

Top 10 invasive insects? Insect family and life history are good predictors of invasive status



Two on right: Corn rootworms
Stripped center: Colorado potato beetle
Left: Asparagus beetle
All Family Chrysomelidae,
Locally abundant, not FQ status, WHY?

FQ, Japanese beetle
Family Scarabaeidae

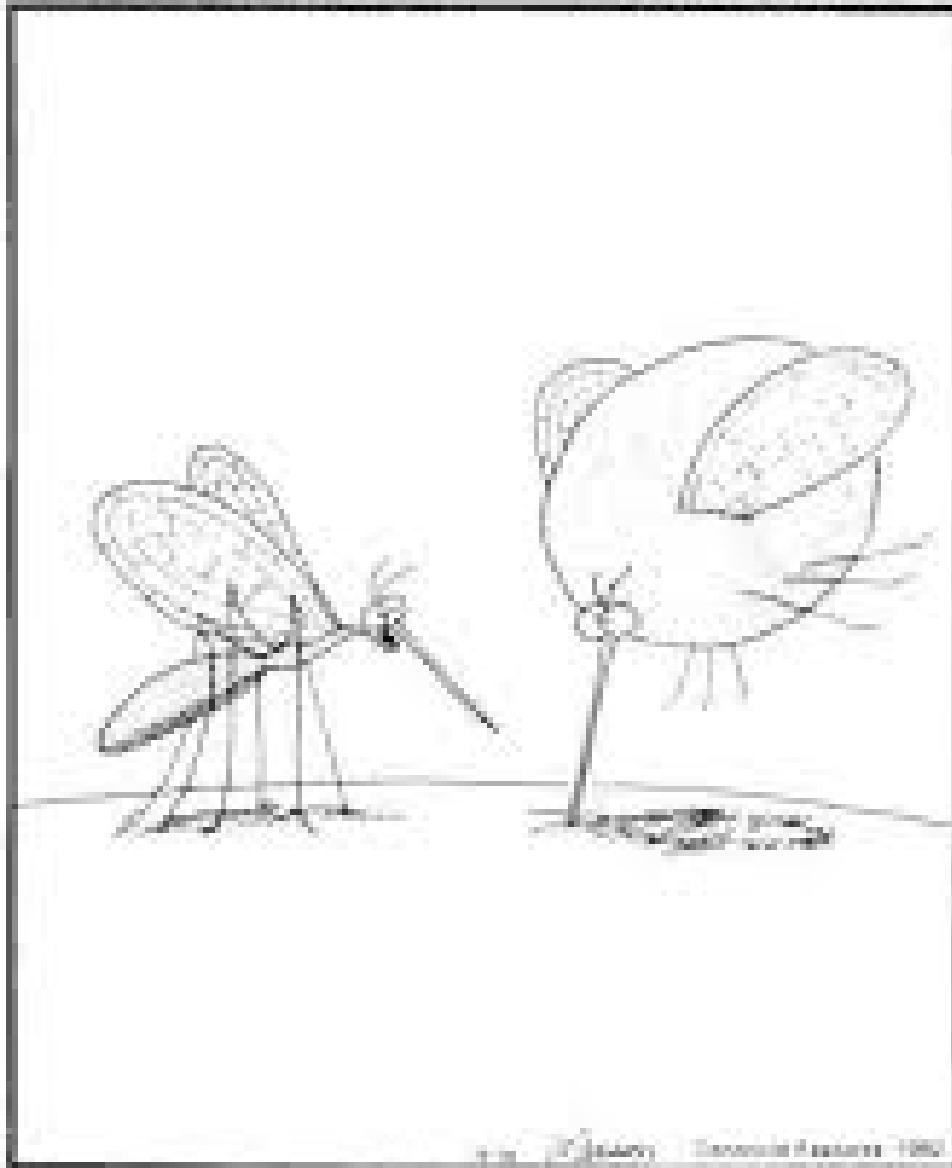
Dr. Vera Krischik, Assoc Professor/Extension Spec,
Depart Entomology, UMinnesota, krisc001@umn.edu
<https://ncipmhort.cfans.umn.edu>
<https://pesticidecert.cfans.umn.edu>

Insect humor: getting your attention



THE FAR SIDE

By GARY LARSON



"Pull out, Betty! Pull out! . . . You've hit an artery!"



Invasive, native, exotic, risk??

- Native, occurs naturally, has predators and pathogens: Elm leaf beetle, introduced, American elm, controlled by *Harmonia*, Asian lady beetle
- Invasive, high population growth, can be native or exotic; native ninebark beetle, not a lot of ninebark shrubs, locally invasive
- Exotic introduced w/o predators and pathogens, high risk, high population size, lots of viburnum shrubs



Outline: Top 10 invasive insects

- **WHAT MAKES SOME SPECIES BETTER AT BEING INVASIVE?**
FAST GROWTH RATE,
FREE FROM PREDATORS AND DISEASES,
ABUNDANT HOST,
GOOD DISPERSAL
- **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 manage invasive pests and the discuss similar species in the landscape that can be managed.**

Invasive, Exotic, Native = risk?

beetle family Buprestidae,
flatheaded bores or metallic wood boring
beetles includes:

Twin lined chestnut borer, native,
follows oak wilt, low risk,

Emerald ash borer, exotic, invasive,
high risk

Flatheaded apple tree borer, native,
follows stress, low risk

Bronze birch borer, native,
European birch high risk



Invasive, Exotic, Native = risk?

**beetle family Cerambycidae,
roundheaded bores or longhorned
beetles includes:**

**Asian longhorned beetle, exotic, invasive,
Maples, high risk**

Dogwood twig borer, native, low risk

**Elm borer, native,
follows stress, high risk, DED vector**

Milkweed beetle, native, low risk



Invasive, Exotic, Native = risk?

beetle family Scarabaeidae,
Scarab beetles includes:

Japanese beetle, exotic, invasive,
Roses. Linden, turf, high risk

Masked chafer, native, low risk

Oriental beetle, high risk,

European chafer, exotic, new MN
Low risk



Outline: Top 10 invasive species in world

- **Kade toad, 1935, from Central/South America, introduced into Australia for biocontrol of 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: Top 10 invasive insect species

- **Africanized “killer” bees**
- **Burmese Python**
- **Black rat**
- **Snakehead Fish**
- **Asian Carp**
- **Cotton whitefly**
- **Asian Tiger Mosquito**
- **Zebra mussels**

Outline of talk: Top 10 insect pests

- 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**

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

Top 10 landscape insect pests

- 1. FQ IE. emerald ash borer: ash
- 2. FQ IE. Gypsy moth; many plants
- 3. FQ IE. hemlock wooly adelgid; hemlocks in Great Smoky MT
- 4. FQ IE. European elm beetle, killed most American Elms
- 5. Native. *Erwinia amylovora* vectored by bees, killed American ash
- 6. IE, birch leaf miner sawfly; birch
- 7. FQ IE. Asian long-horned beetle; maples
- 8. FQ IE. Japanese beetle; lindens, roses
- 9. FQ IE. spotted wing drosophila; all berries
- 10. Q IE. spotted lanternfly; many plants
- 11. FQ IE. brown marmorated stink bug; fruits, veggies
- 12. FQ IE. Asian giant hornet; kills everything
- 13. FQ IE. Jumping worms; destroys soil

worst



Do we send invasive, exotic around the world from the US? YES

2015 Japanese beetle is a serious pest in mainland Europe; at two airports in northern Italy at Piedmont and Lombardy, feeding on both wild plants and nearby crops.

2020 Pine tortoise scale invades umbrella pines in Rome

1840 Monarch butterflies in Hawaii, Australia, New Zealand, Spain, Pacific Islands, and International Space Station!!



***Agrilus planipennis*, Emerald ash borer, Asia, 1992, FQ**



**Arrived 1992 near Detroit, Michigan, and in 2009 in MN
and spread to 30 states and 5 Canadian provinces,
100% fatal in ash, 100 million ash trees killed**

***Lymantria dispar*, gypsy moth, Asia, 1868 feeds gregariously on oaks and other trees; imported to make American silkworm industry; failed**



***Adelges tsugae*, hemlock wooly adelgid,
Japan, 1920 feeds on hemlock and kills the tree**



Adelges tsugae, European elm bark beetle vectors DED, Europe, Asia, 1930 feeds on elms



Beetles the
size of a
Tic Tac

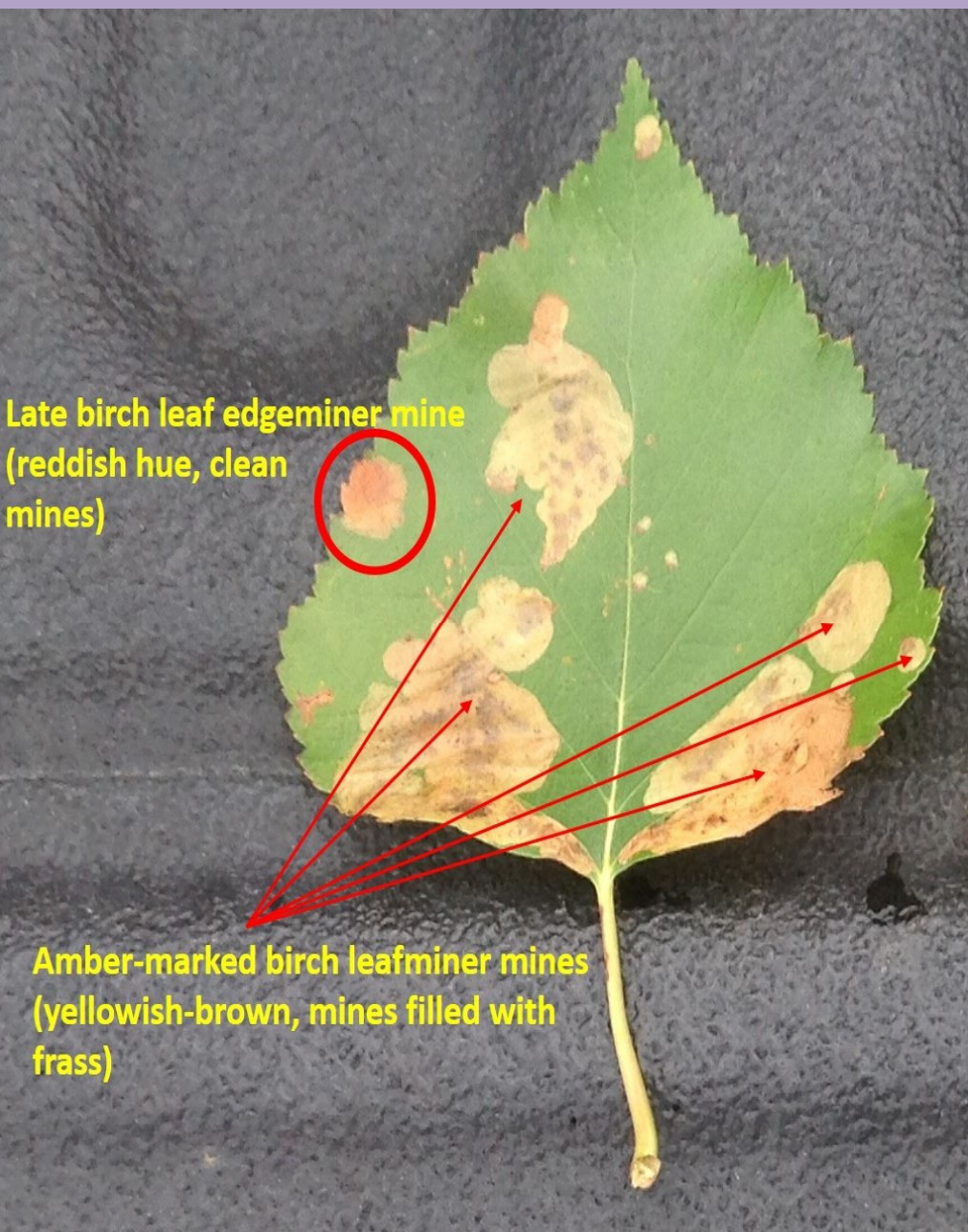


can take
down
trees.

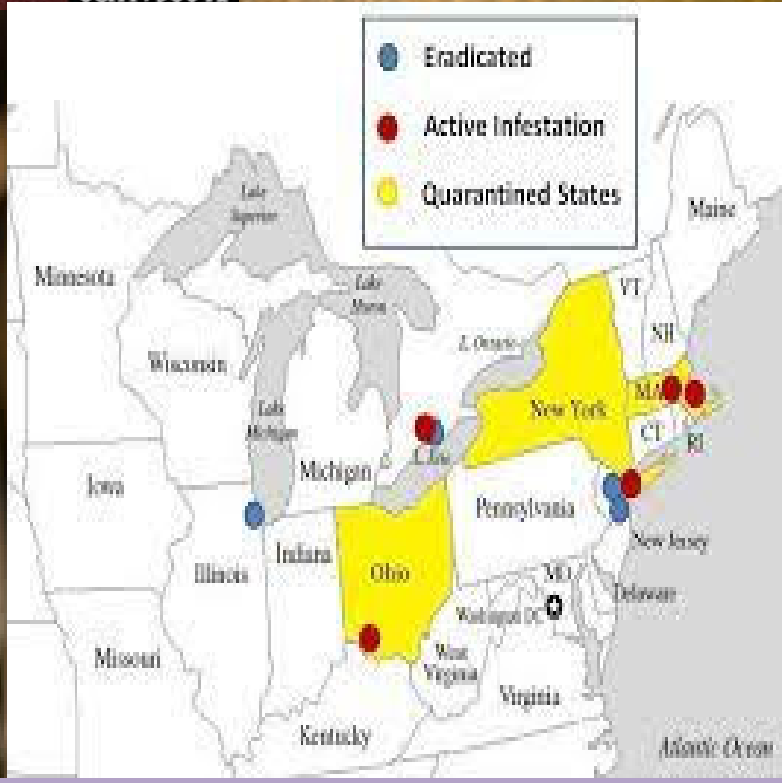
***Erwinia amylovora* bacteria and bees, Japan, 1920 feeds on hemlock and kills the tree**



Fenusa pusilla, birch leaf miner sawfly, Europe, 1900 feeds on birch and kills the tree



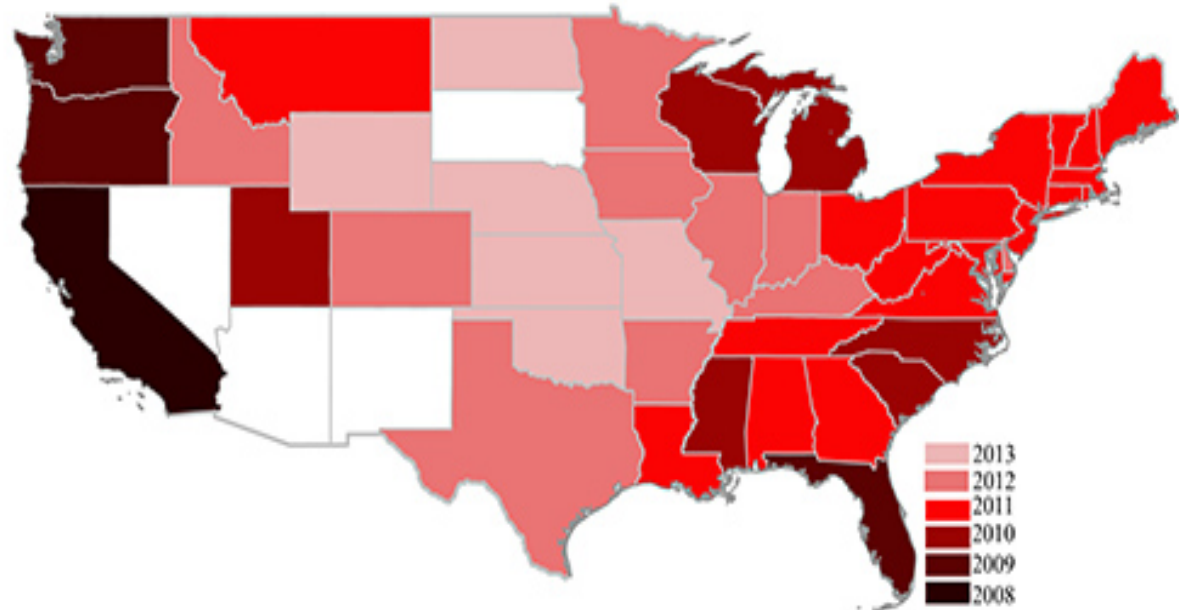
Anoplophora glabripennis, Asian longhorned beetle, China, Korea, 1996 feeds on maple and kills the tree



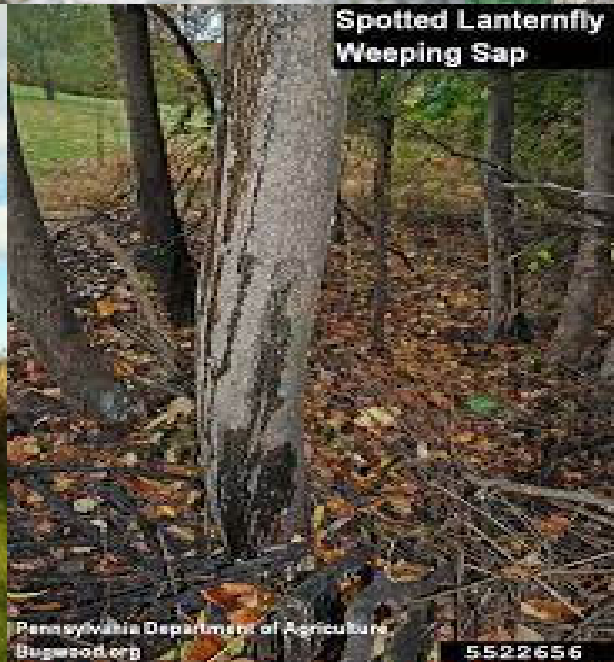
***Popilla japonica*, Japanese beetle, Asia, 1916, spread to
36 state, FQ**



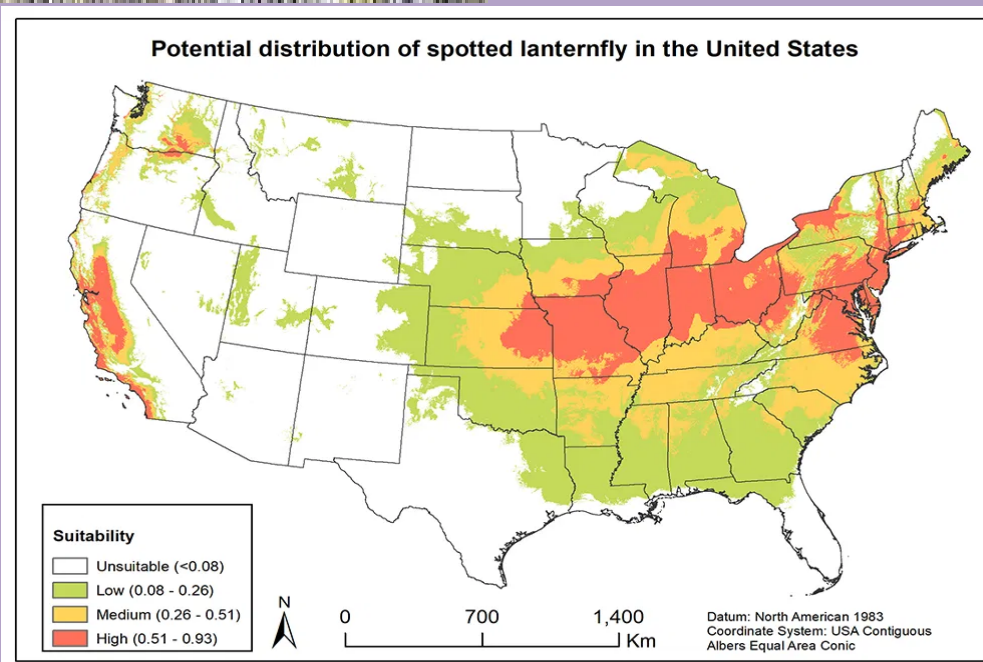
Drosophila suzukii, spotted wing drosophila, Asia, 2008 feeds on native and managed berries



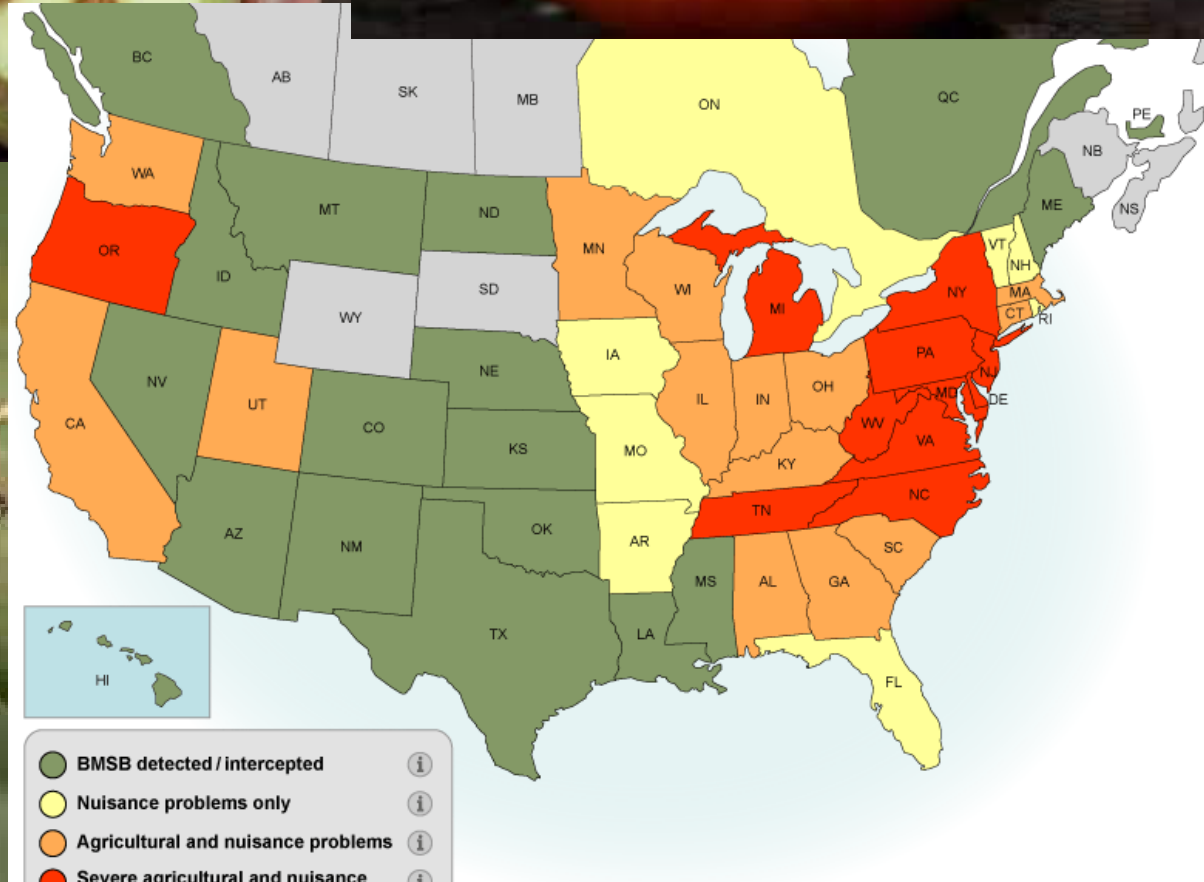
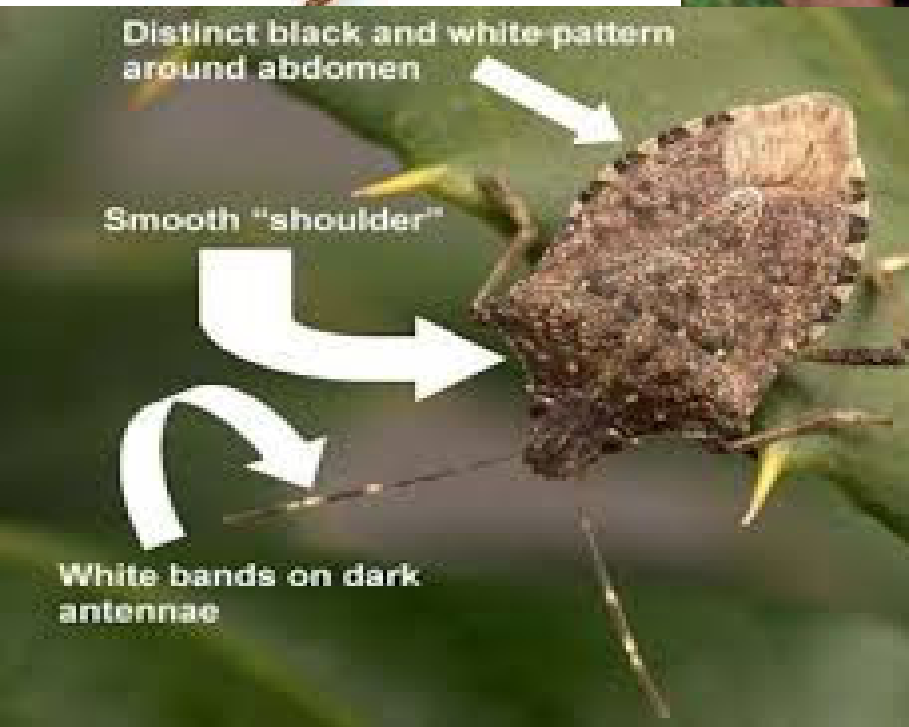
Lycorma delicatula, spotted lanternfly, China, India, Vietnam, 2012 feeds tree sap and kills the tree



Pennsylvania Department of Agriculture
Bugwood.org
5522656



Halyomorpha halys, brown marmorated stink bug, Asia, 1990 feeds on fruits and veggies



***Vespa soror*, Asian Hornet, Asia, kills Asian honeybee larvae/brood**



Vespera mandarinia, Asian giant hornet, Asia, 2019 in Washington State, FQ

Asian giant hornet
Worker (example)



Specimen collected
7/14/2020



Asian giant hornet
Queen (example)



H1274 29 14 July 2020
GH-S-1274-351

***Amyntas agrestis*, *A. tokioensis* and *Metaphire hilgendorfi*,
Jumping worms, Japan, Korea, 1900s, problem since 2000 feeds
on organic material and destroys seedlings**

European nightcrawler
Raised clitellum, further from head

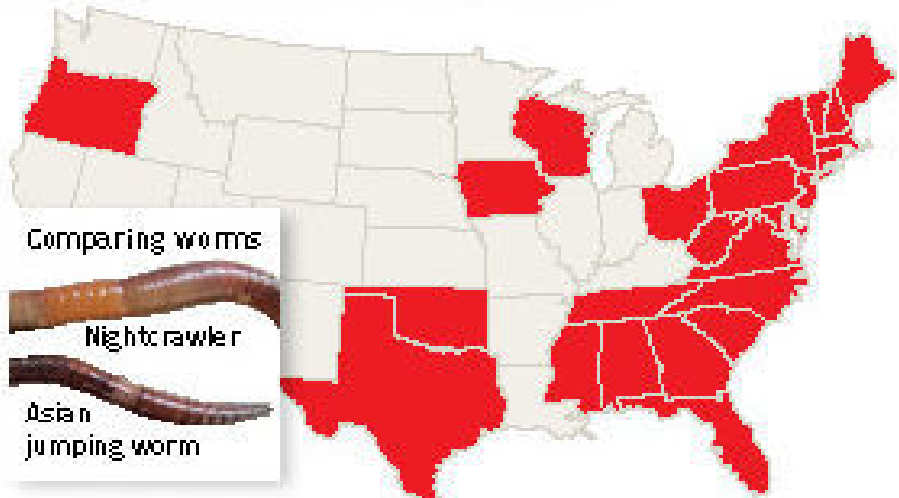


Jumping worm
Smooth clitellum, closer to head



Asian jumping worm

The first discovery in the United States of the Asian jumping worm was in Tennessee. It has since spread across the country.



Source: Centre for Agriculture and Bioscience International

Lee Enterprises graphic



Aphids, soybean aphid, invasive, exotic

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



Ohio State University

**Green peach aphid
adult and young**



Ohio State University

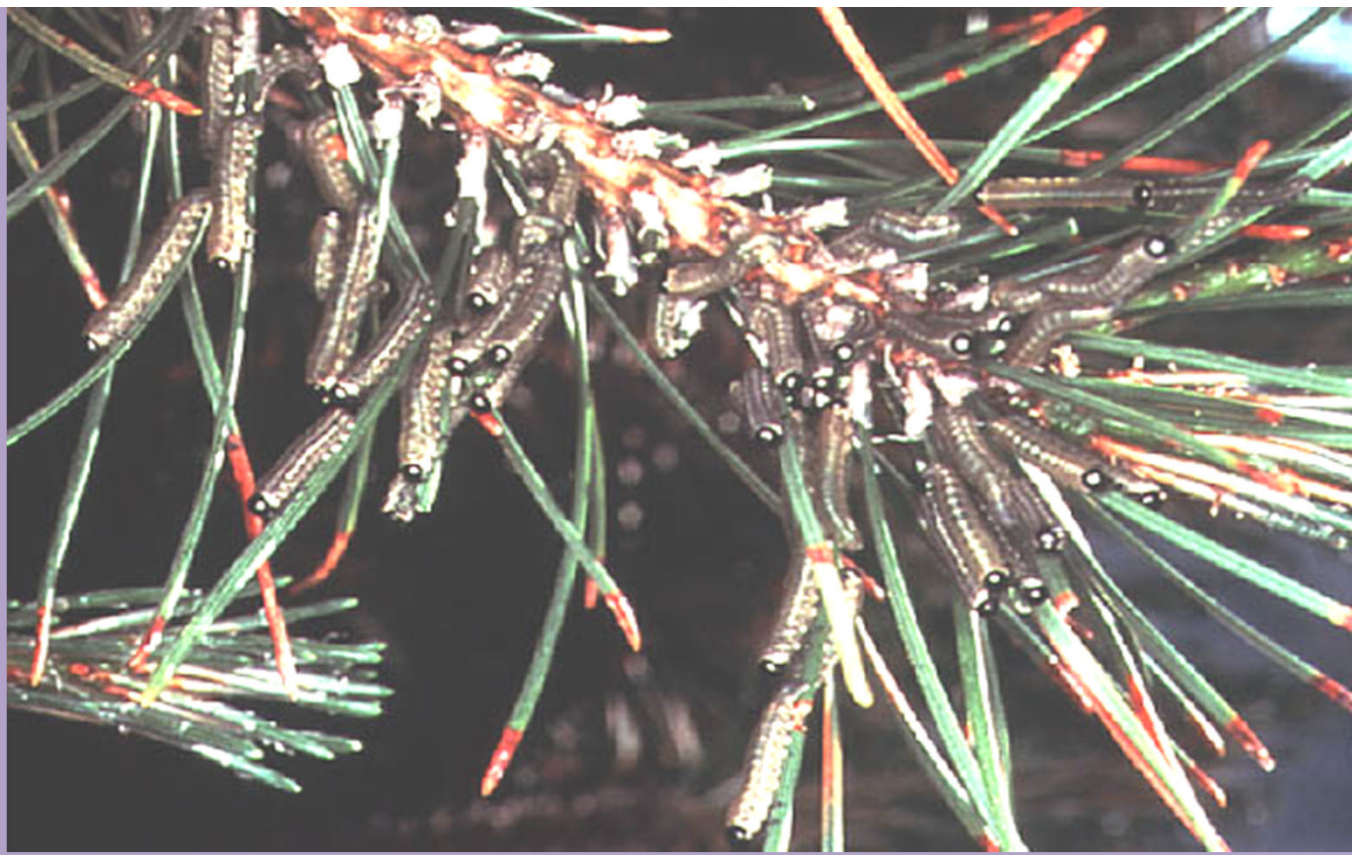
**Winged green peach
aphid adult**

Viburnum clearwing borer, invasive, native

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



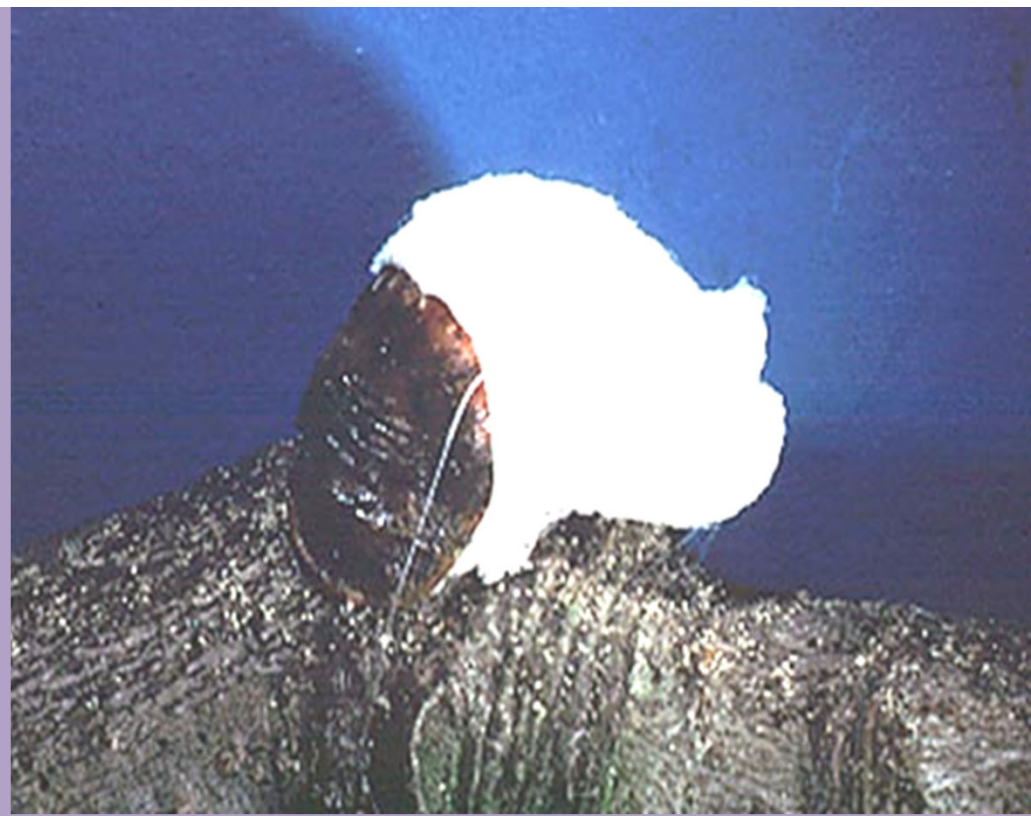


- **European pine sawfly**
- **Order Hymenoptera**
- **Family Diprionidae**
- **Sawfly larvae feed, adults do not feed**
- **Defoliation**
- **Various pines**

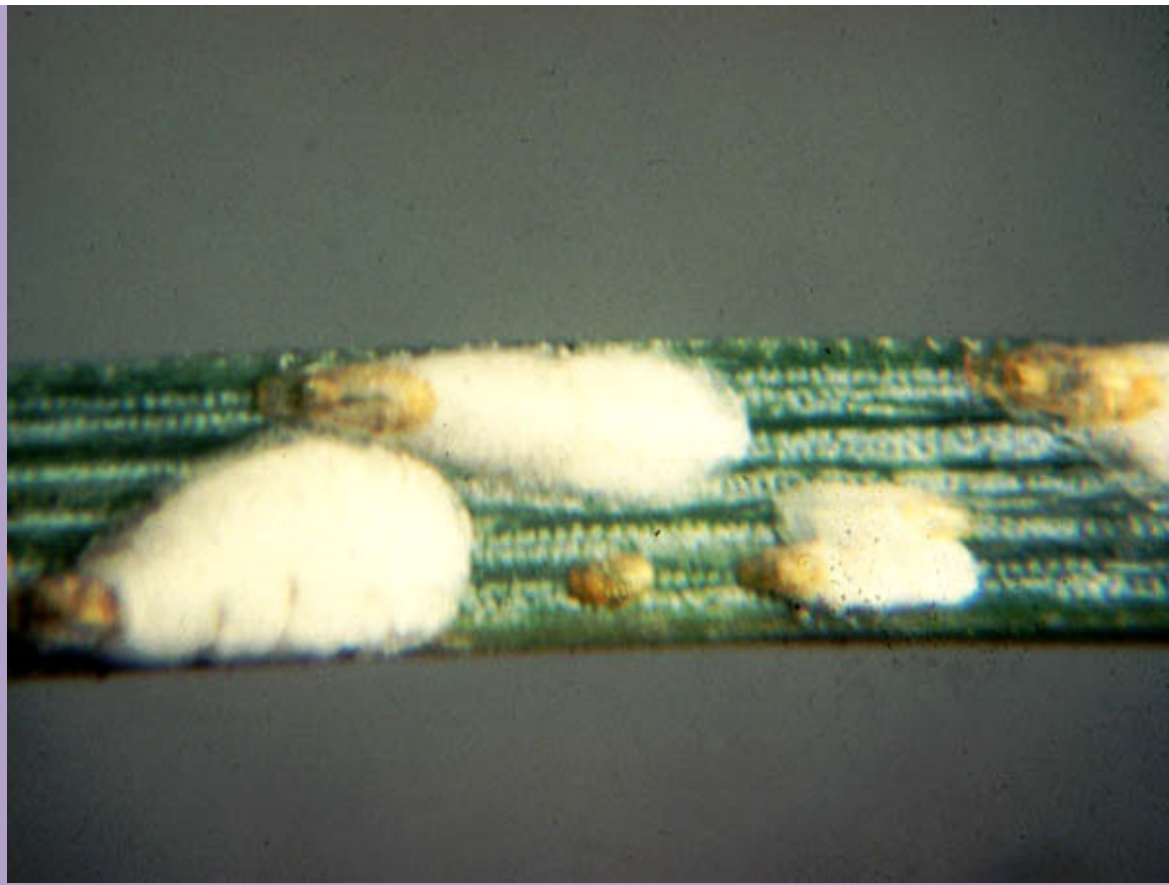


Kathryn Zuzek

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



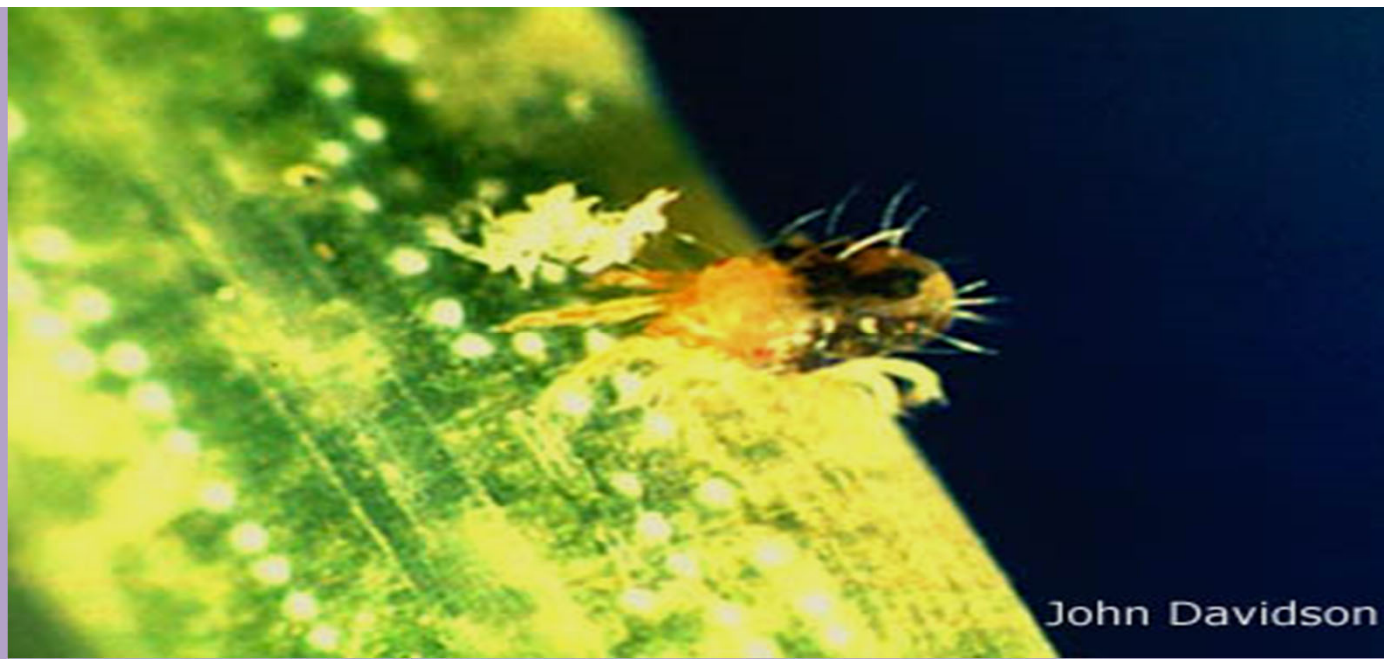
- **Cottony maple scale**
- **Order Hemiptera**
- **Family Coccidae**
- **Soft scale, sap sucking insect**
- **Yellowing, stunting, dieback**
- **Maple, elm, hawthorn, dogwood, poplar, linden**



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



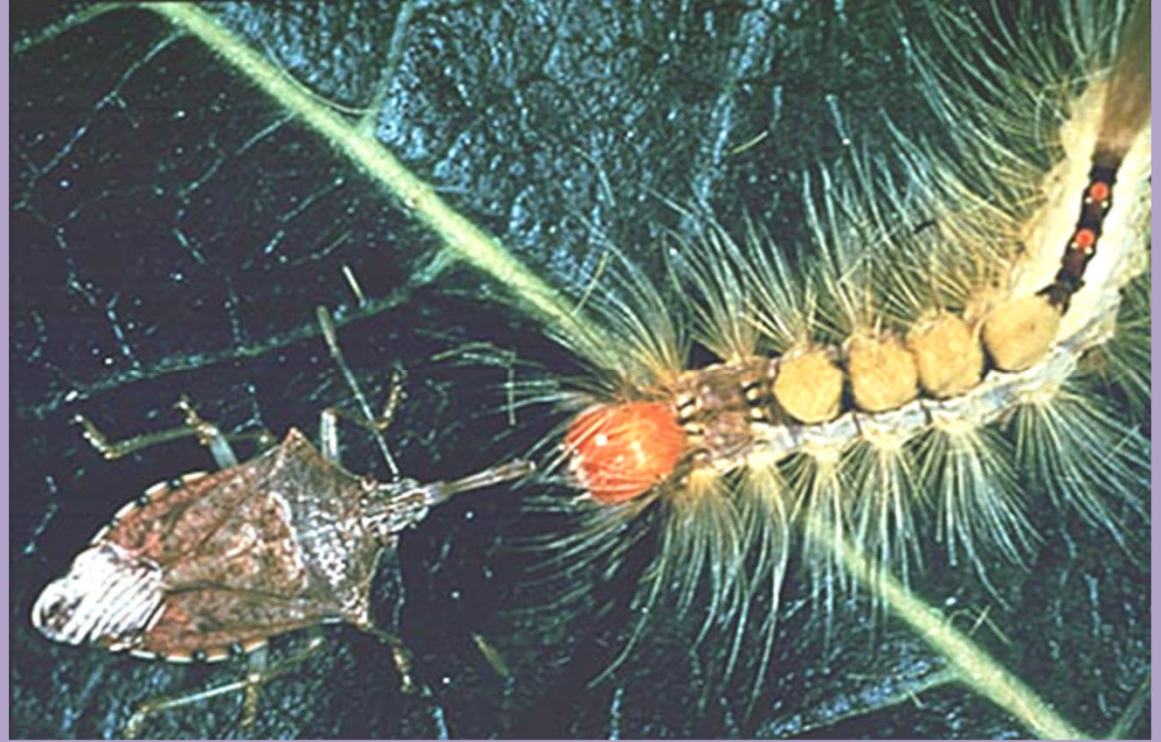


John Davidson

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

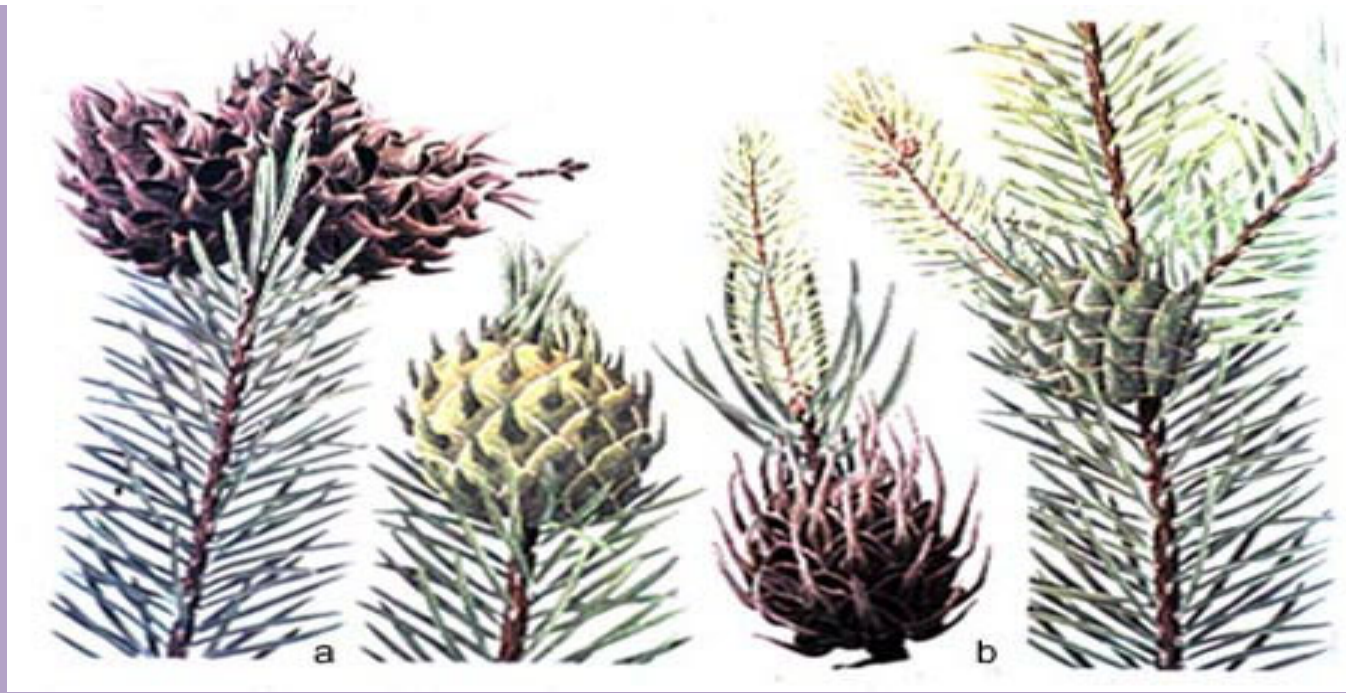


- **Birch leafminer**
- **Order Hymenoptera**
- **Family Tenthredinidae**
- **Sawfly larvae feed, adults do not**
- **Hollow out patches between leaf surfaces**
- **Birch trees**





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



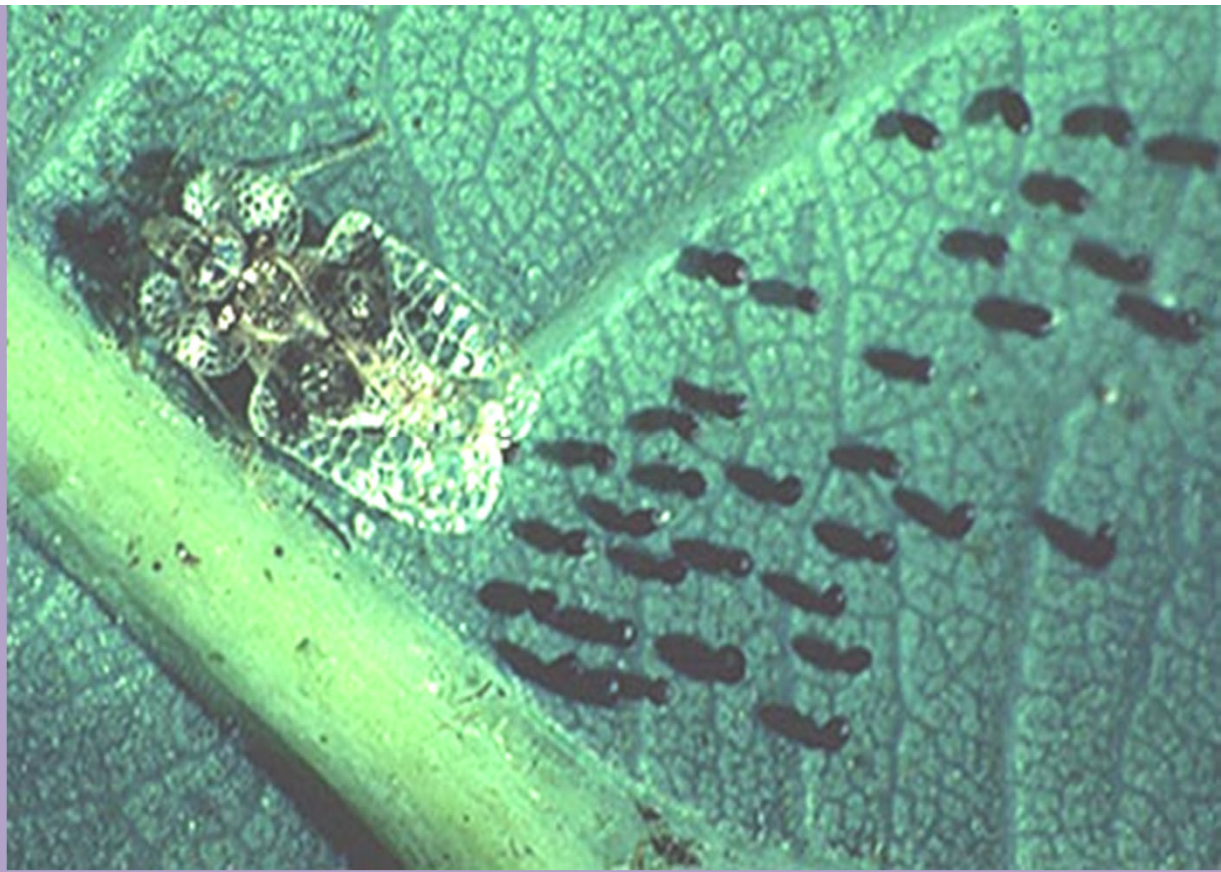
- **Cooley spruce gall adelgid**
- **Order Hemiptera**
- **Family Adelgidae**
- **Aphid like sucking insect**
- **Galls on tips of branches**
- **Spruce and Douglas-fir**

- **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**

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

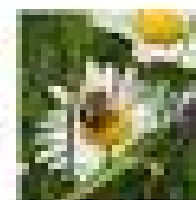
Flowers that are in the lawn provide vital food for bees and long grass is important for Bumble Bee nests and is crucial for butterflies.

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

We have lost 90% of our forestry woodlands since 1970, so giving the bees the flowers in this country helps.

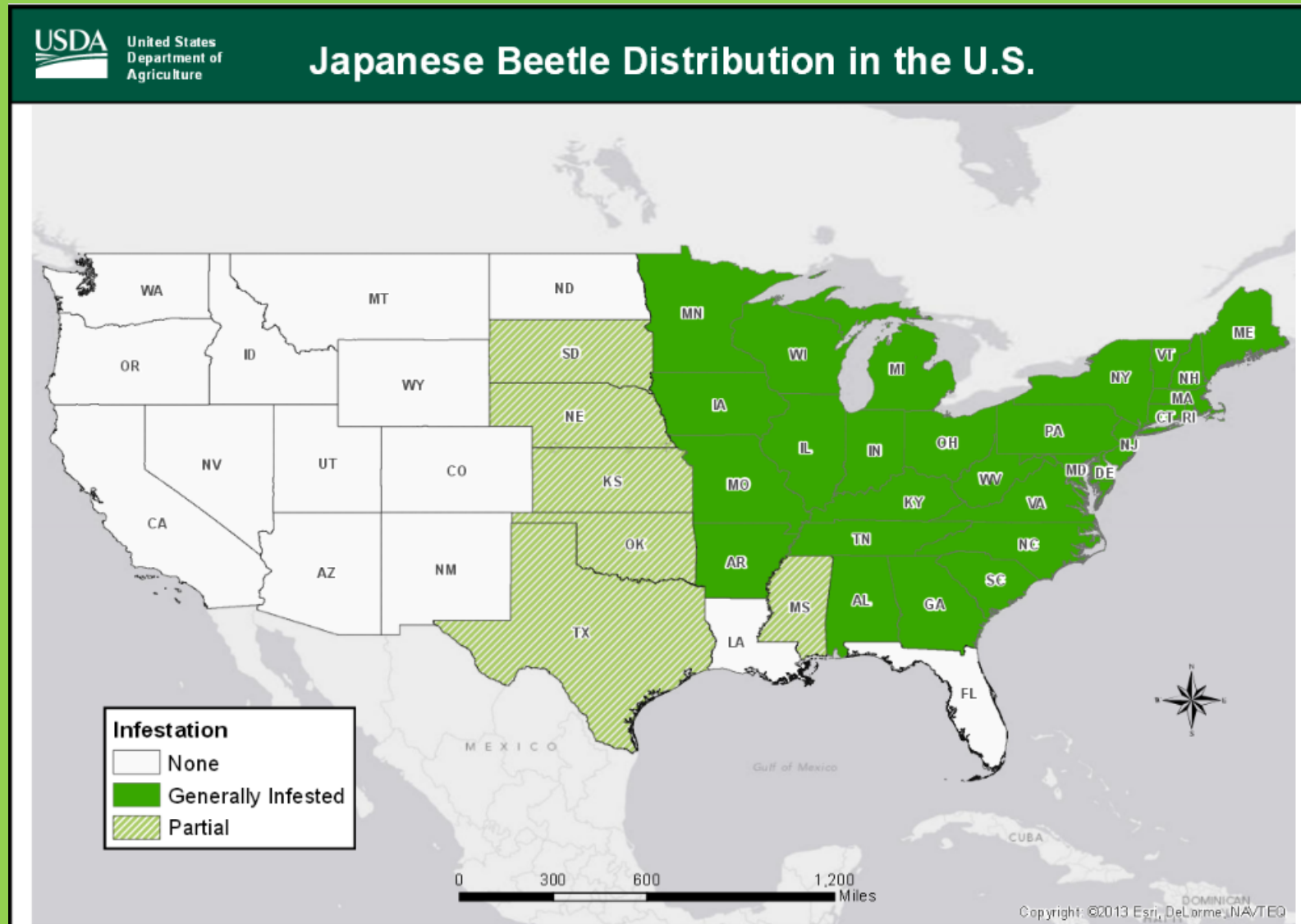
Bumble bees and solitary bees are more important for pollination than honey bees especially for tomatoes, strawberries and apples.

Last year British farmers had to spend 10,000 tonnes (200's of million bees) in order to pollinate soft fruits and tomatoes.



For more info www.beechampion.co.uk/

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

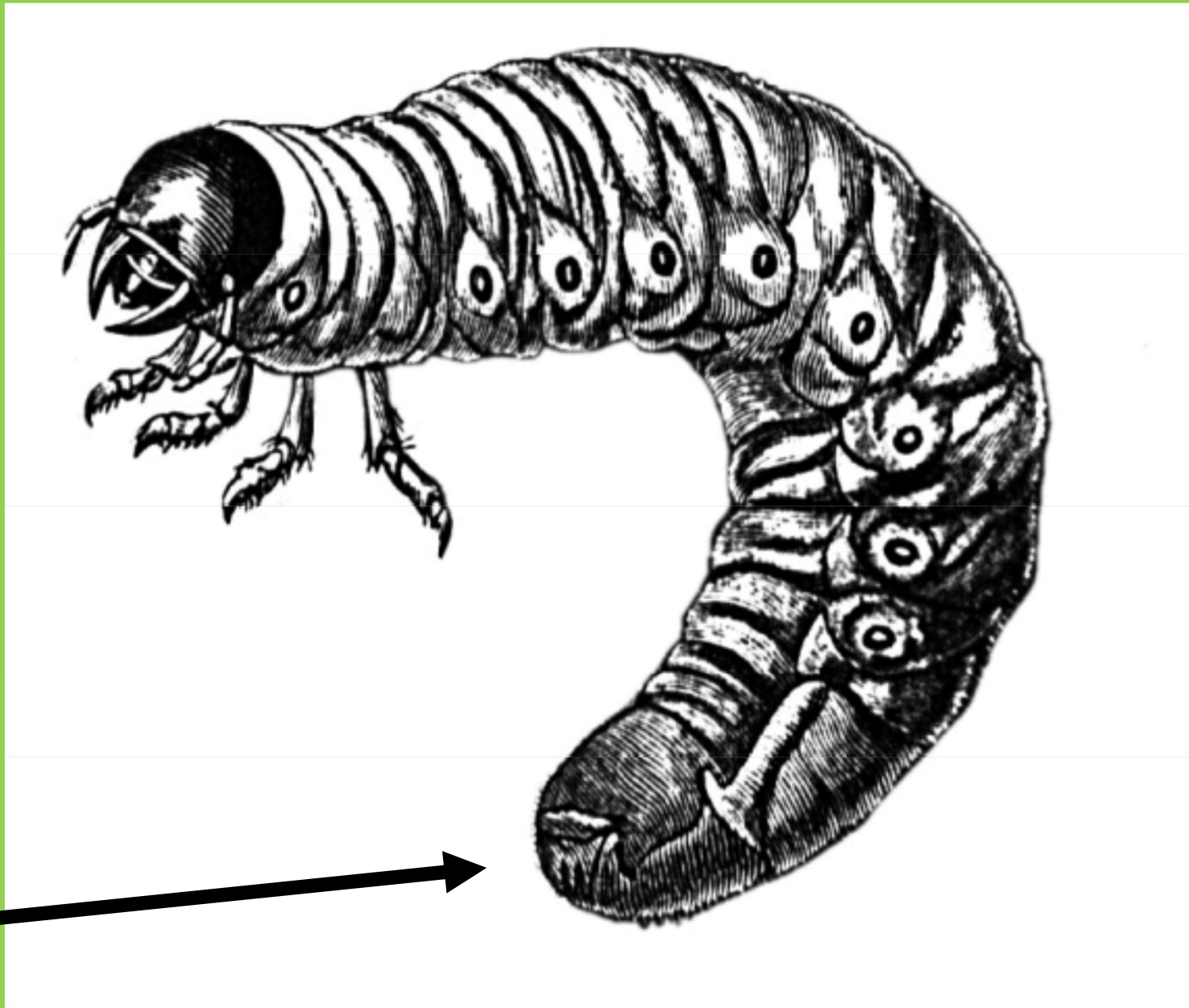


They feed on >300 plants in about 80 families

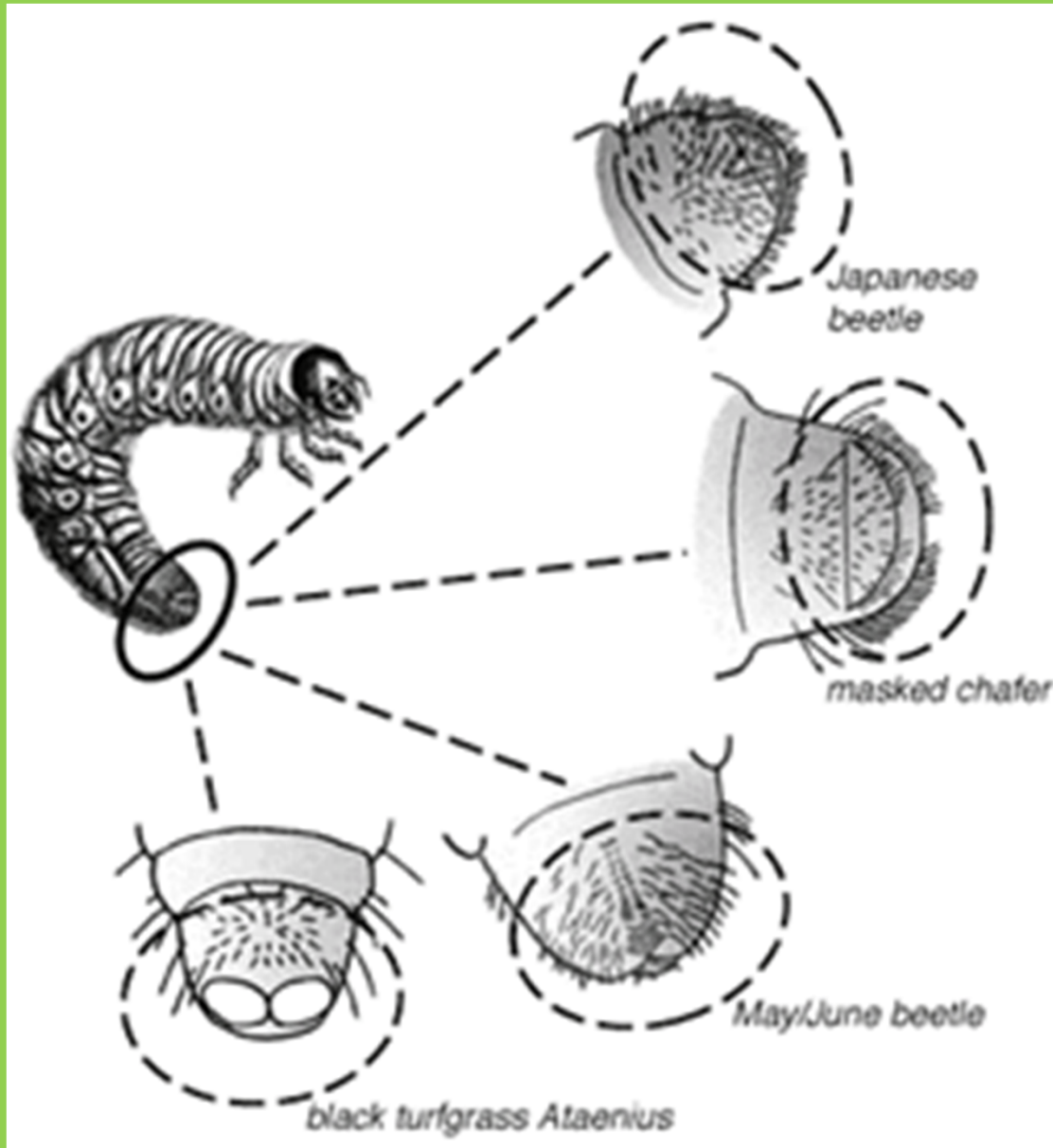
Japanese Beetle Damage to Linden Tree



Raster



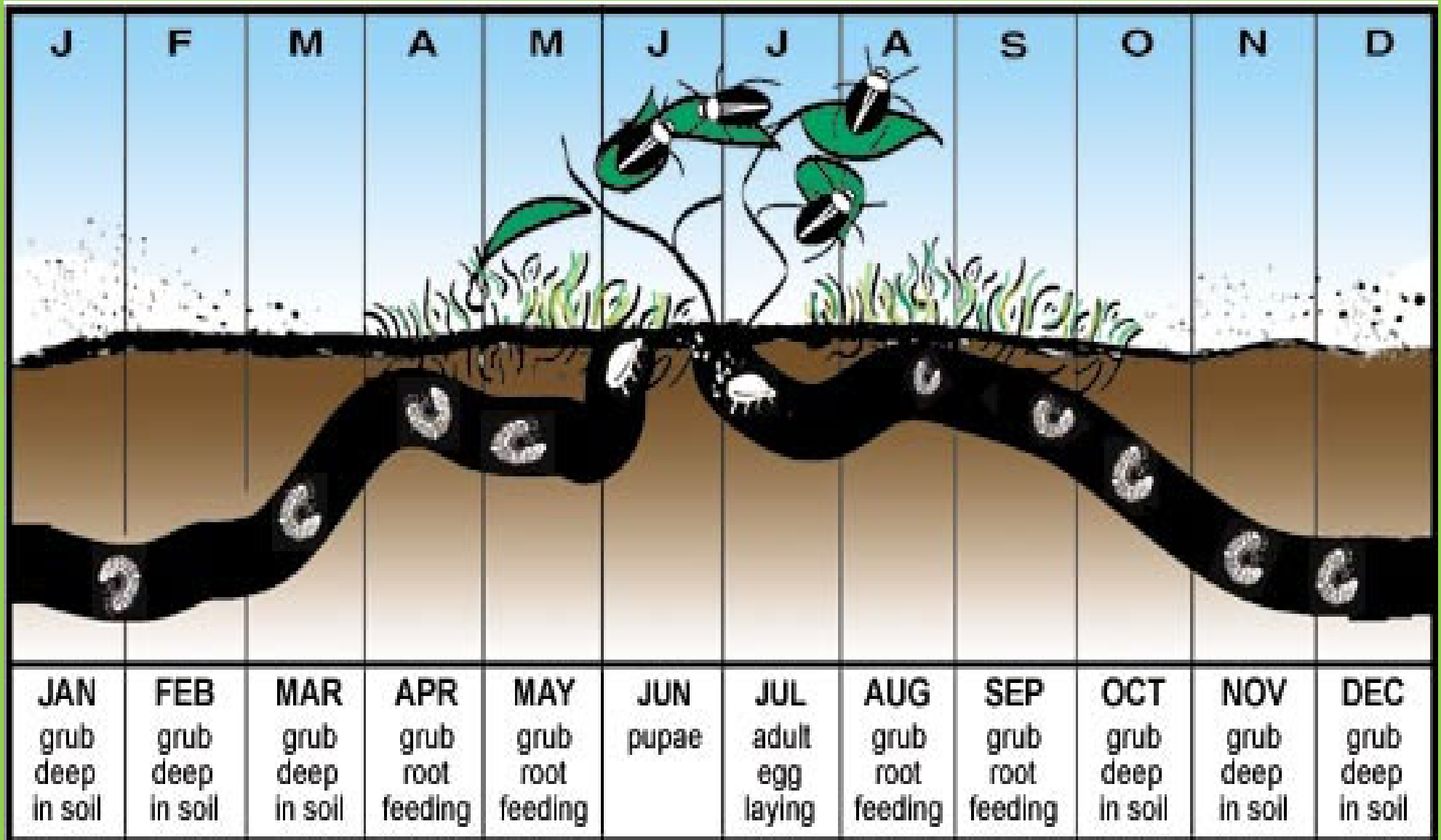
ID white grubs to species by rastral pattern, Why? Damage potential



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</i> <i>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

One year life cycle of Japanese beetle



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

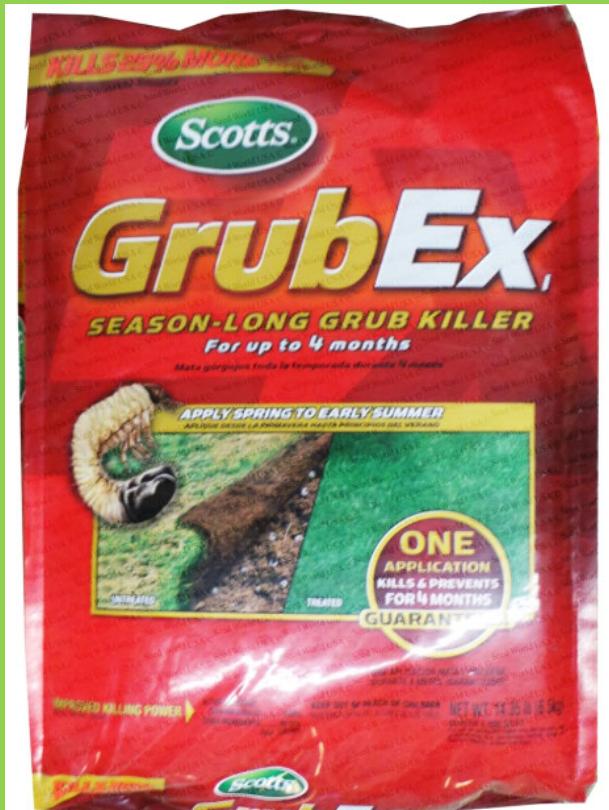
Zylam[®] Liquid
Systemic
Insecticide



Anthranilic Diamides,
bee friendly



Acelepryn[®]



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



Parasitic nematodes

Steinernema carpocapsae

Heterorhabditis bacteriophora



Elm Leaf Beetle Pupa Infected With Nematodes

JB grub damage is the worst in late summer and fall



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

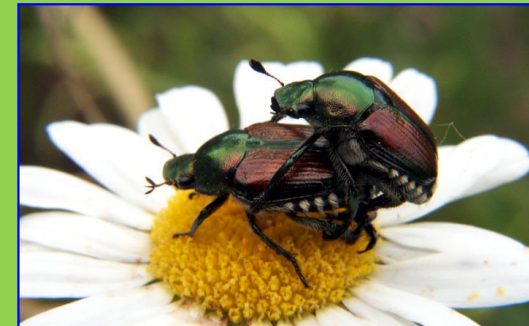
Pyrethroids

Onyx, bifenthrin (4 weeks)

Talstar, bifenthrin (2-3 wks)

Tempo, cyfluthrin

Sevin, carbaryl, harmful to bees
(1-2 weeks residual)

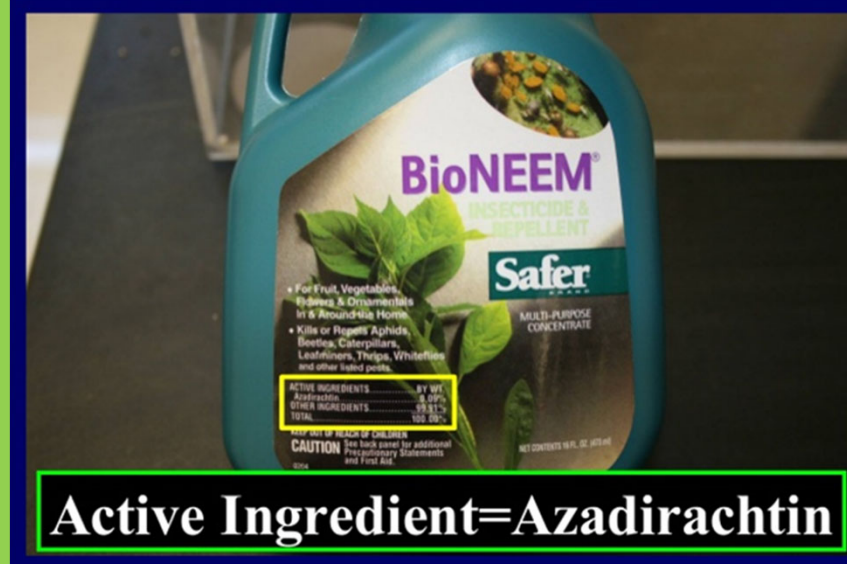


JB adult control: Azadirachtin, anti-feeding



- From Indian neem tree, *Azadirachta indica*
- *Active* against thrips.
- Caterpillars and aphides
- Biodegerades 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



- 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



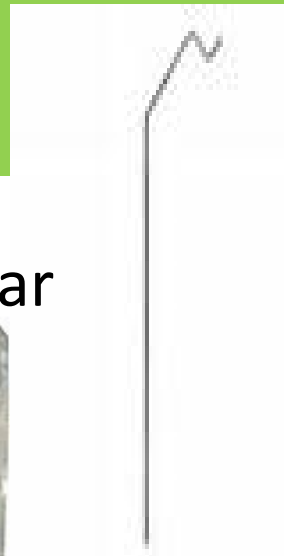
trap



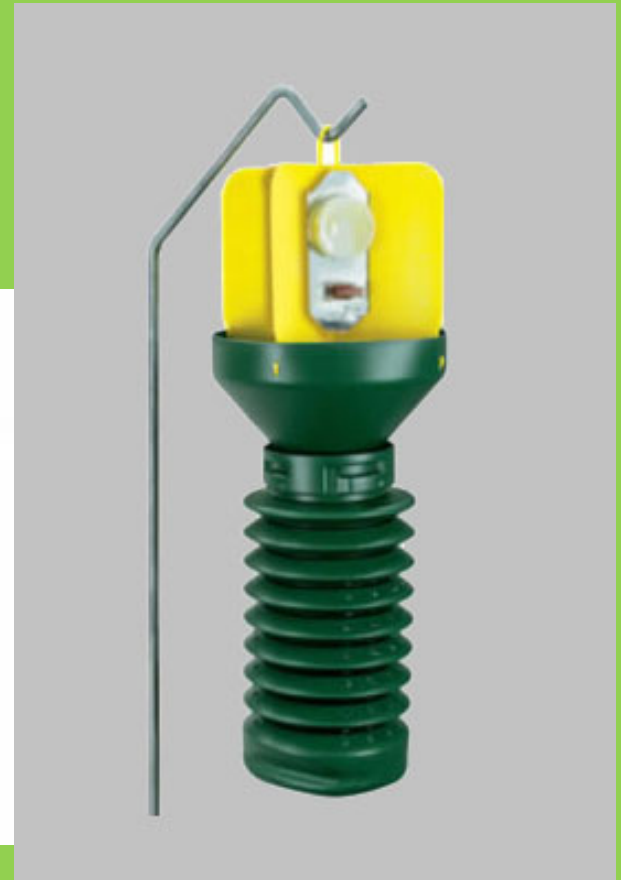
lure in trap



double lure:
pheromone and rose scent



stand or rebar



complete trap

Ecosystem management

susceptible

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

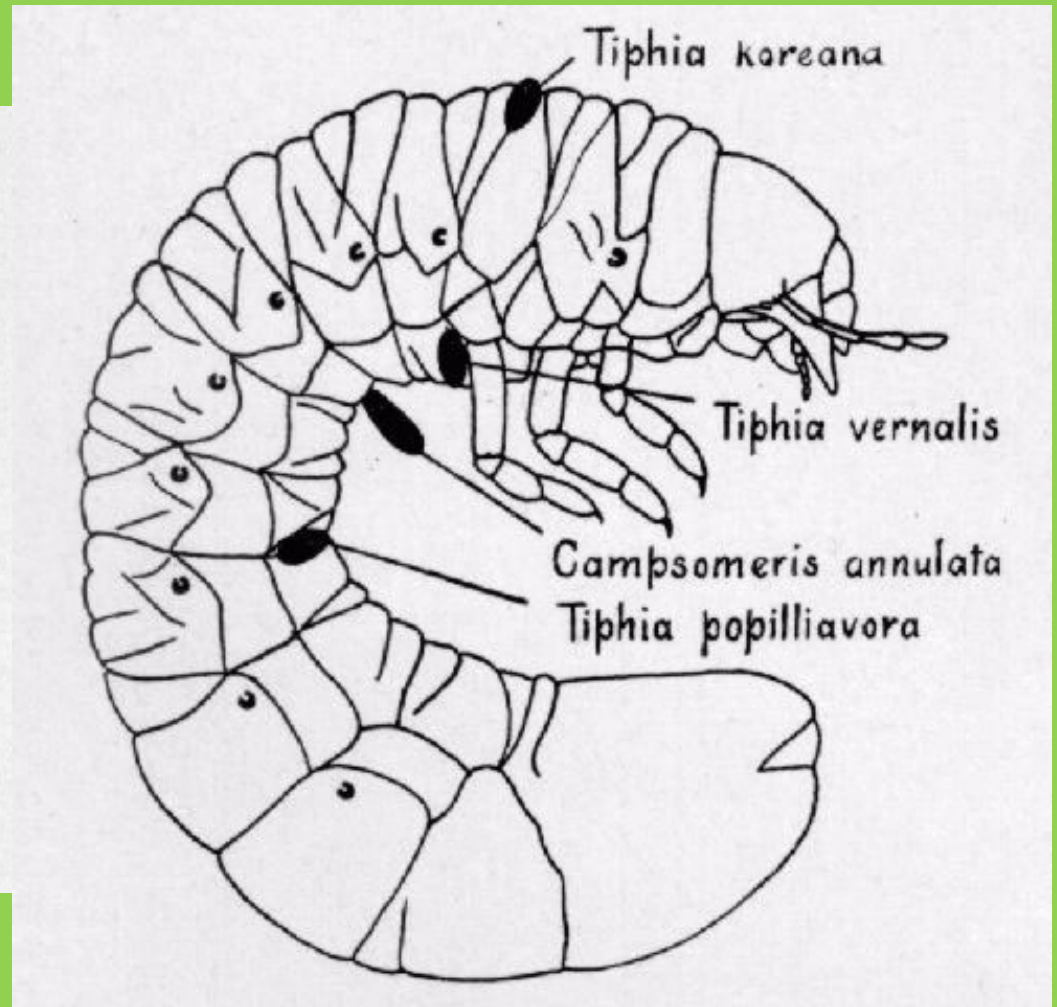
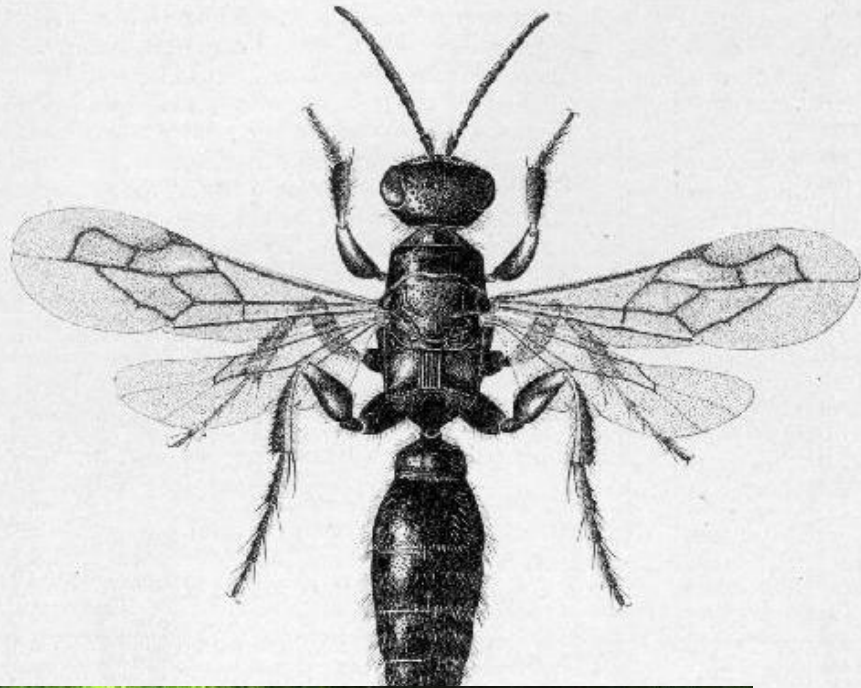
resistant

- 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 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

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

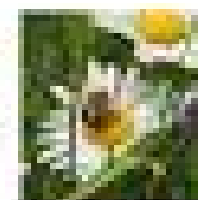
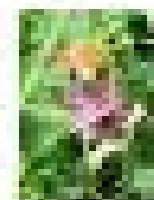
Flowers that are in the lawn provide vital food for bees and long grass is important for Bumble Bee nests and is crucial for butterflies.

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

We have lost 90% of our flower meadows since 1970, so giving the bees the flowers in your meadow helps.

Bumble bees and solitary bees are more important for pollination than honey bees especially for tomatoes, strawberries and apples.

Last year British farmers had to spend 10,000 tonnes (200's of million bees) in order to pollinate soft fruits and tomatoes.



For more info www.beechampion.co.uk/