Better way to manage Japanese beetles in trees, landscapes, and turf, Tues Feb 20 2018

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Summary: Exotic, invasive Japanese beetle (JB) defoliates leaves of many trees, landscape plants and removes roots from turf. The IPM principles are the same, but the pests are different. Learn what insecticides to use to kill pests and conserve predators, parasitoids, and bees. Learn new and old ways to control this invasive pest using trunk injections, bark sprays, and microbial, biorational, and conventional insecticides. Learn why the life history of JB makes it more of a pest that other invasive and native beetle species in the same family. Learn how to identify the adults and grubs of 8 species of beetles in the same beetle family. Learn why JB populations have increased since 2015. 50 minutes with 10 minute discussion and questions. ISA educational credits of 1 credit
Japanese beetle is not a quarantine pest in MN, but is in 11 western states

UMES/MDA bulletin on managing Japanese beetle
Japanese beetle was accidently 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

Trunk injection, soil drench, or bark drench with neonics, is very harmful to bees.
New insecticides for white grubs

Japanese beetle is the worst white grub.
<table>
<thead>
<tr>
<th>species</th>
<th>species</th>
<th>years</th>
<th>larval food</th>
<th>adult food</th>
</tr>
</thead>
<tbody>
<tr>
<td>JB</td>
<td>one year</td>
<td>turf</td>
<td>adults feed on grape, linden, rose</td>
<td></td>
</tr>
<tr>
<td>false JB</td>
<td>one year</td>
<td>unknown</td>
<td>adults feed on grape, linden, rose</td>
<td></td>
</tr>
<tr>
<td>rose chafer</td>
<td>one year</td>
<td>unknown</td>
<td>adults feed on grape, linden, rose</td>
<td></td>
</tr>
<tr>
<td>masked chafer</td>
<td>one year</td>
<td>turf</td>
<td>adults do not feed; do not leave turf</td>
<td></td>
</tr>
<tr>
<td>Ataenius</td>
<td>3 gen. year</td>
<td>turf, manure</td>
<td>adults feed on turf; adults overwinter in woodlots</td>
<td></td>
</tr>
<tr>
<td>Aphodius</td>
<td>June, July, Sept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large June</td>
<td>three years</td>
<td>turf</td>
<td>adults feed on grape, linden, rose</td>
<td></td>
</tr>
<tr>
<td>beetle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Raster
ID white grubs to species by rastral pattern, Why? Damage potential
Japanese beetle

Five tufts of white hairs along the wing margins.
Raster of Japanese beetle
These May/June beetles are attracted to lights. The largest species has a three year life cycle.
Raster of *Phyllophaga*, May/June beetle
Three year cycle of *Phyllophaga* May/June beetle
Northern masked chafer has dark areas in a circular patch behind the head.
Raster of masked chafer beetle
Black turfgrass *Ataenius*

Smallest scarab beetle in turf.
Raster of black turfgrass *Ataenius*
Rose chafer

Note the long legs and pale color.
False Japanese beetles lacks the 5 tufts of white hair along the wing margin.
### Neonicotinyl insecticides are safer for people

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

**Highly toxic (< 2µg/bee)**

**Moderately toxic (2 - 10.9 µg/bee)**

**Slightly toxic (11 - 100µg/bee)**

**Non-toxic (>100µg/bee)**
Japanese beetle adult control

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)
Grub Control: Preventative or Rescue treatments

Differences in time of application.
Grub damage is the worst in late summer and fall

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

Neonicotinoids

imidacloprid  clothianidin

Anthranilic Diamides, bee and beneficial insect friendly

thiamethoxam  dinotefuran

Zylam® Liquid Systemic Insecticide

Acelepryn®

MERIT®  Arena®

GrubEx® SEASON-LONG GRUB KILLER For up to 9 months

Meridian Insecticide
Preventive Grub Insecticides

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
Rescue Treatments

- Expect no more than 75% control once grubs are large
- **2 main products used:** Dylox or the neonicotinoid Arena
- Acelepryn is NOT a curative product
Biological control for white grubs

*Tiphia* wasps

*Isocheta* flies

*Ovavesicula*, protozoan

*Bacillus thuringiensis galleriae* (Btg)

*Grub bGone*

*Bacillus (=Paenibacillus popilliae)* popilliae, does not work any more

Fungus, *Beuaveria, Metarhizium*

Nematodes, *Steinernema, Heterorhabditis*
Parasitic nematodes
Steinernema carpocapsae
Heterorhabditis bacteriophora

Elm Leaf Beetle Pupa Infected With Nematodes
**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.
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
Types of BT

- BT is a protein crystal that puts an 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
Azadirachtin

- 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
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 cinerariafolia*
- 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.
Turf pest: Japanese beetle

Damage, scouting, and management:
or Gemplers, Janesville, WI 53546

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
Ecosystem management

- Japanese beetle parasites *Tipha 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.
Ecosystem management: *Tiphia vernalis*

Females of different species lay eggs on distinct parts of grub.
Ecosystem management: *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%.
Ecosystem management: *Isotecha aldrichii*, 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.
Ecosystem management: Protozoan parasites

- Protozoan pathogens, *Ovavesicula popilliae* and *Gregarina* sp., are abundant where JB has been long established as in CT and NY and suppress population growth. *Ovavesicula*, known to infect approximately 25% of all JB grubs in CT was only found at 1 location in MI.

- The Gregarine parasite found in the digestive system of Japanese beetle larvae in MI is *Stictospora villani*.

- *Stictospora* sp., found in 70% of Japanese beetle larvae in CT was only found in 20% of all MI larvae, and at only 60% of all sites in MI, compared with 100% of all sites in CT.

- In a greenhouse *Stictospora* sp. persisted in soil after infected grubs were removed and caused a 20% reduction in survival of healthy grubs.
Black vine weevil adult
Strawberry root weevil

Joseph Berger, www.forestryimages.org
Life Cycle of Black Vine Weevil (Moorhouse et al., 1992)

- Overwintered Adults
- Summer Adults
- Eggs
- Pupae
- Larvae

January to December:
- Spring damage
- Fall damage
Black vine weevil larva

Peggy Greb
USDA Agricultural Research Service
www.forestryimages.org
Larvae

Scarab beetle grub

Weevil larva
# Pesticides for black vine weevil

<table>
<thead>
<tr>
<th>Common name</th>
<th>Trade name</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acephate</td>
<td>Orthene</td>
<td>organophosphate</td>
</tr>
<tr>
<td><em>Beauveria bassiana</em></td>
<td>Botanigard</td>
<td>biological</td>
</tr>
<tr>
<td>Bifenthrin</td>
<td>Talstar</td>
<td>pyrethroid</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>Tempo</td>
<td>pyrethroid</td>
</tr>
<tr>
<td>Nematodes</td>
<td>Nemasys H</td>
<td>biological</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>Marathon</td>
<td>chloronicotinyl</td>
</tr>
<tr>
<td>Permethrin</td>
<td>Astro</td>
<td>pyrethroid</td>
</tr>
</tbody>
</table>
Beauveria bassiana attacks black vine weevil + white grubs
Parasitic nematodes
*Steinernema carpocapsae*
*Heterorhabditis bacteriophora*
black vine weevil + white grubs
Japanese beetle (JB) arrived in MN in 1990.
JB grubs are controlled by wet, cold springs where temperatures are around 50F for a month.
Warmer springs and less cold winters are helping JB spread in MN.
Soybeans, corn, grapes, and apples are common hosts for JB in other states.
DO not use 1 trap as the traps “call” many individuals.
Some growers in MN put up traps with large pans of soapy water underneath that “catches” the beetles.
Protzoans in the soil control the gubs.