How Characteristics of Insecticides Affect Field Performance/Risks

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ASSOCIATION OF MONTANA TURF, ORNAMENTAL & PEST PROFESSIONALS
AMTOPP

Insecticide Recommendations for Japanese Beetle – 60 Years Ago

Japanese Beetle
Adult Control

Japanese beetle adult

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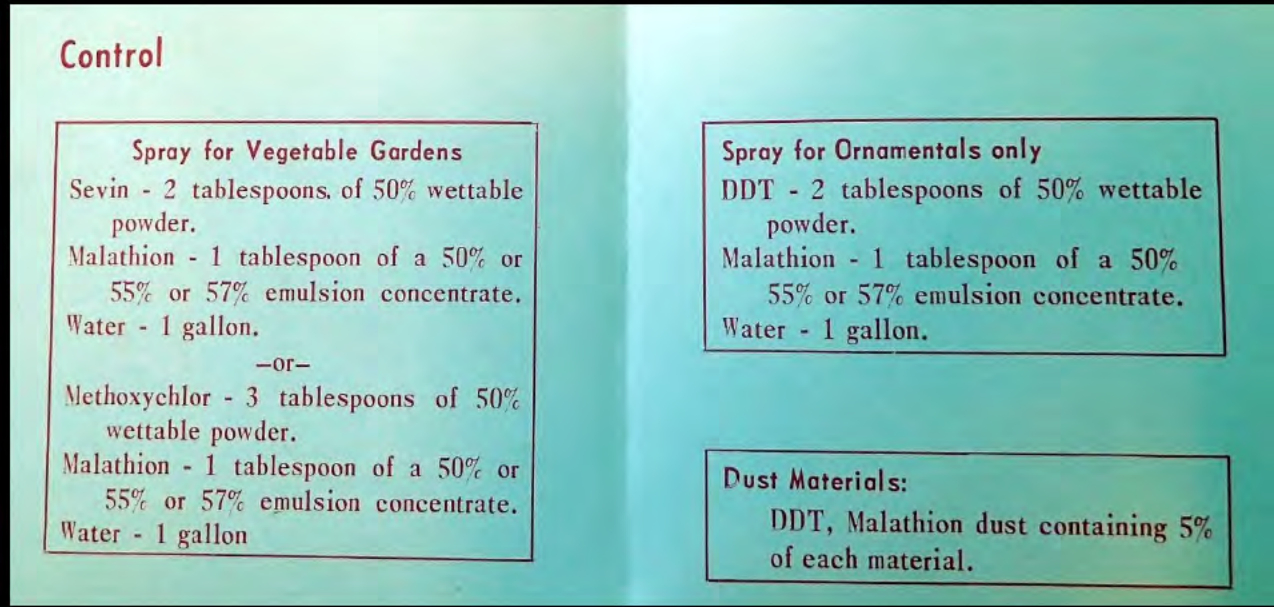
Misc. Pub. No. 89



Control

Spray for Vegetable Gardens

Sevin - 2 tablespoons of 50% wettable powder.
Malathion - 1 tablespoon of a 50% or 55% or 57% emulsion concentrate.
Water - 1 gallon.

–or–

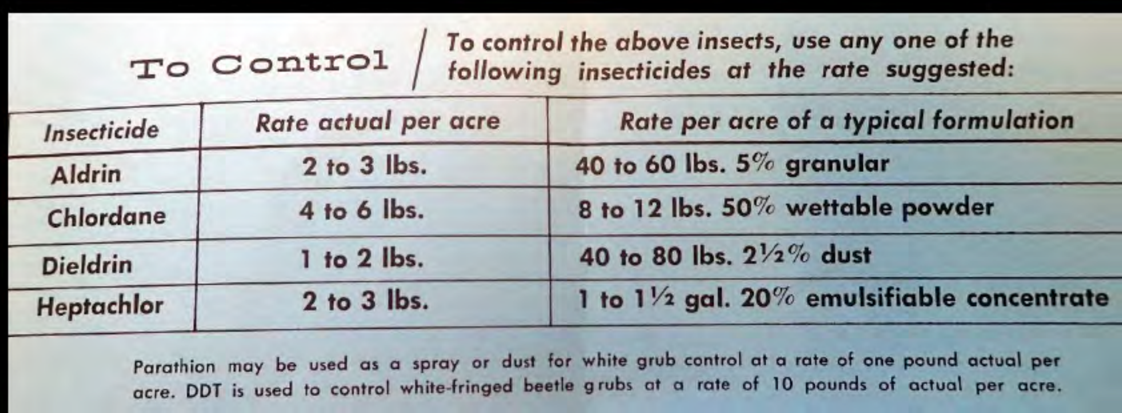
Methoxychlor - 3 tablespoons of 50% wettable powder.
Malathion - 1 tablespoon of a 50% or 55% or 57% emulsion concentrate.
Water - 1 gallon

Spray for Ornamentals only

DDT - 2 tablespoons of 50% wettable powder.
Malathion - 1 tablespoon of a 50% 55% or 57% emulsion concentrate.
Water - 1 gallon.

Dust Materials:

DDT, Malathion dust containing 5% of each material.



To Control | *To control the above insects, use any one of the following insecticides at the rate suggested:*

Insecticide	*Rate actual per acre*	*Rate per acre of a typical formulation*
Aldrin	2 to 3 lbs.	40 to 60 lbs. 5% granular
Chlordane	4 to 6 lbs.	8 to 12 lbs. 50% wettable powder
Dieldrin	1 to 2 lbs.	40 to 80 lbs. 2½% dust
Heptachlor	2 to 3 lbs.	1 to 1½ gal. 20% emulsifiable concentrate

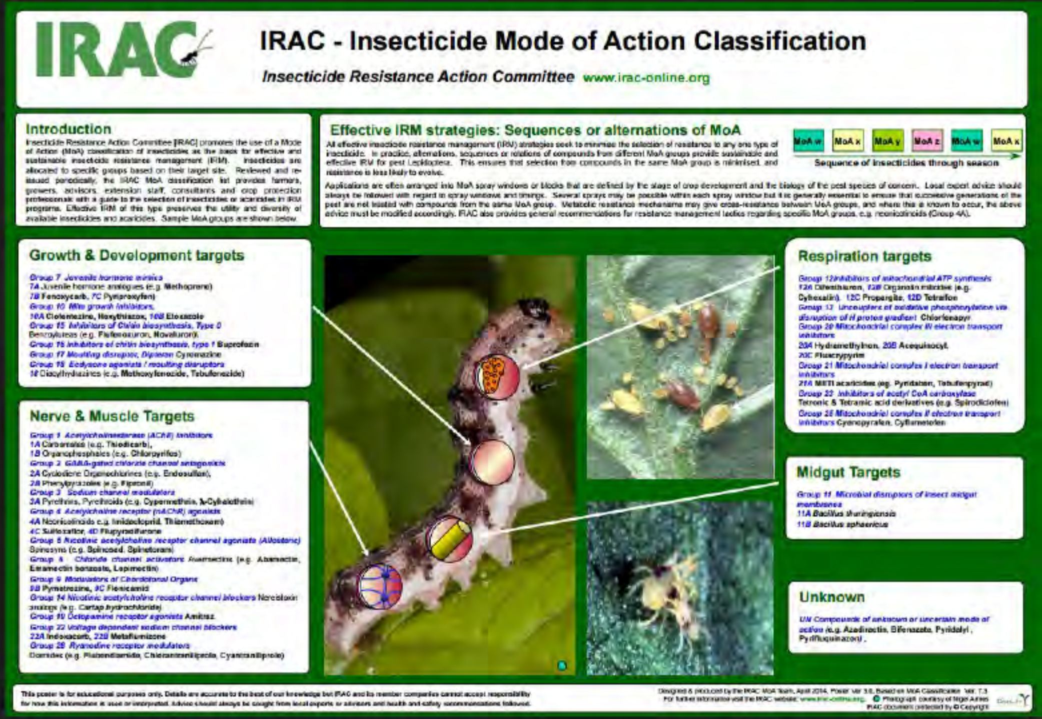
Parathion may be used as a spray or dust for white grub control at a rate of one pound actual per acre. DDT is used to control white-fringed beetle grubs at a rate of 10 pounds of actual per acre.

For soil stages of insects

Chemical characteristics affecting performance can include:

- **Water solubility**
- **Sorption coefficient (Koc)**
- **Persistence after application**
- **Host range of species affected**
- **Mode of action**

A great source of information on insecticide classes and their mode of action



IRAC – Insecticide Resistance Action Coalition

There are over two dozen modes of action of insecticides and miticides

IRAC - Insecticide Mode of Action Classification

Insecticide Resistance Action Committee www.irac-online.org

Introduction

Insecticide Resistance Action Committee [IRAC] promotes the use of a Mode of Action (MoA) classification of insecticides as the basis for effective and sustainable insecticide resistance management (IRM). Insecticides are allocated to specific groups based on their target site. Reviewed and re-issued periodically, the IRAC MoA classification list provides farmers, growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of insecticides or acaricides in IRM programs. Effective IRM of this type preserves the utility and diversity of available insecticides and acaricides. Sample MoA groups are shown below.

Effective IRM strategies: Sequences or alternations of MoA

All effective insecticide resistance management (IRM) strategies seek to minimise the selection of resistance to any one type of insecticide. In practice, alternations, sequences or rotations of compounds from different MoA groups provide sustainable and effective IRM for pest Lepidoptera. This ensures that selection from compounds in the same MoA group is minimised, and resistance is less likely to evolve.

MoA w | MoA x | MoA y | MoA z | MoA w | MoA x

Sequence of insecticides through season

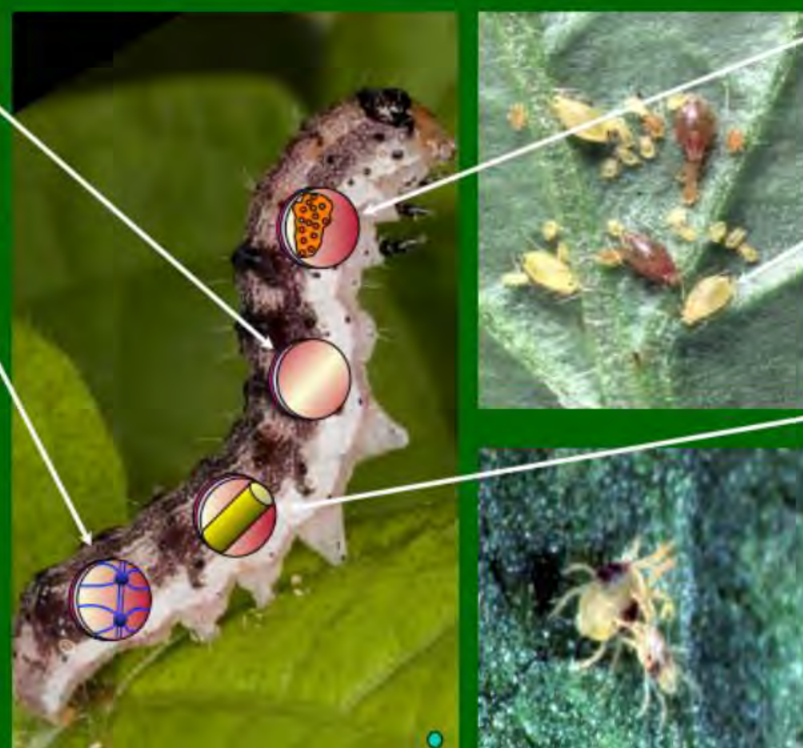
Applications are often arranged into MoA spray windows or blocks that are defined by the stage of crop development and the biology of the pest species of concern. Local expert advice should always be followed with regard to spray windows and timings. Several sprays may be possible within each spray window but it is generally essential to ensure that successive generations of the pest are not treated with compounds from the same MoA group. Metabolic resistance mechanisms may give cross-resistance between MoA groups, and where this is known to occur, the above advice must be modified accordingly. IRAC also provides general recommendations for resistance management tactics regarding specific MoA groups, e.g. neonicotinoids (Group 4A).

Growth & Development targets

Group 7 Juvenile hormone mimics
7A Juvenile hormone analogues (e.g. **Methoprene**)
7B **Fenoxycarb**, 7C **Pyriproxyfen**)
Group 10 Mite growth inhibitors,
10A **Clofentezine, Hexythiazox**, 10B **Etoxazole**
Group 15 Inhibitors of Chitin biosynthesis, Type 0
Benzoylureas (e.g. **Flufenoxuron, Novaluron**)\
Group 16 Inhibitors of chitin biosynthesis, type 1 **Buprofezin**
Group 17 Moulting disruptor, Dipteran **Cyromazine**
Group 18 Ecdysone agonists / moulting disruptors
18 Diacylhydrazines (e.g. **Methoxyfenozide, Tebufenozide**)

Nerve & Muscle Targets

Group 1 Acetylcholinesterase (AChE) inhibitors
1A Carbamates (e.g. **Thiodicarb**),
1B Organophosphates (e.g. **Chlorpyrifos**)
Group 2 GABA-gated chloride channel antagonists
2A Cyclodiene Organochlorines (e.g. **Endosulfan**),
2B Phenylpyrazoles (e.g. **Fipronil**)
Group 3 Sodium channel modulators
3A Pyrethrins, Pyrethroids (e.g. **Cypermethrin, λ-Cyhalothrin**)
Group 4 Acetylcholine receptor (nAChR) agonists
4A Neonicotinoids e.g. **Imidacloprid, Thiamethoxam**)
4C **Sulfoxaflor**, 4D **Flupyradifurone**
Group 5 Nicotinic acetylcholine receptor channel agonists (Allosteric)
Spinosyns (e.g. **Spinosad, Spinetoram**)
Group 6 Chloride channel activators Avermectins (e.g. **Abamectin, Emamectin benzoate, Lepimectin**)
Group 9 Modulators of Chordotonal Organs
9B **Pymetrozine**, 9C **Flonicamid**
Group 14 Nicotinic acetylcholine receptor channel blockers Nereistoxin analogs (e.g. *Cartap hydrochloride*)
Group 19 Octopamine receptor agonists **Amitraz**
Group 22 Voltage dependent sodium channel blockers
22A **Indoxacarb**, 22B **Metaflumizone**
Group 28 Ryanodine receptor modulators
Diamides (e.g. **Flubendiamide, Chlorantraniliprole, Cyantraniliprole**)



Respiration targets

Group 12 Inhibitors of mitochondrial ATP synthesis
12A **Difenthiuron**, 12B Organotin miticides (e.g. **Cyhexatin**), 12C **Propargite**, 12D **Tetraifon**
Group 13 Uncouplers of oxidative phosphorylation via disruption of H proton gradient **Chlorfenapyr**
Group 20 Mitochondrial complex III electron transport inhibitors
20A **Hydramethylnon**, 20B **Acequinocyl**,
20C **Fluacrypyrim**
Group 21 Mitochondrial complex I electron transport inhibitors
21A **METI acaricides (eg. Pyridaben, Tebufenpyrad)**
Group 23 Inhibitors of acetyl CoA carboxylase
Tetronic & Tetramic acid derivatives (e.g. Spirodiclofen)
Group 25 Mitochondrial complex II electron transport inhibitors **Cyenopyrafen, Cyflumetofen**

Midgut Targets

Group 11 Microbial disruptors of insect midgut membranes
11A Bacillus thuringiensis
11B Bacillus sphaericus

Unknown

UN Compounds of unknown or uncertain mode of action (e.g. **Azadiractin, Bifenazate, Pyridalyl, Pyrifluquinazon**).

Designed & produced by the IRAC MoA Team, April 2014, Poster Ver 3.0, Based on MoA Classification Ver. 7.3
For further information visit the IRAC website: www.irac-online.org. Photograph courtesy of Nigel Armes

Mode of action – how does the pesticide work to kill?

Insecticide Resistance Action Committee (IRAC) Web Site

http://www.irac-online.org/

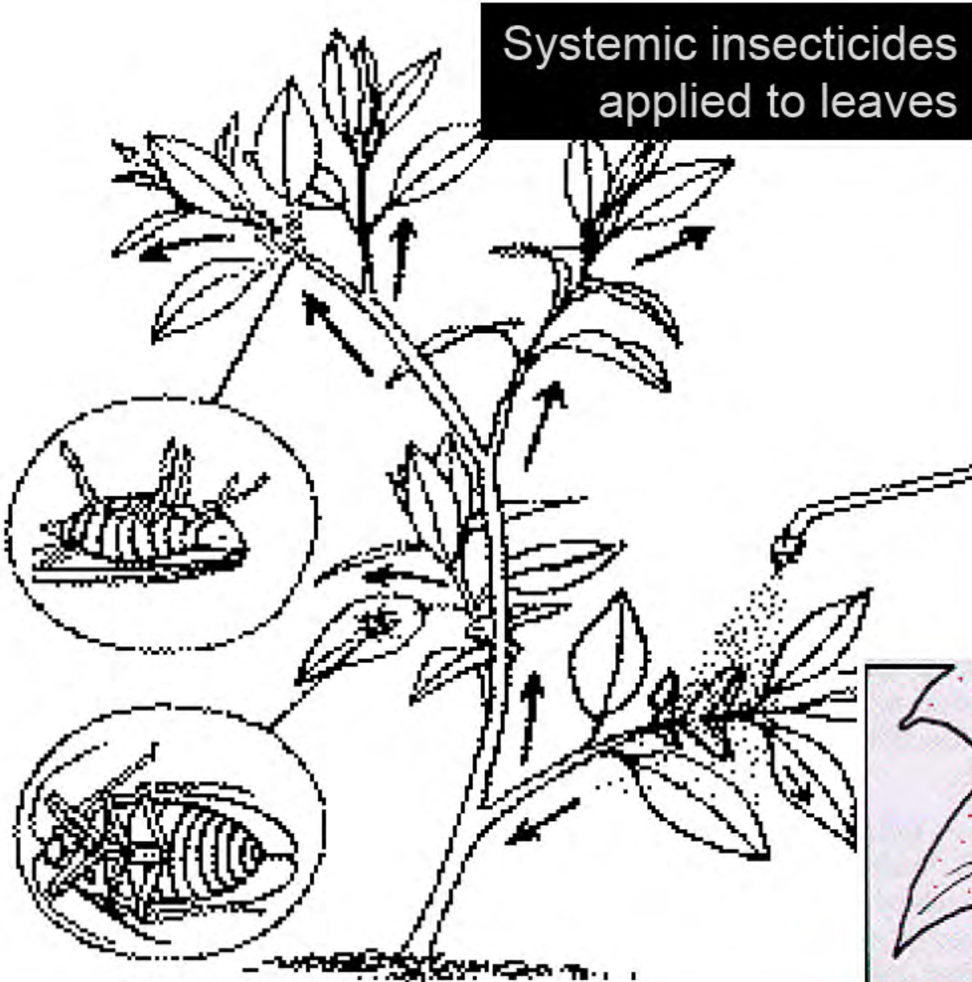
Check the section on Mode of Action to learn of the various classes of insecticides that have been developed

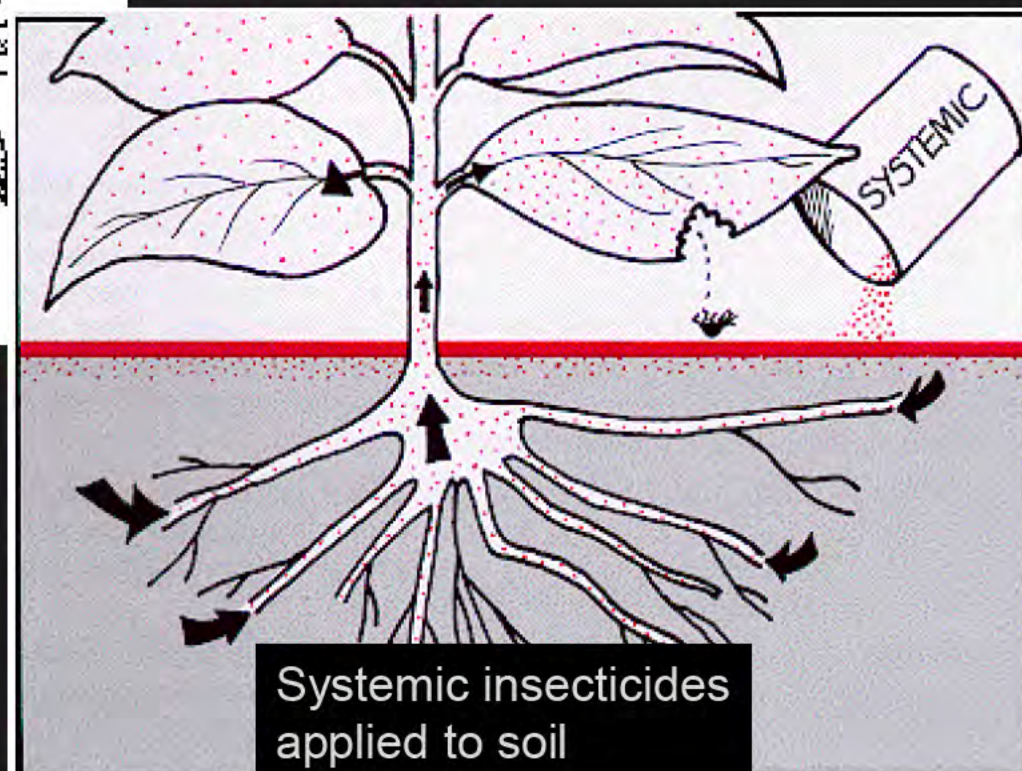
Presently there are 29 insecticide/miticide groups recognized with different modes of action.

Common Insecticide Classes

- Pyrethroids
- Neonicotinoids
- Organophosphates
- Diamides
- Avermectins
- Spinosyns
- Insect growth regulators
- Mite growth inhibitors
- Azadirachtin
- Insecticidal soaps*
- Horticutural oils*
- Microbial insecticides*

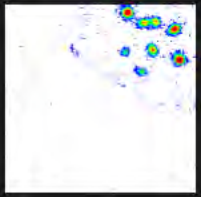
Is a pesticide **systemic** in plants?



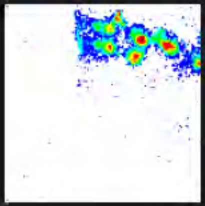


Key Features:
Water solubility,
Koc

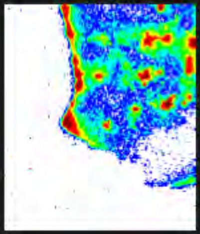
Distribution of C^{14} labeled Thiamethoxam™ 25WG after a foliar application to cucumber leaves



1 hour after application



8 hour after application



24 hour after application

Slide Credit: N. Rechcigl

Water Solubility

- Describes the amount of pesticide that can dissolve in water
- Standard measure is mg/liter (parts per million)
  - The higher the number, the more water soluble it is

Comparison of Water Solubility Between Two Insecticide Classes

Pyrethroids

- Bifenthrin (Onyx)

  –0.1

- Permethrin (Astro)

  –0.006

Neonicotinoids

- Imidacloprid (Merit)

  –610

- Acetamiprid (Tristar)

  –3482

- Dinotefuran (Safari)

  –39,830

Water Solubility among some Organophosphate Insecticides

- Acephate (Orthene)
  - 818,000
- Malathion
  - 130
- Chlorpyrifos (Dursban)
  - 0.4

Sorption Coefficient (Koc)

- Describes the tendency of the chemical to bind to soil particles or organic matter
- Standard measures of what percentage binds to different materials
  - The higher the number, the more the chemical binds to soil, organic matter

Comparison of Koc Values Between Two Insecticide Classes

Pyrethroids

- Bifenthrin (Onyx)
  - 240,000
- Permethrin (Astro)
  - 100,000

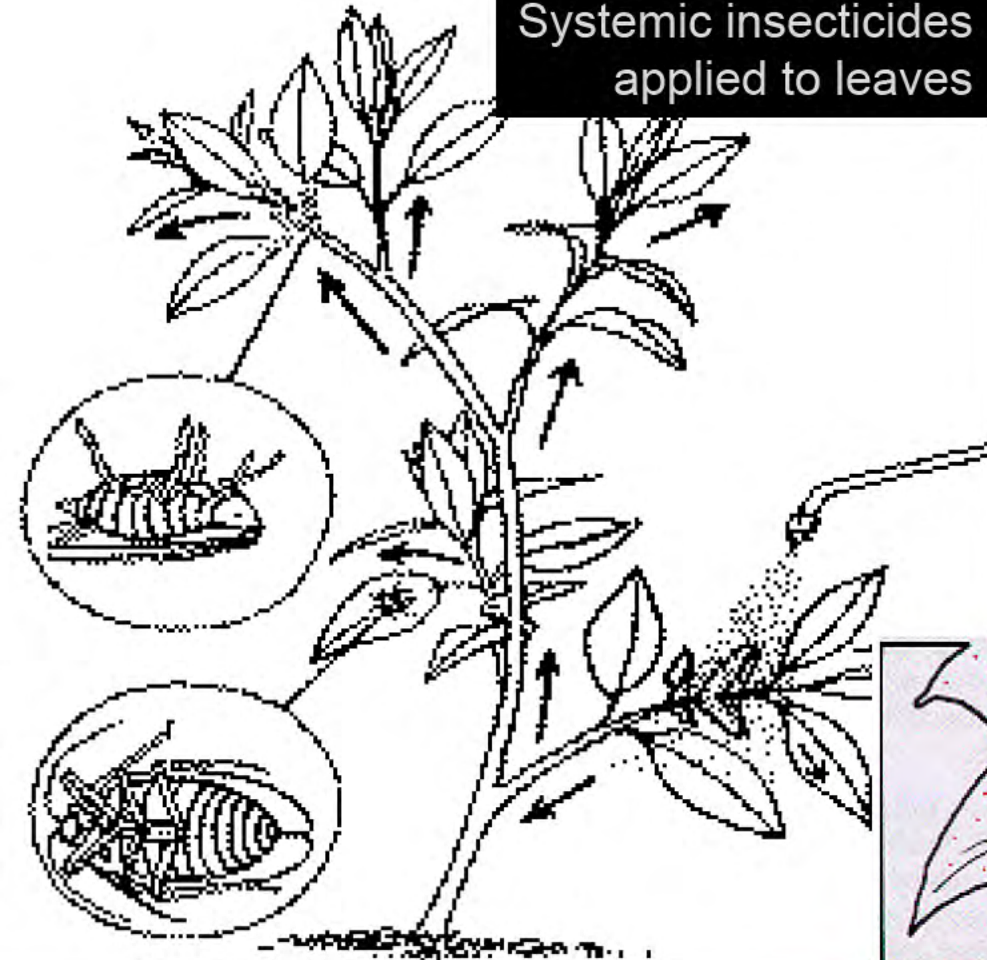
Neonicotinoids

- Imidacloprid (Merit)
  - 300
- Acetamiprid (Tristar)
  - 200
- Dinotefuran (Safari)
  - 25

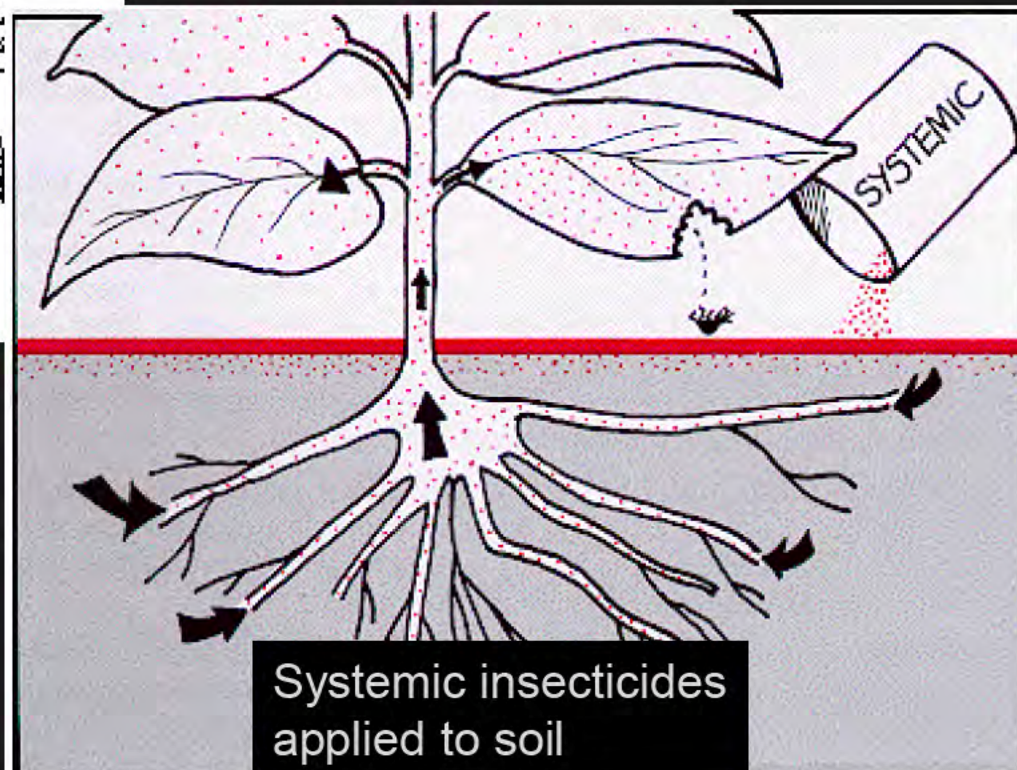
Within an Insecticide Class Koc Values Can Vary (Organophosphate Example)

- **Acephate (Orthene)**
  - **2**
- **Malathion**
  - **1800**
- **Chlorpyrifos (Dursban)**
  - **6070**

Systemic Insecticides will have **high water solubility** and a **low Koc value**



Systemic insecticides applied to leaves

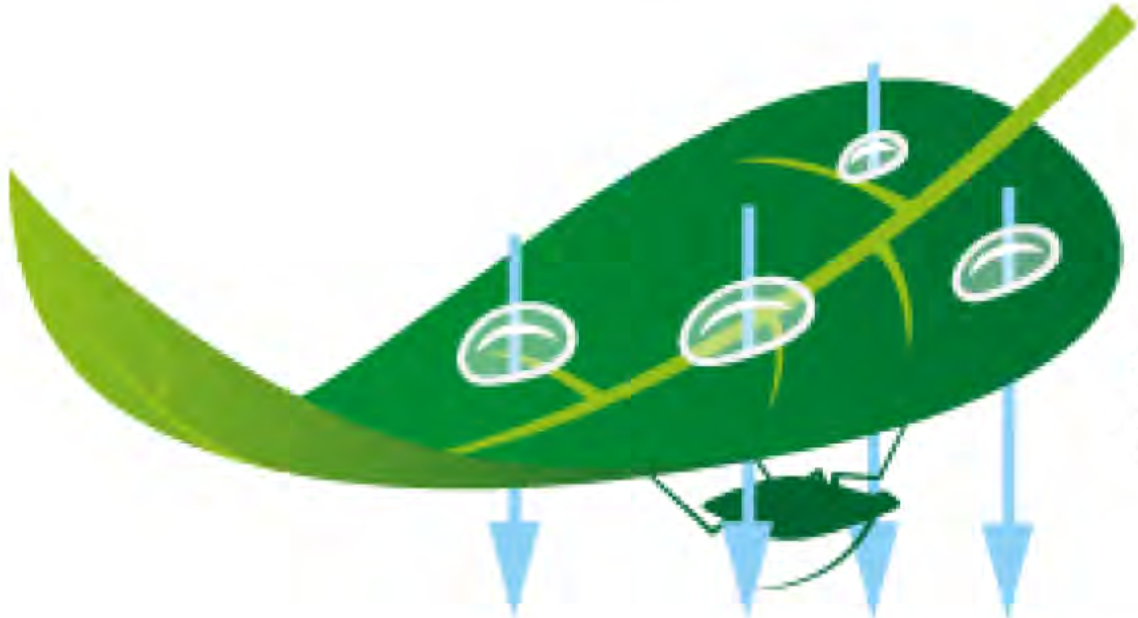


Systemic insecticides applied to soil

Systemic Insecticides

- *Capable of some translocation in plant*
- *Range exists in ability to move in plant*
  - Some limited to translaminar movement
  - Some broadly distribute in plant (usually to newer growth)
- *Systemic activity is limited to a small number of insecticides*
  - Most neonicotinoids
  - Diamides (limited)
  - Abamectin (translaminar only)

Translaminar movement – Insecticide can move through a leaf (but not necessarily to another leaf)

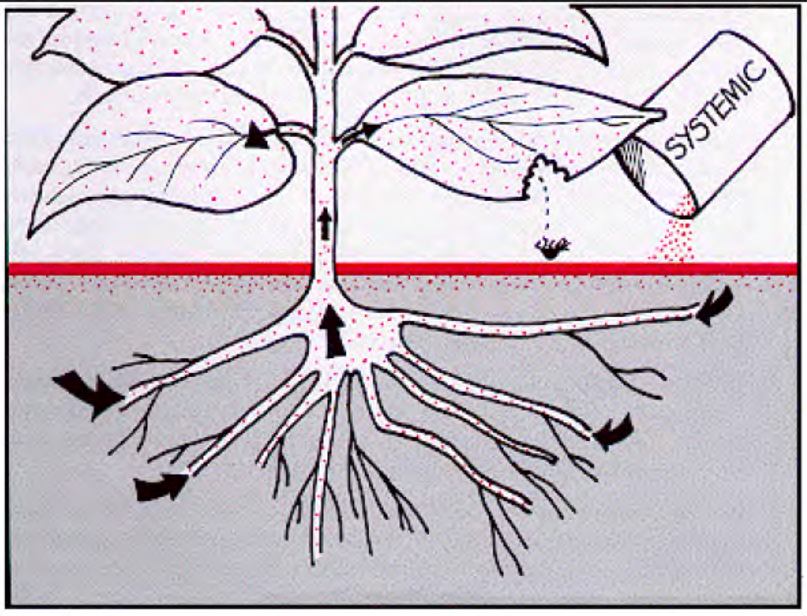


Example: **Foliar applications of abamectin (Avid)**

Systemic Insecticides

- *Capable of some translocation in plant*
- *Range exists in ability to move in plant*
  - Some limited to translaminar movement
  - Some broadly distribute in plant (usually to newer growth)
- ***Systemic activity is limited to a small number of insecticides***
  - **Most neonicotinoids**
  - **Diamides (limited)**
  - **A few organophosphates**
  - **Abamectin (translaminar only)**

Common method of applying systemic insecticides – soil applications for root uptake



Some insecticides can only move systemically if injected into the tree

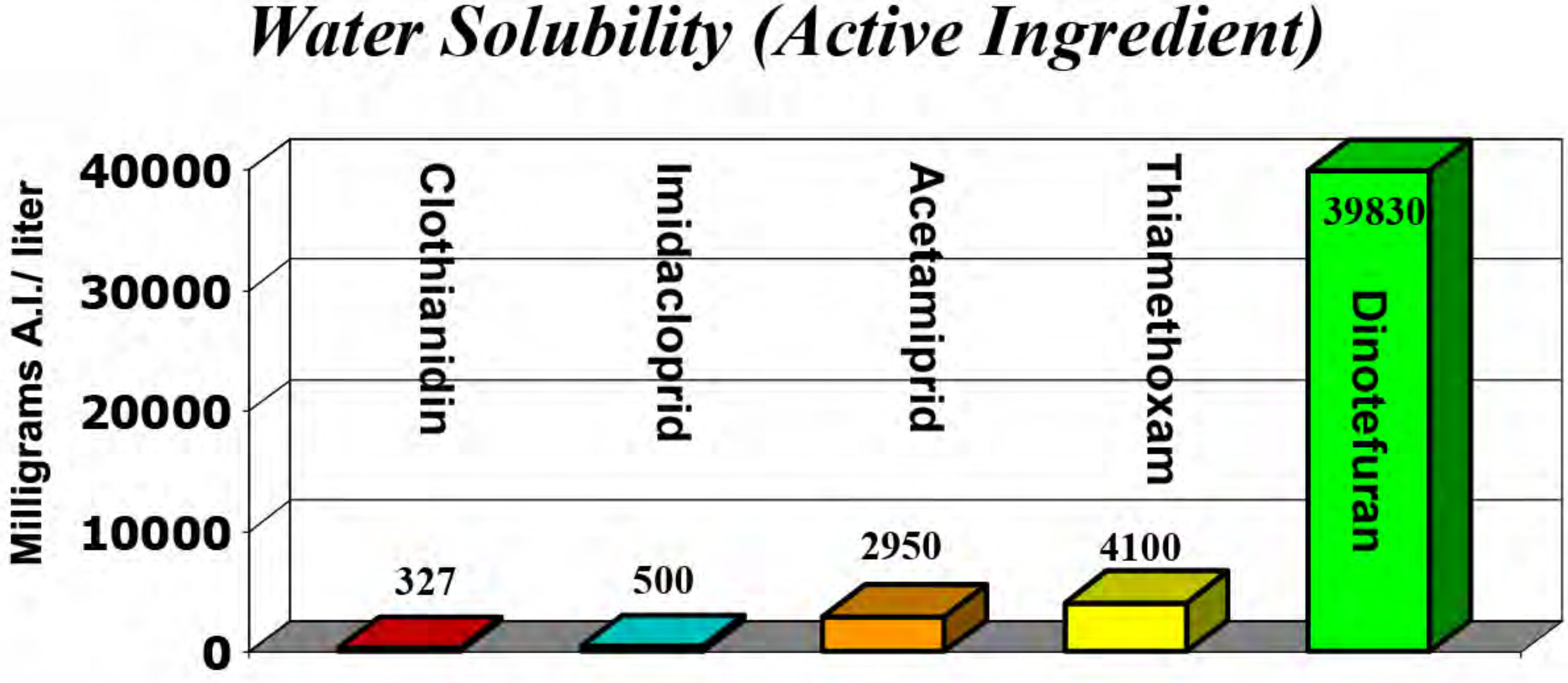
Trunk injection with emamectin benzoate

Trunk injection with azadirachtin (TreeAzin, Azasol, AzaGuard, etc.)

Commonly Used Neonicotinoid Insecticides

- Imidacloprid
  - Merit, Mallet, Dominion, Zenith, Imidacloprid, etc
- Chlothianidan
  - Arena
- Dinotefuran
  - Safari, Transtect, Zylam
- Acetamiprid
  - TriStar

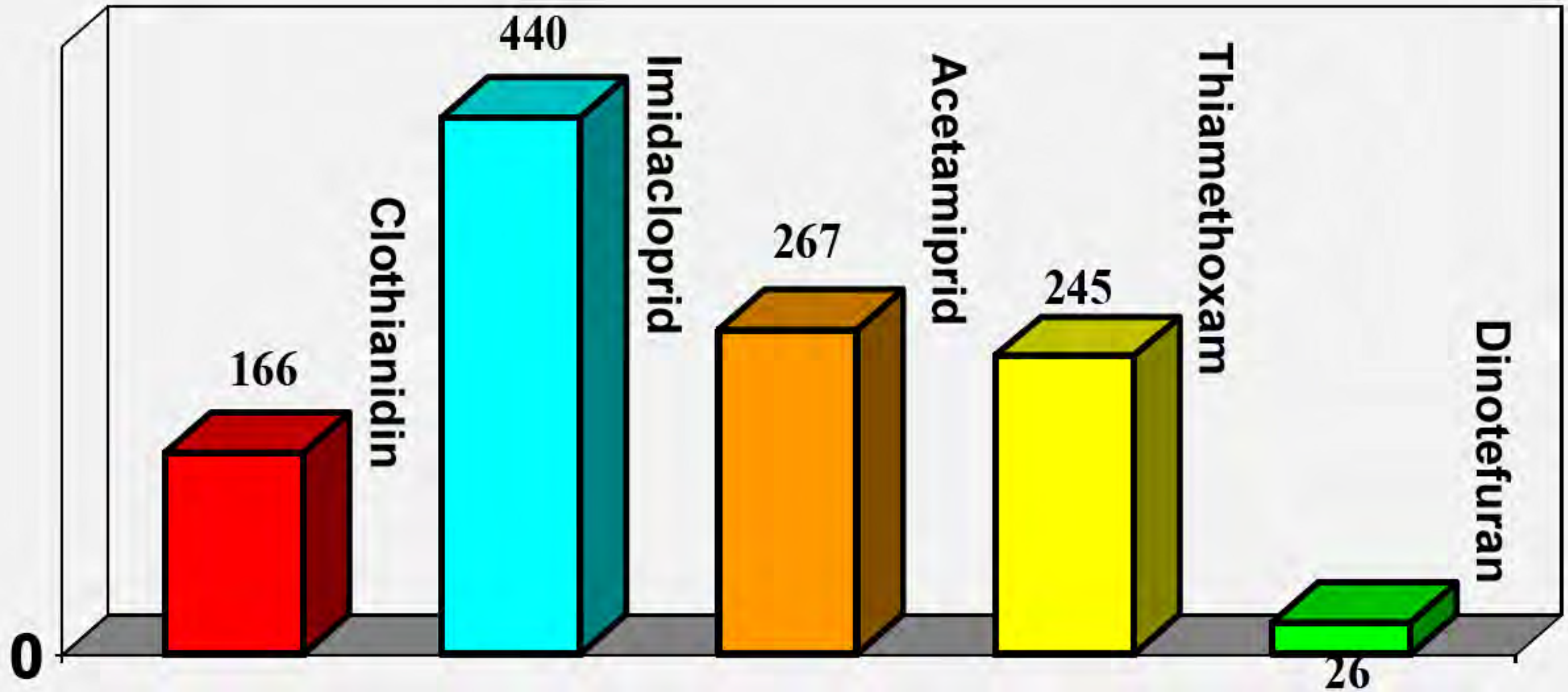
Relative Water Solubility of Neonicotinoids:



Information sources
Clothianidin (Celero), Acetamiprid (Tristar), Dinotefuran (Safari) – EPA Pesticide Fact Sheet
Imidacloprid (Marathon), hiamethoxam (Flagship) – MSDS for Products

Slide information courtesy J. Chamberlin

K_{oc} Values of Neonicotinoids:

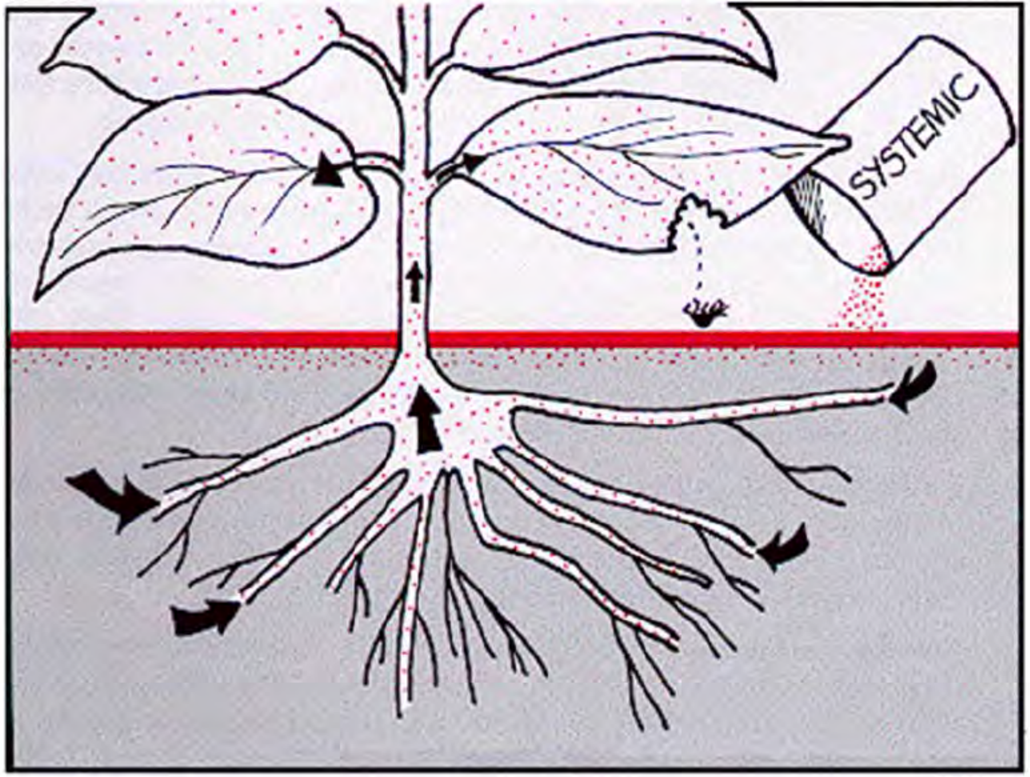


Source Data: EPA Pesticide Fact Sheets

Basal trunk spray with dinotefuran (Safari, Zylam, Transtect)

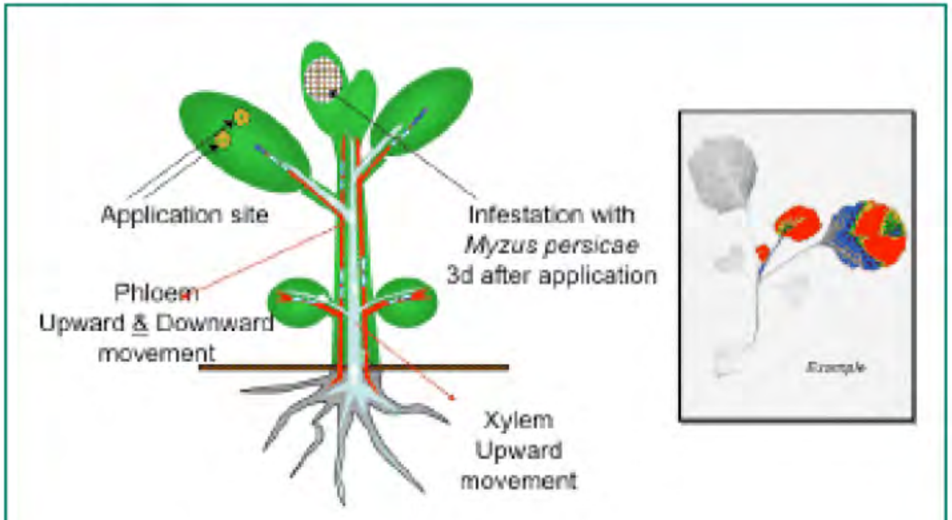
Whole tree sprays produce surface residues on all foliage. Natural enemies are killed. Natural controls are wasted.

Treatment area limited to bark of lower trunk. Impacts on natural enemies are minimized



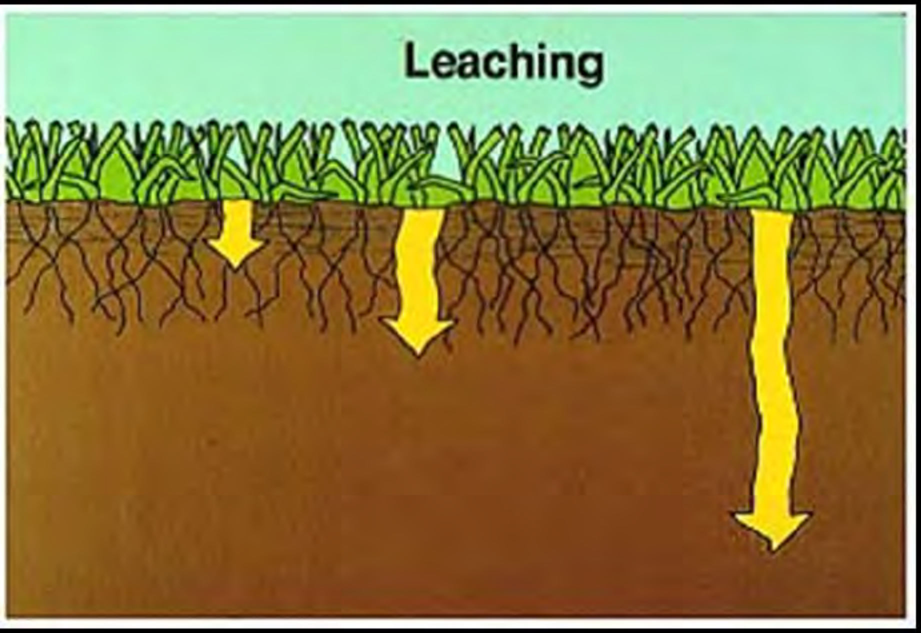
Essentially all systemic insecticides **move upward in the plant, via the xylem**

There is one insecticide **(spirotetramat (Kontos)** that moves readily in both the xylem and the phloem. It presently only has greenhouse/nursery use.



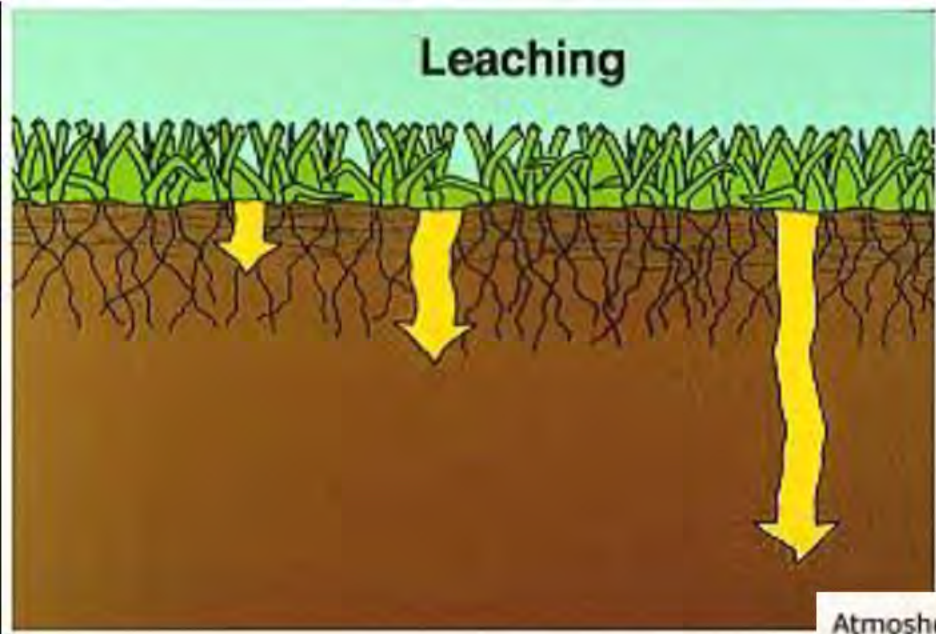
The diagram illustrates the true systemic up-and-down movement of Kontos.

Special Risks of Highly Mobile Insecticides



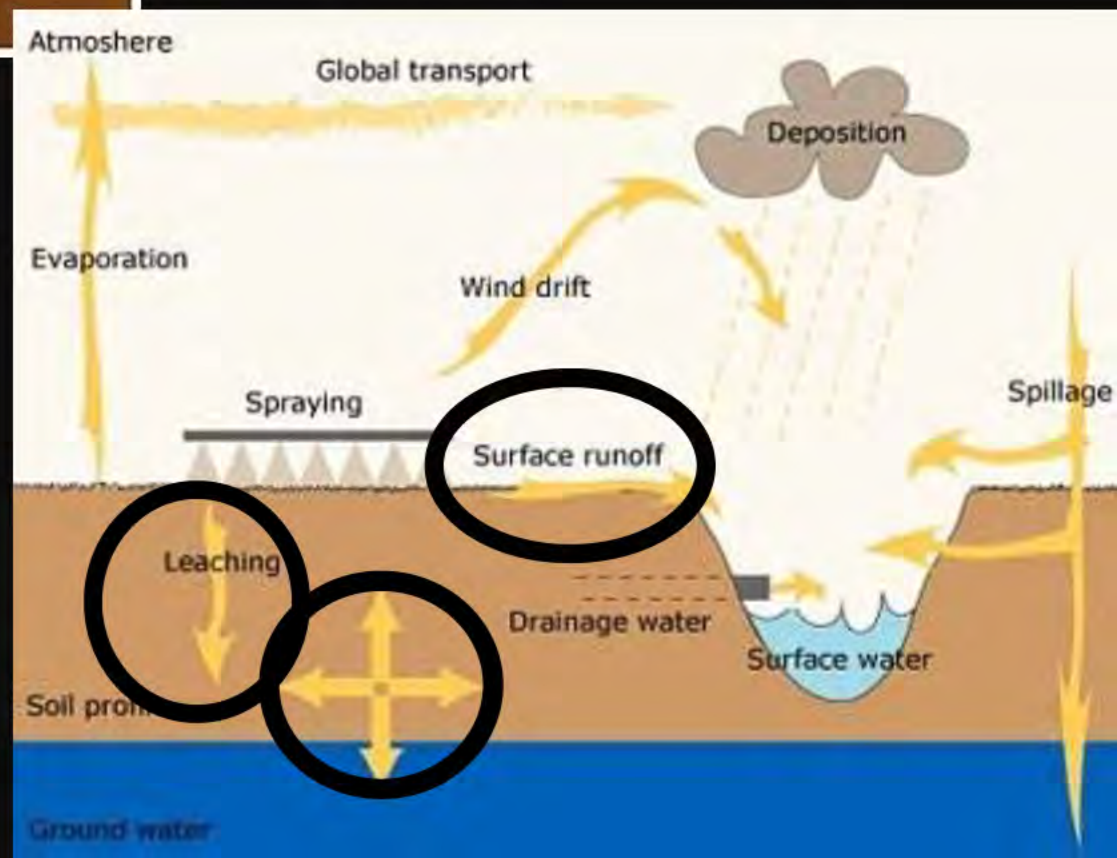
Leaching of insecticide into ground water

Movement of insecticide into nectar and/or pollen



Highly mobile insecticides often have high risk of moving into ground and surface waters

This can occur from downward leaching into groundwater, and from surface movement via run-off.



Dinotefuran is an insecticide with ***high risk of ending in nectar following application***

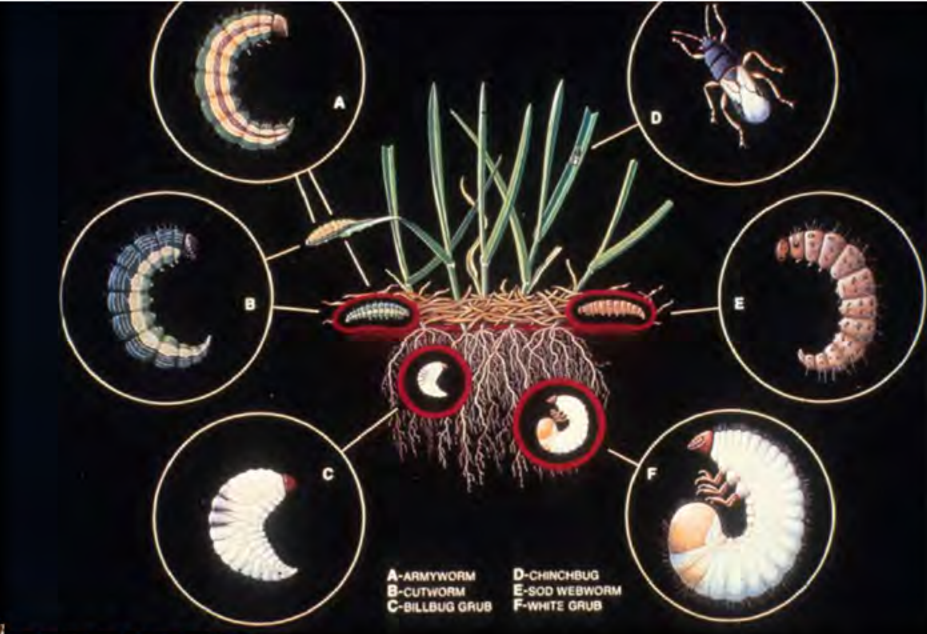
Bumble bee die-off in Wilsonville, Oregon following dinotefuran application

Insecticides and Pollinators: Bottom Line

Always avoid applications to plants *that bees are visiting* – *It is the law!*

Systemic Insecticides and Pollinators: Bottom Line?

Avoid applications to plants *that bees visit* that are in bloom – *or soon will be in bloom*



Surface feeding insects on turfgrass

For some insect control issues the chemicals with **low water solubility and high Koc value are useful features**

Preventive Sprays for Most Wood Borers and Bark Beetles – Key Timing

Target exposed life stages (Egg Laying/Egg Hatch)

Flatheaded borer larva just before egg hatch

Adult bark beetle

Foliar sprays are often used where target insect stages are on the bark

Insecticides Used for Trunk Sprays for Bark Beetles/Wood Borers

- Bifenthrin
  - Water solubility 0.1/Koc 240,000
- Permethrin
  - Water solubility 0.006/Koc 100,000
- Methocychlor
  - Water solubility 0.1/Koc 80,000
- Chlorpyrifos
  - Water solubility 0.4/Koc 6070
- Carbaryl
  - Water solubility 120/Koc 300

Active Ingredients of Wood Borer Insecticides (Trunk Sprays)

- **Permethrin** (Astro, Permethrin, Tengard)
- **Bifenthrin** (Onyx, Bifen, Baseline)

Insecticides with low water solubility and high capacity to bind to soil are ***worthless for treatment of insects in soil and are not systemic in plants***

Insecticide Persistence

- General measure – half life
- Factors affecting degradation
  - Sunlight/UV
  - Moisture
  - pH
  - Microbial degradation

Example of an insecticide that degrades very rapidly in high ph (>8.0) conditions:

Trichlorfon

Examples of insecticides that are very rapidly degraded upon exposure to sunlight

Bacillus thuringiensis

Pyrethrins

Pyrethrins

An example of an insecticide that ***very rapidly breaks down upon exposure to light***

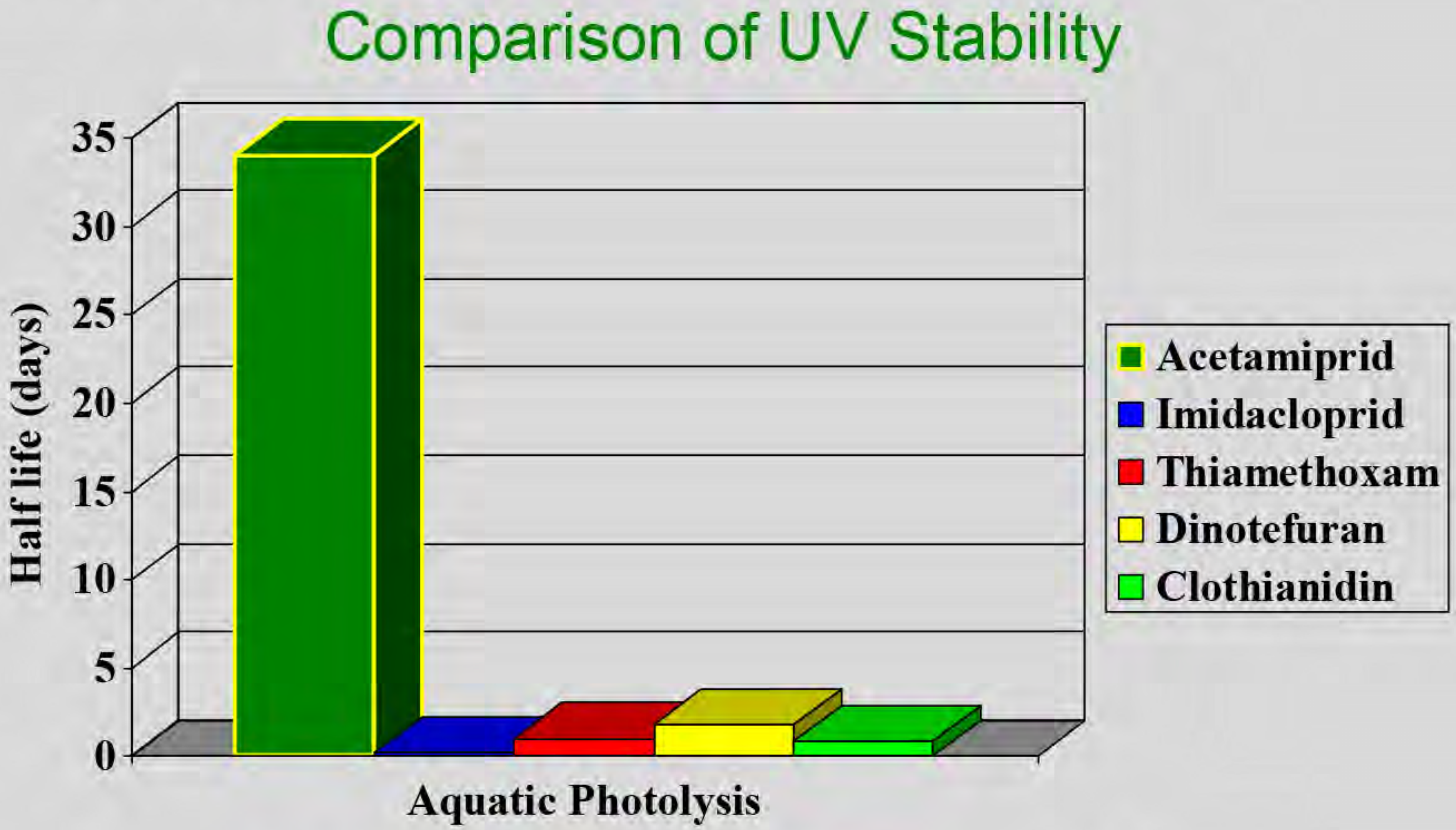
Tancetum (= *Chrysanthemum*) ***cineriariifolium***
Pyrethrum daisy – *source of pyrethrum*

Pyrethroid Insecticides
(a.k.a., synthetic pyrethrins)

Pyrethroid insectides are based on the chemistry of natural pyrethrins

Many pyrethroid insecticides have ability to persist for weeks - months

There is a wide range in stability of neonicotinoid insecticides when exposed to UV light



Data obtained from published EPA registration documents

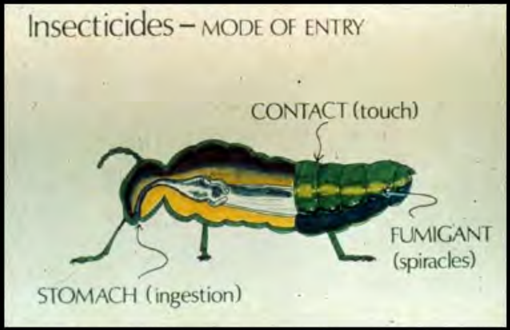
Slide Credit: R. Fletcher

Acetamiprid Characteristics and Niche

- **Advantages**
  - Stable in UV
  - Good on caterpillars
  - Fairly mobile in plant
  - Low toxicity to honey bees
- **Limitation**
  - Not suitable for soil application

Broad Spectrum *or Selective Activity?*

Pesticides can be selective due to ***Mode of Entry***



Soaps, Oils – Must be applied on body of target pest, no persistence

Bacillus thuringiensis – Must be ingested, short persistence

Pesticide that is Selective because it is ***Inherent Toxicity of the Pesticide***

What this means

higher LD_{50}/LC_{50} = less toxic

lower LD_{50}/LC_{50} = more toxic

LD50: Lethal dose that will kill 50% of the test population

To find information on the toxicity of an insecticide to non-target organisms (e.g., fish, birds, beneficial insects) try a search of "ecotoxicology <pesticide common name>"

Ecotoxicity Studies:

Birds

- Oral dose LD_{50}s for chickens, mallard ducks, and Japanese quail are >3000, >9800, and >13,500 mg/kg body weight, respectively.[1]
- Permethrin is low in toxicity to birds.[1] However, some aerosol spray formulations contain a propellant that may pose a hazard to birds by inhalation.[5]

Fish and Aquatic Life

- Permethrin is highly toxic to marine/estuarine, freshwater fish and other aquatic organisms.[3]
- For rainbow trout (***Oncorhynchus mykiss***), the 96-hour LC_{50} is 2.5 µg/L and the 48-hour LC_{50} is 5.4 µg/L. The 48-hour LC_{50}s for bluegill sunfish (***Lepomis macrochirus***) and ***Daphnia*** are 1.8 µg/L and 0.6 µg/L respectively.[1]
- Research with freshwater amphipods indicates permethrin in aquatic sediments may inhibit growth of exposed invertebrates at levels as low as 44-73 ng/g sediment.[36]
- In a sediment toxicity study, researchers found detectable levels of permethrin in 26 of 30 creek sediment samples in California. All 30 samples were found to be toxic to ***Hyalella azteca***, a local species of amphipod, at 15 °C. Several sediment samples also included other pyrethroids and low levels of organophosphates and/or organochlorines. Researchers concluded the main contributors to sediment toxicity in this study were bifenthrin, cypermethrin, cyfluthrin, and lambdacyhalothrin.[37]

Terrestrial Invertebrates

- Permethrin is highly toxic to invertebrates, including honey bees and other beneficial insects. The topical LC_{50} for honeybees is 0.029 µg/bee.[1,3]

This came up in a quick search of "ecotoxicology permethrin"

Pyrethroids are highly toxic to bees

Treated flowers may kill flower visitors for a couple of days after application

Acute Toxicity of Neonicotinoids to Adult Honey Bees

(Oral LD50 – micrograms/bee)

• Acetamiprid	14.53
• Imidacloprid	0.005
• Dinotefuran	0.056
• Thiamethoxam	0.005
• Chlothianidin	0.0003

My favorite/"go to" publication on this subject

Table 4. Active ingredients of commonly used pesticides and their effect on bees in California, Idaho, Oregon, and Washington

Active Ingredient	Highly Toxic to Bees (RT)	Toxic to Bees (RT)	No Bee Precautionary Statement (PS) on Label	Common Product Names	Notes and Special Precautions
Abamectin (Avermectin) *Fermentation products derived from soil bacterium, affects nerve and muscle action of insects and mites*	X 0.025 lb ai/acre 1-3 days ERT, ≤ 0.025 lb ai/acre 8 hours RT [1] [illegible]			Abacide, Abacus, Abba, Agmectin, Agri-Mek, Ardent, Avert, Avicta, Avid, Epi-Mek, Reaper, Solera, Solero, Temprano, Timectin, Zoro	ERT to bumble bees [2], short RT to alfalfa leafcutting bees and alkali bees at 0.025 lb ai/acre [1].
Acephate *Organophosphate insecticide*	X >3 days ERT [1] [illegible]			Bracket, Orthene, Orthonex	Incompatible with bumble bees [2]. ERT to alfalfa leafcutting bees and alkali bees [1].
Acequinocyl *Quinolone insecticide/miticide, metabolic poison*			X	Kanemite, Shuttle	
Acetamiprid *Neonicotinoid insecticide (cyano group)*		X Yes		Assail, Tristar, Transport	Length of residual toxicity to honey bees is unknown. ERT to alfalfa leafcutting bees and alkali bees [3]. 2 day ERT to bumble bees [2]. Cyano group neonicotinoids exhibit lower toxicity to bees than nitro group neonicotinoids [4].

Pollinator protection directions appear in label language.

Those that have highest hazard will have the **"bee box"** with strict use instructions to protect pollinators.

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

(continued)

PROTECTION OF POLLINATORS (continued)

Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications.
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives or off-site to pollinator attractive habitat can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at: http://pesticidestewardship.org/PollinatorProtection/Pages/default.aspx. Pesticide incidents (for example, bee kills) should immediately be reported to the State/Tribal lead agency. For contact information for your State, go to: www.aapco.org. Pesticide incidents should also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekill@epa.gov.

Issue of unusual concern with Japanese beetle

Overlap of adult feeding on flowers – ***and use of those flowers by pollinators***

Acelepryn (chlorantraniliprole) – a diamide class insecticide

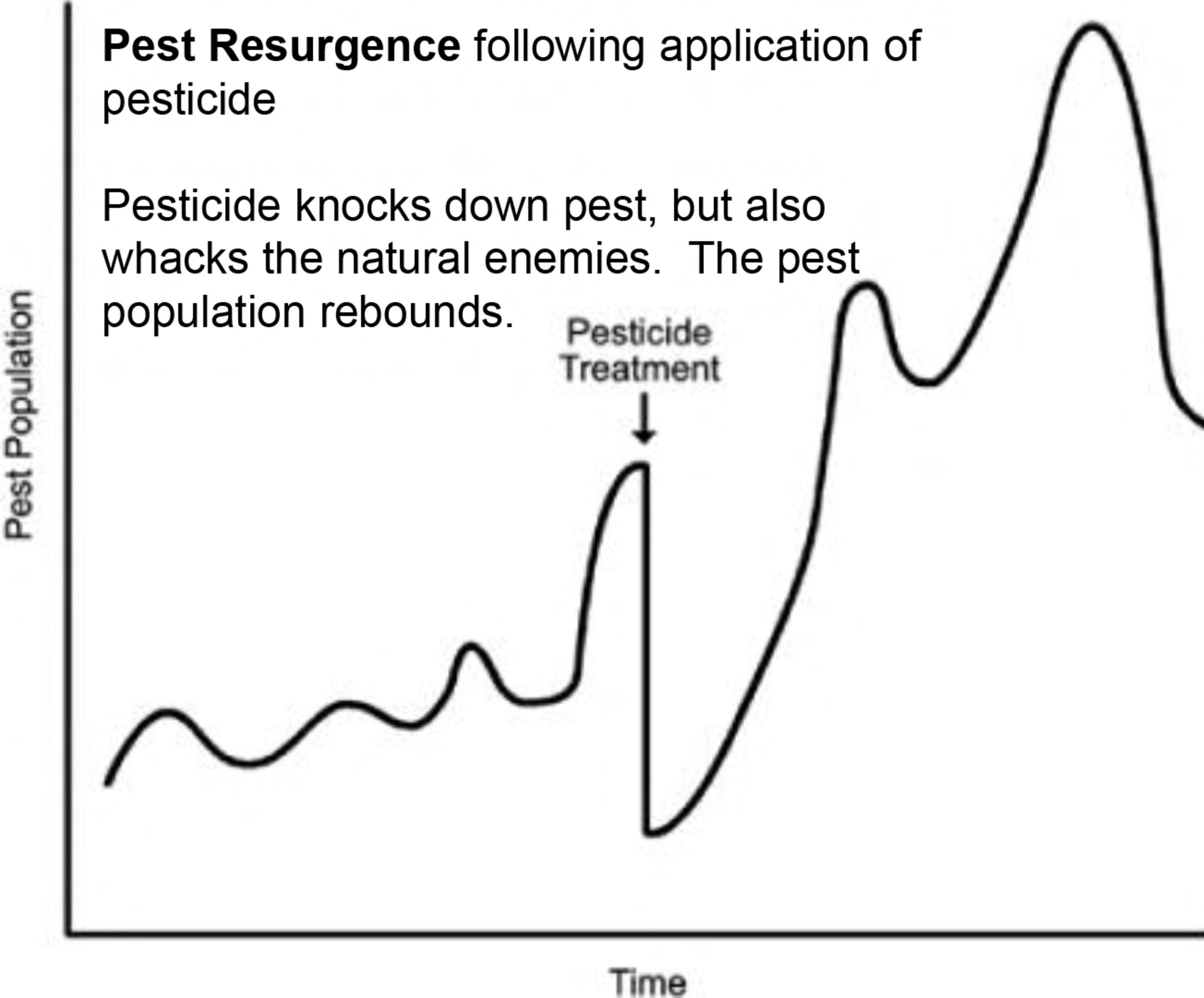
Two insecticides with particularly low hazard to bees, and no pollinator protection language on labels as a result

beetleGONE! (*Bacillus thuringiensis* var. *galleriae*) – a microbial insecticide

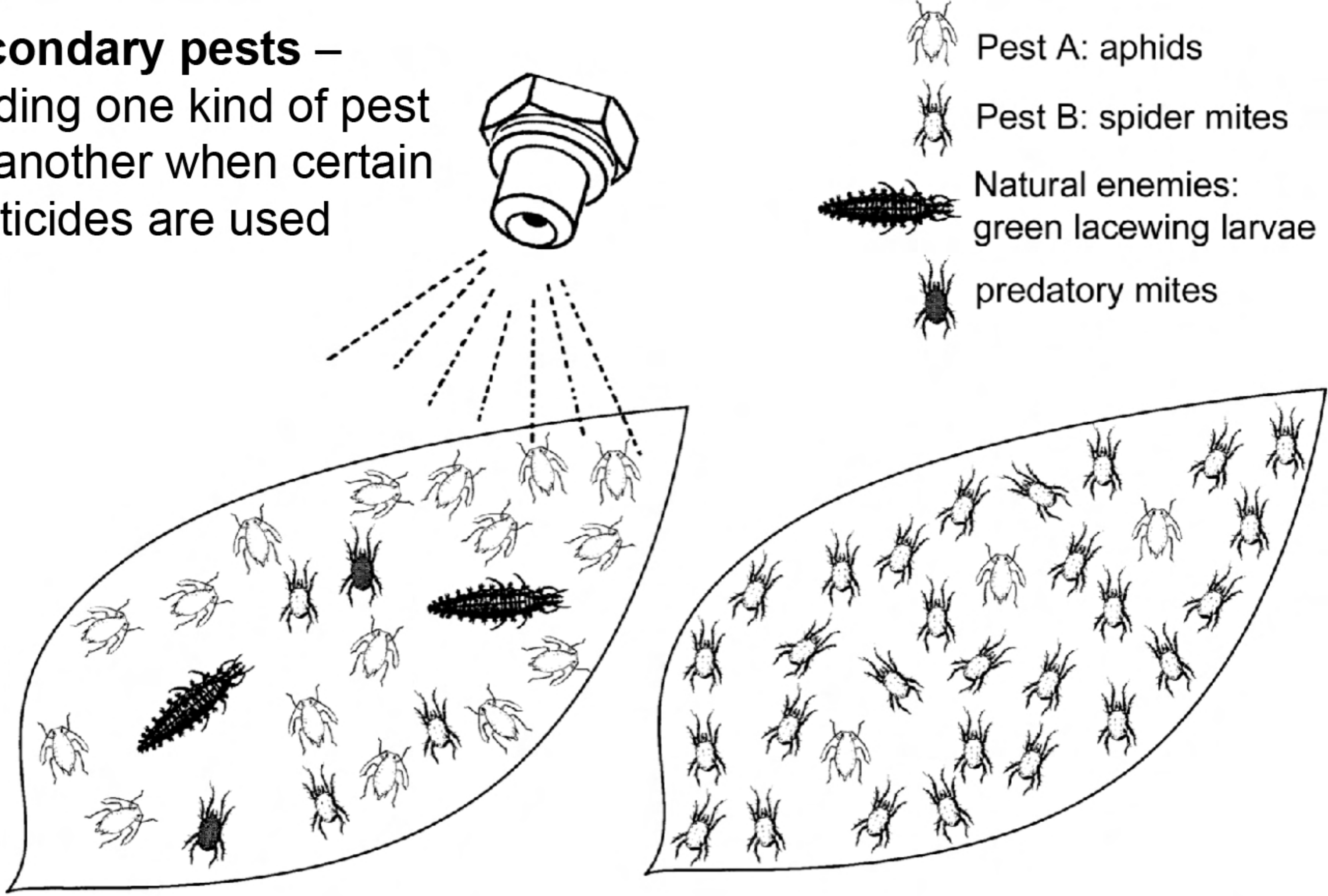
Non-selective pesticides can destroy natural enemies of insect/mite pests

Pest Resurgence following application of pesticide

Pesticide knocks down pest, but also whacks the natural enemies. The pest population rebounds.



Secondary pests – Trading one kind of pest for another when certain pesticides are used



A pesticide applied to control Pest A also kills natural enemies that are controlling Pest B.

Released from the control exerted by natural enemies, Pest B builds up to economically damaging levels.

Two plant pests with common track records of resurgence from inappropriate insecticide use

Scale insects

Spider mites

Use of mountain pine beetle insecticides over time….

…may lead to outbreaks of pine needle scale.

Pyriproxifen

Mimics juvenile hormone.
Target pests: Scale insects, whiteflies, aphids (suppression)

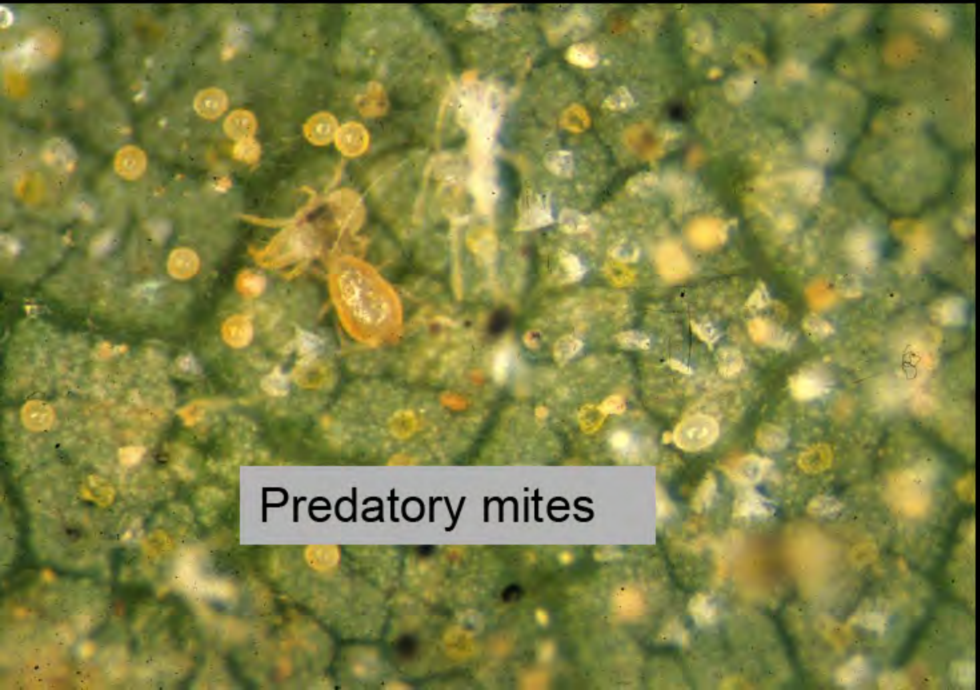
Special Colorado Niche: *A selective insecticide for use on* ***scale insects***

Excellent against neonicotinoid-resistant European elm scale

Use of many pesticides can aggravate (‘flare’) problems with spider mites


Minute pirate bug

Most insecticides will kill predators of spider mites. If they are ineffective against spider mites, then populations often increase.

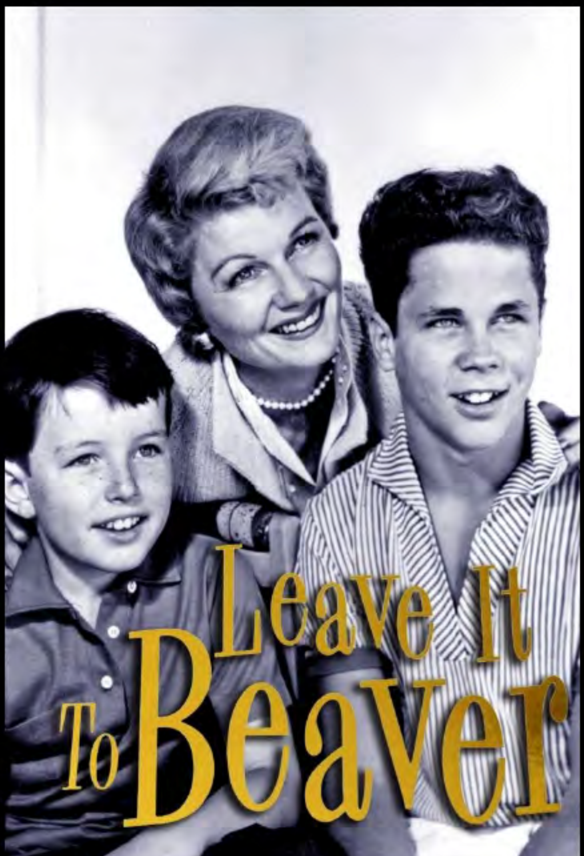

Predatory mites

Predatory thrips

Use of many pesticides can aggravate (‘flare’) problems with spider mites


Hi-Yield
55%
Malathion
SPRAY
Spider Mite
Mealybug
Whitefly
• 1 1/2 Teaspoons Makes 1 Gallon Of Spray.
KEEP OUT
NET CONTENTS ONE QUART (32 Fl.Ozs.)


Hi-Yield
55%
Malathion
SPRAY
• 1 1/2 Teaspoons Makes 1 Gallon Of Spray.
NET CONTENTS ONE QUART (32 Fl.Ozs.)

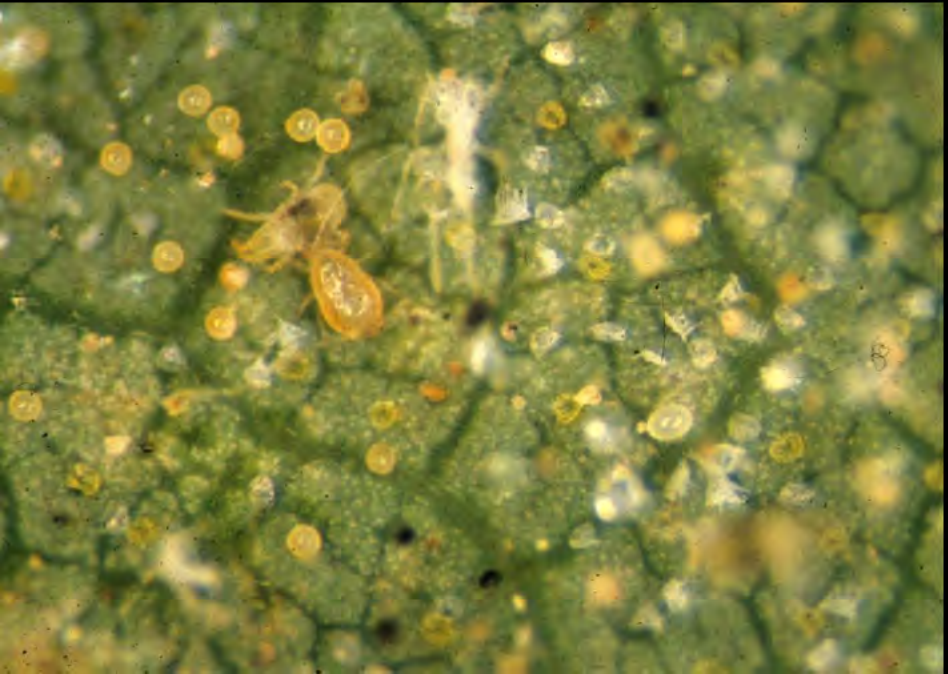

Leave It
To Beaver

Imidacloprid and Spider Mites

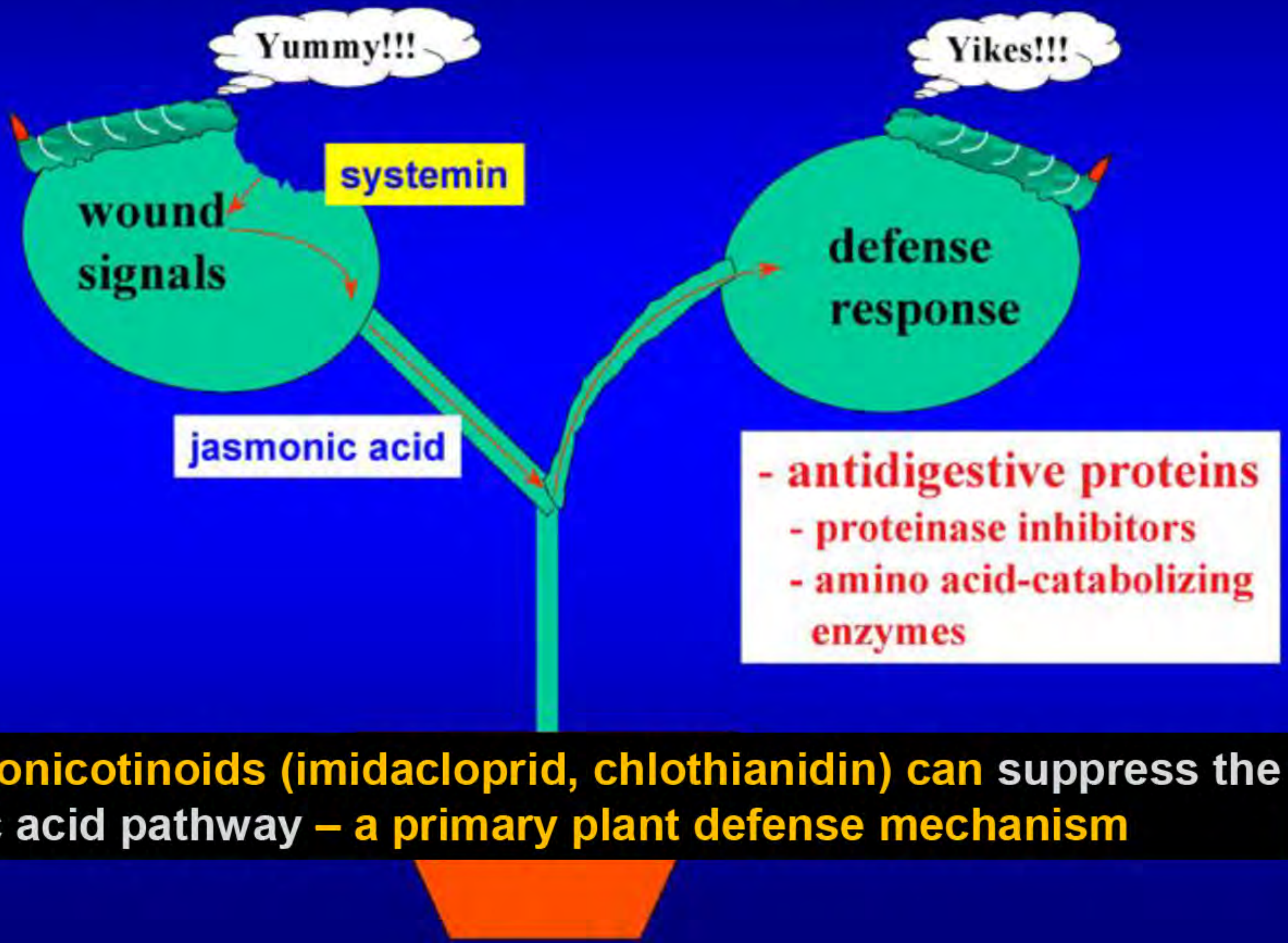
Observation, mid 1990s – Spider mites seemed to be a new problem on many plants treated with imidacloprid

Far more spider mites and injury occurred on plants treated with imidacloprid

Why? Original thought was that imidacloprid was killing the natural enemies of spider mites.



Systemic Wound Response



Some neonicotinoids (imidacloprid, chlothianidin) can suppress the jasmonic acid pathway – a primary plant defense mechanism

Mite Control Products – Commercial Applicators

- Least disruptive of natural enemies
  - Floramite (bifenazate)
  - TetraSan (extoxazole)
  - Hexygon (hexythiazox)
  - Horticultural oils*
- Moderately disruptive of natural enemies
  - Forbid (spiromesifan)
  - Avid (abamectin)
- Highly destructive to natural enemies
  - All pyrethroids (Onyx, Talstar, Scimitar…)**

Pesticides that only act on spider mites

- Floramite (bifenazate)
- TetraSan (extoxazole)
- Hexygon (hexythiazox)




"WORKS LIKE A CHARM"
MAGIC®
BRAND
PEST SCOURGE
• KILLS EVERYTHING
• USE ON ALL PLANTS
• WORKS INSTANTLY
• COMPLETELY SAFE
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MITES
WEEDS
DISEASES
IRS AGENTS
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Questions?

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