

**Top ten invasive insects?  
IPM, Integrated pest management**



**Dr. Vera Krischik, Asso Professor/Extension Spec,  
Department of Entomology, University of Minnesota,  
phone: 612.625.7044,  
email: [krisc001@umn.edu](mailto:krisc001@umn.edu)**

**UM CFANS CUES website [cues.cfans.umn.edu/](http://cues.cfans.umn.edu/)**

**Outline of talk: Top10 invasive insects, IPM,**

- Insect pests can be grouped according to the way they damage the plant.
- Insects that vector diseases are the most damaging and insects that remove leaf tissue are the least.
- Insect evolution is conservative so if you know the family of the insect, then most insects in that family will perform similar damage.
- We will discuss how to develop IPM programs fro 10 major landscape pests, and proper insecticide choice and timing. We will discuss how to conserve pollinators and beneficial insects, while managing pest insects.

**Outline of talk: Top 10 invasive species in world**

Kade toad, 1935, from Central/South America, introduced into Australia for biocontrol Greyback cane beetle.



Kudzo, vine, fast growing, from Asia in 1876, introduced to control soil erosion and increase soil fertility as it is a legume and fixes nitrogen in US



**Outline of talk: Top 10 invasive insct species**

- Afrancanized “killer” bees
- Kudzo, vine from Japan, fast growing, introduced to control soil erosion in US
- Burmese Python
- Black rat
- Snakehead Fish
- Asian Carp
- Cotton whitefly
- Asian Tiger Mosquito
- Killer bees
- Zebra mussels

**Outline of talk: IPM, residues, effects on bees and beneficials of neonicotinoid insecticides**

- **The top 10 invasive insects in landscapes**
- **What is the difference between IPM and organic control**
- **Most insecticides kill bees, why are neonicotinoids receiving so much scrutiny?**
- **JB control w/o neonicotinoids**

**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



**Binomial nomenclature, 1758**

**Carl Linnaeus, born 1707, Sweden  
Systema Naturae, from 1737-1758**

**Order: Lepidoptera  
Family: Lymantriidae, tussock moth  
Genus, species  
*Lymantria dispar*  
Common name: gypsy moth**

**Aphids**

Adult aphids give birth to live young. Generally, aphids begin giving birth when they are 7 to 10 days old, depending on temperature.



Green peach aphid adult and young




Winged green peach aphid adult

- 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


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

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

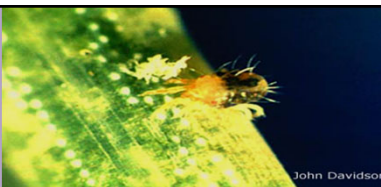
- Cottony maple scale
- Order Hemiptera
- Family Coccidae
- Soft scale, sap sucking insect
- Yellowing, stunting, dieback
- Maple, elm, hawthorn, dogwood, poplar, linden



- **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, sap sucking
- Chlorosis, foliage distortion, and tip dieback.
- Oaks



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



- **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 Lepidoptera
- Family Geometridae
- Moth larvae feed, adults do not feed
- Defoliation, shot hole injury
- Apple, elm, oak, hickory, linden, birch, beech, maple

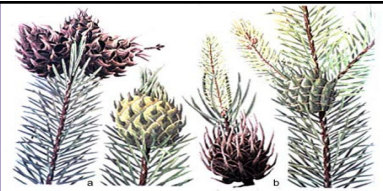
- **Birch leafminer**
- Order Hymenoptera
- Family Tenthredinidae
- Sawfly larvae feed, adults do not
- Hollow out patches between leaf surfaces
- Birch trees




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




- **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




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




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







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



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



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



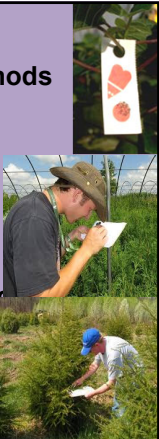
- **White pine weevil**
- Order Order Coleoptera
- Family Curculionidae
- Weevil larvae and adults feed
- Leader dieback
- Pine and spruce

**Outline of talk: IPM, residues, effects on bees and beneficials of neonicotinoid insecticides**

- The top landscape pests
- **What is the difference between IPM and organic control**
- Most insecticides kill bees, why are neonicotinoids receiving so much scrutiny?
- JB control w/o neonicotinoids

**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, physical, genetic, biological, chemical
- Least toxic pesticide first and use spot treatments
- Conserve beneficial insects



### What are best management practices (BMP) for landscapes

- Use woody ornamentals and herbaceous perennials
- Prepare the planting bed tilling to a depth of 8 - 12 in.
- Add appropriate amendments.
- Avoid general-purpose fertilizers in the planting hole.
- Apply 3 to 5 inches of mulch on the soil surface.

### 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

### How to control overwintering insects?

- Tillage exposing insects in the soil
- Horticultural oils in the fall to killing overwintering stages on woody plants
- Removal of weeds to remove overwintering sites.
- Removal of all debris that may harbor pests.

### 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

### 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.

### 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.

### Characteristics of organic pesticides

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

### Microbial insecticides OMRI approved

- BT
- *Beauveria bassiana*, *Mycotrol-O*, many
- *Chromobacterium subtsugae*, *Grandevo*, many
- *Cydia pomonella granulosis*, *CYD-X*, codling moth
- Spinosad, *Entrust*, soil bacteria toxin, caterpillars
- Nematodes, *Steinernema* and *Heterorhabditis*, *Biosafe*, *Bio Vector*, *Nemasys*, soil inhabiting insects

### Organic OMRI=natural sources pesticide?



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

### When should biological control be used?

Biological control is most effective when enemies are release during low pest densities.

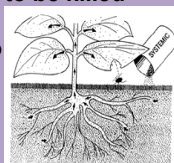
When using biological control agents in the greenhouse, it is important to avoid broad-spectrum pesticides; these may be detrimental to biological control agents. Carefully choose biorational insecticides to conserve biological control agents in the greenhouse.



### 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, trunk-inject
- Insect must eat leaf, pollen, or nectar to be killed
- Toxicity can last for months to years, unknown
- Flowers that open will have the insecticide in pollen and nectar for months to years, unknown

### 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: 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

### Types of BT



- BT is a protein crystal that puts a hole in the insect's gut wall after ingestion.
- Kurstaki, **moth larvae**, Dipel, Javelin
- Aizawai, **moth larvae and suckers**, Xentari
- tenebrionis, **beetle larvae**, Trident
- galleria, **grubs**, Grubgone
- bifenthrin, NOT organic, **grubs**, Grub B Gone Ortho
- chlorantraniliprole, NOT organic but conserves beneficials, **grubs**, Grub Ex Scotts
- israelensis, **fly larvae**, Aquabac
- Burkholderia, **caterpillars**, Venerate

### *Beauveria bassiana* is a fungus

- *Beauveria bassiana* is a fungus which causes a disease. When spores of this fungus come in contact with the cuticle (skin) of susceptible insects, they germinate and grow directly through the cuticle to the inner body of their host. Here the fungus proliferates throughout the insect's body, producing toxins and draining the insect of nutrients, eventually killing it.
- Unlike bacterial and viral pathogens of insects, *Beauveria* and other fungal pathogens infect the insect with contact and do not need to be consumed by their host to cause infection.

### Use biorational insecticides for bees: *Beauveria bassiana* is a 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*



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

~~Nicotine (leaves tobacco), rotenone (roots of *Derris* sp, other legumes) Ryania (Ryania shrub), Sabadilla (tropical lily), no longer approved~~

- 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 (*Azadirachtin indica* tree fruits), Azatin, AzaGuard
- Garlic oils? Consumer, aphids, beetles, caterpillars, Garlic barrier
- Hot peeper extract, Capasaicin, ? Consumer, Nemitol
- Rosemary oil, with peppermint oil, Ecotrol, Ecotec
- New in progress, Citronella, Pennyroyal

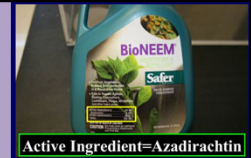


## Azadirachtin



- From Indian neem tree, *Azadirachta indica*
- Active against thrips.
- Caterpillars and aphides
- Biodegrades in sun.
- More effective on young larvae.
- Works best at temperatures, greater/equally to 70
- **Azera** combination product with azadirachtin

## Neem Oil



- From Indian neem tree, *Azarchta indica*
- Clarified hydrophobic extract of neem, very little azadirachtin in neem oil
- MOA suffocates by blocking breathing pores.
- Good for soft bodied, aphids, spider mites, scales, whiteflies, mealybugs
- Can kill beneficials
- Low mammalian toxicity

## Dusts

- Kaolin clay, **Surround**, can kill stink bugs



## Pyrethrins/Pyrethrum

- South African daisy, *Tanacetum cinerariaefolia*
- Requires PBO, piperonyl butoxide synergist, **PyGanic**



## Oils and soaps

- Oils, mites, scales, aphids
- Triact 70, clarified hydrophobic extract of Neem oil
- Mantis EC is an agriculture grade organic insecticide/miticide formulated with the natural insecticidal activity of rosemary, peppermint, and NON-GMO soybean botanical oils.



## Botanical Oils (Insecticidal Oils)

Mantis EC is an agriculture grade organic insecticide/miticide formulated with the natural insecticidal activity of rosemary, peppermint, and NON-GMO soybean botanical oils.



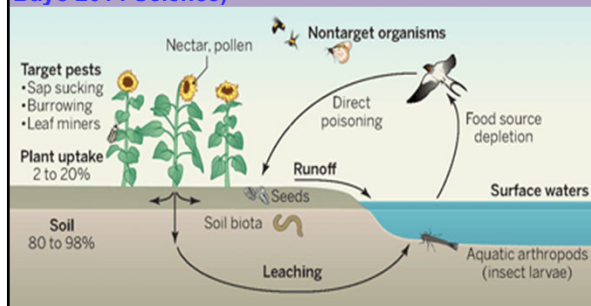
**Outline of talk: IPM, residues, effects on bees and beneficials of neonicotinoid insecticides**

- The top landscape pests
- What is the difference between IPM and organic control
- Most insecticides kill bees, why are neonicotinoids receiving so much scrutiny?
- JB control w/o neonicotinoids

**Understanding the partial contribution of pesticides to bee mortality and developing BMP to mitigate mortality, IPM is part of BMP**



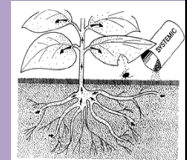
**Neonicotinoid birds + bees: Fate of neonicotinoids + pathways of environmental contamination (Sanchez-Bayo 2014 Science)**



**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, trunk-inject
- Insect must eat leaf, pollen, or nectar to be killed
- Toxicity can last for months to years, unknown
- Flowers that open will have the insecticide in pollen and nectar for months to years, unknown

**A really big issue understanding systemic compared to contact insecticides.**



**Why are neonicotinoids so much more toxic to bees compared to other insecticides?**

- Receptors in bees not in mammals
- Adjuvants increase toxicity
- Alters behavior +foraging at sublethal doses
- Water soluble
- Binds with soil

<b>Pesticides : toxicity / bees (LD<sub>50</sub> ng/bee)</b>					
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

Neonicotinoids are 5,000-10,000X more toxic than DDT to bees

LD50 DDT ... 27,000ng/bee

LD50 neonicotinoid insecticides

Imidacloprid .....4 ng/bee....40 ppb

Clothianidin .....4 ng/bee....40 ppb

Dinotefuran .....4 ng/bee....40 ppb

Thiamethoxam .....5 ng/bee....50 ppb

aspirin 80mg=80,000microg=80,000,000ng

### Imidacloprid rates vary among sites

#### Agricultural field

0.1 mg imid/canola seed (Gaucho)

1.2 mg imid/corn seed (Gaucho)

4 mg imid/sg ft ag field (soil, Admire Pro)

2.5 mg imid/sg ft ag field (foliar, Admire Pro)

#### Nursery/greenhouse

300 mg /3 gallon pot (~1 sg ft surface) (Marathon1%G)

#### Landscape

3.7 mg/sg ft turf (Bayer Adv Season Long Grub)

122 mg rose @ 4 times/yr (Bayer Adv Rose FI)

10.2mg/sg ft beds @ 4 times/yr (Bayer Adv Rose FI)

### Why are bumblebee more susceptible to neonicotinoids?

- Honeybee queens never forage.  
Bumble bee queens forage in fall + spring.
- Honeybee colonies have 50,000 workers  
Bumble bee colonies have 30 workers.
- Honeybee forager is the last stage in lifecycle.  
Bumble bee workers forage at any age.
- Honeybee bread=pollen+ nectar+ saliva+ hypo pharyngeal secretion, detoxifies
- Bumble bees do not make bee bread.

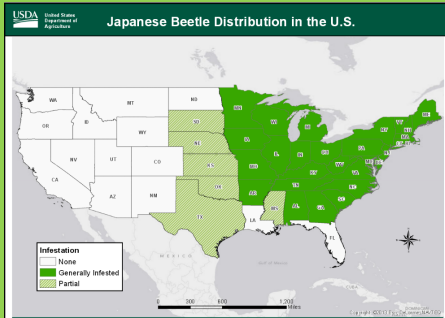
### Outline of talk: IPM, residues, effects on bees and beneficials of neonicotinoid insecticides

- The top landscape pests
- What is the difference between IPM and organic control
- Most insecticides kill bees, why are neonicotinoids receiving so much scrutiny?
- JB control w/o neonicotinoids

### Outline of talk: IPM, residues, effects on bees and beneficials of neonicotinoid insecticides

- What is the difference between IPM and organic control
- Most insecticides kill bees, why are neonicotinoids receiving so much scrutiny?
- JB control w/o neonicotinoids

Japanese beetle was accidentally brought to the US prior to 1916, first found in NJ



Currently established in over 25 states

Adult Japanese Beetle: About ½ in. long, emerald green with copper elytra



Main symptom is skeletonized leaves from feeding between veins

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

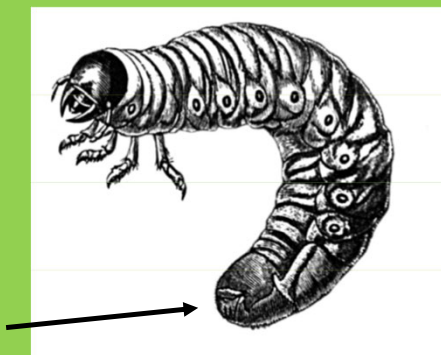


They feed on >300 plants in about 80 families

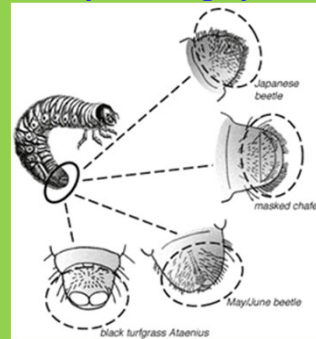
Japanese Beetle Damage to Linden Tree









Raster

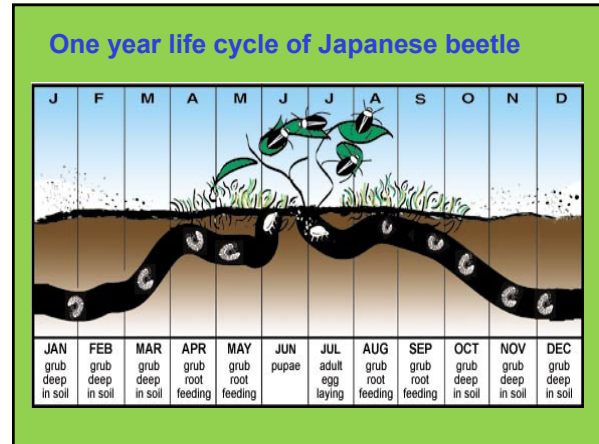


ID white grubs to species by rastral pattern, Why? Damage potential




**Life history of scarabs in turf**

species	species	years	larval food	adult food
	JB	one year	turf	adults feed on grape, linden, rose
	false JB	one year	unknown	adults feed on grape, linden, rose
	rose chafer	one year	unknown	adults feed on grape, linden, rose
	masked chafer	one year	turf	adults do not feed; do not leave turf
	<i>Ataenius Aphodius</i>	3 gen. year June, July, Sept	turf, manure	adults feed on turf; adults overwinter in woodlots
	Large June beetle	three years	turf	adults feed on grape, linden, rose



**Use different insecticides for JB adults or grubs**




**Japanese beetle is the worst white grub.**

**Neonicotinyl insecticides are safer for people**

Active ingredient	Classes	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...**

**JB grub control**

**Neonicotinoids**

imidacloprid    clothianidin




thiamethoxam    dinotefuran



Zylam® Liquid Systemic Insecticide

**Anthranilic Diamides, bee friendly**




**JB grub control**


**Grub gone, Phyllo 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



**Parasitic nematodes**  
*Steinernema carpocapsae*  
*Heterorhabditis bacteriophora*



Elm Leaf Beetle Pupa Infected With Nematodes

**JB grub damage is the worst in late summer and fall**



Grub Damage  
 Grass Pulls Up Easily

Symptoms: Turf turns brown and easily rolls back, like a rug

**JB grub control in August**


- Expect no more than 75% control once grubs are large
- 2 main products used: Dylox or a neonicotinoid
- Acelepryn is NOT a curative product, slow acting



**JB adult control: insecticides**

**Acelepryn** (4 weeks residual)  
 Pyganic OMRI approved, pyrethrins  
 Pyrethroids

**Onyx, bifenthrin** (4 weeks)  
 Talstar, bifenthrin (2-3 wks)  
 Tempo, cyfluthrin  
 Sevin, carbaryl, harmful to bees (1-2 weeks residual)

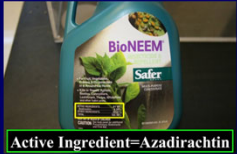


**JB adult control: Azadirachtin, anti-feeding**



- From Indian neem tree, *Azadirachta indica*
- Active against thrips.
- Caterpillars and aphides
- Biodegrades in sun.
- More effective on young larvae.
- Works best at temperatures, greater/equally to 70
- Azera** combination product with azadirachtin

**JB adult control: Neem oil, anti-feeding**



Active Ingredient=Azadirachtin

- From Indian neem tree, *Azarchta indica*
- Clarified hydrophobic extract of neem, very little azadirachtin in neem oil
- MOA suffocates by blocking breathing pores.
- Good for soft bodied, aphids, spider mites, scales, whiteflies, mealybugs
- Can kill beneficials
- Low mammalian toxicity

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



### Ecosystem management

#### susceptible

- Most lindens
- Purple leaf plum
- Purple sandcherry
- Norway maple
- Roses
- Certain crabapples
- Birch

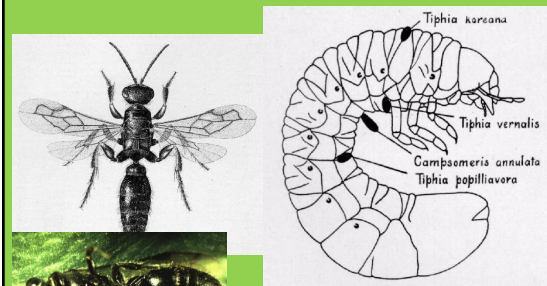
#### resistant

- Red maples
- Dogwoods
- Redbud
- Beech
- Tuliptree
- Sweet gum

### 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 extrafloral 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: *Istocheta aldrichi*, tachnid fly

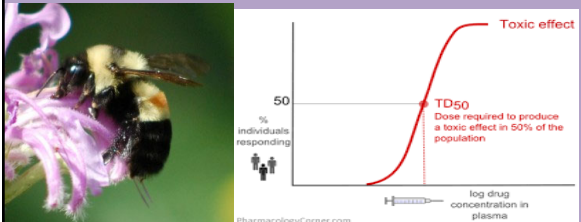
- This solitary fly is an internal parasite of adult Japanese beetle.
- The female flies deposit 100 eggs during a period of about 2 weeks.
- The eggs are usually laid on the thorax of the female beetles and the maggot bores directly into the body cavity.
- Food sources: aphid nectar and Japanese knotweed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

- 2018 Conserving the endangered rusty patched bumble bee; create habitat and decrease pesticide
- 2018 Updated Insecticide toxicity to pollinators on website with pdf of this ppt



### 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

Flowers that are in the lawn provide vital food for bees and long grass is important for Bumble Bee nests and is crucial for hoverflies.

We have lost half our bees in the last 20 years due to loss of habitat and pesticides.


We have lost 87% of our honey bee colonies since 1987, so giving the bees the flowers in my lawn is vital.

Butterflies and solitary bees are also important for pollination. Their nesting bees especially for bumblebees, blueberries and alfalfa.

Last year British farmers had to import 50,000 containers (that's 5 million bees) in order to produce all fruits and vegetables.





### Changing the paradigm: reduce pesticide use



**KEEP THE BUZZ IN LEIGHTON BUZZARD**  
**Bee Champion**

I am letting my lawn grow so the flowers in it help the bees


Flowers that are in the lawn provide vital food for bees and long grass is important for Bumble Bee nests and is crucial for hoverflies.

We have lost half our bees in the last 20 years due to loss of habitat and pesticides.

We have lost 87% of our honey bee colonies since 1987, so giving the bees the flowers in my lawn is vital.

Butterflies and solitary bees are also important for pollination. Their nesting bees especially for bumblebees, blueberries and alfalfa.

Last year British farmers had to import 50,000 containers (that's 5 million bees) in order to produce all fruits and vegetables.



- Use contact insecticides
- Not use systemic neonicotinoid insecticides
- Reduce herbicide use
- Do not use fungicides w/o diagnosis
- Promote bee lawns