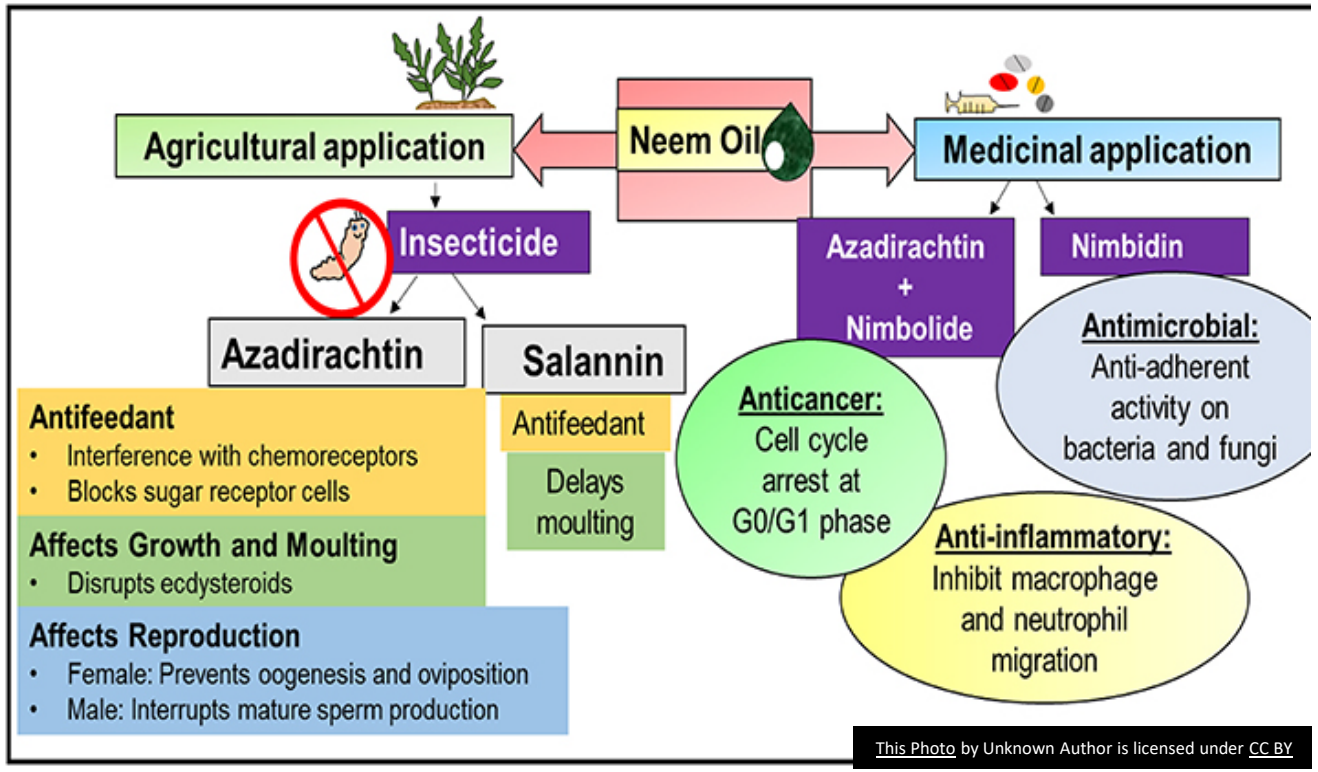
Acute toxicity

Rapidly produced toxicity, usually resulting from a single exposure

Chronic toxicity

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

Possible chronic effects:



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

Tests to register a pesticide must include chronic toxicity evaluations

- Acute oral toxicity
- Acute dermal toxicity
- Acute inhalation
- Acute intraperitoneal
- Eye irritation
- Dermal 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

Do you feel better now?

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

WE MANAGE RISKS DAILY

TOXICITY X EXPOSURE = HAZARD

Organic vs. synthetic

- Organic pesticides include products derived from natural sources
- Synthetic pesticides are human-produced

What’s OMRI

- OMRI is a 501(c)(3) nonprofit organization that provides an independent review of products, such as fertilizers, pest controls, livestock health care products, and numerous other inputs that are intended for use in certified organic production and processing.
- Food and fiber products that use the term "organic" are required to be certified by an independent third-party certifier.
- Supply food and fiber producers with certified organic choices

Some terms

Contact - you get what you hit

Residual - continues to kill on surfaces after dry

Systemic - refers to water soluble insecticides that are taken up in plant's phloem system

Translaminar - some movement into leaf, controlling insects on inside of leaf or on leaf undersides

Pesticide Labeling

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

Parts of a Label

- Names
- Formulation type
- Precautionary information
- Instructions for use
- Allowed sites

Names…

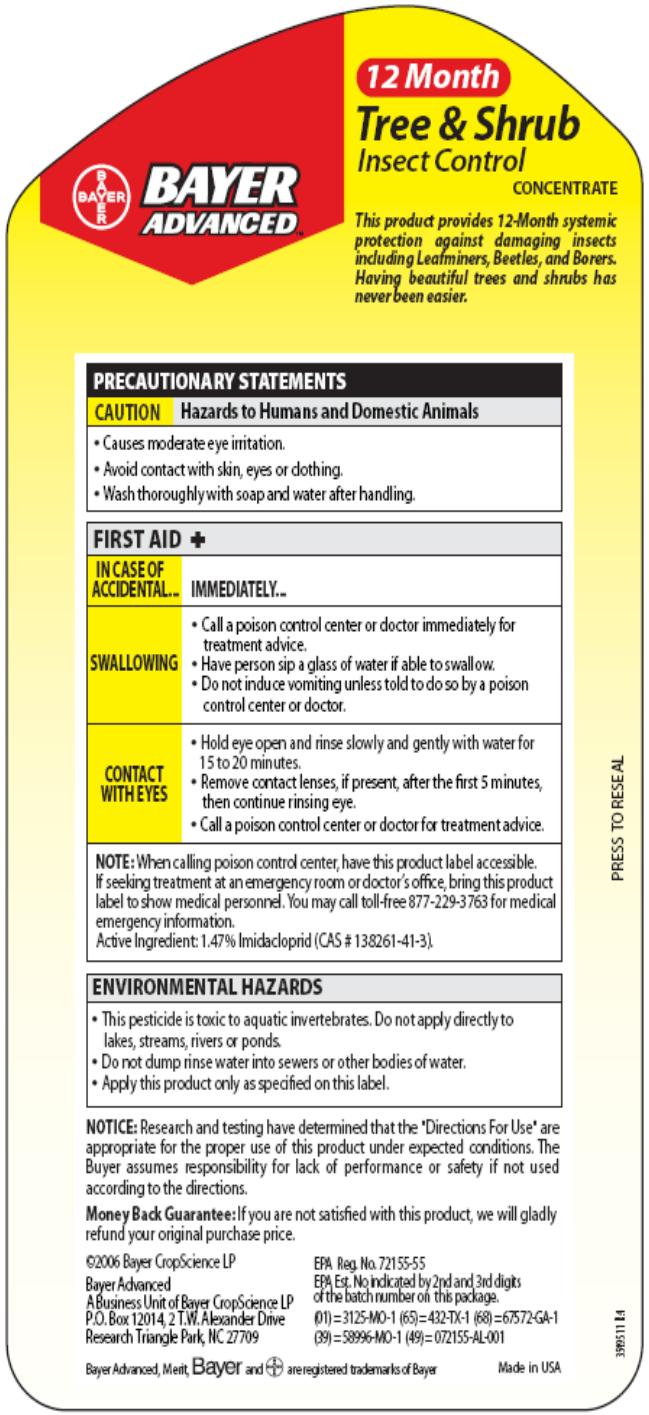
- Trade name is a proprietary name used by a company (e.g., Demon®)
- Common name is the generic name for the pesticide (e.g., cypermethrin)
- Chemical names (sometimes) on labels, for example:

  (±) alpha-cyano-(3-phenoxyphenyl) methyl(+)cis, trans-3-(2,2-dichloroethenyl)2,2-dimethylcyclopropane carboxylate =

  cypermethrin

Parts of a label: Formulation

- Make the active ingredient safer and easier to use
- Examples:
  - Granules
  - Baits
  - Dusts
  - Liquid concentrates
  - Aerosols
  - Suspensions
  - RTU (ready to use)



Parts of a Label

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

front

READ THE LABEL FIRST!

Indicaciones en español después de las de inglés

OPEN Resealable Label for Directions & Precautions

NO SPRAYING!

JUST MIX...

AND POUR.

PROTECTS ENTIRE TREE for up to 12 months!

FOR OUTDOOR RESIDENTIAL USE ONLY

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
COVERAGE	**Trees:** 32" of distance around tree(s) **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

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-MO-1 (65) = 432-TX-1 (68) = 67572-GA-1
(39) = 58996-MO-1 (49) = 072155-AL-001

3549511 R4

6 87073 02802 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, Crabapple, Loquat, Mayhaw, Oriental Pear, Pear, Pecan, Quince

CONTROLS

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

page 2

Examples of Allowed Sites

- Indoors, residential
- Indoors, commercial
- Food handling areas, kitchens
- Outdoor landscapes
- Indoor plantscapes
- Residential lawns
- Commercial lawns
- Vegetable gardens
- Fruit and nut trees
- Around building/home foundations

Leeway with labels?

- 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

Older Chemical Classes & Synthetics

- Organo-phosphates
  - chlorpyrifos (Dursban)
  - diazinon
  - acephate (Orthene)
  - malathion
- Carbamates
  - Nerve toxins: acetylcholinesterase inhibitors
  - Variable residual life (short to moderate)
  - Broad spectrum, toxic to beneficials, fast acting
  - Examples:
    - carbaryl (Sevin®)
    - indoxacarb (Advion™)
    - Advion™ bait fastest broadcast treatment for fire ants
- Pyrethroids
- Neo-nicotinoids

Low impact pesticides

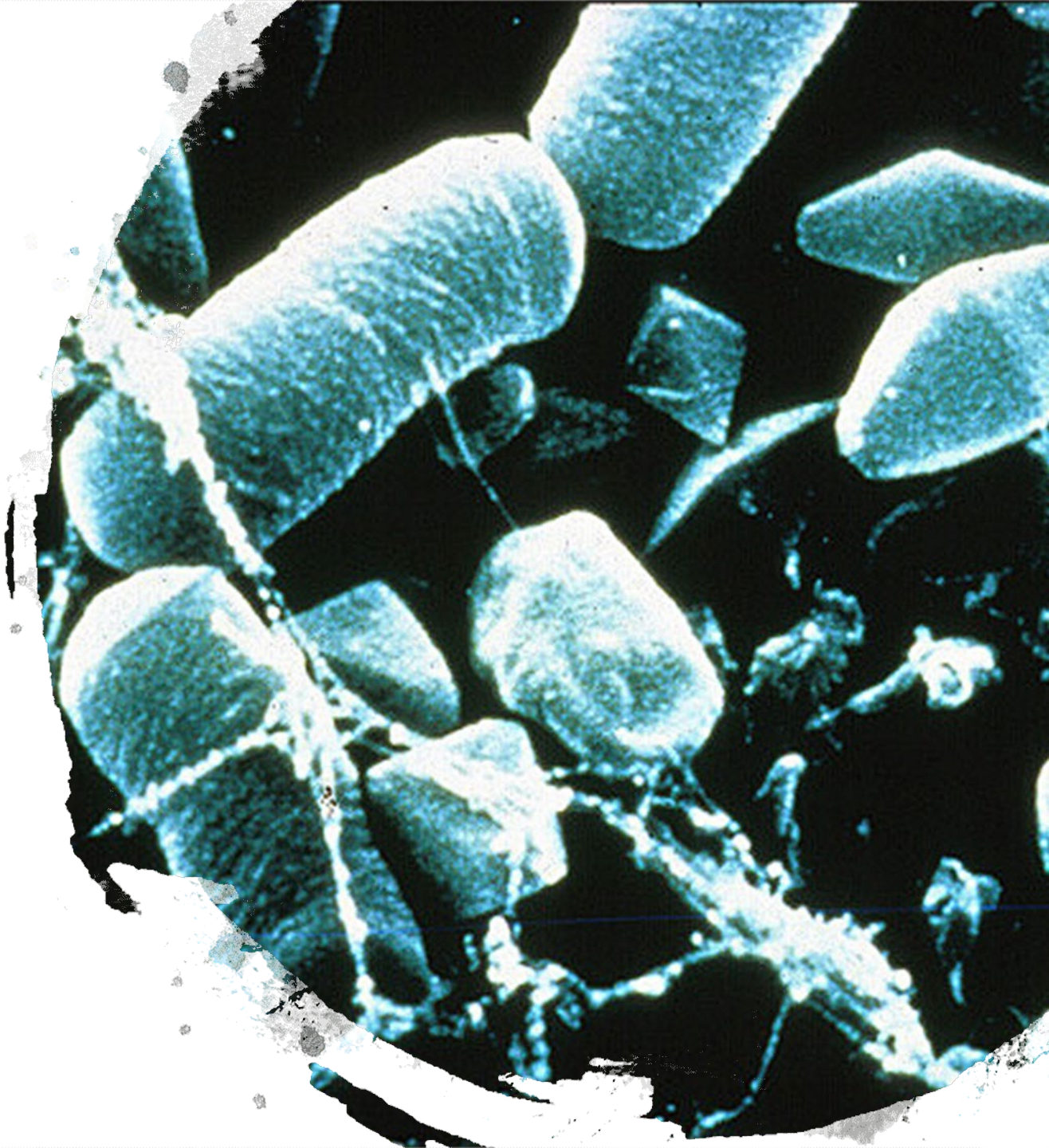
- Contact or short-lived insecticides
  - Insect growth regulators
  - Botanicals - pyrethrums
  - Microbials – Bt, Spinosad
  - Baits – roach, cricket
  - Low toxicity inorganics – DE, boric acid
  - Soaps & oils

Certain inorganic pesticides

- Examples
  - Boric acid
  - Disodium octoborate tetrahydrate (borates)
  - Silica aerogel
  - Diatomaceous earth
- Stomach poisons (borates and boric acid)
- Sorptive dusts (silica aerogel, diatomaceous earth) that absorb the waxy layer from the cuticle of pests.
- Derived from minerals or chemical compounds that occur as deposits in nature

Microbials

- Active or killed microbes
  - *Bacillus thuringiensis, Beauveria bassiana*, etc.
    - Larvae of moths, butterflies, mosquitoes
- Microbial byproducts
  - Spinosad (see next slide)
  - Avermectin
    - Examples
      - avermectin (Advance, Avid, Vendetta)
      - Ivermectin (pets and head lice)
      - milbemectin (Safer Caterpillar Killer)
        - is a reduced-risk product
    - Nerve toxin, chloride channel activators
    - Microbe bases
      - avermectin derived from fermentation of *Streptomyces avermitilis*, a soil microorganism



Spinosyns (Naturalyte class)

- Examples
  - Monterey Garden Insect Spray
  - Conserve SC Spinosad Insecticide
- Nerve toxin at site of nicotinic acetylcholine receptor
- Leaf residual 2-16 days
- Safe for many beneficials, toxic as direct spray to honey bees
- Okay to use in vegetable gardens for fire ants
- OMRI Certified

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


HARTZ
Control
Pet Care System
FOR CATS
ULTIMATE FLEA COLLAR
KILLS FLEAS, KILLS EGGS
FOR 7 MONTHS
KILLS FLEA EGGS


EXTINGUISH
Professional Fire Ant Bait
Eliminates Fire and Pavement Ant Colonies
Stops the Development of New Mounds
No Withdrawal Period or Grazing Restrictions on Treated Areas
1 Bag Treats 25 Acres with Precor® Insect Growth Regulator
KEEP OUT OF REACH OF CHILDREN
CAUTION

IGRs

Botanicals

- Derived directly from plants
- Some more toxic than others
- Sometimes referred to as “organic”
- Break down faster in the environment
- Various modes of action
- Usually short-residual
- Short residuals usually mean minimal impact on beneficials

- Pesticides derived from plants
  - pyrethrins
  - neem extracts
  - various plant oils
  - rotenone
  - limonene, linalool
  - Mint oils
  - citrus oils
  - clove oil
  - 2-phenethyl proprionate
  - other essential oils

Pyrethrum (pyrethrins = natural)

- 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

Baits

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

Soaps and Oils

- Insecticidal soaps & oils
- Kill small and soft-bodied insects and mites. Must come in direct contact with pest to kill. Short residue.
- Easy recipe: 1 ½ teaspoons of Dawn liquid detergent per one quart of water.
- Examples: Safer's soap, Sunspray Ultrafine Spray Oil, vegetable and neem oils

Mode of action

Soaps most likely kill insects through cell destruction via entering through spiracles, and other body openings

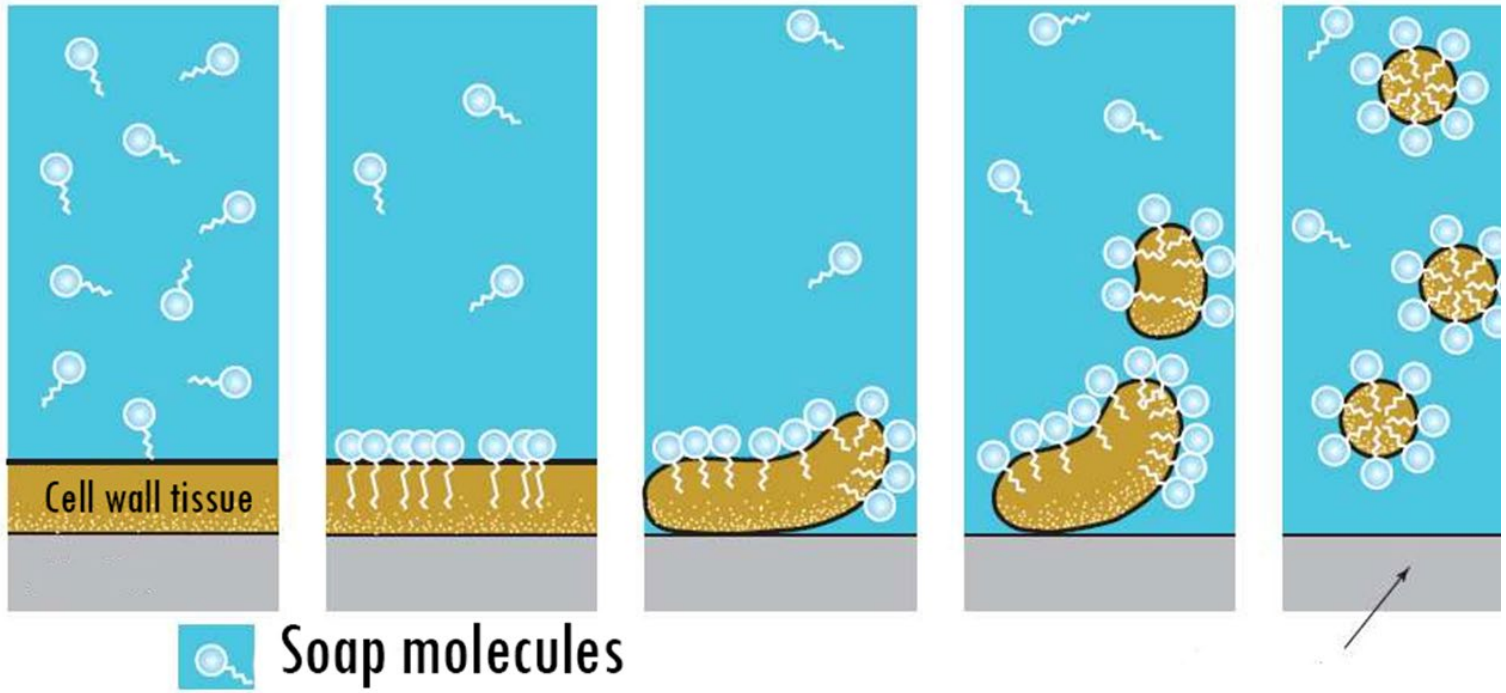


Image modified from http://guernseydonkey.com

Pyrethroids – Synthetic (not natural)

- Broad spectrum replacements for Dursban®
  - permethrin
  - cyfluthrin
  - bifenthrin
  - allethrin
  - sumithrin
  - tetramethrin
  - Esfenvalerate
  - Fluvalinate
- Good residual in soil, on leaves
- Affects nerves at sodium channel

- Low in toxicity to birds and mammals, but hazardous to fish
- Bind tightly to organic matter in soil, difficult to move into soil profile
- Some cause skin irritation to humans
- Wide applicability and useful residual

Nicotinoids

- Examples
  - Acetamiprid (Temprid SC Insecticide)
  - Clothianidin (Tandem Insecticide)
  - Dinotefuran (Safari & Merit)
  - Imidacloprid (Merit)
  - Nitenpyram (Guardian mostly for pets)
  - Thiacloprid (Rose Shield concentrate)
  - Thiamethoxam (Helix Xtra)
- Nerve toxins at nicotinic receptor (mimics nicotin)
- Systemic, Good residual in plants, soil.
- Moderate impact on beneficials
- Toxic to Pollinators

Neonicotinoid controversies

- Several studies claim to show that neonicotinoids cause colony collapse disorder (CCD)
- Bee researchers in U.S. claim that CCD is result of multiple factors, neonics a minor problem
- Conservationists pressing EPA for bans or restrictions on these pesticides
- Urban use accounts for very minor slice of overall neonicotinoid market
- New labels and labelling will address the issue

The End

You made it – pat yourself on the back

Visit our Podcast

https://bugs-by-the-yard.captivate.fm/