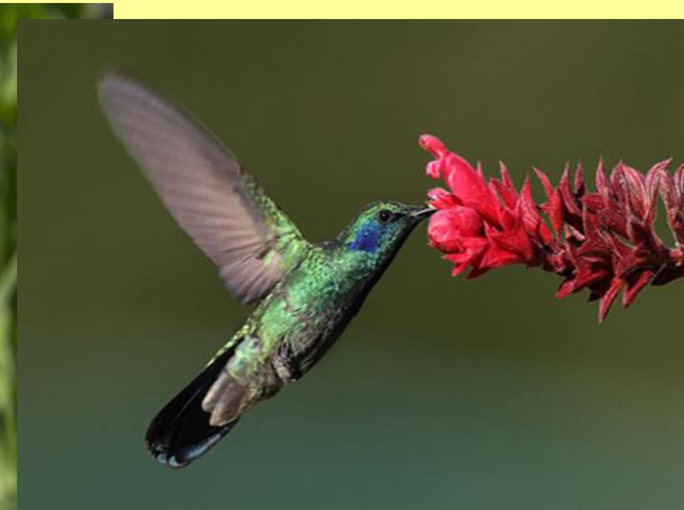
July 20 2023 Use IPM and pollinator plants to reduce pesticide use and conserve pollinators







Dr. Vera Krischik, Associate Professor, Ento, UMN,krisc001@umn.edu

Outline: Site Specific IPM programs

- *Integrated pest management and native landscaping for healthcare facilities,* **30 min. incl. Q&A**
- **Dr. Vera Krischik, Associate Professor, College of Food, Agricultural and Natural Resource Sciences, University of Minnesota**
- **What is IPM? Is our contractor truly doing IPM? Learn the basics of integrated pest management using prevention and exclusion, bio-control and native plantings to support pollinators and community health.**

Outline: Site Specific IPM programs

- Introduction
- Resources Krischiklab
- What is IPM
- Pollinator Conservation
- Top insect pests

Understanding bird, bee, butterfly, beneficial insect conservation in the landscape and IPM






Landscapes for people





Landscapes for BBBB





Supporting you and wildlife

Butterfly houses do not work

Stem nesting bee houses work, get the right one

Bird houses work, get the right one

Water features work, ponds, fountains cleaned daily

Feed sunflower chips not whole seeds to reduce mess

Most cheap bird foods are not worth the money




Help humming birds with feeders and plants

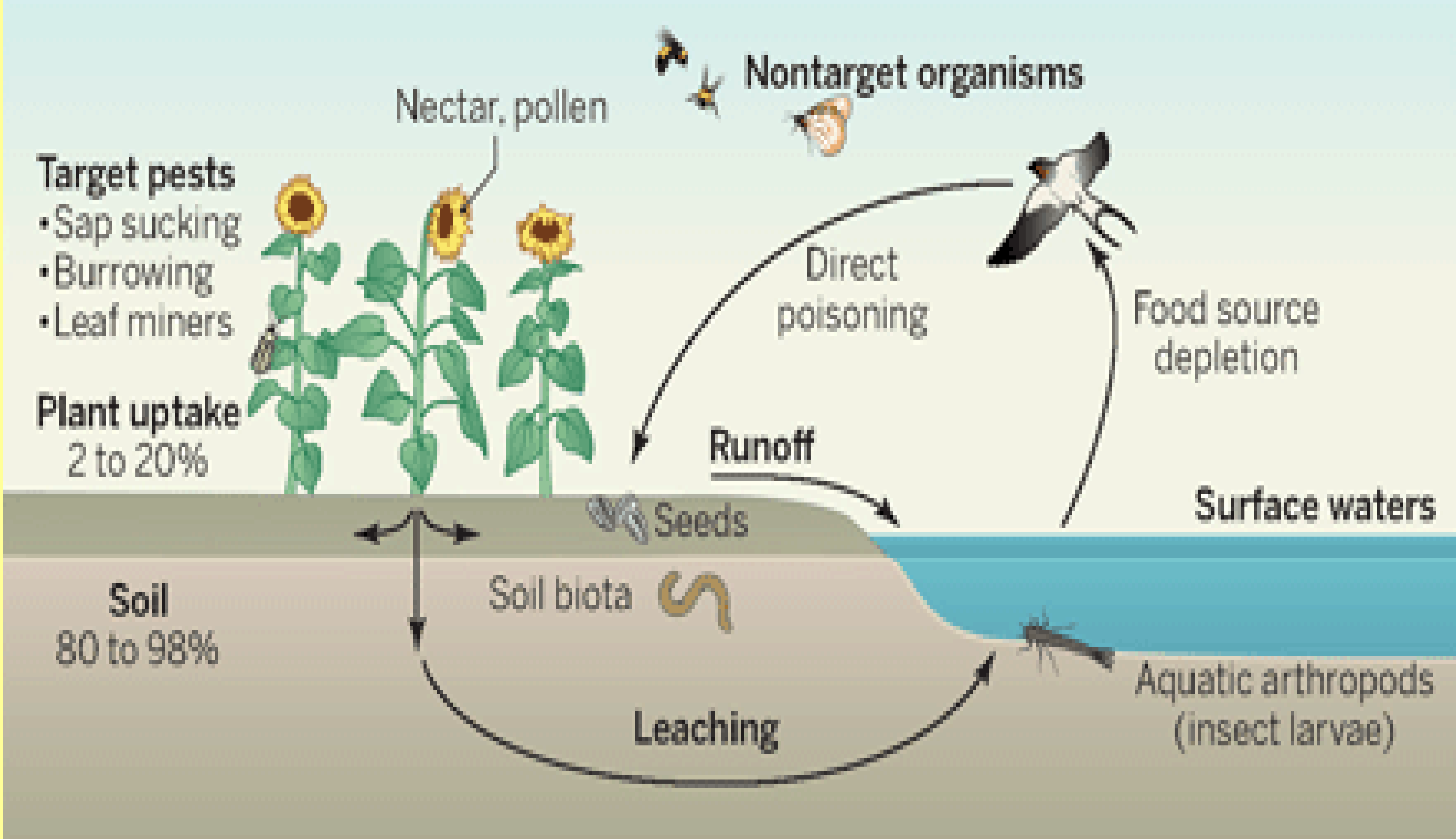



Leaf-cutter bees, Megachilid bees (*Megachile* sp)

Leaf cutter bees use rose leaves to line their nests, add a ball of pollen and nectar and lay an egg. Important pollinators of backyard fruits and crops. Larvae killed by imidacloprid.

Neonicotinoid birds + bees: Fate of neonicotinoids + pathways of environmental contamination (Sanchez-Bayo 2014 Science)

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND
Legislative Citizen Commission on Minnesota Resources (LCCMR)
Conservation Biocontrol 2017 - 2020



Why are there flowers?
Insects started it 146 million years ago. We will learn about pollinator conservation and systemic insecticides, a bad mix.

Era	Period	Dates (mya)
Cenozoic	Neogene	23-0
	Paleogene	65-23
Mesozoic	Cretaceous	146-65
	Jurassic	200-146
	Triassic	251-200
Paleozoic	Permian	299-251
	Carbonifer ous	359-299
	Devonian	416-359
	Silurian	444-416
	Ordovician	488-444
	Cambrian	542-488

flowering plants

Meta morph

wing folding

wings

first insects

Why do plants make flowers?

- Silurian/Devonian, age of fish, 444 million years crustaceans crawled onto land and evolved into insects.
- First insect looked like basement silverfish.
- Insects are ancestors of shrimps, crabs, and lobsters

Why do plants make flowers?

- 150 million years, Angioseperms evolved, flowering plants coevoled with insects to pollinate flowers.
- Flower color, shape, nectar and pollen rewards are due to insects.


Why do plants make flowers?

- Conifers, ginkgos, cycads, seed ferns are earliest plants
- Angioseperms, flowering plants evolved 150 million years, flowers and fruits containing seeds

Why do plants make flowers?

- beetles evolved ~300 million years ago,
- flies evolved ~250 million years ago,
- moths evolved ~150 million years ago

Before the birds and bees, what is coevolution of insects and plants?

Violetear hummingbirds are coevolved with red flowers

Ocellated turkey brillant male color from sexual selection.

Coevolution

- **Coevolution is where two species reciprocally affect each other's evolution.**
- **An evolutionary change in the morphology /physiology of a plant alters the morphology/physiology of an herbivore .**
- **Coevolution is likely to happen when different species have close ecological interactions with one another. Including:**

1. **Predator/prey and parasite/host**
2. **Competitive species**
3. **Mutualistic species**

Coevolution

Extra floral nectaries, such as sugar droplets on peony, fig, or citrus trees attract wasps and predators to kill pest insects

Why do plants make flowers and are aromatic?




- Plants evolved chemical defenses against insects, which evolved mechanisms to deal with plant toxins.
- Insects used these toxins for protection themselves from predators.
- Insects advertise their toxicity using warning colors.
- Over time, this led to coevolved species.

Bee Plants

How are plants pollinated?

- **Pollen collects on hairs and scales of insects.**
- **Most bees also have specialized structures called corbiculae or scopae to collect pollen.**

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Krischik lab websites

IPM resources for landscapes, turf, greenhouses **http://cues.cfans.umn.edu/**

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

MNLA online course for certification training for MDA pesticide license
Online at MNLA

Pollinator Conservation Biocontrol

Welcome. In addition to biocontrols, this website provides how-to instructions, plant lists, helpful links, videos and downloads on beneficial insect and pollinator conservation, insect identification, integrated pest management (IPM), and pollinator best practices for backyards, veggie gardens and parks & open spaces. Find course registration and class materials under resources, courses.

This website contains the following topics:

- Integrated pest management (IPM)
- Pesticides and pollinators
- Best practices for pollinators introduction
- Krischik lab research staff
- Krischik lab at work
- Research projects

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND
Legislative Citizen Commission on Minnesota Resources (LCCMR) Conservation Biocontrol 2017 - 2020

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

11. Family Megachilidae (common name: mason bee)

***Osmia* spp.** Blue, green, metallic, dull appearing black, moderately hairy, bulky, large head with mandibles **Size:** Small - medium, 6 - 11 mm (0.2 - 0.4 in) **Tongue:** Medium - long, 7 - 9 mm (0.3 - 0.4 in) **Nest:** collect mud to line their burrows in stems, old nests, wood or rocks, nest materials include mud, leaves, sand, gravel, and woodchips **Flight distance:** 91 m (300 ft) **Pollen collection:** Abdominal scopae

7. Family Halictidae (common name: green sweat bee)

***Agapostemon* spp.** Bright green, blue in some species with black and white (yellow) abdomen **Size:** Small - medium 7 - 15 mm (0.3 - 0.6 in) **Tongue:** Short, 2 - 6 mm (0.08 - 0.2 in) **Nest:** Ground in sandy loam soil **Pollen collection:** Scopae on hind legs

Agapostemon spp. (Peter Bryant, BugGuide)

Agapostemon spp. carrying pollen (Betsy Betros, BugGuide)

Agapostemon ground nest (Diane Wilson, BugGuide)

IPM for Professionals

Websites for IPM information and pesticides

Pesticides Registered in MN, Kelly Solutions

Compatibility of Pesticides and Beneficials, Koppert

Pesticide Labels, CDMS

Christmas Tree IPM

2021 NCSU Frasier Fir Scouting Manual

2014 USDA Forest Service

Dr. Vera Krischik is an Extension Specialist and Associate Professor in the Department of Entomology at the University of MN. Her research and extension collaborations are on pesticide use and safety, IPM, beneficial insect conservation, reducing pesticide use, pest and IPM identification for consumers and the green industry. Collaborations include answering questions on pesticide use for the UM Bee lab, proving talks and workshops for the UMN Pesticide Safety group, and commodity groups such as MNLA (MN nursery and landscape association), MGSA (MN golf course superintendents association, CTA (MN Christmas Tree Association) and consumers organizations. Also, I work with the UM Plant Disease Clinic on identifying insects, and the MN Depart of Ag, and MN Department of Natural Resources on pesticide use and invasive species. I am a member with other extension educators and specialists of the UM Horticulture Specialization and the UM Invasive Species Community of Practice. My research is on the effects of insecticides on beneficial insects and bees; insecticide residue in landscapes and crops; and developing site specific IPM programs to manage pests

Krischik's Talks and Extension Bulletins

2020 Krischik, Understanding Pesticide Toxicity to Pollinators

2020 Krischik, IPM for Endangered Species: Rusty Patched Bumble Bee

2020 Krischik, Insecticides for Trees

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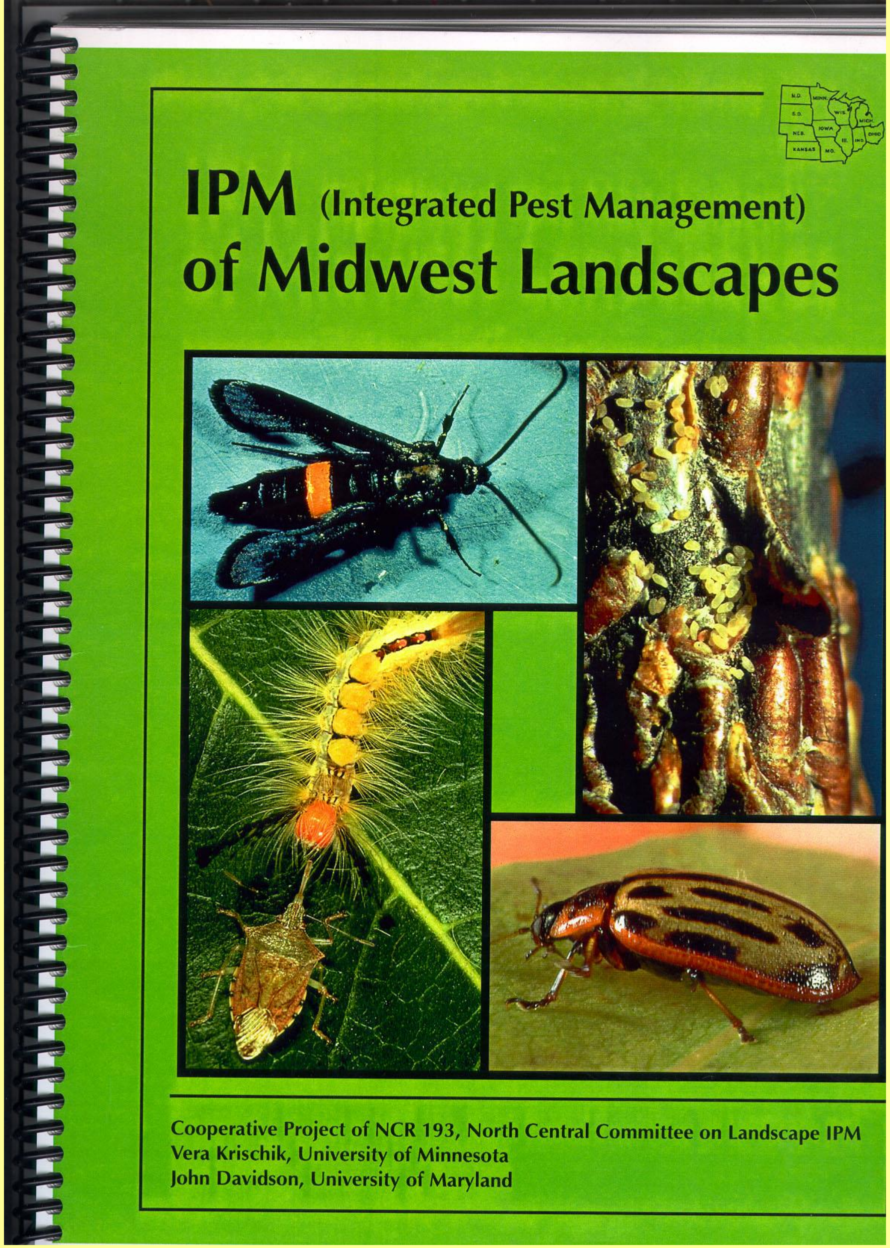
2021 Krischik, Top Invasive Insects

Turf Insects: white grubs and adults

IPM of Midwest landscapes (2004)

Vera Krischik, UM Entomology



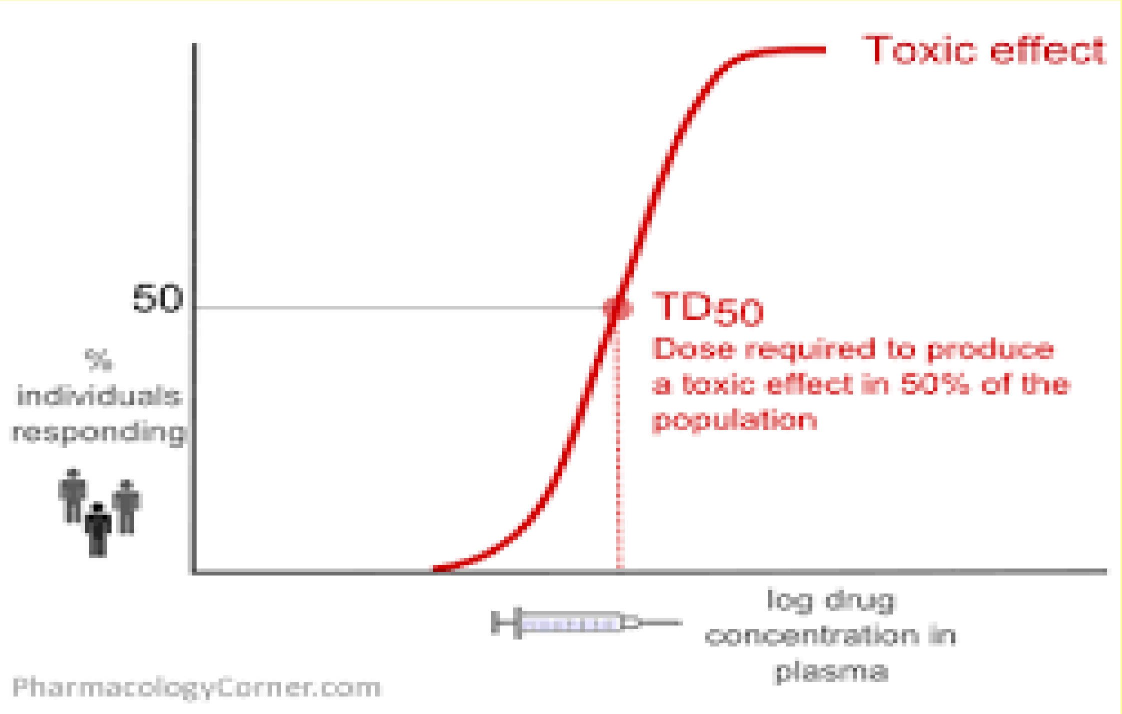
http://cues.cfans.umn.edu/

Pests of Trees and Shrubs

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

Issues with IPM in urban areas:

- **2018 Conserving the endangered rusty patched bumble bee; create habitat and decrease pesticide**
- **2020 Updated Insecticide toxicity to pollinators; are pesticides safe?**



2020 Understanding Pesticide Toxicity to Pollinators

Vera Krischik, Dept. Entomology, University of Minnesota, krisc001@umn.edu, 612.625.7044

Pesticide Toxicity to Pollinators

The active and inert ingredient can be found on the label on the pesticide container. The active ingredient is the chemical registered by the EPA as causing the toxicity of the product to the pest or beneficial insect. Recent papers demonstrate that inert ingredients are highly toxicity to bees as well. Inert ingredients are penetrating agents, odor maskers, stabilizers, preservatives, diluents, surfactants, emulsifiers, propellants, solvents, spreaders, stickers, antifoaming agents, dyes, and drift retardants that modify the physicochemical properties of the spray mixture. Some recent papers demonstrate that the inert ingredient called "organosilicone surfactant adjuvants" increase virus transmission in bees. Also, in recent studies fungicides demonstrated toxicity to bees. Another major issue is that the EPA registers the active ingredient and determines toxicity of the chemical based on short term, 4 day, LD 50 tests (lethal dose to 50% of the population) and not chronic, long term exposure. However, numerous papers are demonstrating that lower, sub-lethal amounts of pesticides affect behavior and alter the ability of insects to find food and survive. For these and numerous other reasons many insecticides are not safe to use around bees and other beneficial insects, such as lady beetles.

IPM: Systemic Compared to Contact Insecticides

The conservation of beneficial insects, that includes bees, insect predators, parasitic wasps, and butterflies, is an essential part of Integrated Pest Management (IPM) programs. IPM promotes multiple tactics to manage pests and to suppress the population size below levels that will damage the plant. Beneficial insects can only manage small, pest populations, when populations of pests are high, conventional insecticides must be used. For most pests that eat leaves, use contact insecticides that sit on the leaf surface and do not move into the plant and the toxicity to pests last for a few days on the foliage. Flowers that open after being sprayed with contact insecticides do not contain insecticide residue. Systemic insecticides move from the leaves or soil into OTHER plant parts as nectar and pollen. Flowers that open after systemic insecticides are sprayed can absorb the insecticide and the residue in leaves and flowers can last for many months.

Systemic, neonicotinoid insecticides are widely used, due to their low mammalian toxicity and the ability of the insecticide to move systemically from soil into the entire plant. However, they often move into pollen and nectar and when fed on by bees alter bee behavior or increase bee mortality. Application methods include seed treatments, foliar sprays, soil and trunk drenches, and trunk-injections. There are six systemic neonicotinoid active ingredients, imidacloprid, dinotefuran, thiamethoxam, clothianidin, acetamiprid and thiacloprid. You will find these active ingredients listed on the insecticide label in small print. Neonicotinoid insecticides are very toxic to bees and beneficial insects, especially as residue in pollen and nectar.

Manage with IPM by using cultural control, sanitation, biological control, using insecticides friendly to beneficial insects (low toxicity in the table). Remember "organic MRI approved insecticides" can be very toxic.

1. Scout for populations of both pest and beneficial insects, such as lady beetles and bees.
Determine if the good bugs are suppressing the pest bugs and no loss to flowering or food production can be found.
2. If beneficial insects are present and the pest population is increasing, then spray CONTACT insecticides on the foliage. Contact insecticides are degraded in a few days by light, water, and microbes.
3. Do not apply insecticides to flowers.
4. Spray contact insecticides on leaves in the evening when bees and lady beetles are not foraging.
5. Use insecticides that are less toxic to bees, such as oils, soaps, neem oil, Acelepryn (chlorantraniliprole), miticides, and insect growth regulators

Toxicity to pollinators of insecticides used in greenhouse, nursery, landscape.
Highlighted in gray are less toxic AI.

			Toxicity to honeybees**			
Chemical class/MOA	**Common name/MOA**	**Trade name**	**LD50* ug/bee**	**Non**	**Moderate**	**Highly**
Carbamates/1A	carbaryl	Sevin	0.014			x
	methomyl	Lannate	0.816			x
Neonicotinoids/4	imidacloprid	Merit, Marathon	0.004			x
	thiamethoxam	Flagship, Meridian	0.004			x
	clothianidin	Arena, Aloft	0.005			x
	dinotefuran	Safari, Venom	0.023			x
	imid+bifenthrin	Allectus	0.004			x
	imid+cyfluthrin	Discus	0.004			x
	flypyradifurone	Altus	1.2			x
	sulfloxaflor+spinetoram	XXpire cancelled	0.02+0.1			x
	acetamiprid	Tristar, Assail Calypso	14.5		x	
	thiacloprid		27.8	x		
Organophosphates/1B	acephate	Orthene	0.1082			x
	chlorpyrifos	Dursban/Lorsban	0.06			x
	dimethoate	Dimethoate	0.038			x
	malathion	Malathion	0.16			x
	phosmet	Imidan	0.1			x
Pyrethroids/3A	bifenthrin	Attain/Talstar	0.1			x
	cyfluthrin	Tempo, Decathalon	0.001			x
	fenpropathrin	Tame	0.05			x
	lambda-cyhalothrin	Scimitar	0.038			x
	permethrin	Astro, Pounce	0.029			x
	resmethrin	foggers	0.065			x
Botanical/3	pyrethrin	Pyganic	0.15			x
Insect growth regulators	diflubenzuron/15	Adept, Dimilin	25	x		
	tebufenozide/18	Confirm	234	x		
	azadirachtin/UN	Aza-Direct, Azatin	2.5		x	
	Neem oil		163	x		
	buprofezin/16	Talus	100	x		
	pyriproxyfen/7C	Distance, Fulcrom	100	x		
	novaluron/15	Pedestal	150	x		
	cyromazine/17	Citation	25	x		
Juvenile hormone /7A	s-kinoprene	Enstar II	35	x		
Anthranilic Diamides/28	chlorantraniliprole	Acelepryn	>104	x		
	cyantraniliprole	Mainspring	0.116			x
Macrocyclic lactones/6	abamectin	Avid, Sirocco	0.009			x
	emamectin-benzoate	Tree-age, Enfold	0.41			x
Miticides	acequinocyl/20B	Shuttle	>100	x		
	etoxazole/10B	TetraSan, Beethoven	200	x		
	fenpyroximate/21A	Akari, Vendex	162	x		

Think IPM

for pollinator conservation Integrated Pest Management

White lined sphinx moth

Painted lady butterfly

BIOLOGICAL CONTROL

is the use of natural enemies to control insect pest populations. Natural enemies include insect predators and parasitoids (such as lady beetles and braconid wasps) plus pathogens including bacteria, fungi and viruses.

PLANT NATIVE & HEIRLOOM

plants that provide pollen and nectar to attract natural predators. Many are attracted to flowering plants and also contribute to pollination services.

INTEGRATED PEST MANAGEMENT

is an ecosystem-based approach that employs long-term prevention of pests through inspection, monitoring, forecasting, thresholds, education and recordkeeping. While pesticides simply respond to the pest, IPM addresses the source of pest problems.

Mining bee

Dakota skipper

LAWN CARE

Limit insecticide/herbicide use, aerate, mow less often, less grasses grow to 4" or more, add nutrient-rich compost, and plant low growing perennials such as self-heal, clover, creeping thyme, blanket flowers, and pussy toes.

Spider wasp

Black & yellow mud dauber

Monarch butterfly

MONITORING

Long term prevention through regular monitoring of plants, pests and weather helps to project ahead and plan. Track and compare year to year to determine what works best.

CHEMICAL CONTROLS

Biorational insecticides are less harmful than conventional insecticides, as they target pests and conserve good bugs (eg. horticultural soaps and oils, corn gluten, spinosad and *Bacillius thuringiensis*).

CONSERVE POLLINATORS

Bees, flies, wasps, beetles and other pollinators are crucial for crops, landscapes, and natural areas. Avoid pesticides, provide nesting areas, and plant pollinator habitat for food sources.

Cicada killer wasp

Variegated Fritillary

Rusty patched bumble bee

Monarch butterfly

Black swallowtail

Yellow banded bumble bee

Polyphemus moth

ncipmhort.dl.umn.edu

By Dr. Vera Krischik and Laurie Schneider
University of Minnesota, Dept. of Entomology
Center for Urban Ecology & Sustainability CUES

LACEWING
Predator of aphids. Known as aphid lions.

SPIDERS
Arachnids eat many pest insects at any stage from egg to adult.

SYRPHID FLY or HOVER FLY
Adults feed on pollen and nectar. Larvae are predators on small insects.

PIRATE BUG
Adults and nymphs are predators of small insects.

LADY BEETLES
Larvae and adults are predators of small insects.

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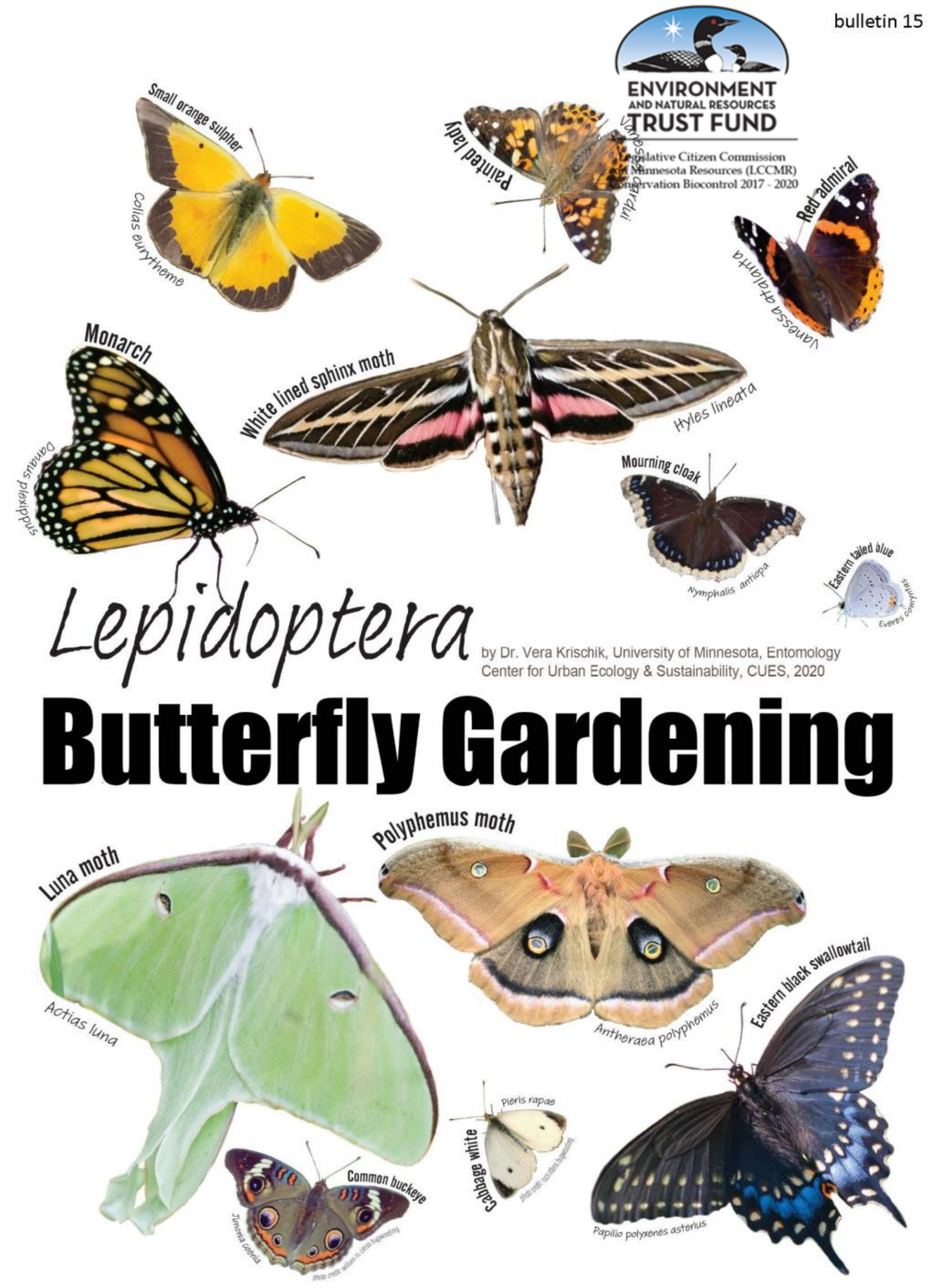
Pollinator Friendly Alliance

National Award Winner

American Society for Horticultural Science

Extension Division



Integrated Pest Management

Integrated Pest Management (IPM) is an ecosystem-based approach that employs long-term prevention of pests and pest damage through monitoring of plants, pests and weather to project ahead and plan. IPM addresses the source of the pest problems, whereas pesticides simply respond to pests. IPM minimizes the use of chemicals harmful to pollinators and beneficial insects, and toxic to the environment. The recommended best practice is to use cultural controls to reduce pest populations such as compost, bio fertilizers and aeration instead of pesticides.

Integrated pest management practices include:

1. Inspection and monitoring: Regular and close examination of plants is essential to diagnose pest problems. Monitoring includes devices such as traps, and practices such as observation and recordkeeping.
2. Forecasting: Weather and plant growth cycles (called plant phenology) help predict potential pest outbreaks. Properly timed pesticide applications will be more effective and reduce need for re-application.
3. Thresholds: Set thresholds for pest populations and plant damage. Use hardy plants that are naturally resistant to pests to avoid exceeding pest thresholds. Accept some plant damage.
4. Education: Regularly update the IPM plan and pesticide/treatment list so it remains effective. Stay educated and updated on IPM and best management practices.
5. Recordkeeping: Keep updated records to compare year to year and for decision-making. Track data including weather patterns, when pests appear, number of pests, plant damage, and practices that work and don't work.

Minnesota Threatened and Endangered Species

Excerpt from *Environmental Quality Board, Minnesota State Agency Pollinator Report 2018.*

Endangered: Persius duskywing, Ottoe skipper, Dakota skipper, Assiniboia skipper, Uncas skipper, Karner blue, Poweshiek skipperling, Uhler's artic.
Threatened: Garita skipperling.
Special Concern: Arogos skipper, Disa alpine, Leonard's skipper, Nabokov's blue, Grizzled skipper, Regal fritillary.

In addition to federally-listed species, Minnesota has **8** state-listed endangered pollinator species, **1** threatened, **10** species of special concern, and an additional **19** non-listed species in greatest conservation need.

Outline: Site Specific IPM programs

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What is PM?

- 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 are best management practices (BMP) for landscapes

- Use soil test for fertilization needs.
- Avoid over-fertilization.
- Manage pests with principles of IPM, Integrated Pest Management.
- Plant flowers and shrubs for pollen and nectar for beneficial insects that kill pest insect, pollinators, and butterflies

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

Understanding the partial contribution of pesticides to bee mortality and developing BMP to mitigate mortality

- Spot treatments not broad cast sprays
- Spray at less than 8 mph and when bees are not active in early morning and evening
- Spray less often, tolerate more weeds
- Use contact insecticides.
- Use the money saved on herbicide use to add nutrients back to the soil and turf to increase turf and plant health.
- Promote bee lawns + decreased herbicides

Insecticides: biorational, conventional, and organic

Biorational: Compatible with bees and beneficials

Organic: OMRI approved natural products; toxic to good bugs

Conventional: Toxic to pests, bees, beneficials

What is organic pest control?

- **Organic means a practice that is governed by certification 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.**

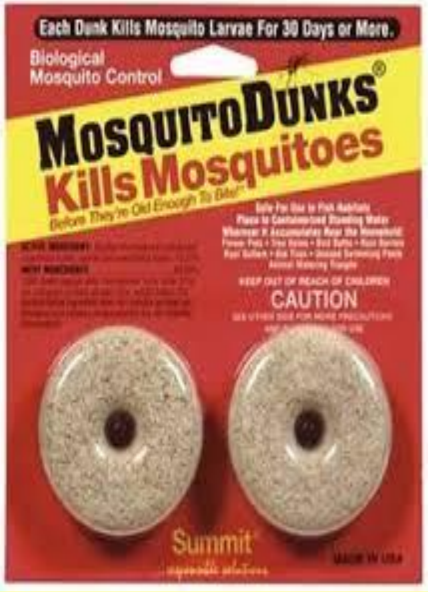
Organic OMRI=natural insecticides?

- **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**

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 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**

Order Coleoptera, Family Scarabeidae

Popilla japonica, Japanese beetle, 1916, spread 36 states

Adults are active from mid-June to mid-August and are polyphagous

They feed on **>300 plants in about 80 families**

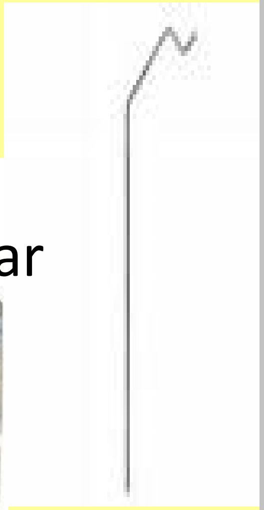
Japanese Beetle Damage to Linden Tree

JB traps: Do not use unless you empty daily before 6pm

trap

lure in trap

double lure:
pheromone and rose scent



stand or rebar

complete trap

Outline: Site Specific IPM programs

- Resources Krischiklab
- What is IPM
- Pollinator Conservation
- Top insect pests

JB grub control

Neonicotinoids

imidacloprid

MERIT®

clothianidin

Arena®

thiamethoxam

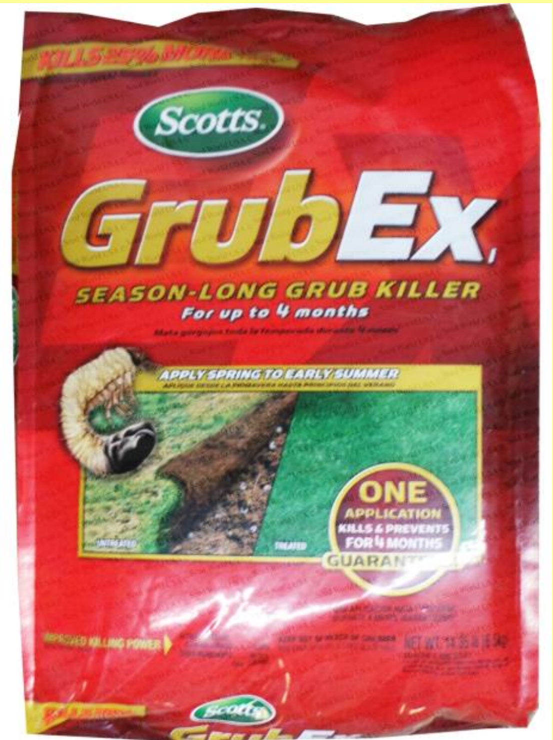
Meridian™ Insecticide

dinotefuran

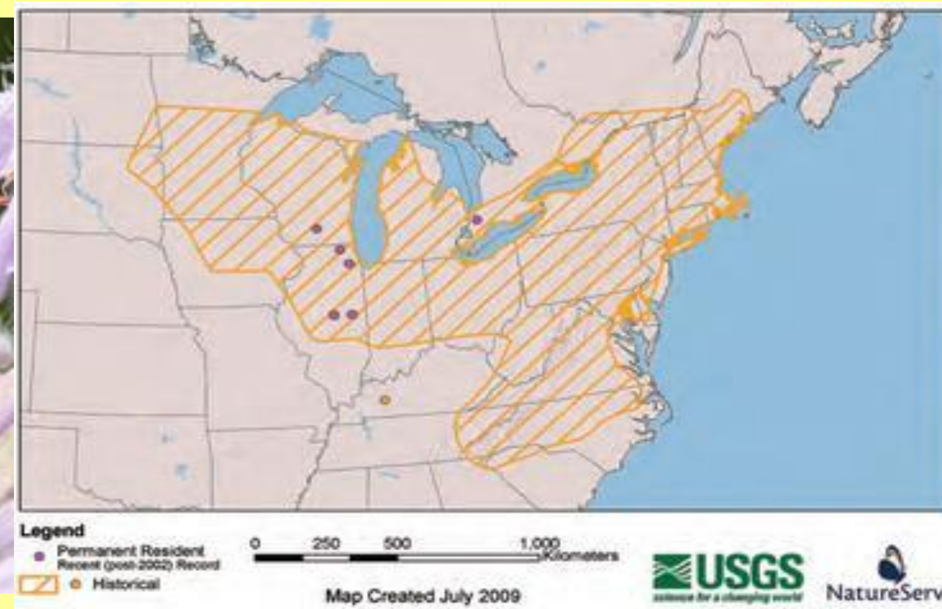
Zylam® Liquid Systemic Insecticide

Anthranilic Diamides, bee friendly

Acelepryn®



IPM Case Study: Rusty Patched Bumble Bee



Professionals, if you find rusty patched bumble bee on your land you must contact the Minnesota Department of Agriculture (MDA) and Department of Natural Resources (DNR) to develop a pest management program that protects the rusty patched bumble bee. The rusty patched bumble bee is a federally endangered species. In addition to contacting the appropriate agencies, photograph and send image to Bumblebeewatch.org for species confirmation.

Use biorational insecticides for bees

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




JB grub control

Grub gone, Phyllom Bio Products

Bacillus thuringiensis galleriae **(Btg)**

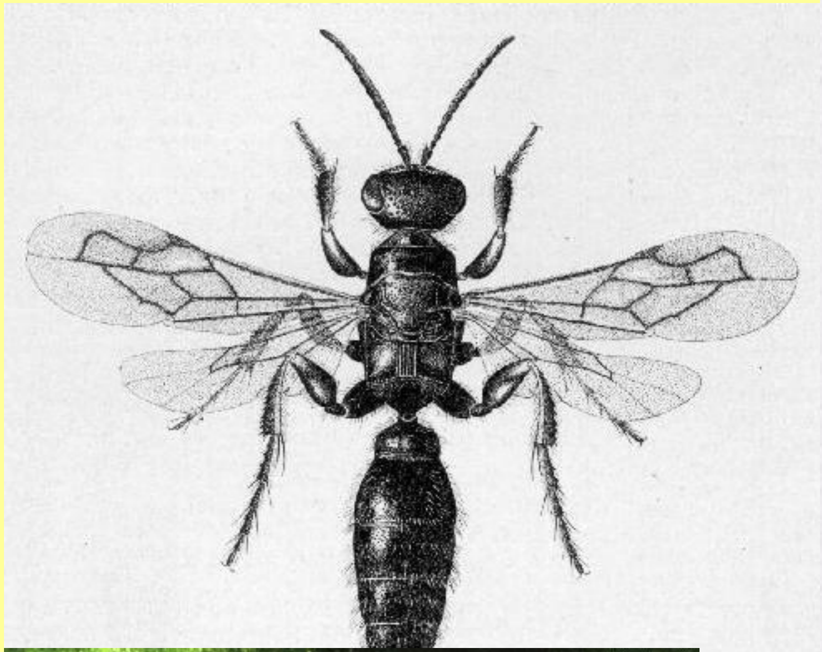
Japanese, Asiatic, June and Oriental Beetles, and European, Cupreous, Southern and Northern Masked Chafers. is an effective control of the larger, beetles

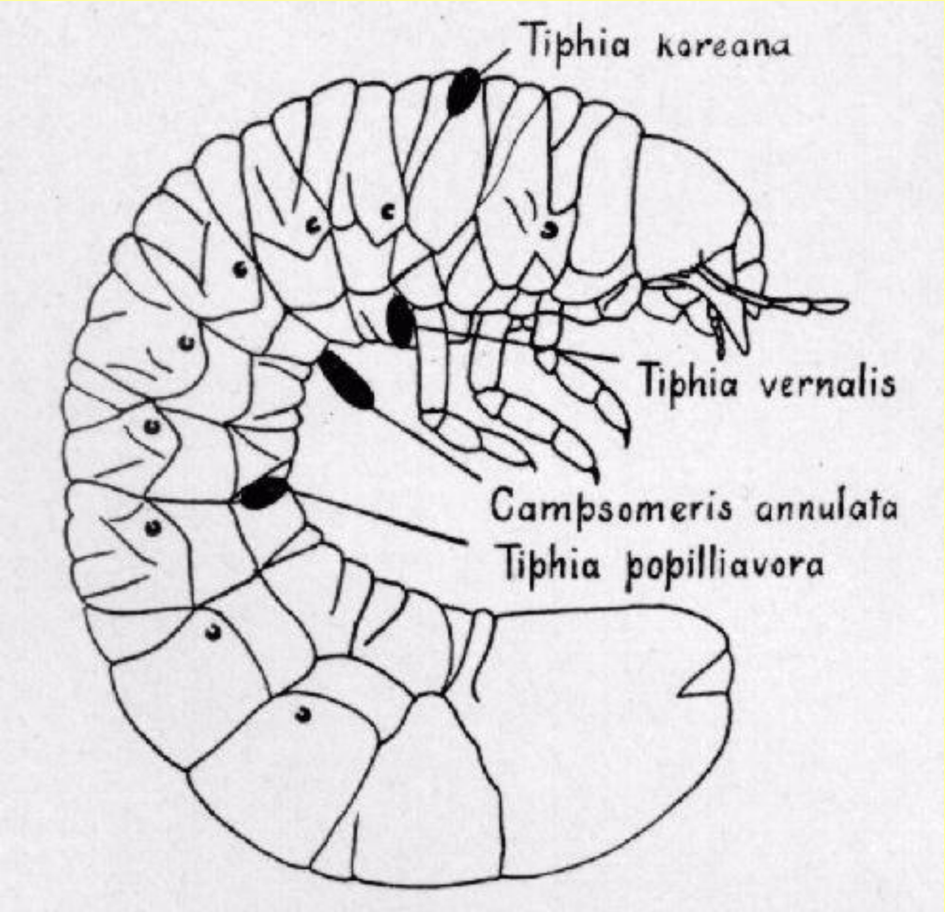
Biological control of JB

- **Japanese beetle parasites *Tiphia vernalis* (Hymenoptera) and *Istocheta* sp. (Diptera) known to be active in MA and CT**

- **MDA is released both in MN, but are not affective at control.**

Biological control of JB: *Tiphia vernalis*





Females of different species lay eggs on distinct parts of grub.

Biological control of JB: *Tiphia vernalis*

- **In the northeastern U.S., adult spring *Tiphia* wasps feed primarily on the honeydew exuded from aphids, scale insects, and leafhoppers.**

- **The wasp will also feed on the nectar of blossoms, such as forsythia, and on the extra-floral nectaries of peonies.**

- **In China the knowledge of food plants to increase the rates of *Tiphia* parasitization of white grubs to an average of 85%.**

Biological control of JB: *Isotecha aldrichi,* tachnid fly

- This solitary fly is an internal parasite of adult Japanese beetle.
- The female flies deposit 100 eggs during a period of about 2 weeks.
- The eggs are usually laid on the thorax of the female beetles and the maggot bores directly into the body cavity.
- Food sources: aphid nectar and Japanese knotweed (*Polygonum cuspidatum*), a persistent perennial weed native to Japan.

Biological control of JB: : Fungal pathogen

- **Fungal microsporidian pathogen, *Ovavesicula popilliae,* infects JB Malpighian tubules and spreads systemically. JB has been long established in CT and NY and it suppresses JB population growth. It infected approximately 25% of all JB grubs in CT.**

- **After introduction in MI it reduced winter survival by 25 to 50 %. Female JB emerging from infected grubs lay about 50 percent fewer eggs. Results indicate *O. popilliae* caused a 75 percent decline in JB populations during the 15-year study period. It takes the pathogen about six years to have a noticeable effect.**

- **Kentucky, Colorado, and Arkansas have introduced *Ovavesicula.***

- ***Ovavesicula* needs to be introduced in Minnesota**

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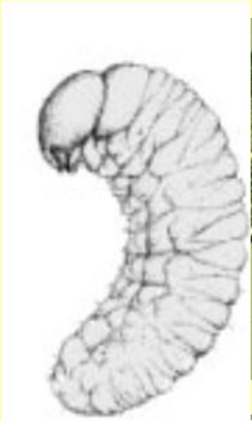
Specific IPM program for bluegrass billbug, black vine weevil, JB



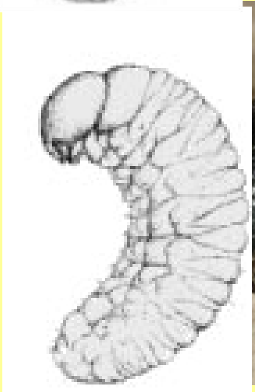
Billbug

Adults: after May contact insecticides

Biorationals: chlorantraniliprole, spinosad

Larvae: After Jul 15 IGR, *Steinernema glaseri* and JB nematodes, chlorantraniliprole

Conventional: imidacloprid, clothianidin



Black vine weevil

Adults: at night and all summer contact insecticides

Biorational: chlorantraniliprole, spinosad

Larvae: IGR, *Steinernema glaseri* and *Heterorhabditis bacteriophora* nematodes, chlorantraniliprole

Conventional: imidacloprid, clothianidin

JB

Adults: contact insecticides July-Sept

Biorational: chlorantraniliprole, spinosad

Larvae: After July 15

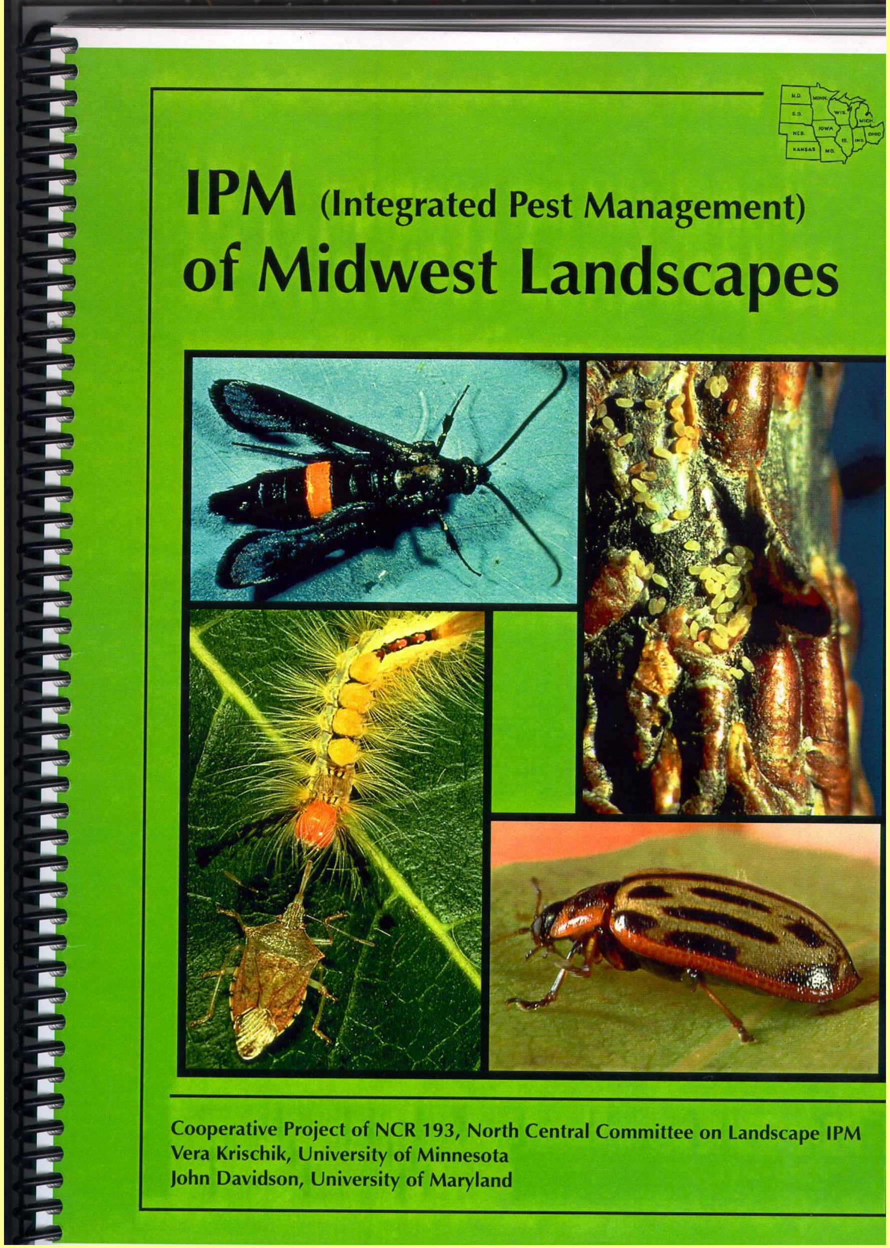
Biorationals: IGR, *Steinernema glaseri* nematodes, *JB* nematodes, Grub b gone BTg bacteria, chlorantraniliprole

Conventional: imidacloprid, clothianidin

Turf Insects: white grubs and adults

IPM of Midwest landscapes (2004)

Vera Krischik,
UM Entomology



http://cues.cfans.umn.edu/