Sept 23 2020: IPM, insecticides, conserving beneficial, Forest ENT guest

Dr. Vera Krischik, Department of Entomology, University of Minnesota

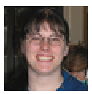
Vera Krischik 75%(67%) Extension, 25%(32%) research

Welcome to Dr. Vera Krischik's Lab!

Animated spider by Lisa Konrad, http://www.arthouse.org/

People


Vera Krischik


Emily Tenczar

no image Cassie Kurtz


Mary Rogers

no image Sarah Mittelstadt

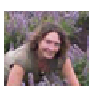
no image Aruna Varshney

no image Alice Broderson

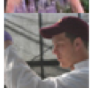

Garima Gupta


Jamison Scholer

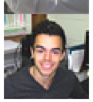

Luis Martin


Kristen Waurio


Emory Matts


Tyler Obermoller

no image Alyson Landmark


Rafael De Los Rios Boulton

no image Scott Smith

no image Jason Dreis

no image Marcus Zbinden

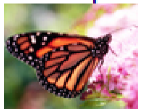
Research

2005-2008 Cottonwood Leaf Beetle

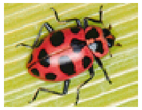

Management with a transplant soak and biorationals


Standard & novel imidacloprid treatments

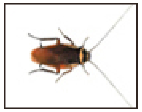
2005-2008 Non-Target Effects of Imidacloprid


Butterflies


Green Lacewings

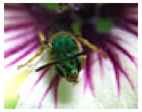

Lady Beetles

Residential IPM


Residential IPM

Educational Resources

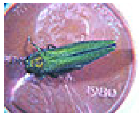
Academic Courses


Entomology 4015: Ornamentals and Turf Entomology 2000-2014

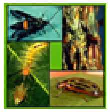

Hort 5009: Pesticides in Horticulture: Their Use and Abuse 2004-2014

Public Courses


Master Gardener


MDA A&E, MNLA, UM Pesticide Certification Training workshops

Extension Publications


IPM of Midwest Landscapes Online Book


CUES Extension Publications

Research Publications

Krischik, V. A., M. Zbinden, and C. Reed. Landscape IPM: Conservation of beneficial insects with species of native Midwest plants (in manuscript)

Krischik, V, M Spivak, K Klyczek, K Mogen, J Wu, J Scholer. Effect of chronic exposure of imdacloprid in sugar syrup on honeybee colony health, PLOSONE (in manuscript)

Krischik, V., M. Rogers, G. Gupta, and A. Varshney. 2014.Soil-applied imidacloprid is translocated to ornamental flowers and reduces survival of adult *Coleomegilla maculata, Harmonia axyridis*, and *Hippodamia convergens* ladybeetles, and larval *Danaus plexippus* and *Vanessa cardui*. submitted to PLoS ONE on April 23 2014, revised Dec 10 2014

Scholer, J. and V. Krischik. 2014. Chronic exposure of imidacloprid and clothianidin reduce queen survival, foraging, and nectar storing in colonies of *Bombus impatiens*. PLoS ONE 9(3): e91573. doi:10.1371/journal.pone.0091573

Tenczar, E. G., and V. A. Krischik. 2007. Comparison of standard (granular and drench) and novel (tablet, stick soak, and root dip) imidacloprid treatments for cottonwood leaf beetle (Coleoptera: Chrysomelidae) management on hybrid poplar. J. Econ. Entomol. 100: 1611-1621.

Krischik, V. A., A .Landmark, and G. Heimpel. 2007. Soil-applied imidacloprid is translocated to nectar and kills nectar-feeding *Anagyrus pseudococci* (Girault) (Hymenoptera: Encyrtidae) Environ. Entomol. 36(5): 1238-1245.

Tenczar, E. G., and V. A. Krischik. 2007. Effects of new cultivars of ninebark on feeding and ovipositional behavior of the specialist ninebark beetle, *Calligrapha spiraeae* (Coleoptera: Chrysomelidae). HortScience 42(6): 1396-1399.

Rogers, M. A., V. A. Krischik, and L. A. Martin. 2007. Effect of soil application of imidacloprid on survival of adult green lacewing, *Chrysoperla carnea* (Neuroptera: Chrysopidae), used for biological

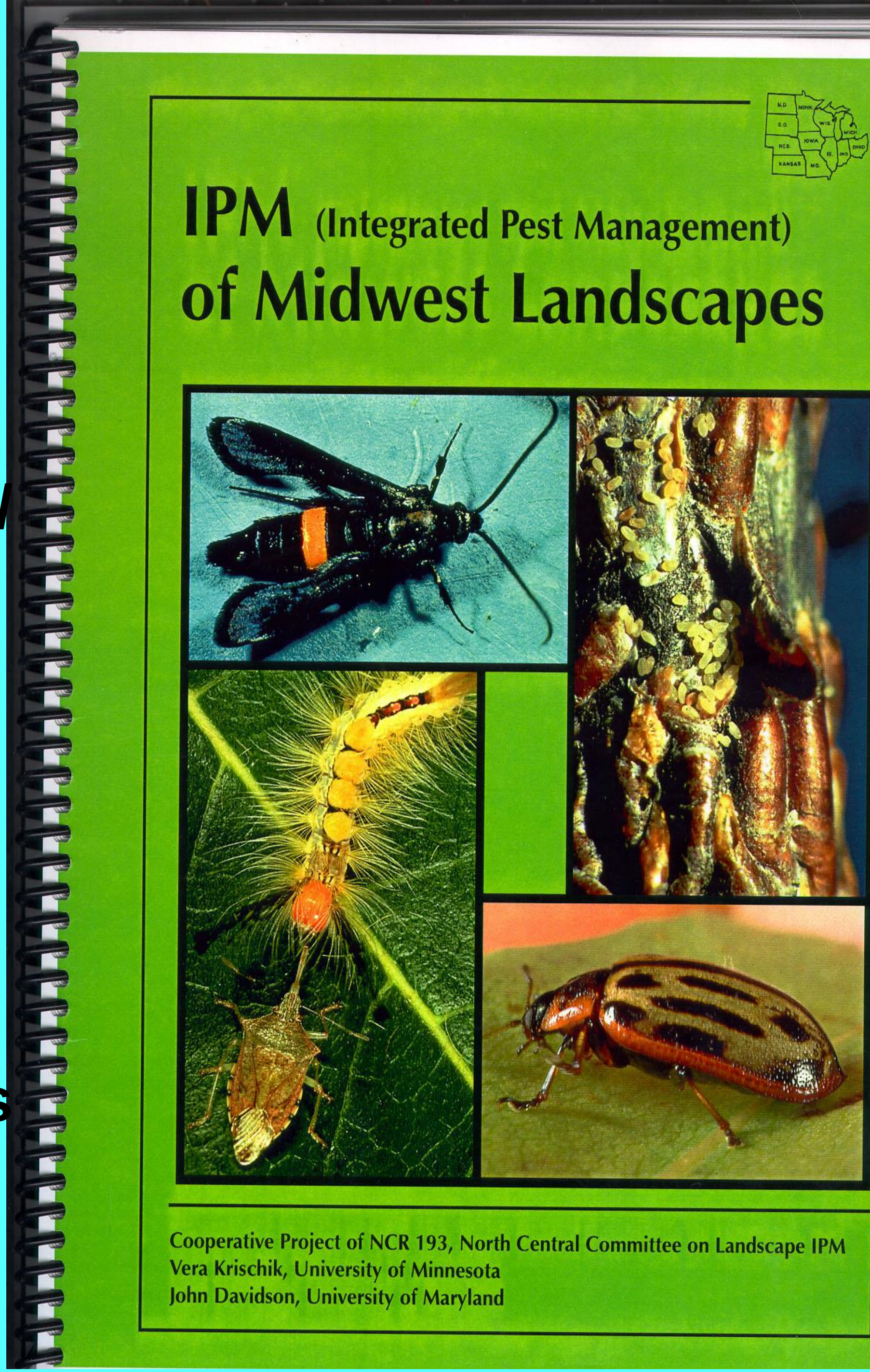
(2005) Vera Krischik

websites
CUES Center for urban sustainability
http://cues.cfans.umn.edu/

Pollinator Conservation
https://ncipmhort.cfans.umn.edu/

Online course for passing the MDA pesticide license at MNLA.biz

Sign up for the test at MDA pesticide licensing
https://www.mda.state.mn.us/pesticide-fertilizer/pesticide-applicator-licensing



CUES Center for urban sustainability http://cues.cfans.umn.edu/

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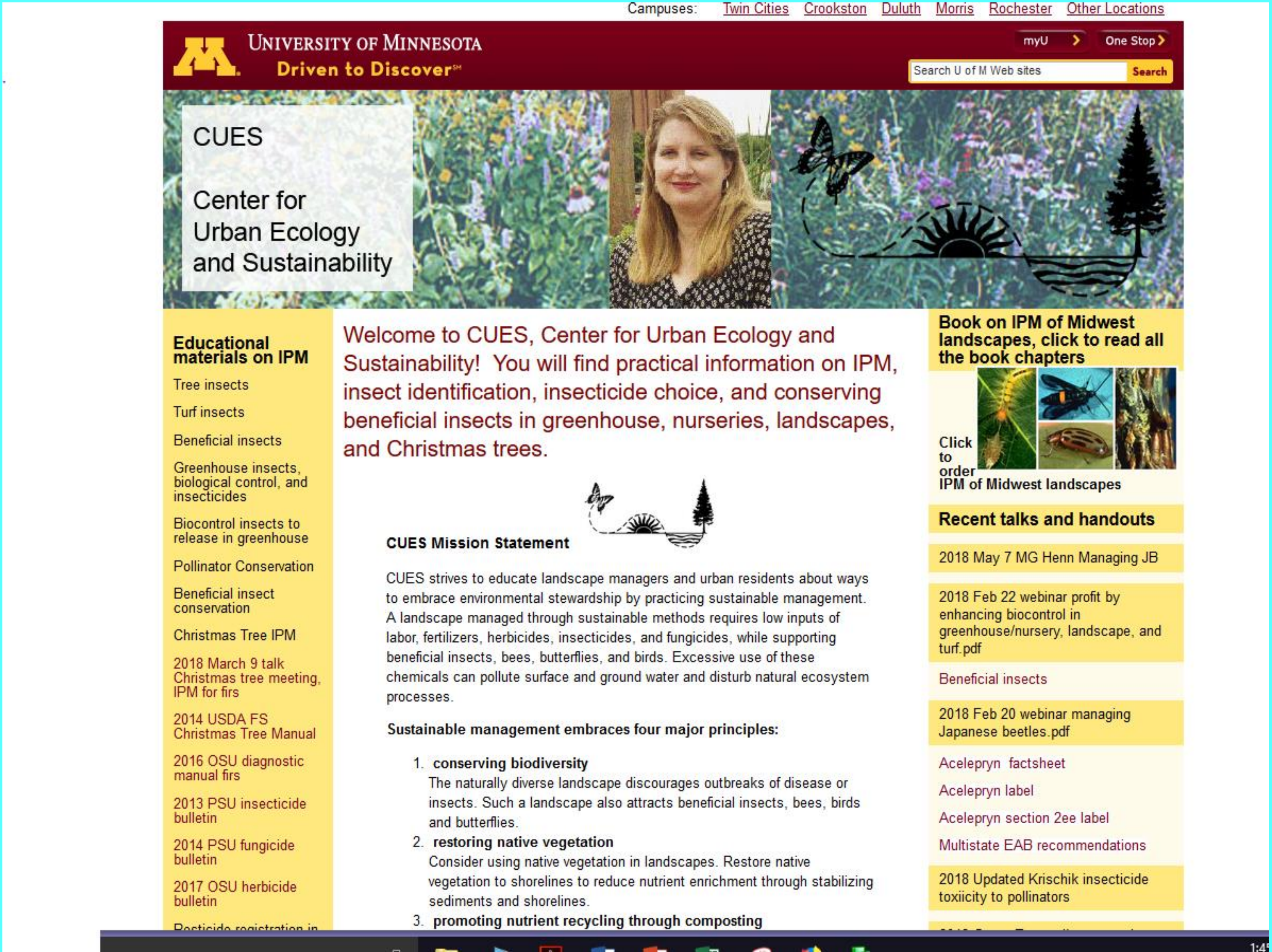
IPM of Midwest Landscapes

Pests of Trees and Shrubs

Alder spittlebug	*Clastoptera obtusa*	Lesser peachtree borer	*Synanthedon pictipes*
Ambrosia beetle	*Xylosandrus germanus*	Lilac/ash borer	*Podosesia syringae*
American hornet moth	*Sesia tibialis*	Linden borer	*Saperda vestita*
Aphids	Family Aphididae	Locust borer	*Megacyllene robiniae*
Apple bark borer	*Synanthedon pyri*	**Maple bladdergall mite**	*Vasates quadripedes*
Arborvitae leafminer	*Argyresthia thuiella*	Maple callus borer	*Synanthedon acerni*
Ash flower gall mite	*Aceria fraxiniflora*	Maple spindlegall mite	*Vasates aceriscrumena*
Ash plant bug	*Tropidosteptes amoenus*	Maple velvet erineum gall mite	*Aceria aceris*
Asian longhorned beetle	*Anoplophora glabripennis*	Mimosa webworm	*Homadaula anisocentra*
Azalea lace bug	*Stephanitis pyrioides*	Mountainash sawfly	*Pristiphora geniculata*
Bagworm	*Thyridopteryx ephemeraeformis*	Mourningcloak butterfly	*Nymphalis antiopa*
Balsam twig aphid	*Mindarus abietinus*	**Oak borer**	*Paranthrene simulans*
Banded ash clearwing	*Podosesia aureocincta*	Oak clearwing borer	*Paranthrene asilipennis*
Birch lace bug	*Corythuca pallipes*	Oak cynipid galls	Family Cynipidae
Birch leafminer	*Fenusa pusilla*	Obscure scale	*Melanaspis obscura*
Black pineleaf scale	*Nuculaspis californica*	Oriental beetle	*Exomala orientalis*
Black vine weevil	*Otiorhynchus sulcatus*	Oystershell scale	*Lepidosaphes ulmi*
Boxelder bug	*Boisea trivittatus*	**Pales weevil**	*Hylobius pales*
Boxwood spider mite	*Eurytetranychus buxi*	Peachtree borer	*Synanthedon exitiosa*
Bronze birch borer	*Agrilus anxius*	Pear sawfly	*Caliroa cerasi*
Brownheaded ash sawfly	*Tomostethus multicinctus*	Pin oak kermes	*Allokermes galliformus*
Calico scale	*Eulecanium cerasorum*	Pine bark adelgid	*Pineus strobi*
Cankerworms	*Alsophila pometaria, Paleacrita vernata*	Pine engraver	*Ips pini*
Clearwing borers	Family Sesiidae	Pine needle scale	*Chionaspis pinifoliae*
Clover mite	*Bryobia praetiosa*	Pine root collar weevil	*Hylobius radicis*
Cooley spruce gall adelgid	*Adelges cooleyi*	Pine shoot beetle	*Tomicus piniperda*
Cottonwood leaf beetle	*Chrysomela scripta*	Pine spittlebug	*Aphrophora parallela*
Cottony maple scale	*Pulvinaria innumerabilis*	Pine thrips	*Gnophothrips* sp.
Currant borer	*Synanthedon tipuliformis*	Pine tortoise scale	*Toumeyella parvicornis*
Cyclamen mite	*Phytonemus pallidus*	Pitch mass borer	*Synanthedon pini*

CUES Center for urban sustainability http://cues.cfans.umn.edu/



Pollinator Conservation
https://ncipmhort.cfans.umn.edu

Pollinator Conservation Biocontrol LCCMR

Home | **IPM & Pesticides** | Pollinator Best Practices | Pollinators & Beneficial Insects | Research | Resources & Courses

Home › Integrated Pest Management (IPM) for Pollinators

Integrated Pest Management (IPM) for Pollinators

Integrated Pest Management (IPM) › is an approach to solving pest problems that applies knowledge about pests and plants to prevent plant damage early before it becomes a problem. IPM promotes multiple tactics to manage pests and suppress population size below thresholds that cause unacceptable levels of damage to plants or crops.

IPM responds to pest problems with the most-effective, least-risk and least-toxic option. IPM is a science-based decision-making process that includes monitoring and long-term planning. By correcting conditions that lead to pest problems and using approved pesticides only when necessary, IPM provides more effective control while reducing pesticide use and using alternatives to pesticides. The conservation of beneficial insects, which include bees, insect predators, parasitic wasps, and butterflies, is an essential part of IPM.

From backyards to public parks, any individual or organization can adopt an IPM plan; therefore it's important for land managers, farmers and gardeners to learn how to implement IPM. IPM plans should be updated annually, and staff need to be trained on pesticide use and pollinator best practices.

Checking sticky pheromone traps for Plum curculio, photo: L. Schneider

What is IPM?

- A system utilizing multiple methods
- A decision making process
- A risk reduction system
- Information intensive
- Biologically based
- Cost effective
- Site specific
- Multiple tactics: cultural, physic
  genetic, biological, chemical
- Least toxic pesticide first and
  use spot treatments
- Conserve beneficial insects

What is IPM?

When developing an IPM program, it is important to know the pests. Learn the major characteristics for pest identification, damage, and how to monitor for the pests.

- **Determine threshold levels for each pest.**
- **Identify cultural practices to reduce pest populations.**
- **At low densities, biological control and biorational pesticides may be used.**
- **High pest densities may call for conventional pesticides, but these should be avoided whenever possible to conserve beneficials.**

Reducing insecticide use to increase beneficial insect survival

- Spot treatments not broadcaast sprays.
- Spray at less than 8 mph and when bees are not active in early morning and evening.
- Use thresholds and scout pre and post application.
- Use contact insecticides when effective.

Tactics and Tools to Manage Insects of Landscapes

- **Insect pests can be grouped according to the way they damage the plant.**

- **Insects that vector diseases and borers are the most damaging and insects that remove leaf tissue and are gall makers are the least damaging.**

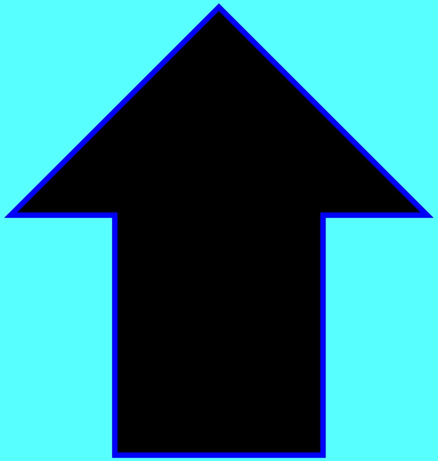
- **Insect evolution is conservative so if you know the family of the insect, then most insects in that family will perform similar damage.**
- **Clearwing borers, not specific pests are on pesticide label.**

- **We will discuss how to develop IPM programs, proper insecticide choice, and timing. We will discuss how to conserve pollinators and beneficial insects, while managing pest insects.**

Top 10 landscape pests

- 1. Japanese beetle; lindens, roses
- 2. emerald ash borer: ash
- 3. aphids
- 4. borers
- 5. scales
- 6. slugs
- 7. sawflies on conifers
- 8. conifer mites
- 9. caterpillars
- 10. galls

worst



- Clearwing borer
- Order Lepidoptera
- Family Sesiidae
- Moth borer larvae feed under bark; adults do not feed
- Chlorosis, wilting, and dieback
- Many deciduous trees and shrubs

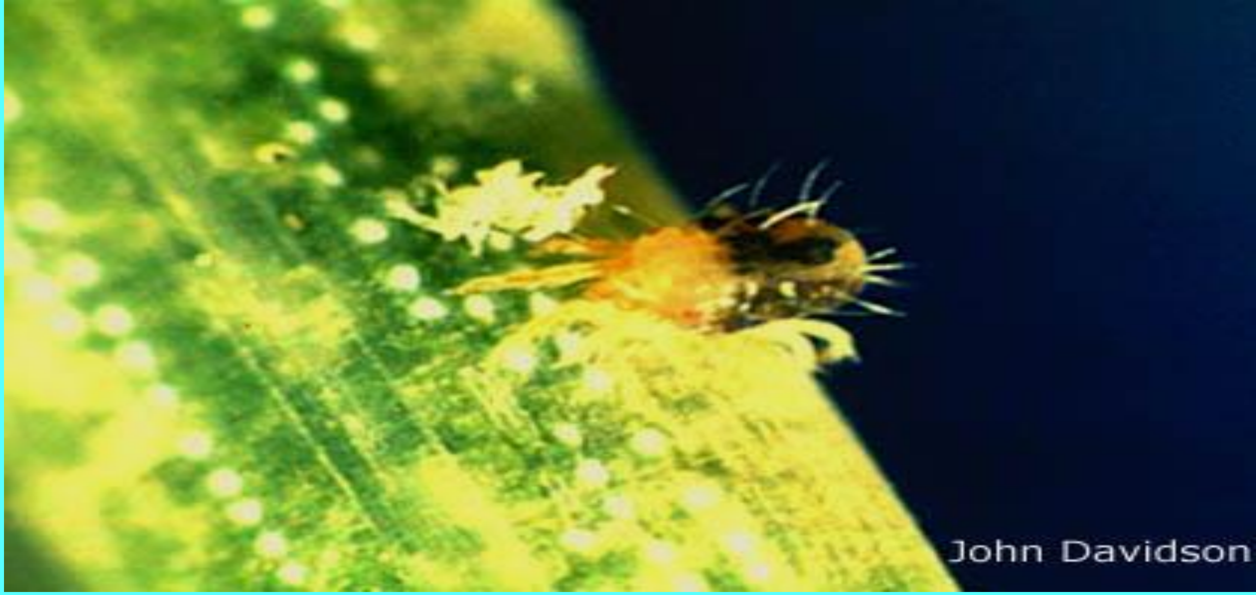
- White pine weevil
- Order Order Coleoptera
- Family Curculionidae
- Weevil larvae and adults feed
- Leader dieback
- Pine and spruce

- Black vine weevil
- Order Coleoptera
- Family Curculionidae
- Weevil larvae and adults feed
- Root and leaf damage
- Yews, many other perennials

- Cottony maple scale
- Order Hemiptera
- Family Coccidae
- Soft scale, sap sucking insect
- Yellowing, stunting, dieback
- Maple, elm, hawthorn, dogwood, poplar, linden

- Pine needle scale
- Order Homoptera
- Family Diaspididae
- Armored scale, sap sucking
- Stunting and dieback
- Spruce, pine

- Kermes scale
- Order Hemiptera
- Family Kermestidae
- Gall-like scale scale, sap sucking
- Chlorosis, foliage distortion, and tip dieback.
- Oaks

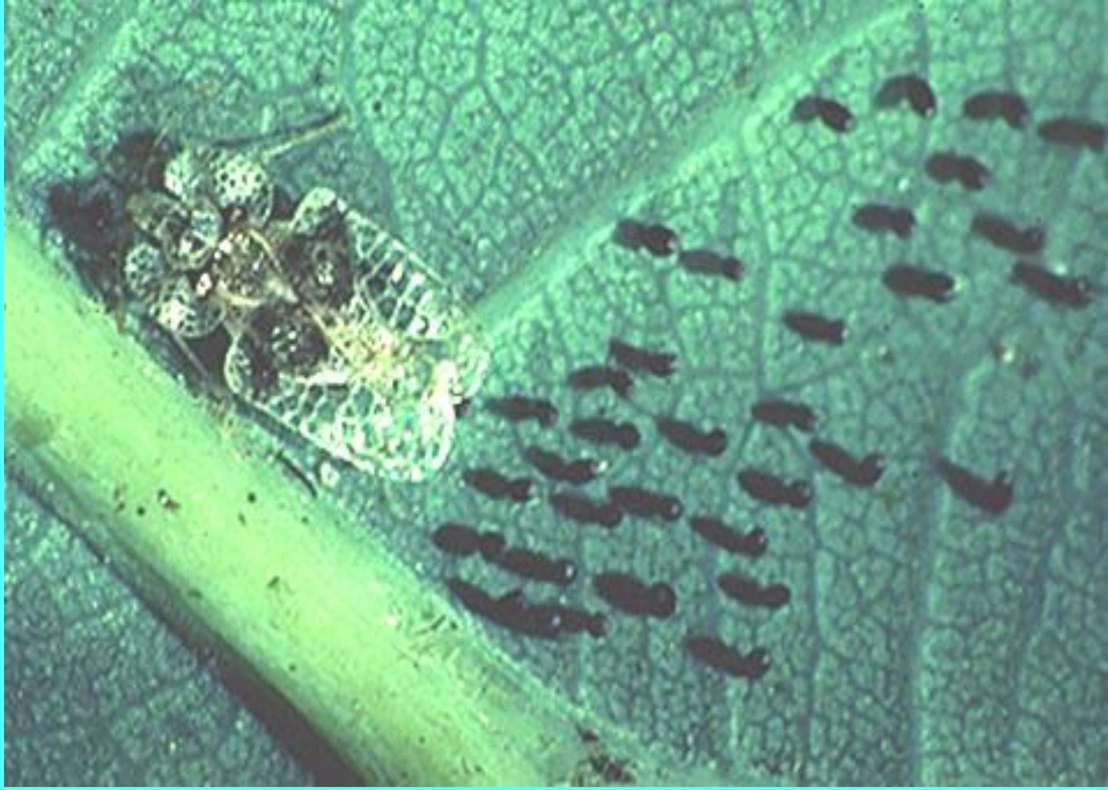


- Spruce spider mite
- Order Acari
- Family Tetranychidae
- Sucking, spider relatives
- Suck out cells
- Conifers

Aphids

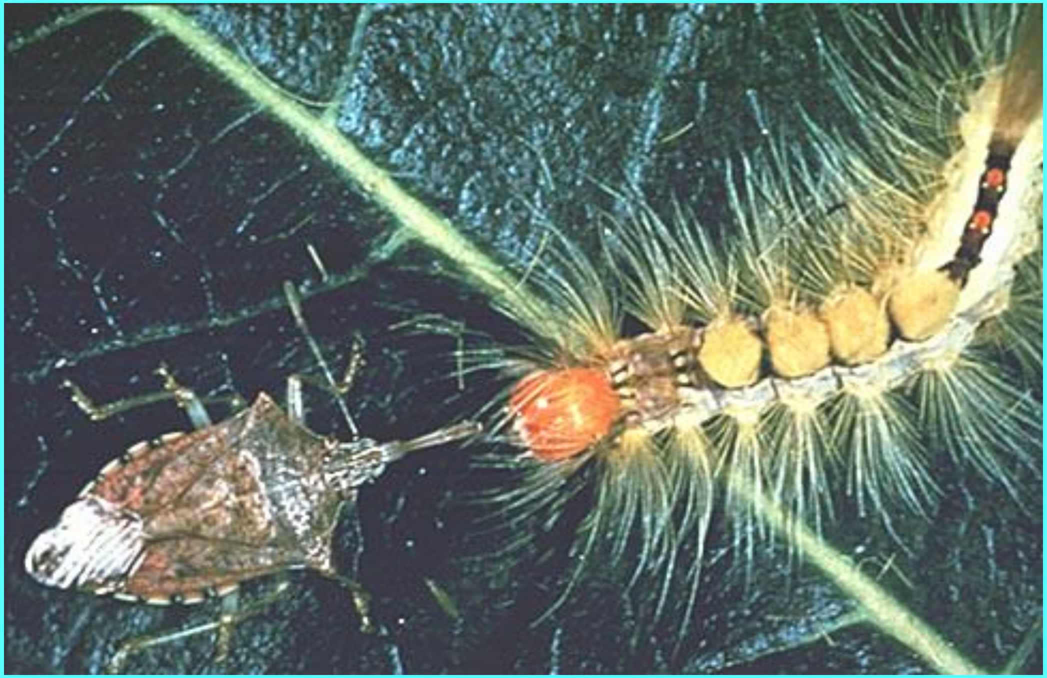
Green peach aphid
adult and young

Winged green peach
aphid adult



- Lace bug
- Order Hemiptera
- Family Tingidae
- Lace bug nymphs and adults feed
- Stippled, discolored foliage, and dieback
- Various trees and shrubs

- Forest tent caterpillar
- Order Lepidoptera
- Family Lasiocampidae
- Moth larvae feed, adults do not feed
- Defoliation
- Fruit and shade trees

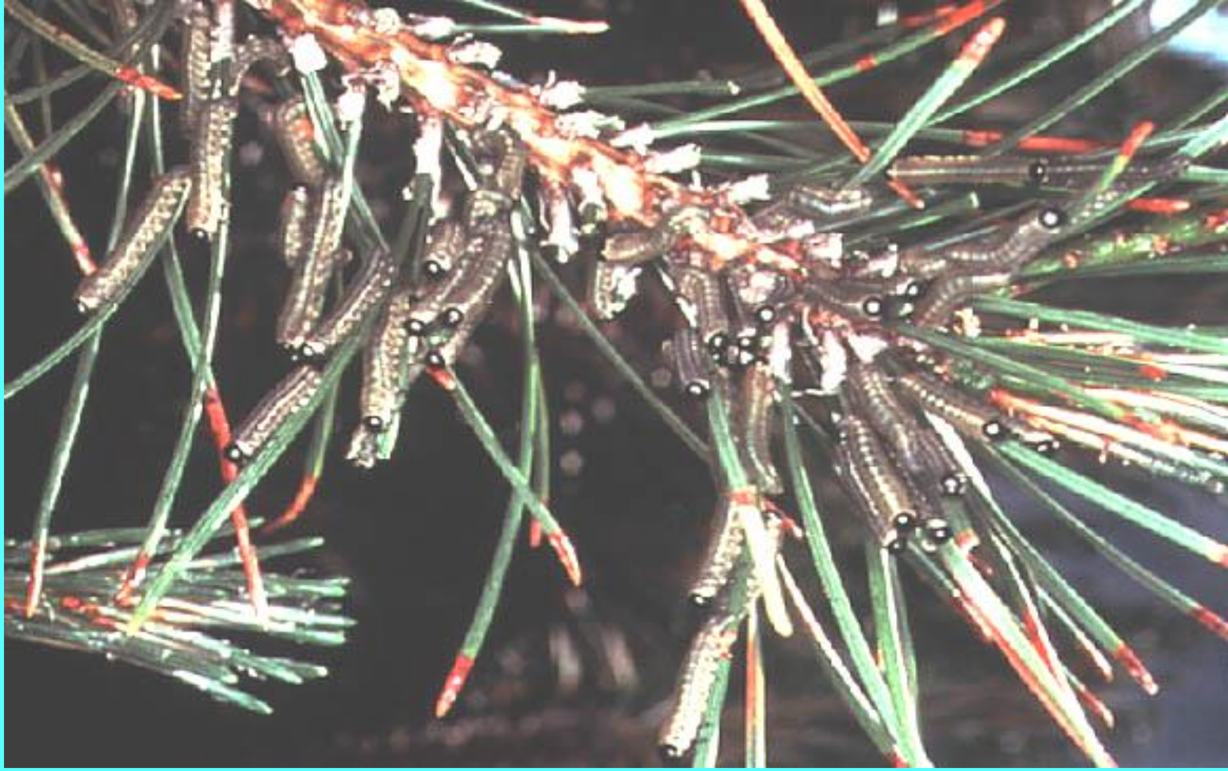


- Whitemarked tussock moth
- Order Lepidoptera
- Family Lymantriidae
- Moth larvae feed, adults do not feed
- Defoliation
- >60 various host plants

- Spring cankerworm
- Order Lepidopera
- Family Geometridae
- Moth larvae feed, adults do not feed
- Defoliation, shot hole injury
- Apple, elm, oak, hickory, linden, birch, beech, maple

- Birch leafminer
- Order Hymenoptera
- Family Tenthredinidae
- Sawfly larvae feed, adults do not
- Hollow out patches between leaf surfaces
- Birch trees

- Rose slug sawfly
- Order Hymenoptera
- Family Tenthredinidae
- Sawfly larvae feed, adults do not feed
- Larvae skeletonize upper leaf surface
- Roses



- European pine sawfly
- Order Hymenoptera
- Family Diprionidae
- Sawfly larvae feed, adults do not feed
- Defoliation
- Various pines

- Elm leaf beetle
- Order Coleoptera
- Family Chrysomelidae
- Beetle larvae and adults feed
- Defoliation
- Most elm species

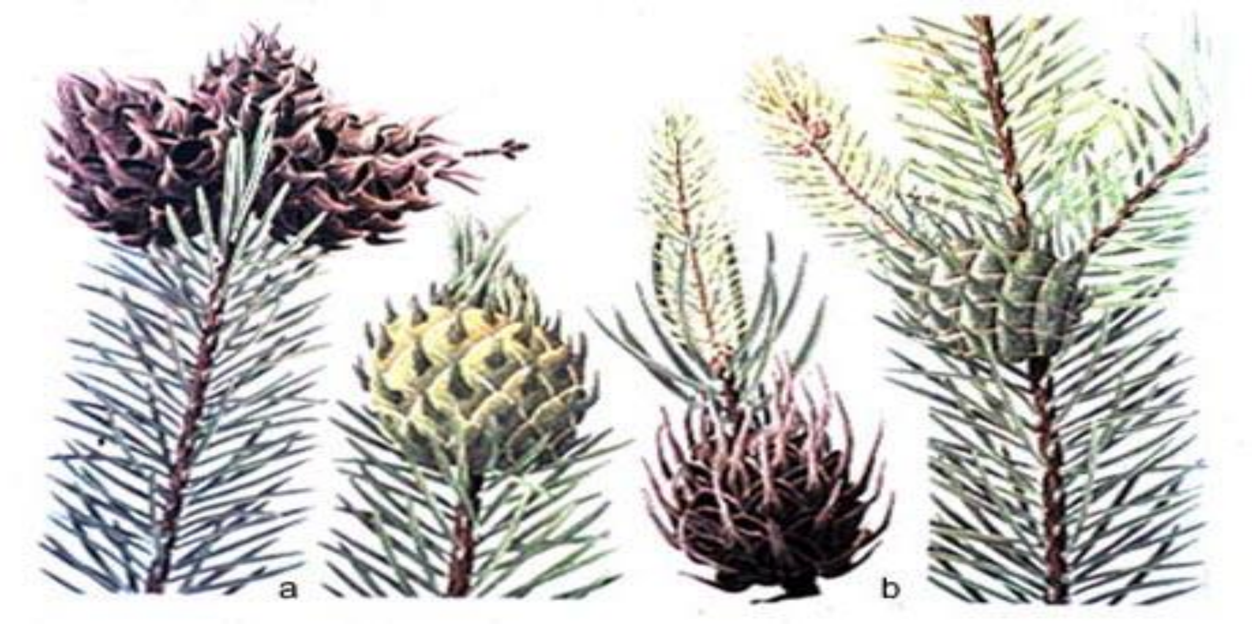
- Cottonwood leaf beetle
- Order Coleoptera
- Family Chrysomelidae
- Beetle larvae and adults feed
- Defoliation
- Various willow and cottonwood

Use different insecticides for JB adults or grubs

Japanese beetle is the worst white grub.

- **Honeylocust plant bug**
- **Order Hemiptera**
- **Family Miridae**
- **Plant bug nymphs and adults feed**
- **Stippled leaf discoloration and distortion**
- **Honeylocust**

- Hackberry nipple gall maker
- Order Hemiptera
- Family Psyllidae
- Adult psyllid, aphid-like
- Plant forms gall over insect nymph
- Hackberry



- Cooley spruce gall adelgid
- Order Hemiptera
- Family Adelgidae
- Aphid like sucking insect
- Galls on tips of branches
- Spruce and Douglas-fir

- Eriophyid mites
- Order Acari
- Family Eriophyidae
- Sucking arachnids causing erineum, spider relatives
- Erineum are gall like, foliage discoloration
- Various deciduous and coniferous species

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Insecticides biorational, conventional, and organic

Biorational: Compatible with bees and beneficials

Organic:OMRI approved naturalproducts

Conventional: Toxic to pests, bees, beneficials

Toxicity x exposure=risk:

- Toxicity to humans and insects are found in different tables
- LD50 based on 72, 96 hr exposure by oral, dermal, and inhalation routes.
- LD50 is lethal death to 50% of the test animals.
- Sublethal rates alter behavior and foraging.
- Active ingredients, AI,
- Inert ingredients, adjuvants
- Trade name, off patent in 20 yrs

Neonicotinyl insecticides are safer for people

Active ingredient	Class	Application method	Toxicity bees	LD50 (µg/bee)	LD 50 (mg/kg rats)
Imidacloprid	Neo	Oral acute (24–48h)	Highly	0.004 -.04	450
Clothianidin	Neo	Oral acute	Highly	0.004	2000
		Contact acute	Highly	0.044	4000
Thiamethoxam	Neo	Oral acute	Highly	0.005	1563
		Contact acute	Highly	0.024	2000
Chlorpyrifos	OP	Acute oral	Highly	0.36	155
		Acute contact	Highly	0.070	202
Coumaphos	OP	Acute oral	Moderately	2.030	13 - 41
Esfenvalerate	PYR	Acute contact	Highly	0.21	88.5
Fluvalinate	PYR	Acute contact	Highly	0.2	2000

highly toxic (< 2µg/bee)
moderately toxic (2 - 10.9 µg/bee)
slightly toxic (11 - 100µg/bee)
non-toxic (>100µg/bee)

but NOT for bees…

Pesticides : toxicity / bees (LD_{50} ng/bee)

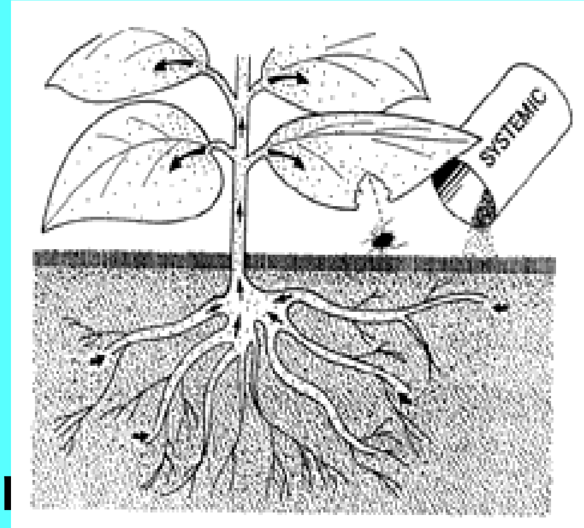
pesticide	®	Use	Dose g/ha	LD50 ng/ab	Tox/DDT
DDT	Dinocide	insecticide	200-600	27 000.0	1
thiaclopride	Proteus	insecticide	62,5	12 600.0	2.1
amitraze	Apivar	acaricide	-	12 000.0	2.3
acetamiprid	Supreme	insecticide	30-150	7 100.0	3.8
coumaphos	Perizin	acaricide	-	3 000.0	9
methiocarb	Mesurol	insecticide	150-2200	230.0	117
tau-fluvalinate	Apistan	acaricide	-	200.0	135
carbofuran	Curater	insecticide	600	160.0	169
λ-cyhalothrine	Karate	insecticide	150	38.0	711
thiaméthoxam	Cruiser	insecticide	69	5.0	5 400
fipronil	Regent	insecticide	50	4.2	6 475
imidaclopride	Gaucho	insecticide	75	3.7	7 297
clothianidine	Poncho	insecticide	50	2.5	10 800
deltamethrine	Décis	insecticide	7,5	2.5	10 800

A really big issue understanding systemic compared to contact insecticides.

Contact compared to systemic insecticides

Contact insecticides:

- Many used; sprayed on foliage
- Insect must eat leaf or walk on leaf to be killed
- Toxicity lasts 1-3 weeks
- Flowers that open after spraying do not contain insecticides.



Systemic insecticides:

- Uncommon; treated-seed, soil drench, tru
- Insect must eat leaf, pollen, or nectar to be killed
- Toxicity can least for months to years, unknown
- Flowers that open will have the insecticide in pollen and nectar for months to years, unknown

Systemic insecticides

Organophosphates

aldicarb (Temik), oxamyl (Vydate), dimethoate (Cygon)

Neonicotinoids

imidacloprid (Marathon, Merit), clothianidin, thiamethoxam, dinotefuran

Novel mode of action

pymetrozine (Endeavor)

Translaminar, or local, systemic activity

Microbial- abamectin (Avid)
IGR- pyriproxyfen (Distance)
PR- chlorfenapyr (Pylon)
SP- spinosad (Conserve)
OP- acephate (Orthene)
C- carbofuran (Furadan)

How to reduce resistance: Rotate chemical class/mode of activity. The mode of action is the mechanism that kills the insects.

IRAC numbers

- **The Insecticide Resistance Action Committee (www.irac-online.org) has assigned IRAC numbers for each chemical class, and these numbers are on labels to make it easier to rotate classes of insecticides and prevent resistance. This is called resistance management.**
- **Neonicotinoid class, 4A**
- **Organophosphates, class 1B**

Chemical class/mode of activity
The mode of action is the mechanism that kills the insects.

1. Organophosphates and Carbamates
Inhibit the enzyme cholinesterase. This prevents the termination of nerve impulse transmission.

2. Organochlorines, DDT, Phenylpyrazols, Fipronil

3. Pyrethroids and Chlorinated Hydrocarbons
Destabilize nerve cell membranes.

4. Neonicotinyls
Work on central nervous system, cause over-stimulation and blockage of the postsynaptic nicotine acetylcholine receptors.

5-31. Novel insecticides
Mode of action specific.

1. Properties: Organophosphates

Inhibit the enzyme cholinesterase. This prevents the termination of nerve impulse transmission.
Long lasting.
Toxic to bees.
Long term effects on humans so most of these insecticides are taken off the market.

Active ingredients

Acephate (Orthene) and malathion for homeowner use.
Chloropyrifos (golf courses and nursery only).
Dimethoate not very available, previously used for birch leaf miner sawfly

1. Organophosphate toxicity to humans

Insecticide (Common Name)		Trade Name(s)
acephate		Orthene
Classification	**LD_{50} Oral (mg/kg)**	**LD_{50} Dermal (mg/kg)**
organophosphate	235	400

Manufacturer

Valent

1. Properties: Carbamates

Inhibit the enzyme cholinesterase. This prevents the termination of nerve impulse transmission.
Short acting.
Toxic to bees.
Low mammalian toxicity.

Active ingredients

Carbaryl

1. Carbamate toxicity to humans

Insecticide (Common Name)		Trade Name(s)
carbaryl		Sevin

Classification	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/kg)
carbamate	246	>4000

Manufacturer

Drexel

2. Organochlorines and phenylpyrazoles

Insecticide (Common Name)	Trade Name(s)
DDT	NA

Classification	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/kg)
Organochlorines		>4000

Manufacturer
NA

3. Properties: Pyrethroids

Contact insecticides that destabilize nerve cell membranes. Chemistry based on botanical extracts of pyrethrum.
Do not last long on plants.
Toxic to fish and cats.
Toxic to bees.
Low mammalian toxicity.

Active ingredients

Bifenthrin (Talstar)
Cyfluthrin (Decathalon)
Deltamethrin (Deltagard)
Fluvalinate (Mavrik)
Lambda-cyhalothrin (Scimitar, Battle)
Permethrin (Astro, Spectracide)

3. Pyrethroid toxicity to humans

Insecticide (Common Name)		Trade Name(s)
bifenthrin		Talstar

Classification	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/kg)
pyrethroid	375	>2000

Manufacturer

FMC

4. Properties: Neonicotinoids

Work on central nervous system, cause over-stimulation and blockage of the postsynaptic nicotine acetylcholine receptors.
Long duration of environmental persistence.
Highly toxic to bees.
Low mammalian toxicity.

Active ingredients

Imidacloprid
Clothianidin
Thiamethoxam
Dinotefuran

4. Neonicotinoid toxicity to humans

Insecticide (Common Name)		Trade Name(s)
imidacloprid		Merit, Marathon, Provado, Admire

Classification	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/kg)
neonicotinoid	460	2000

Manufacturer

Bayer

6-31. Unique class

Insecticide (Common Name)		Trade Name(s)
chlorantranipirole		Acelepryn
Classification	**LD_{50} Oral (mg/kg)**	**LD_{50} Dermal (mg/kg)**
anthranilic diamide	>5000	>5000

Manufacturer

Dow

6-31. Unique class

Insecticide (Common Name)
pymetrozine

Trade Name(s)
Endeavor

Classification
pyridine

Inhibits sucking mouthparts

LD_{50} Oral (mg/kg)
>5000

LD_{50} Dermal (mg/kg)
>2000

Manufacturer
Syngenta

UNB,UNE,UNF,UNM. Microbial bacterial, botanical, fungal, mechanical insecticides

Products of natural microbes.
Specific in action.

Active ingredients

Bacillus thuringiensis **var.** ***kurstaki***
Bacillus thuringiensis **var.** ***tenebrionis***
Bacillus thuringiensis **var.** ***israelensis***
All 3 ***B.t.*** **varieties have low toxicity to bees**
Rosemary oil
Beuavaria bassiana
Diatomaceous earth
Nematodes

Microbial insecticide toxicity to humans

Insecticide (Common Name)	Trade Name(s)
spinosad	Conserve, Entrust

Classification	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/kg)
microbial	3783	>5000

Manufacturer
Dow

7,9,10, 18 Properties: Insect growth regulators

Kill immature insects as they develop, by either disrupting the molting process, or by producing sterile adults. All but neem products can kill aquatic crustaceans. Do not apply near streams.

Active ingredients

Halofenozide (Mach 2 by Dow): Used on turf for moths and grubs
Tebufenozide (Confirm by Dow)
Cyromazine (Citation by Syngenta)
Diflubenzuron (Dimilin by Uniroyal)
Fenoxycarb (Precision by Syngenta)
Hexythiazox (Hexygon by Gowan)

Insecticides biorational, conventional, and organic

Biorational: Compatible with bees and beneficials

Organic:OMRI approved naturalproducts

Conventional: Toxic to pests, bees, beneficials

When is biological control be used?

- Biological control is most effective during low pest densities.

- When using biological control agents it is important to avoid broad-spectrum pesticides.

- Carefully choose biorational insecticides to conserve beneficials.

- Biological control is most effective during low pest densities.




Characteristics of biorational insecticides

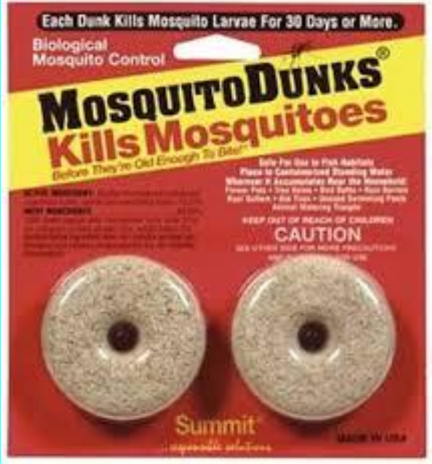
- **Short residual**
- **Degrade due to light, water, microbes.**
- **Work on smaller insects and immatures**
- **Less harmful to beneficial insects, predators, parasitoids, bees.**
- **Low mammalian toxicity.**
- **May take longer to kill a pest.**

Use insecticides compatible with biocontrol.

- Acelepryn, chlorantraniliprole for grubs in soil and on landscape plants.
- Spinosad for caterpillars and sawflies
- Neem oil, soaps, and oils for aphids
- Need imidacloprid or dinotefuran for borers.




Use biorational insecticides for bees: BT, *Bacillus thuringiensis*



- **BT is a protein crystal that puts an hole in the insect's gut wall after ingestion.**
- **BT kurstaki, moth larvae, Dipel, Javelin**
- **BT aizawai, moth larvae and suckers, Xentari**
- **BT tenebrionis, beetle larvae, Trident**
- **BT galleria, grubs, Grubgone**
- **BT israelensis, fly larvae, Aquabac**
- **Burkholderia, caterpillars, Venerate**

Use biorational insecticides: Soaps and oils

- **Triact 70, clarified extract of Neem oil**
- **Mantis EC insecticide/miticide formulated with the natural insecticidal activity of rosemary, peppermint, and NON-GMO soybean botanical oils. Oils, mites**

Use biorational insecticides:*Beauveria bassiana* fungus

- **Fungal spores contact and germinate and grow directly through the cuticle to the inner body. The fungus proliferates throughout the insect's body, producing toxins and KILLING IT.**

Use biorational insecticides for bees

Parasitic nematodes: *Steinernema carpocapsae*

Heterorhabditis bacteriophora

What is organic pest control?

- **Organic means a practice that is governed by certifi in each state to grow food without the use of synthetic pesticides in soils that are considered living and maintained by adding organic materials and not synthetic fertilizers.**
- **The National Organic Standards Board (NOSB)advises the National Organic Program (NOP).**
- **An organic certification is obtained from a USDA certified organic agency.**
- **The OMRI Organic Materials Research Institute has a list of organically approved products. Excluded are nitrogen(N), phosphate (P), or potash/potassium (K), and ammonia and nitrate fertilizers.**

Characteristics of organic pesticides

https://www.omri.org/

- **OMRI listed**
- **Are natural plant products or microbial organisms**
- **Degrade due to light, water, microbes.**
- **Work on smaller insects and immatures**
- **Low mammalian toxicity ???**

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Organic OMRI=natural insecticides?

- **OMRI approved**
- ***Bacillus thuringiensis*, *Beauveria bassiana*, Boric acid, *Cydia pomonella granulosis*, diatomacous earth (HT), garlic, Koalin clay, limonene, neem oil, azadiractin, horticultural oil, pyrethrins (HT), spinosad (HT), pheromone, boric acid**

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OMRI Botanical insecticides are toxic to bees, beneficial, and mammals

- **Pyrethrins, Pyganic**
- **Linalool (citrus peel oil derivatives) consumer**
- **Limonene (citrus peel oil derivatives)**
- **Avenger, OrangGuard**
- **Neem oil, clarified hydrophobic extract of neem,**
- **Dyna-Gro, Triact70**
- **Azadirachtin (*Azadiractin indica* tree fruits),**
- **Azatin, AzaGuard**
- **Garlic oils? Consumer, aphids, beetles, caterpillars,**
- **Garlic barrier**
- **Hot peeper extract, Capasaicin, Nemitol**
- **Rosemary oil, with peppermint oil, Ecotrol, Ecotec**
- **New in progress, Citronella, Pennyroyal**

What is IPM?


KEEP THE BUZZ IN
LEIGHTON BUZZARD
Bee Champion
I am letting my lawn grow so the flowers in it help the bees
Bee Friendly Lawn
Bee unfriendly lawn

What is IPM?

* A system utilizing multiple methods
* A decision making process
* A risk reduction system
* Information intensive
* Biologically based
* Cost effective
* Site specific
* Multiple tactics:
    legal, cultural, physical,
    genetic, biological, chemical