RUTGERS
New Jersey Agricultural Experiment Station

Home Gardener School – Sat 3-24-12

Knowing and Manageing the Good and Bad Bugs in your Lawn

Albrecht Koppenhöfer

Rutgers Cooperative Extension

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New Jersey Agricultural Experiment Station

Outline

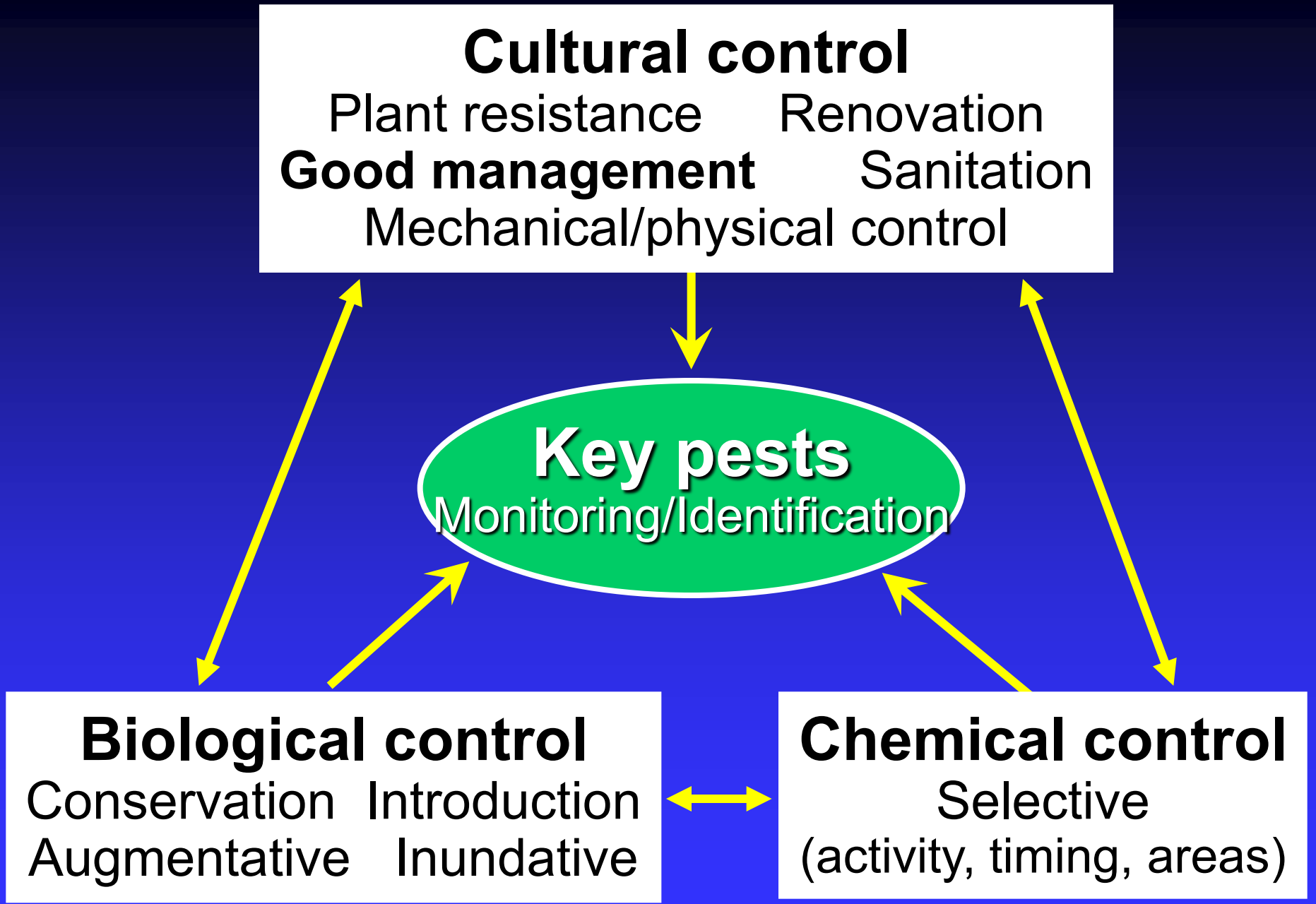
- **TURF INSECT PEST MANAGEMENT (3-20)**
- **ID, BIOLOGY & SPECIAL CONTROL CONSIDERATIONS**
  - **White grubs (21-39)**
  - **Billbugs (40-47)**
  - **Chinch bugs (48-54)**
  - **Sod webworms (55-61)**
  - **Beneficial insects and insect pathogens (62-79)**

INTEGRATED PEST MANAGEMENT

IPM is the considered and coordinated use of pest control tactics in turf management.

The goal of IPM is to maintain healthy, functional turf in an economically viable and environmentally sound manner.

IPM is a decision making and management system.


Cultural control
Plant resistance
Renovation
Good management
Sanitation
Mechanical/physical control
Key pests
Monitoring/Identification
Biological control
Conservation
Introduction
Augmentative
Inundative
Chemical control
Selective
(activity, timing, areas)

Good turf management

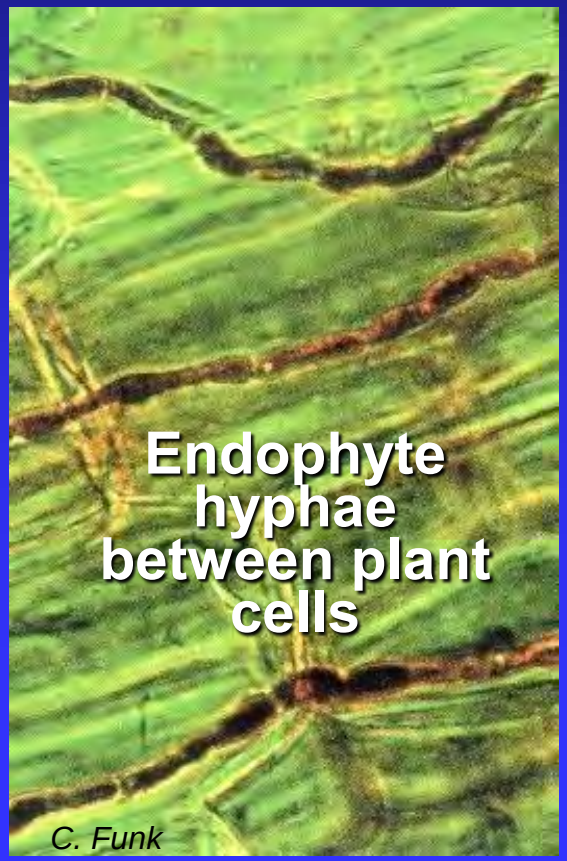
- Sound management (irrigation, mowing, fertilization, etc.) increases turf vigor, pest tolerance, and recuperative potential.
- Light irrigation and/or fertilization can improve turf recovery after light insect damage

Insect Tolerance

- Use grasses adapted to local conditions → less stressed, more tolerant.
- Use blends of improved, adapted turfgrasses.
- Thin-leafed, aggressive creeping, heat tolerant Kentucky bluegrasses generally more billbug tolerant
- Deep-rooting, heat/drought tolerant warm season grasses and tall fescue more white grub tolerant

Insect Resistance - Endophytes

- Endophytic fungi in many cvs. of tall fescue, fine fescues, perennial ryegrass
- Reside in above-ground part of plants
- Produce alkaloids that are feeding-deterrent or toxic to many insects
- Little transfer into roots
- Endophytic grasses resistant to billbugs, chinch bugs, greenbugs, sod webworms, fall armyworm



Thatch management

- Thatch prime habitat for many insect pest
- Barrier to penetration of control agents
- Best preventative control → healthy earthworm populations
- Soil pH 6-7, coring, slicing, vertical cutting, and light topdressing can reduce thatch.

DETECTION & MONITORING

Monitoring is the regular and ongoing inspection of areas where pest problems do or might occur.

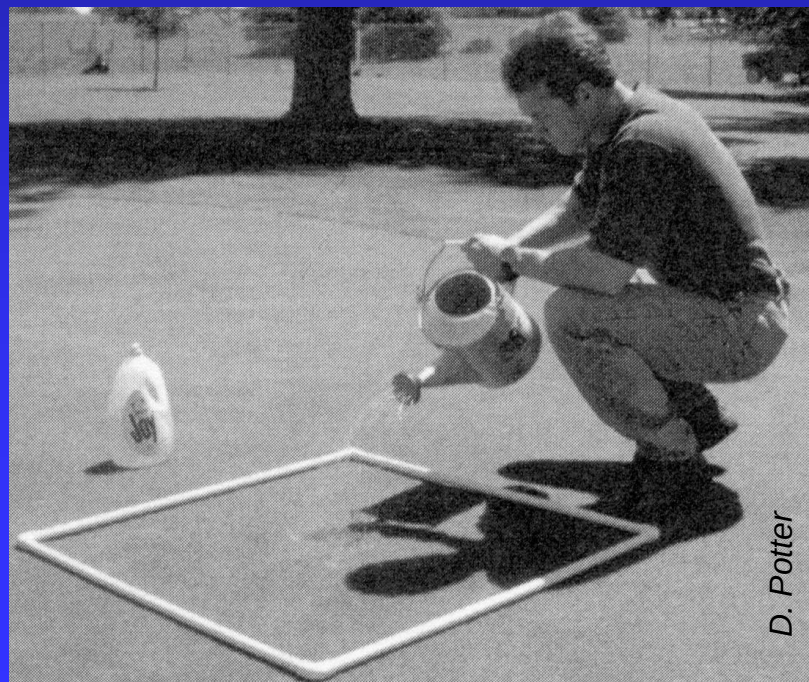
Visual Inspection

- Scan for signs of infection.
- “hands-and-knees method”).
- Use hand lens
- Check boundary between healthy and damaged areas.
- Check for signs of insect activity.
- Observe adult pest activity.
- Observe vertebrate predator activity.

Disclosing (Irritant) Solution

Sod web/cut/armyworms, billbug adults, mole crickets (best on short grass and warm, moist soil)

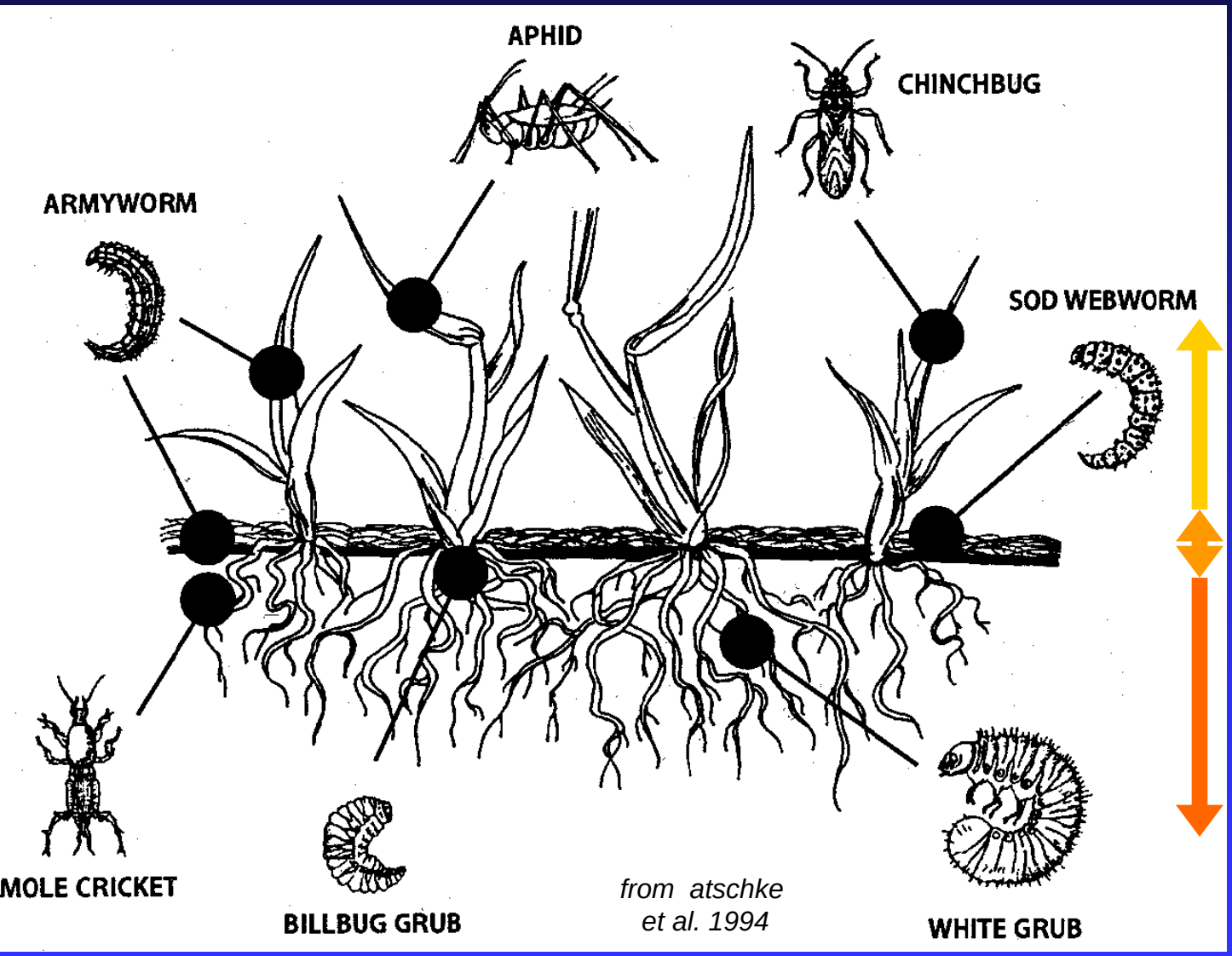
- 2 gal water + 1 oz liquid dish-washing detergent (e.g. Joy®) or 2 drops of pyrethroid
- Apply over 1 yd^2 → insect emerge in 5-10 min (small sod webworms up to 20 min)
- Count / ID emerging pests
- Irrigate
- Sample every 14-21 days
- Evaluate treatments 3-4 days after application



Soil Pest Sampling

White grubs, billbug larvae, root-feeding insects

- **Take soil core (~3” deep), brake up, count, ID insects.**
- **Split core in ½s, ¼s, etc., to expose grubs.**
- **Replace soil/sod cap**
- **Sample in grid pattern**
- **Irrigate if dry**



from atschke et al. 1994

Turf zones:

Foliar/stem

Stem/thatch

Thatch/soil

Target principle

- Control agent has to be delivered to the target zone in which the pest feeds or hides.
- The target zone determines:

  a. insecticide formulation

  b. timing of application

  c. application technique

  d. watering in of treatment

Target principle – stem/foliar zone

- Liquid: coarse spray (2 gal/1,000 ft^2)
- Coincide treatments with feeding activity of pest
- Delay irrigation and mowing for 1-2 d
- Granular formulation only if compound systemic (→ post-application irrigation)

Target principle – thatch/stem zone

- Granular and liquid formulations
- Liquid: coarse spray (2 gal/1,000 ft^2)
- Light post-treatment irrigation (~0.1”)
- Systemics for pests inside stems
- Delay irrigation and mowing for 1-2 d

Target principle – soil/thatch zone

- Pre-irrigate dry soil 1 d before treatment (especially when thatchy)

→ draws insects closer to surface

→ improves infiltration

- Granular and liquid formulations
- Liquid: coarse spray (2 gal/1,000 ft^2)
- Water in (or timely rainfall) (~0.25”)

Turfgrass Insecticides:
Classification & Ecotox Profiles

Class	AI	Trade name
Carbamate	Carbaryl	Sevin, Bay.Adv. complete insect killer
Organo-phosphate	Trichlorfon	Dylox, Bay.Adv. 24-Hr grub killer
Pyrethroid	Bifenthrin Cyhalothrin Cyfluthrin Deltamethrin	Talstar, various… Tempo, various… Scimitar, various… DeltaGard, various…
Neonicotinoid	Imidacloprid	Merit, Bay.Adv. season-long grub control, various…
Spinosyn	Spinosad	Conserve, Bulls-Eye
Anthranilic diamide	Chlorantra-niliprole	Acelepryn, Grub-ex

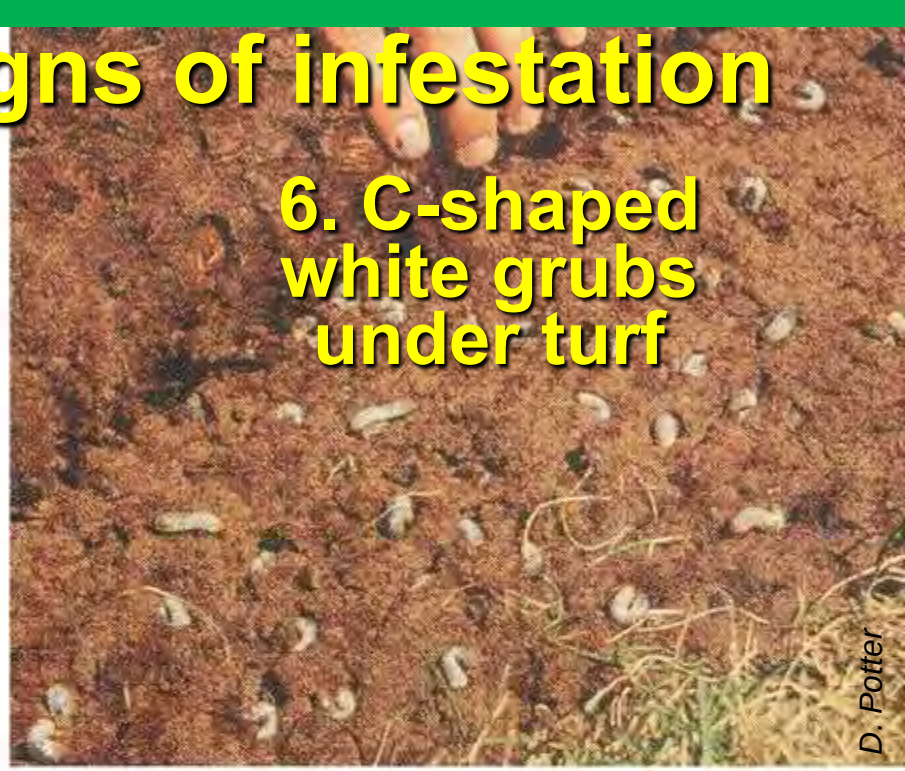
Class	Trade name	Use rate (lb ai/a.)	Mammal LD50 (mg/kg)	Avian LD50 (mg/kg)	Fish LC50 (ppm)	Bee LC50 (µg/bee)
Carb	carbaryl	2.0–8.0	550	>2,179	2	
OP	trichlorfon	5.5–8.2	400	>5,000	430	60
Pyr	bifenthrin	0.04–0.11	63	2,150	<0.01	<0.1
Neo-nic	imidaclopr	0.3–0.4	424	>4,797	>8,300	0.4
	thiametho.	0.2–0.27	1,563	576	>100	<0.1
	clothianid	0.2–0.33	>5,200	>2,000	105	4
Spin	spinosyn	0.08–0.4	>5000	>2,000	30	<0.1
Diac	halofenoz	1.0–2.0	>5,000	>5,000	9	>100
Oxa	indoxac.	0.04–0.24	1,000	>5,620	650	1.3
Anth	chlorantr.	0.03–0.26	>5,000	2,200	>15 k	> 4

White grubs
(Coleoptera: Scarabaeidae)

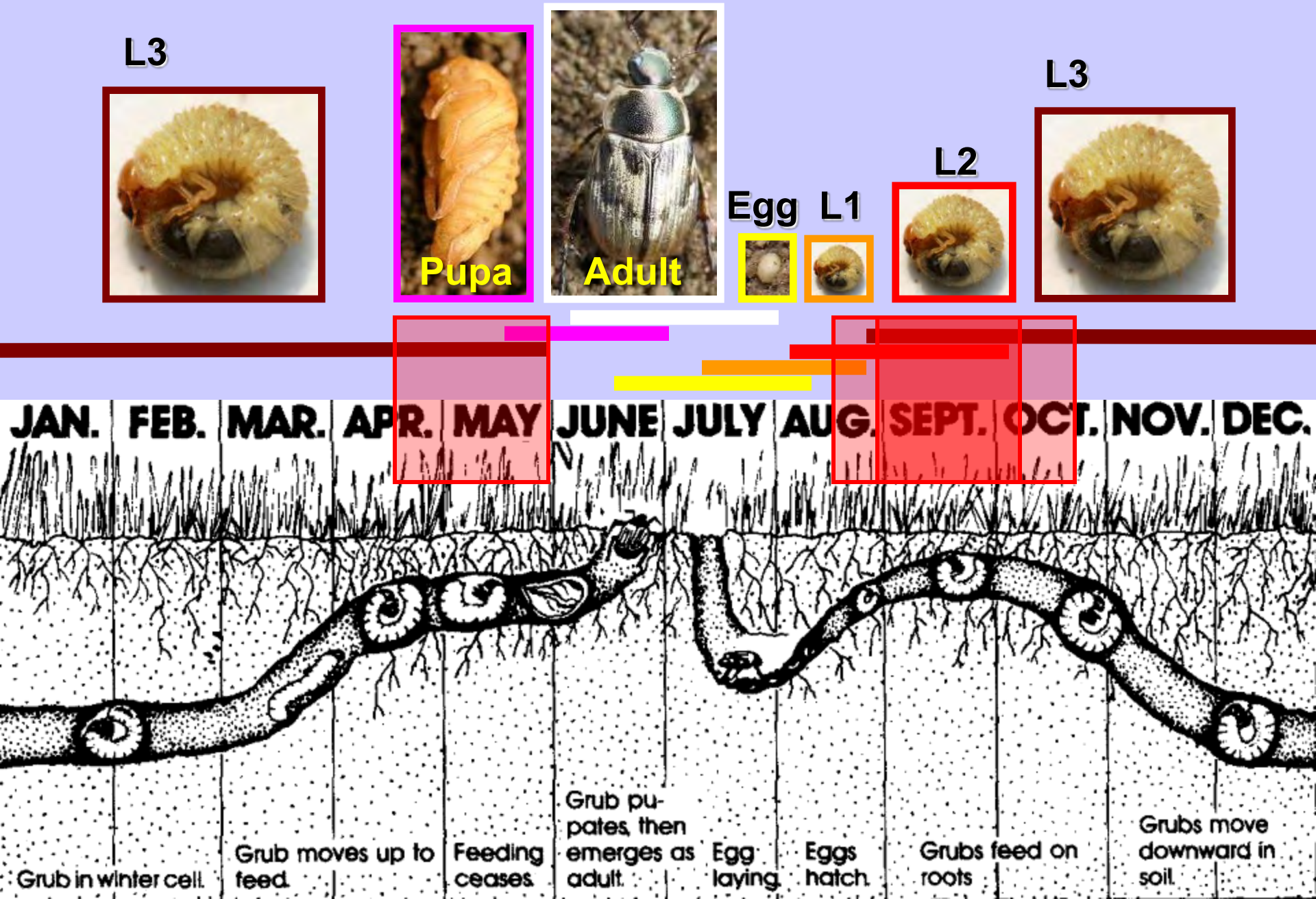
- Most widespread and destructive insect pests in cool-season and transition zones
- Primary damage: feeding on roots near soil surface (severe in hot dry weather)
- Secondary damage: vertebrate predators foraging on grubs

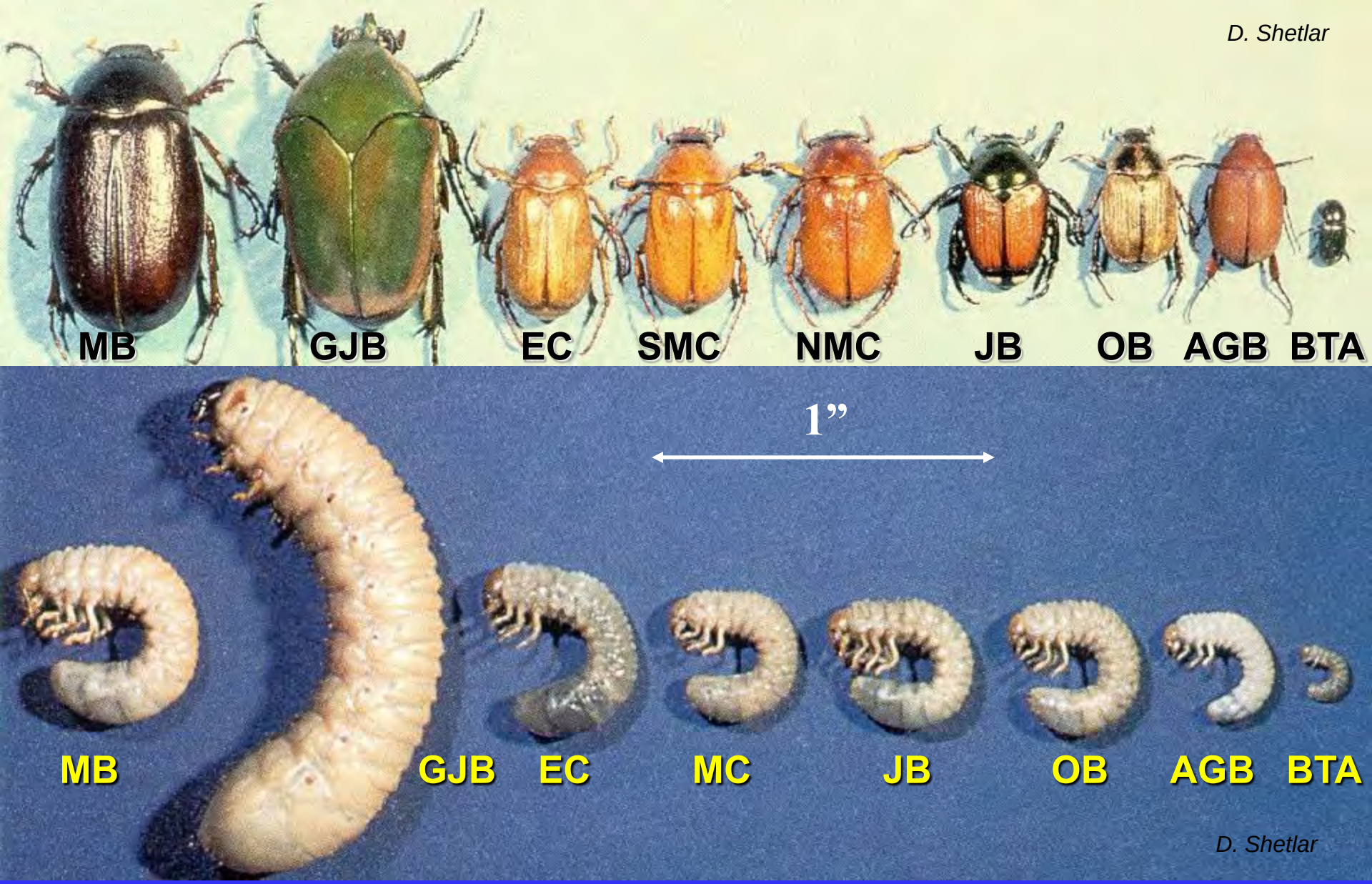
White grubs - Signs of infestation

White grubs - Signs of infestation



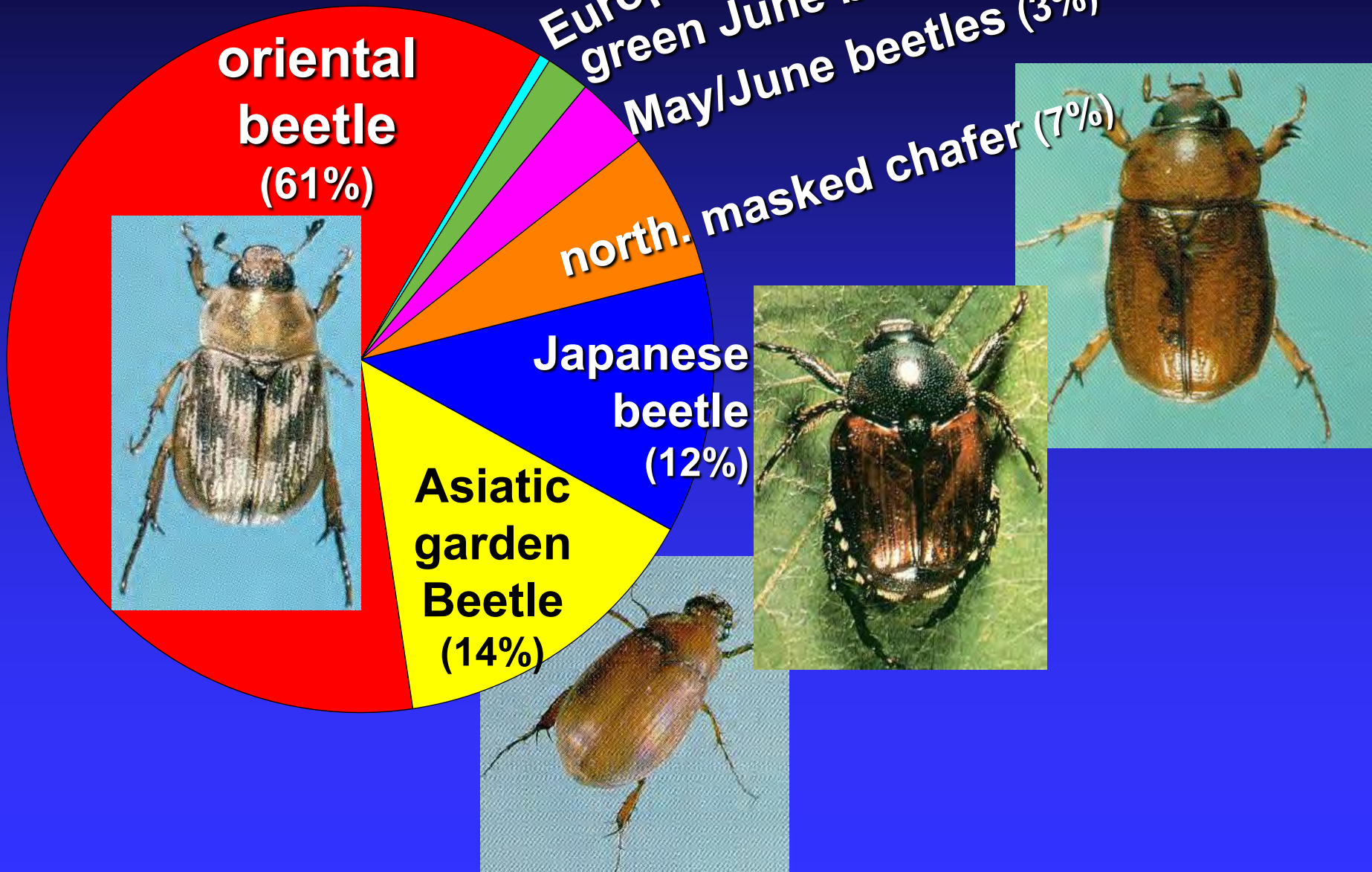
White grub – Seasonal Lifecycle

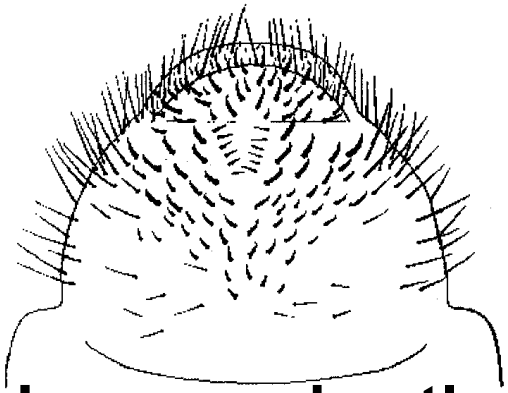




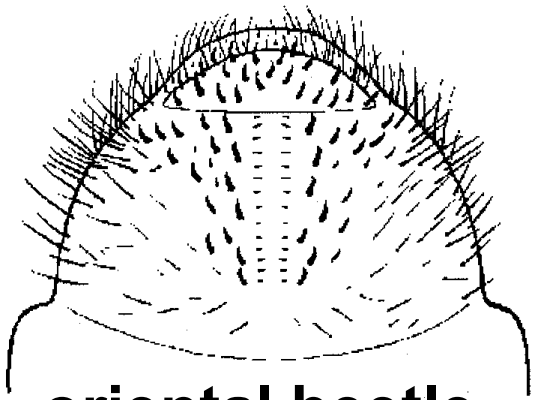
MB, May beetle; GJB, green June beetle; EC, European chafer;
MC, masked chafer (S/N, southern/northern); JB, Japanese beetle
OB, oriental beetle; AGB, Asiatic garden beetle; BTA, black turfgrass ataenius

White grubs complex in NJ lawns

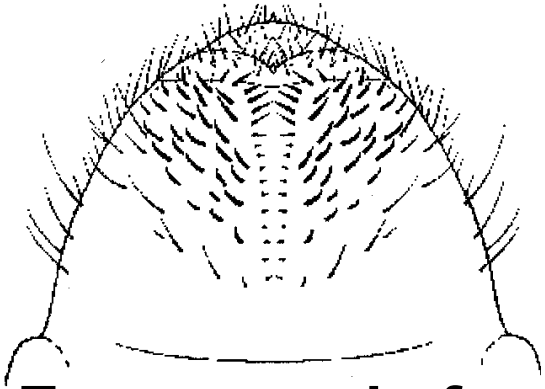




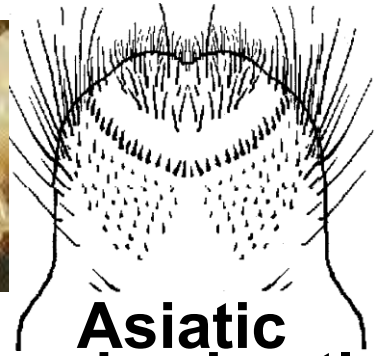
Japanese beetle



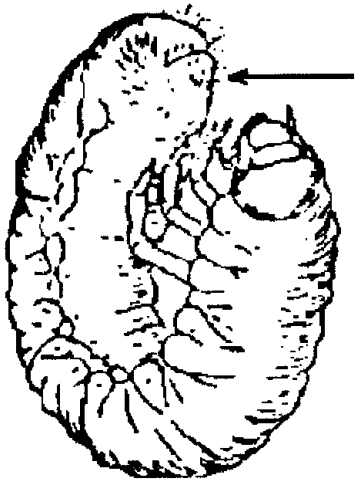
oriental beetle

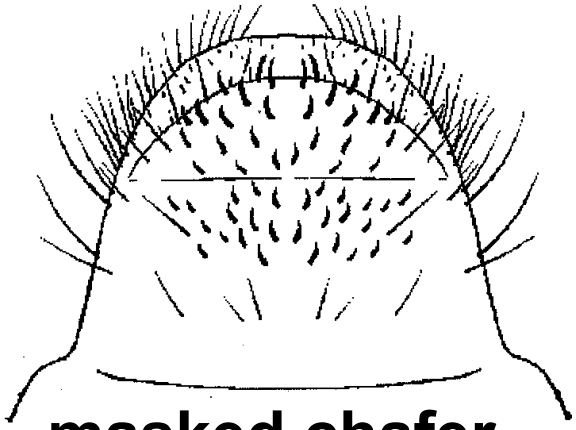


European chafer

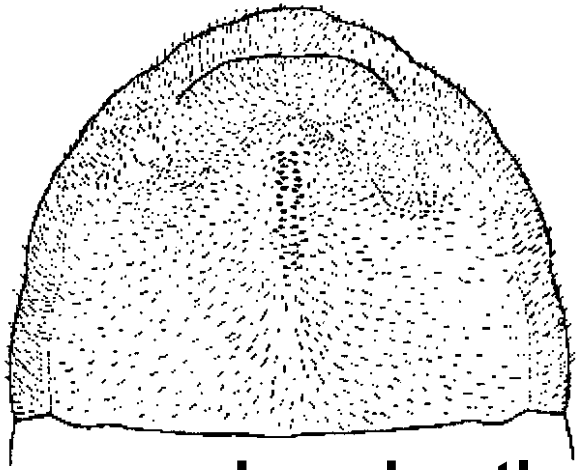


Asiatic garden beetle

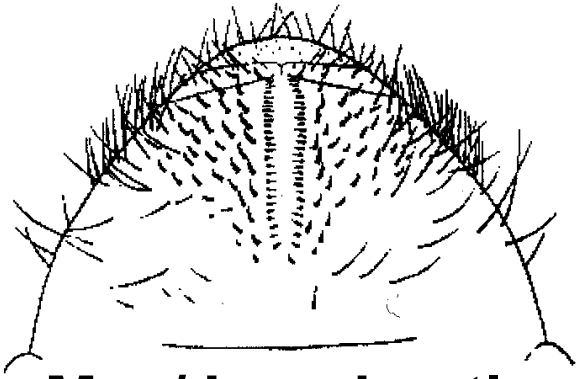




masked chafer



green June beetle



May/June beetle

D. Shetlar

White Grubs - Detection & Monitoring

Keep a close eye & sample sites with:

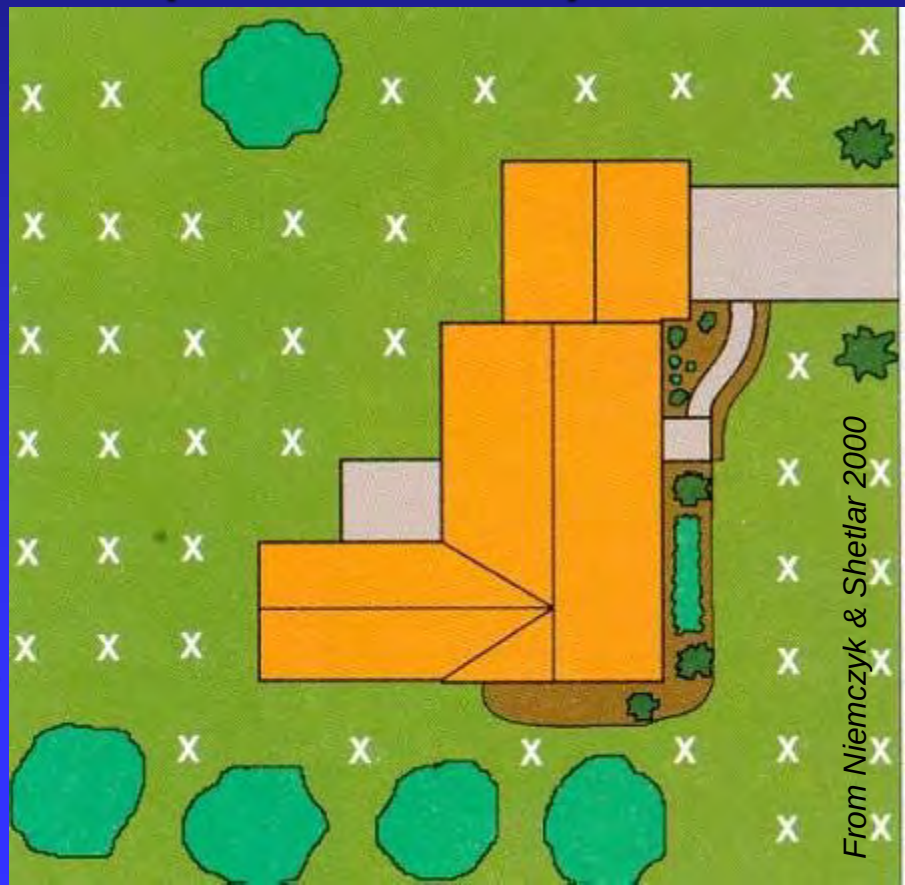
- adult activity in June/July (traps)
- areas infested in previous years
- vertebrate predator activity

Sample using:

- Cup cutters or flat-blade spade

White grub – mapping & surveying
Home lawns / sport fields

- Best when grubs 2nd instars (~mid August)
- Prepare map of area
- Sample in grid pattern: 6-10’ (home lawn), 10-20’ (sports field)
- Record number and species (hand lens!) per sample (also 0’s!).
- Standard cup cutter → 1 grub = 10/ft².
- Several adjacent sample w/ ≥ 1 grub → hot spot → consider treatment



White grubs – Cultural control

- Good turfgrass management to increase tolerance and recuperative potential
- Irrigation and light fertilization to mask damage and improve recovery
- No resistant turfgrass cultivars known
- Endophytic fungi do not provide much resistance
- Tall fescue relatively tolerant

Preventive control

- Application before infestation is recognized, ideally around egg-hatch
- Long residual insecticides (Acelepryn, Arena, Meridian, Merit, Mach2)
- Pro: Insurance
- Contra: Often unnecessary, expensive, long term suppression of natural enemies

→ Restrict to high-risk areas (history of infestation, high adult activity, lowest tolerance for damage)

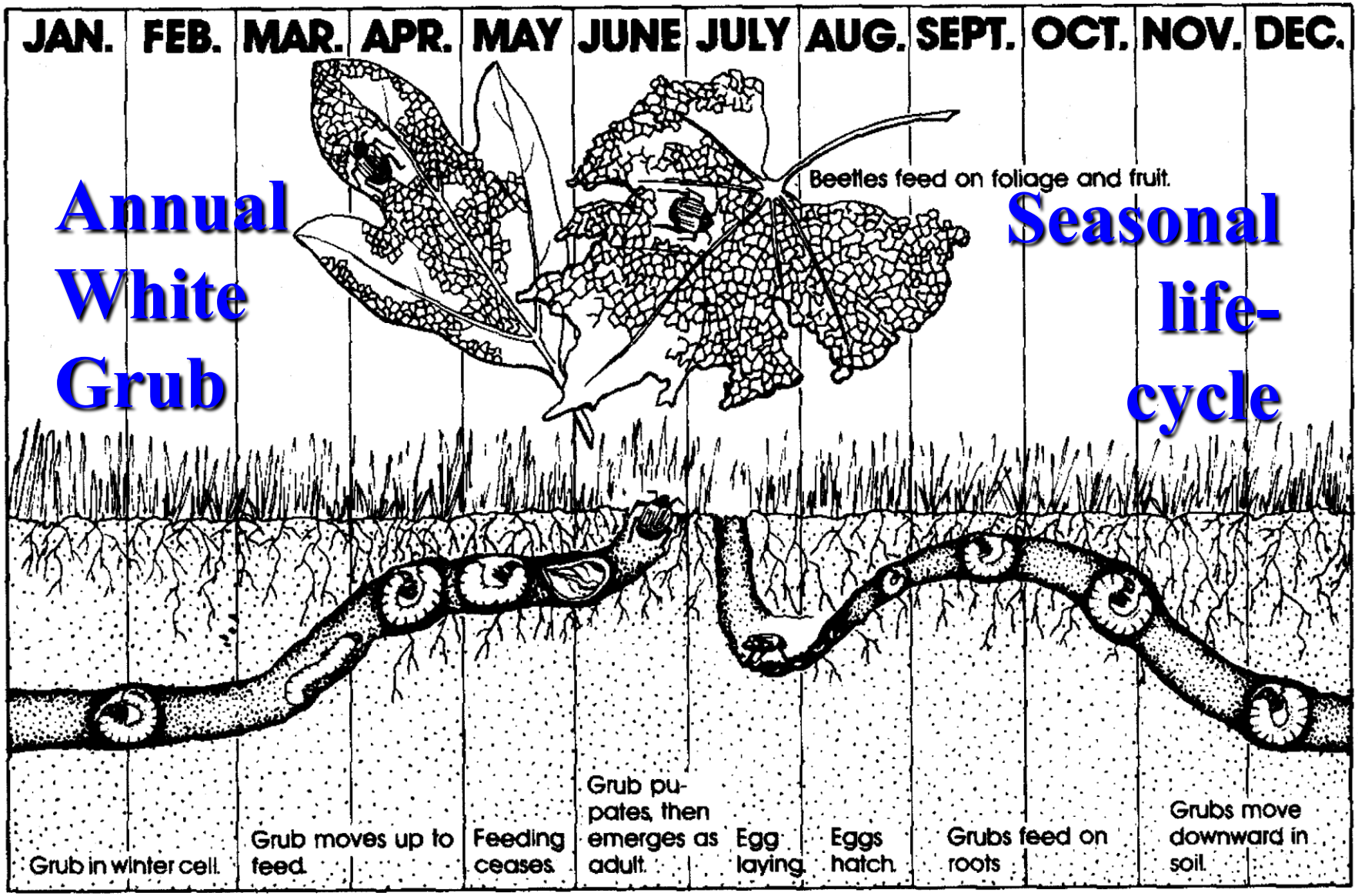
Curative control

- Application when infestation is recognized (sampling, damage)
- Short or long residual insecticides (Arena, Dylox, Sevin)
- Pro: Cheaper, more localized negative effect on natural enemies
- Contra: Labor (sampling) or risk (damage)

→ Use in areas with higher damage tolerance

Annual White Grub

Seasonal life-cycle

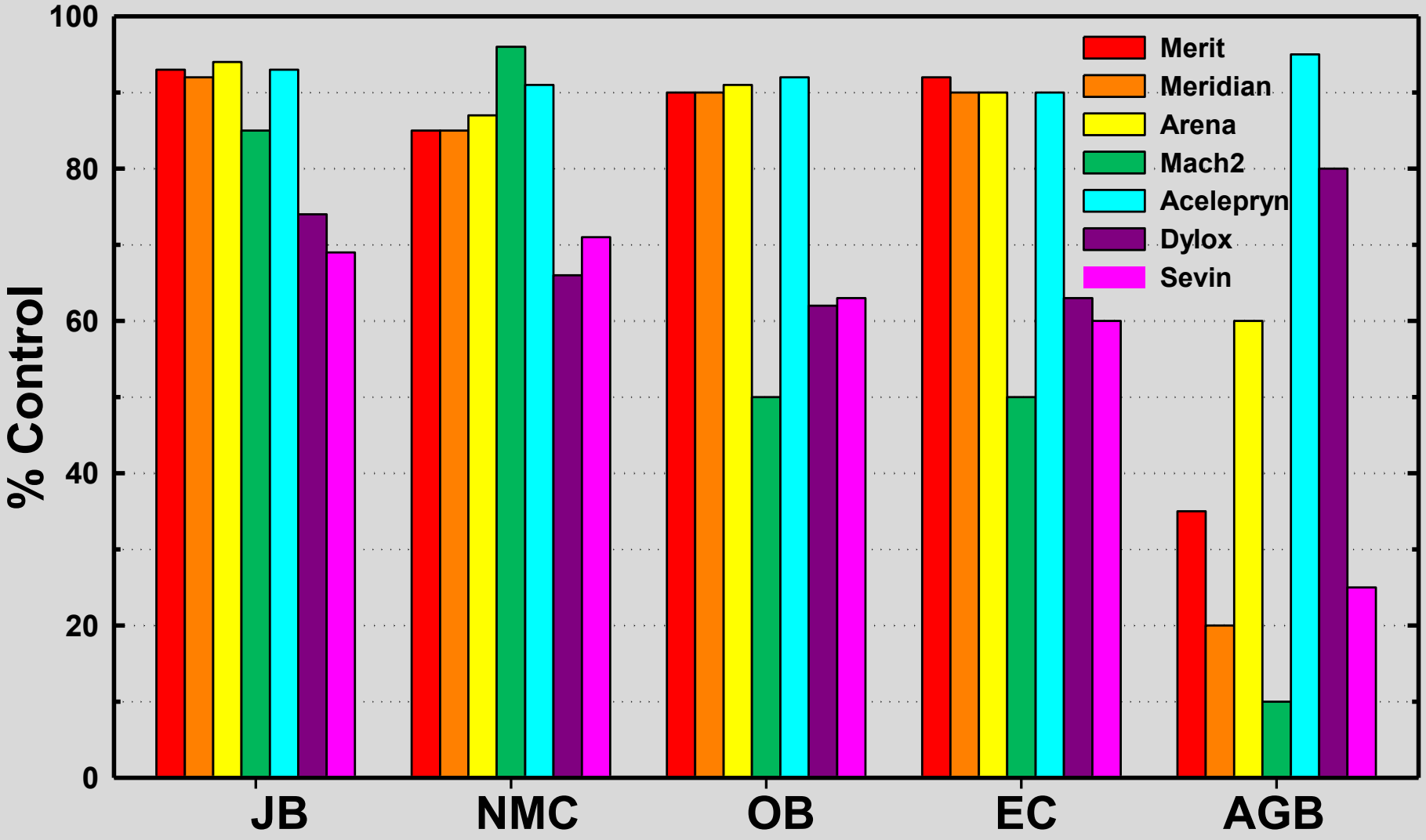


From Shurtleff et al 1987

Preventative treatment

Curative treatment

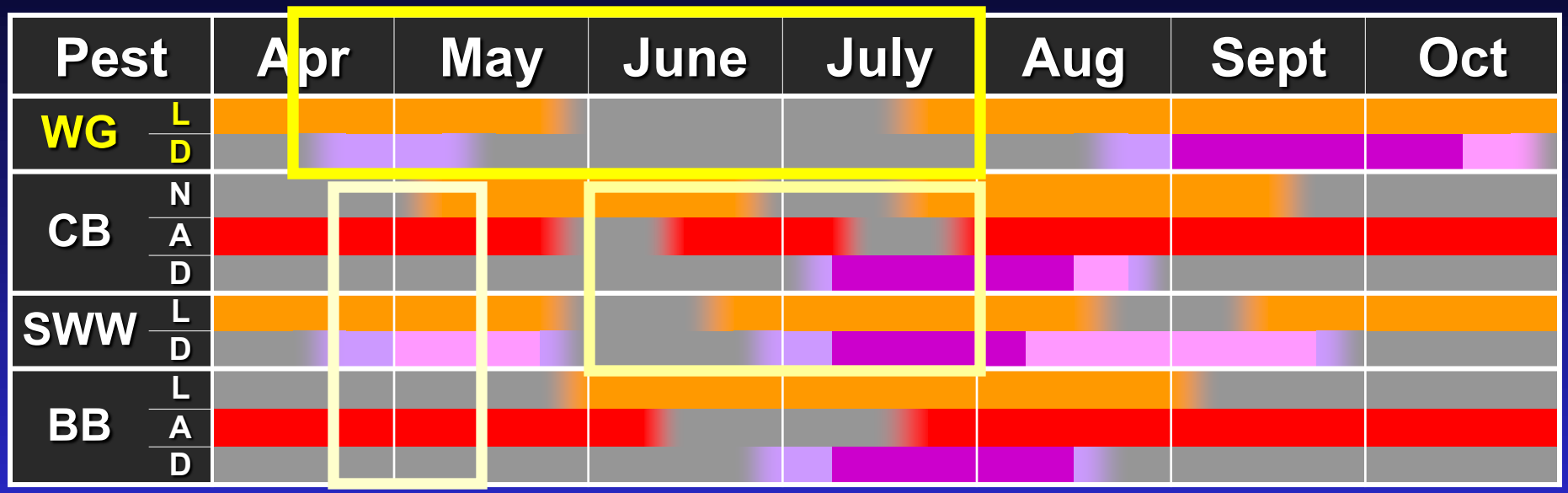
White Grub Insecticide Efficacy



Multi Target Principle

- Correct AI at right time and rate can control more than 1 (potential) pest
- But prioritize key pest !!!
- Use to reduce labor AND ‘toxicity load’ for environment.

Scen.#2: Key pest: *WG*; Approach: *preventive*

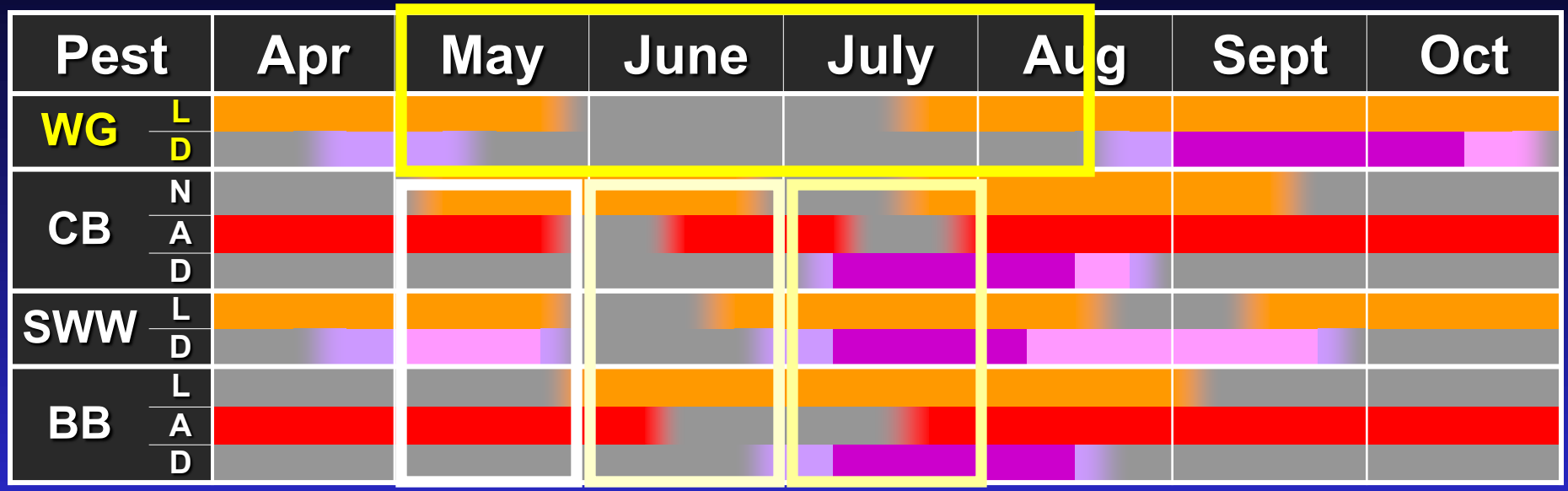


- **Acelepryn: mid-April-July; 0.1 lb ai/ac**

→ June/July: also SWW control, CB suppression

→ late April-May: BB and SWW control

Scen.#2: Key pest: *WG*; Approach: *preventive*



- **Merit: May-July; 0.3 lb ai/ac**

→ July: also SWW and CB suppression

→ Jun: also BB control; SWW, CB suppression

→ May: also BB control

Milky disease, *Paenibacillus popilliae*

- bacterial pathogen
- grubs ingest spores with soil during feeding
- colonizes grub's body fluid
- grub starves; death in ~4 wk
- forms spores → white color
- spores released from dead grub survive for years in soil

Milky Disease

- Most grub species have their own strain
- Commercials strain effective (?) only vs. Japanese beetle
- Inoculative applications in a 3'x 3' grid pattern
- Recycling in hosts → 1-3 year to spread throughout treated area
- Best establishment at high Japn. btl. densities and where soil temperatures stay > 70°F for longer periods

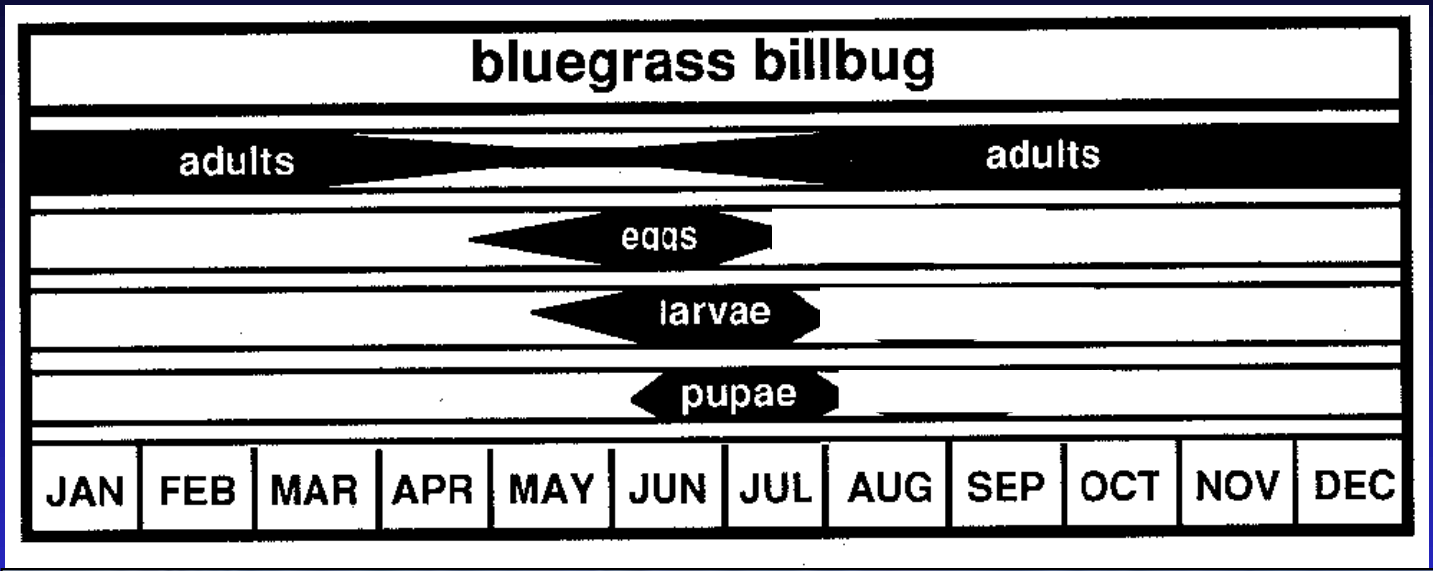
Billbugs

Sphenophorus spp.

(Coleoptera: Curculionidae)

0.3-0.5"

Billbugs - Development



Hunting BB, uneven BB, Small BB Probably similar in NE

From Brandenburg & Villani 1995

Injury

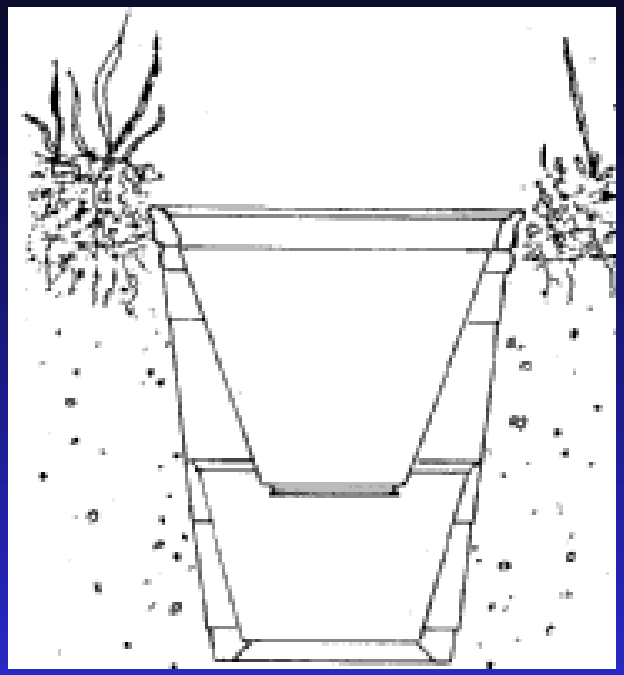
- Young larvae feed inside grass stems, then burrow down to feed on crown.
- Older larvae feed externally on crowns, roots, and rhizomes.
- Stems break off at crown, are hollowed out or filled with sawdust-like frass.

Injury

- Initially scattered dead stems, later growing patches of dead turf
- Damage in mid/late summer, especially during extended dry periods
- Symptoms often attributed to drought, dollar spot, brown patch, other insects

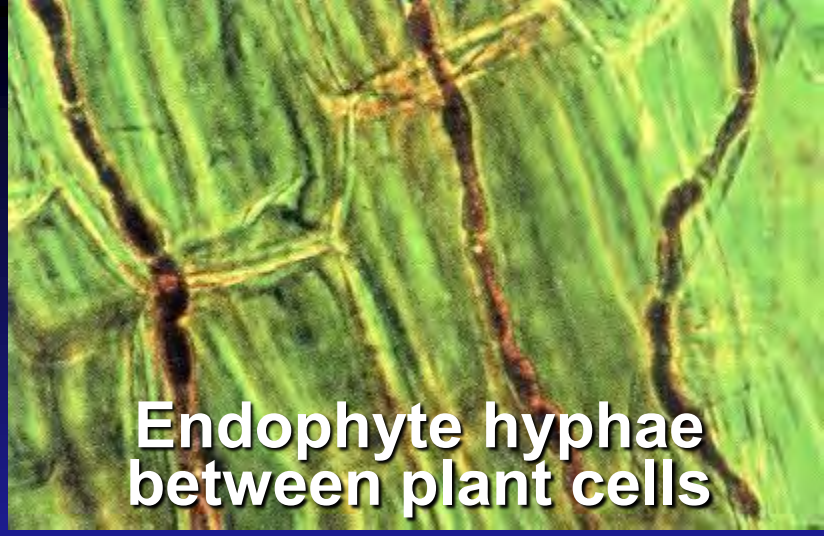
Billbugs - Monitoring

- Monitor adults in spring visually or with pitfall traps. Check 2-3 times/week. If > 7-10 adults/trap day, expect severe damage.
- Detection of adults and older larvae with cup cutter sampling.
- "Tug test" to confirm billbug damage.



Cultural control

- Endophyte-enhanced grasses are more or less resistant to billbugs.

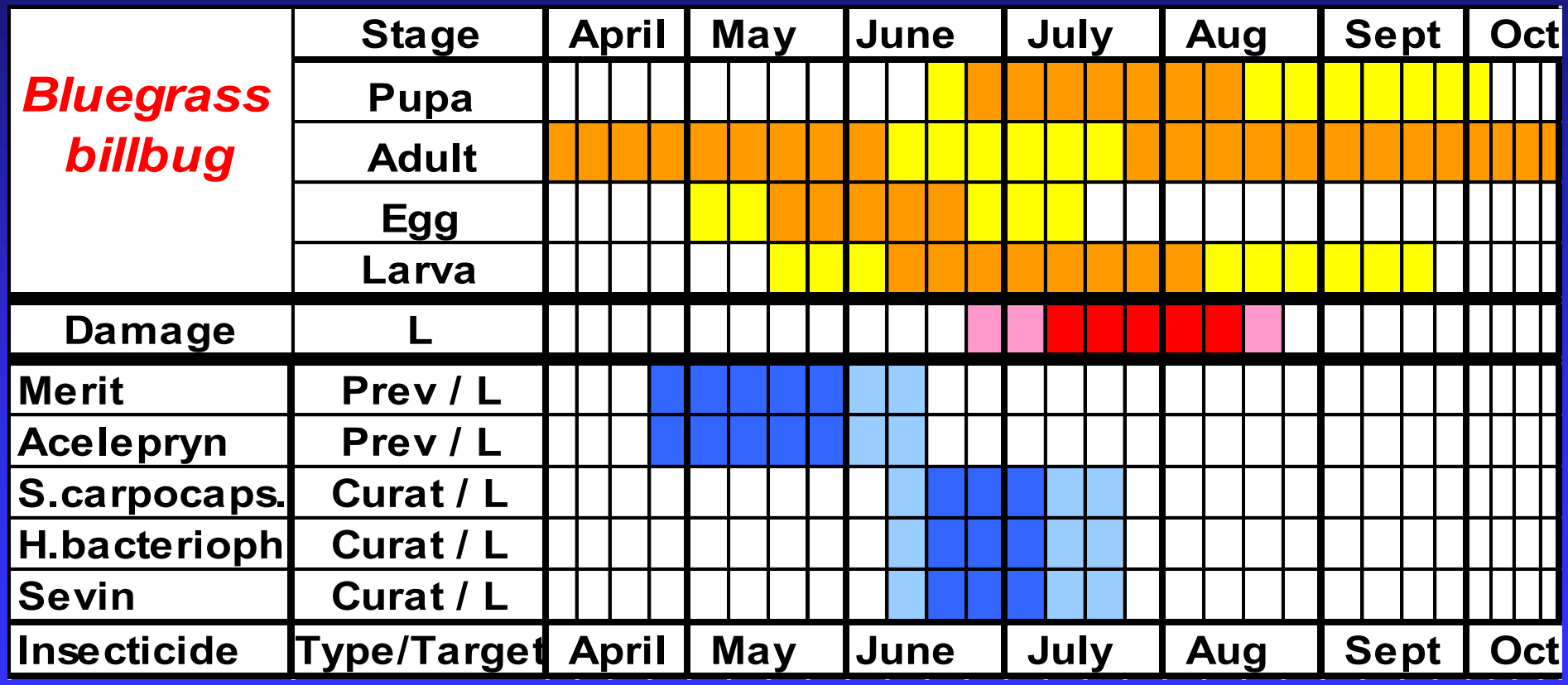


- KY bluegrass varieties that are thinner leaved, aggressive creepers, and/or more heat/drought tolerant are more billbug-tolerant.
- Moderate damage can be masked by light fertilization and deep watering.

Management

- Preventive treatments vs. young larvae in plants with systemic insecticides: spray or granules; 1/8” post-treatment irrigation.
- Curative treatments vs. larvae in soil: spray or granules; ¼” post-treatment irrigation.

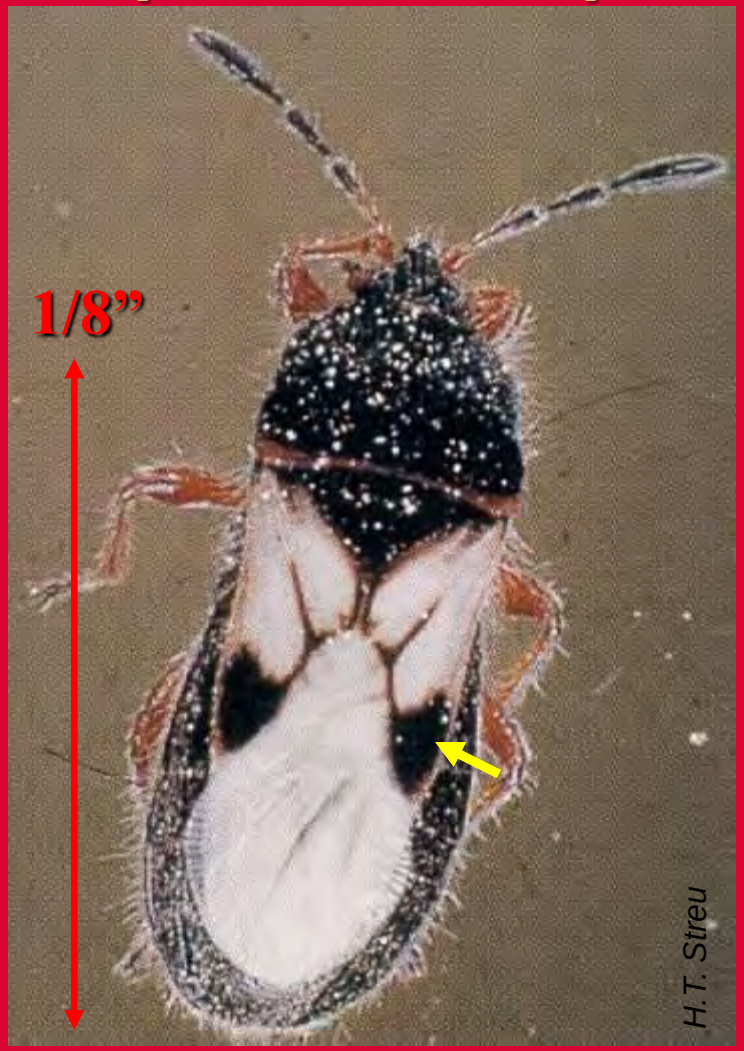
Billbugs
Timing & Choices



Chinch bugs

Blissus spp. (Hemiptera: Heteroptera: Lygaeidae)

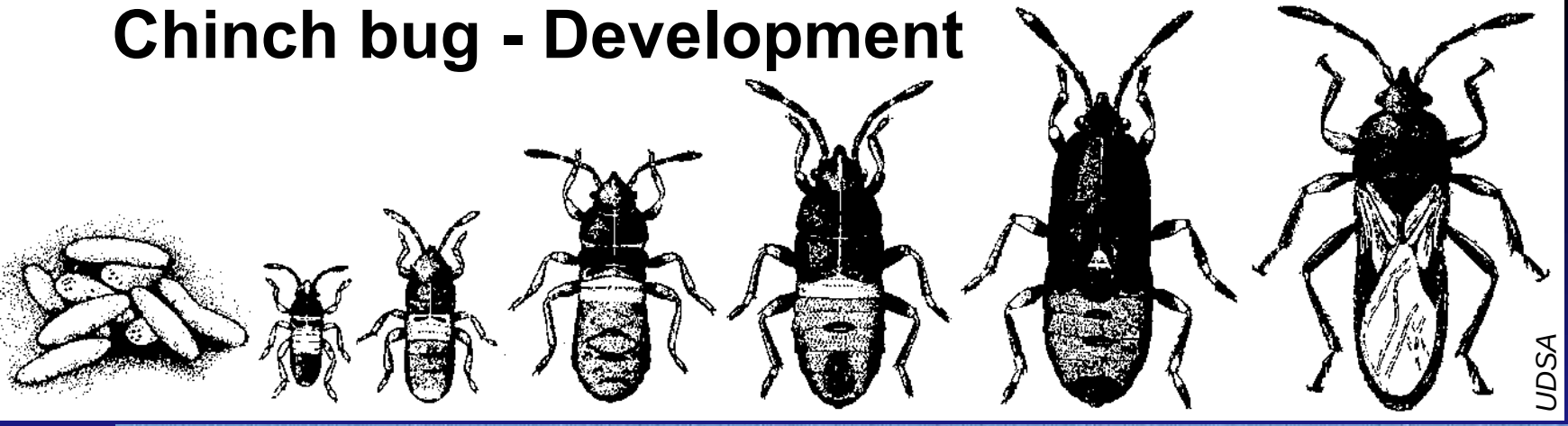
Adult
short-winged

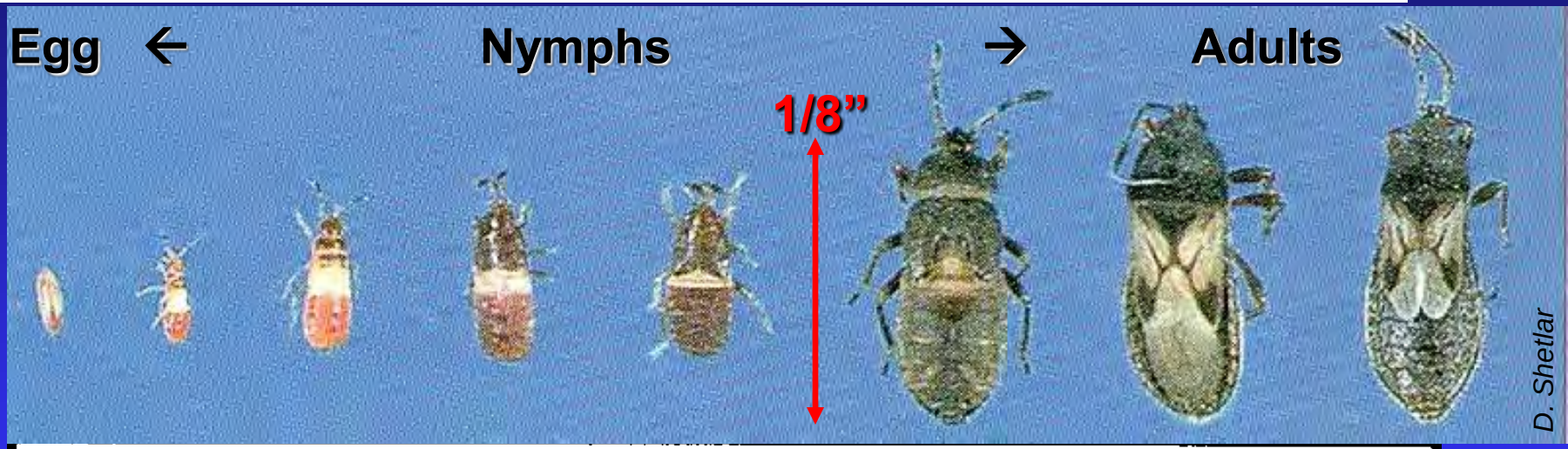


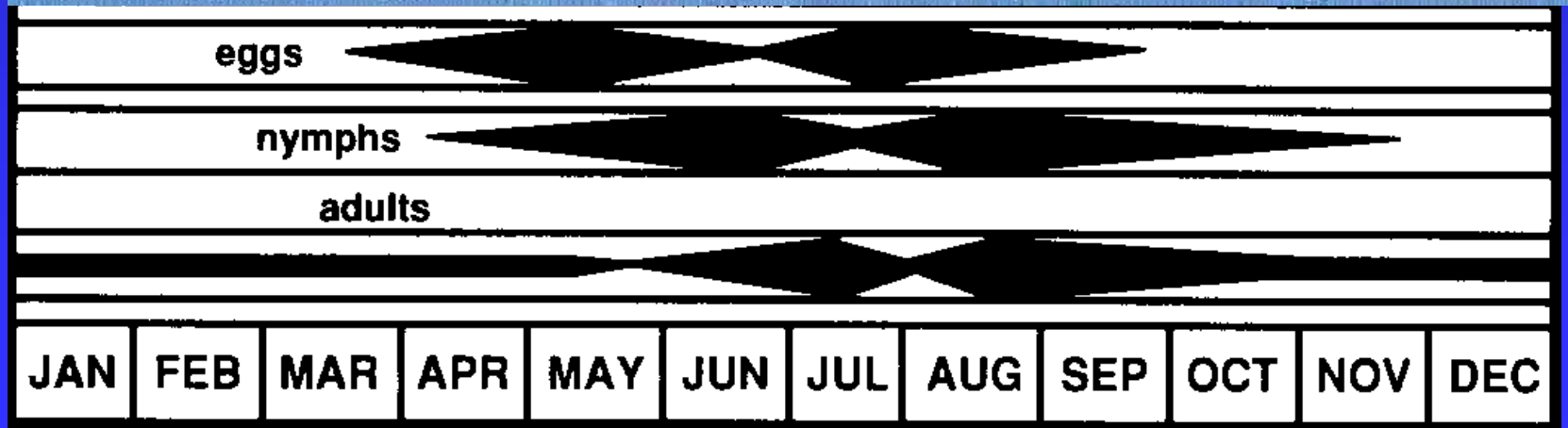
Adult
long-winged

Nymph
3rd instar

Chinch bug - Development







From Brandenburg & Villani 1995

Chinch bugs - Pest status & injury

- **Hairy chinch bug** important pest of cool-season grasses and zoysiagrass in Northeast and upper Midwest

Nymphs and adults suck juices from stems and crown and inject toxic saliva → cloggs conductive tissues in grass stem.

Chinch bugs - Injury

- Irregular patches of wilted, yellow-brown turf
- Coalesce into larger areas of dead turf
- Damage in hot, dry periods in July/Aug. in sunny lawns w/ thick thatch w/ south. exposure
- Damage often masked by drought dormancy
- Warm, dry springs favor chinch bug buildup.

Chinch bugs - Monitoring

- Best in June when nymphs are feeding, before damage starts
- In areas with chinch bug history.
- Later, check areas with symptoms of infestation.
- ‘Hand-and-knees’ method

Chinch bugs – Cultural Control

- Conserve natural enemies (selective insecticide use!).
- *Beauveria bassiana* can control chinch bugs under moist conditions (fungicides suppress *Beauveria*!).
- Irrigate during dry periods to increase tolerance (also promotes *Beauveria*).
- Control thatch.
- Endophytic grasses resistant to chinch bugs.

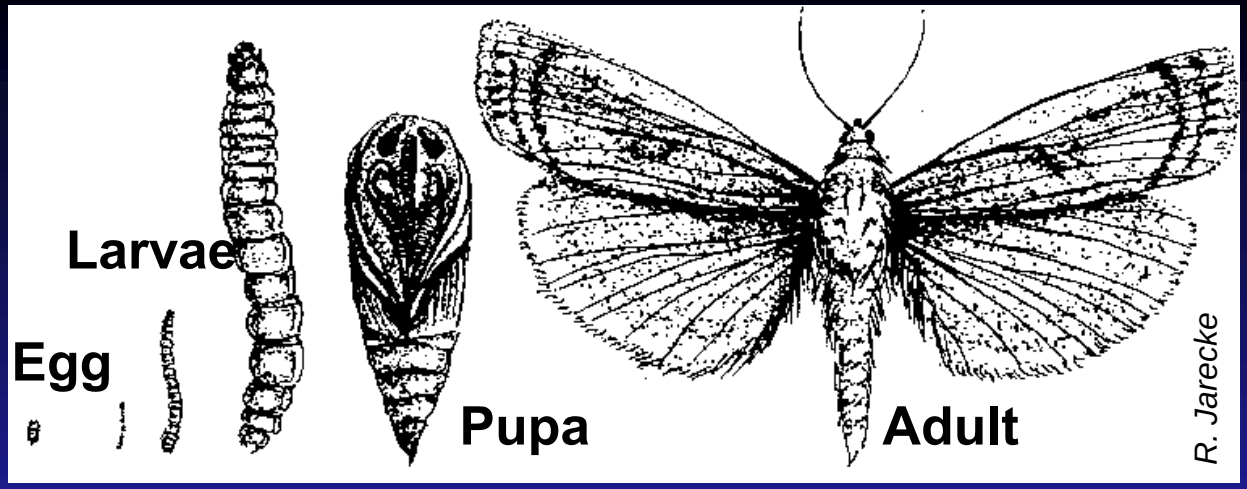
Chinch bugs - Timing & Choices

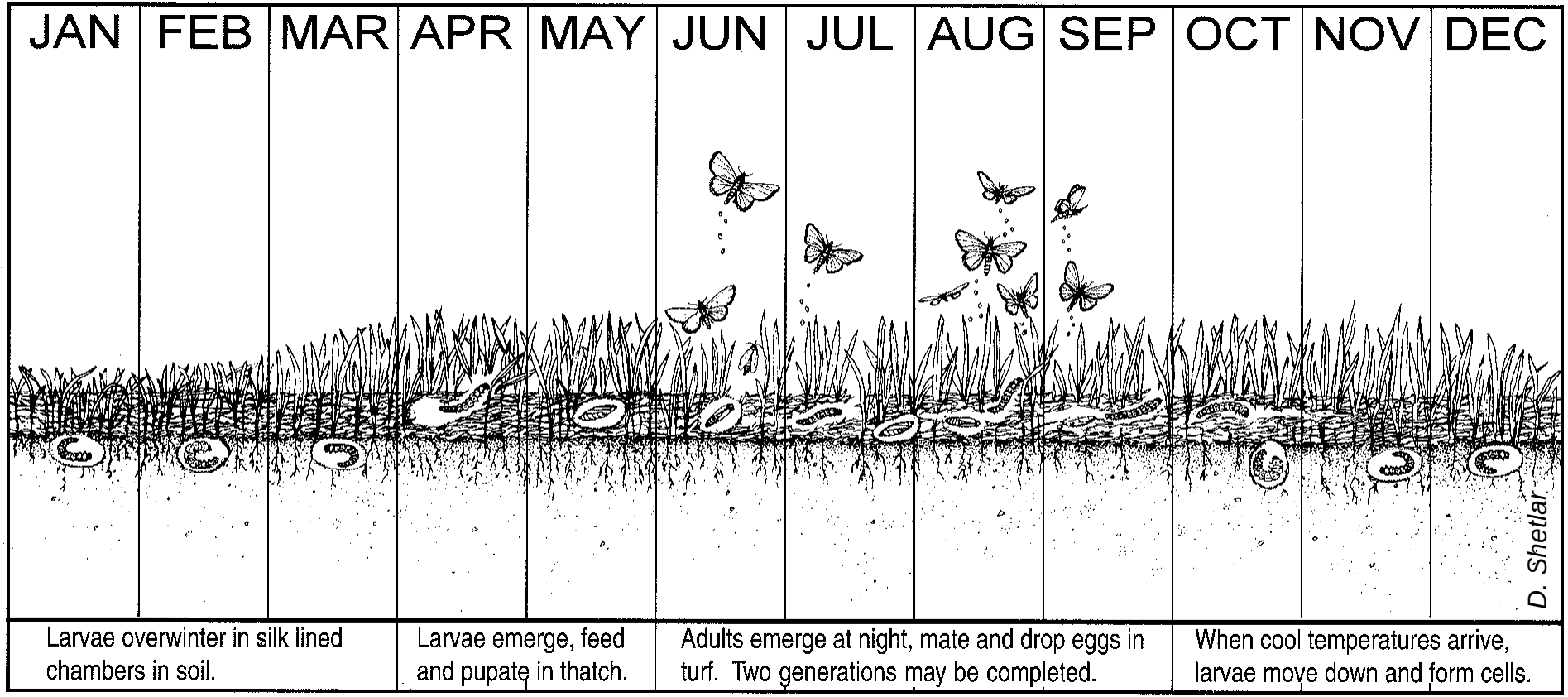
- Curative spot-treatments as needed; liquid or granular formulations; 1/8” post-treatment irrigation; delay deep irrigation for 1-2 days.

Hairy chinch bug	Stage	April	May	June	July	Aug	Sept	Oct
	Nymph							
	Adult							
Damage	N+Ad							
Arena	Cur / N + Ad							
Pyrethroids	Cur / N + Ad							
Sevin	Cur / N + Ad							
Insecticide	Type/Target	April	May	June	July	Aug	Sept	Oct

Sod webworms
(Lepidoptera: Pyralidae)

Bluegrass Webworm life cycle (NJ latitude)





Sod webworm - Pest status & injury

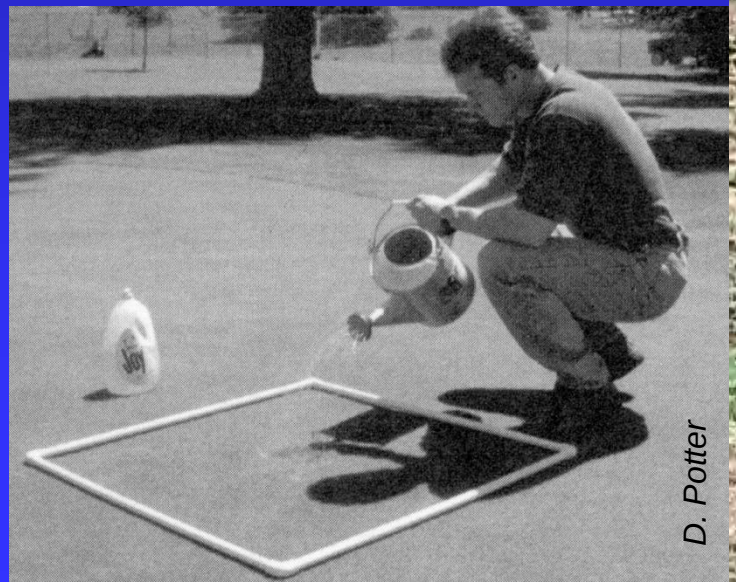
- > 20 species throughout USA
- Damage greatest in Midwest & eastern USA
- Prefer new sod field and lawns.
- Larvae feed at night from silken tunnels in thatch or surface soil; chew off leaves and stems just above crown.

Sod webworm - Injury

- General thinning → patches of brown closely cropped grass → if severe, coalesce into large irregular patches.
- Weak or drought stressed grass may die due to sun exposure of crowns.
- Damage often on south-facing slopes and other warm areas

Sod webworm - Monitoring

- Visual inspection for flying adults
- Bird activity + 'Hand-and-knees' to check for larvae
- Pheromone traps for some species
- Soap flushing: best in early morning, small larvae may take 20 min
- Treatment threshold ~ 10-15/y^2


D. Potter


D. Shetlar

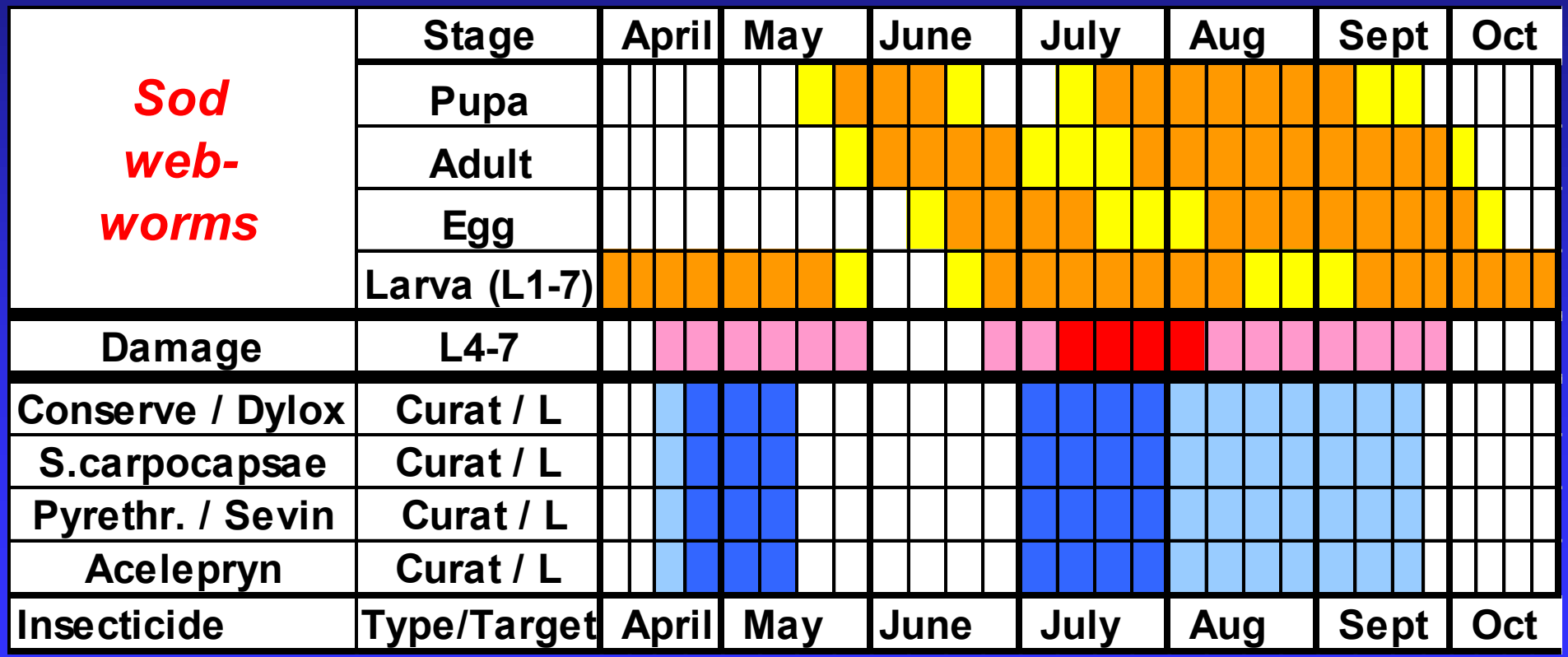
Bird probing

Sod webworms - Management

- Balanced irrigation + fertilization during dry periods increases tolerance and recovery
- Endophytic grasses relatively resistant
- In healthy lawns, natural enemies take heavy toll on eggs and larvae → Conserve natural enemies
- Apply only curative spot treatments as needed

Sod webworms - Management

- Bt- or azadirachtin-products vs. young larvae.
- Apply treatments as sprays late in day.
- Delay irrigation and mowing for 1-2 d

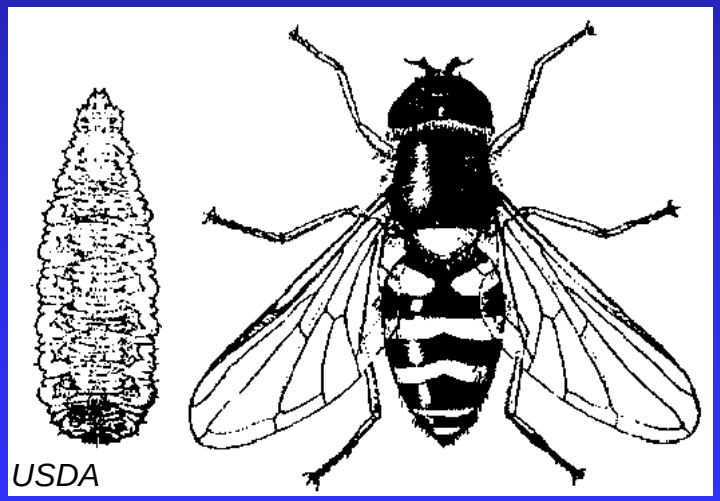


Beneficial insects & insect pathogens

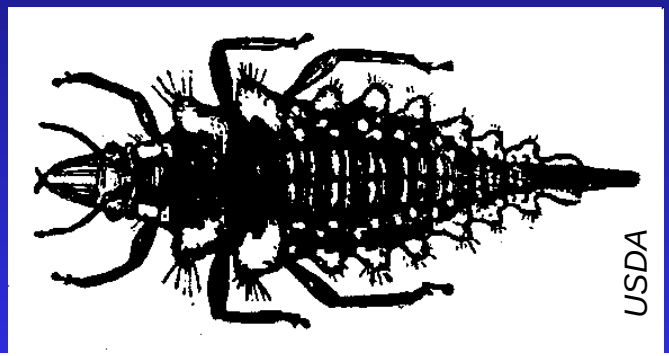
- Predators
- Parasites
- Pathogens

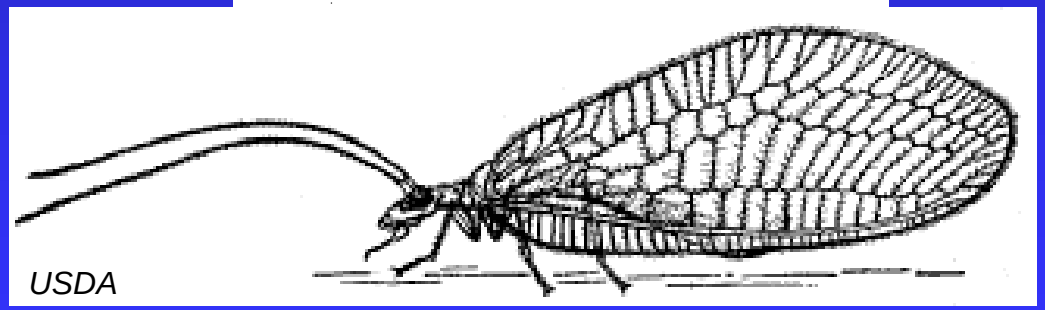
Beneficial turfgrass insects - Predators

Big-eyed bugs
(Chinch bugs & small insects, eggs)



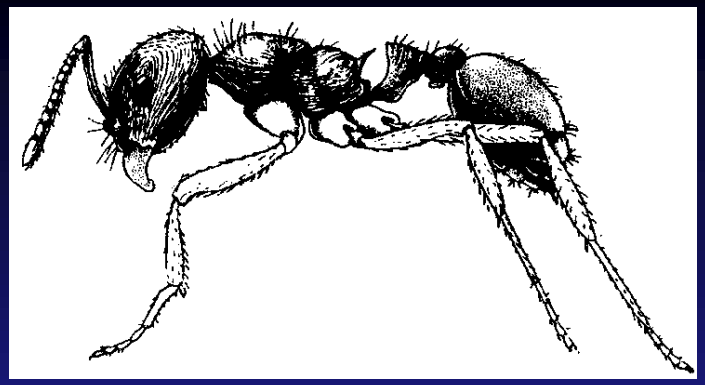
Sirphid flies
(aphids, mealybugs)



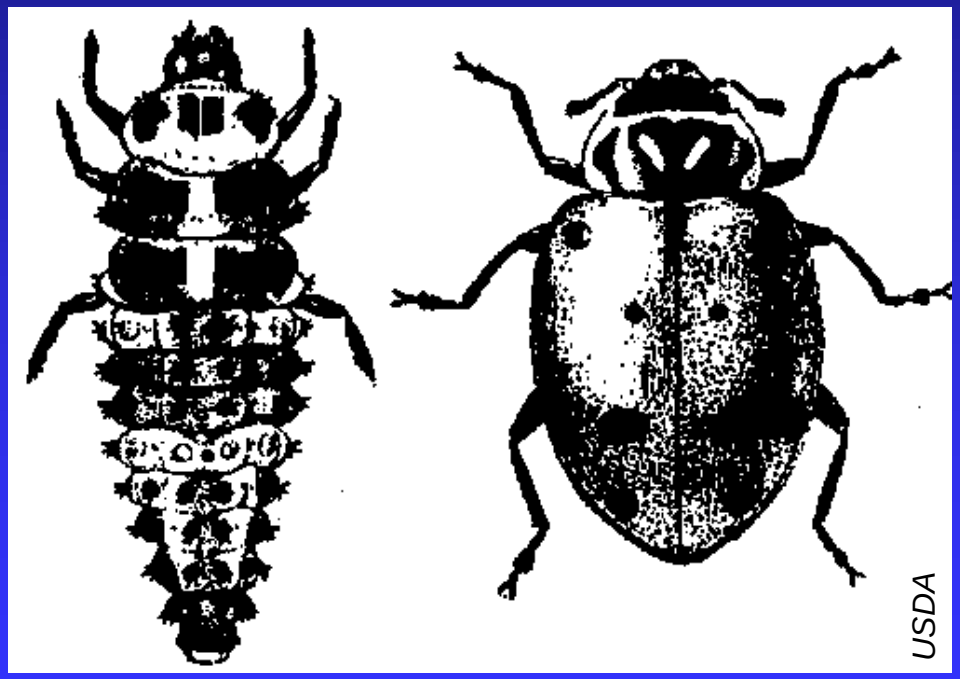


Lacewings
(aphids, mealybugs)

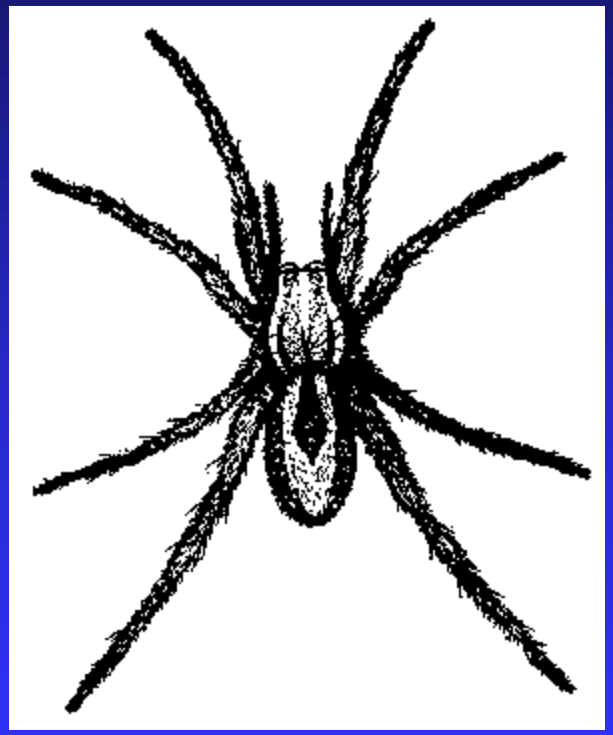
Beneficial turfgrass insects - Predators



Ants (generalists)

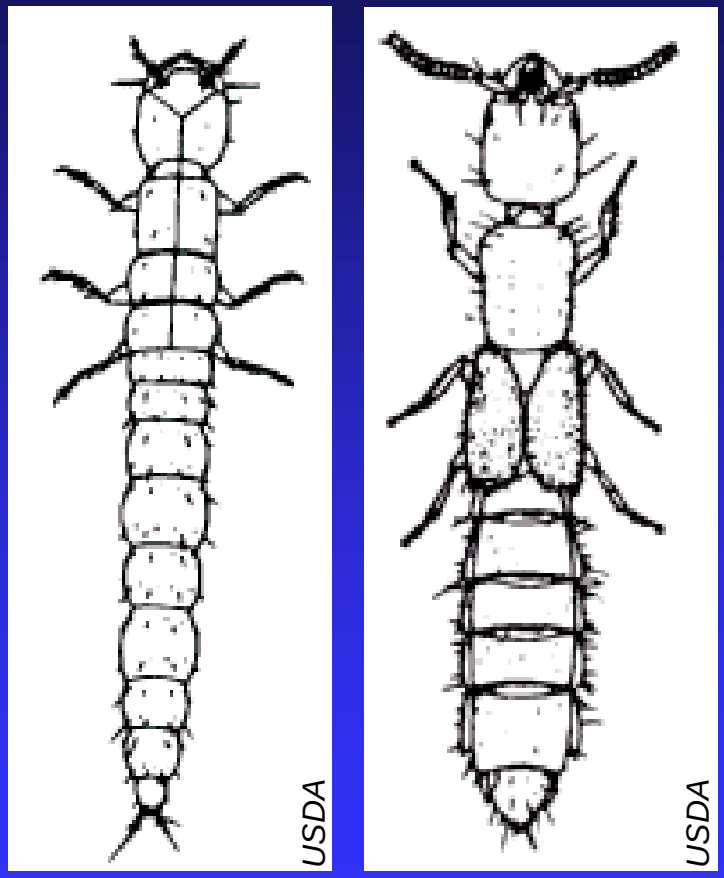


Lady beetles (aphids, mealybugs)

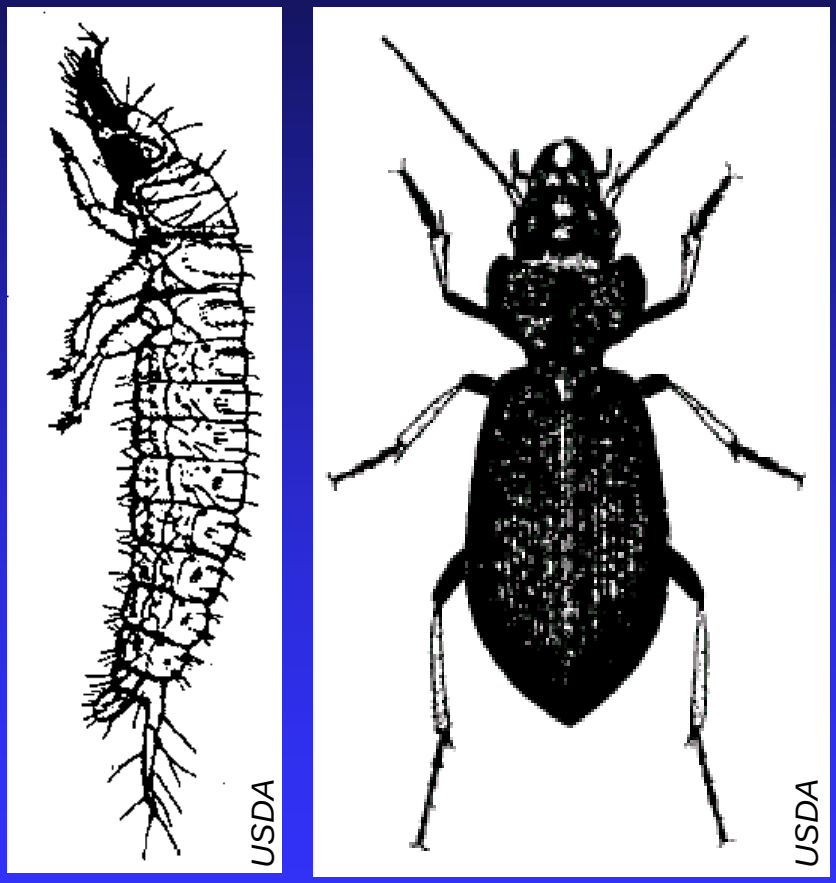


Ground spiders (generalists)

Beneficial turfgrass insects - Predators

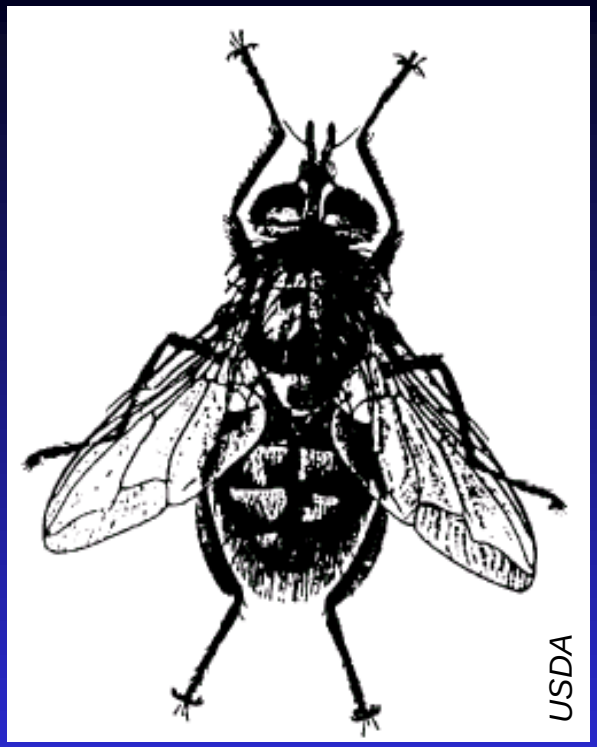


Rove beetle
(generalists)

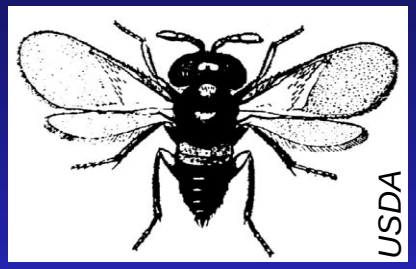


Ground beetle
(generalists)

Beneficial turfgrass insects - Parasites

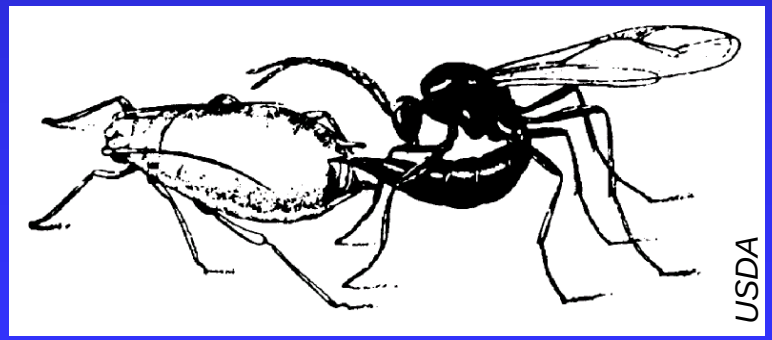


Tachinid flies
(larvae, adults of various pests)



Chalcid wasps
(eggs, larvae, pupae of various pests)

Tachinid larva on white grub



Aphelinid wasps (aphids)

Beneficial turfgrass insects - Parasites

Tiphiid wasps
(white grub spp.)

Young *Tiphia* larva

Mature *Tiphia* larva

Scoliid wasps
(white grub spp.)

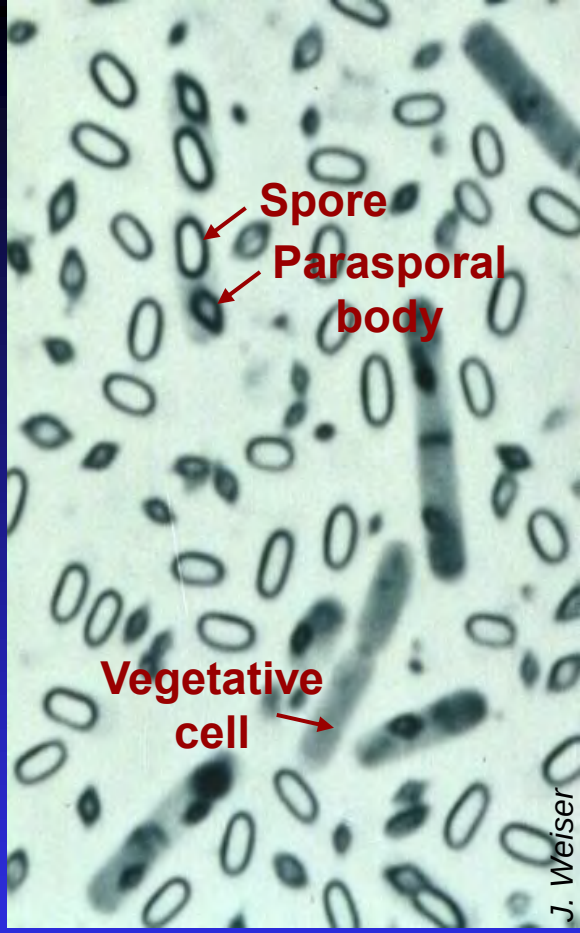
***Tiphia* cocoon**

Naturally Occurring Pathogens of Turfgrass Insect Pests

- Entomopathogenic nematodes
  (*Steinernema* spp., *Heterorhabditis* spp.)
- Entomopathogenic fungi
  (*Beauveria* spp., *Metarhizium anisopliae*)
- Bacteria
  (*Paenibacillus popilliae*, *Serratia* spp.)
- Rickettsia, Microsporidia, Protozoa

Bt - Bacillus thuringiensis

- Endospore-forming insect pathogen common in soil and sediment
- Produces insecticidal crystal protein (delta endotoxin)



- When ingested, endotoxin disrupts midgut epithelium → gut paralysis → septicemia, starvation → death.
- Strains specific to different insect groups.

Bt - Bacillus thuringiensis

- ***Bt*** **rapidly inactivated by UV light → for foliar applications use UV protectants and apply late in day.**
- ***Bt kurstaki*** **(DiPel, Javelin),** ***Bt aizawai*** **(XenTari) active vs. young armyworms and sod webworms (not black cutworm)**
- ***Bt japonensis*** **(Buibui) in development: active vs. young stages of some white grubs**

Entomopathogenic Fungi

- facultative lethal parasites of insects
- *Beauveria* & *Metarhizium* species
- host range +/- broad; many different strains

before spore germination after

Metarhizium anisopliae **(white grub)**

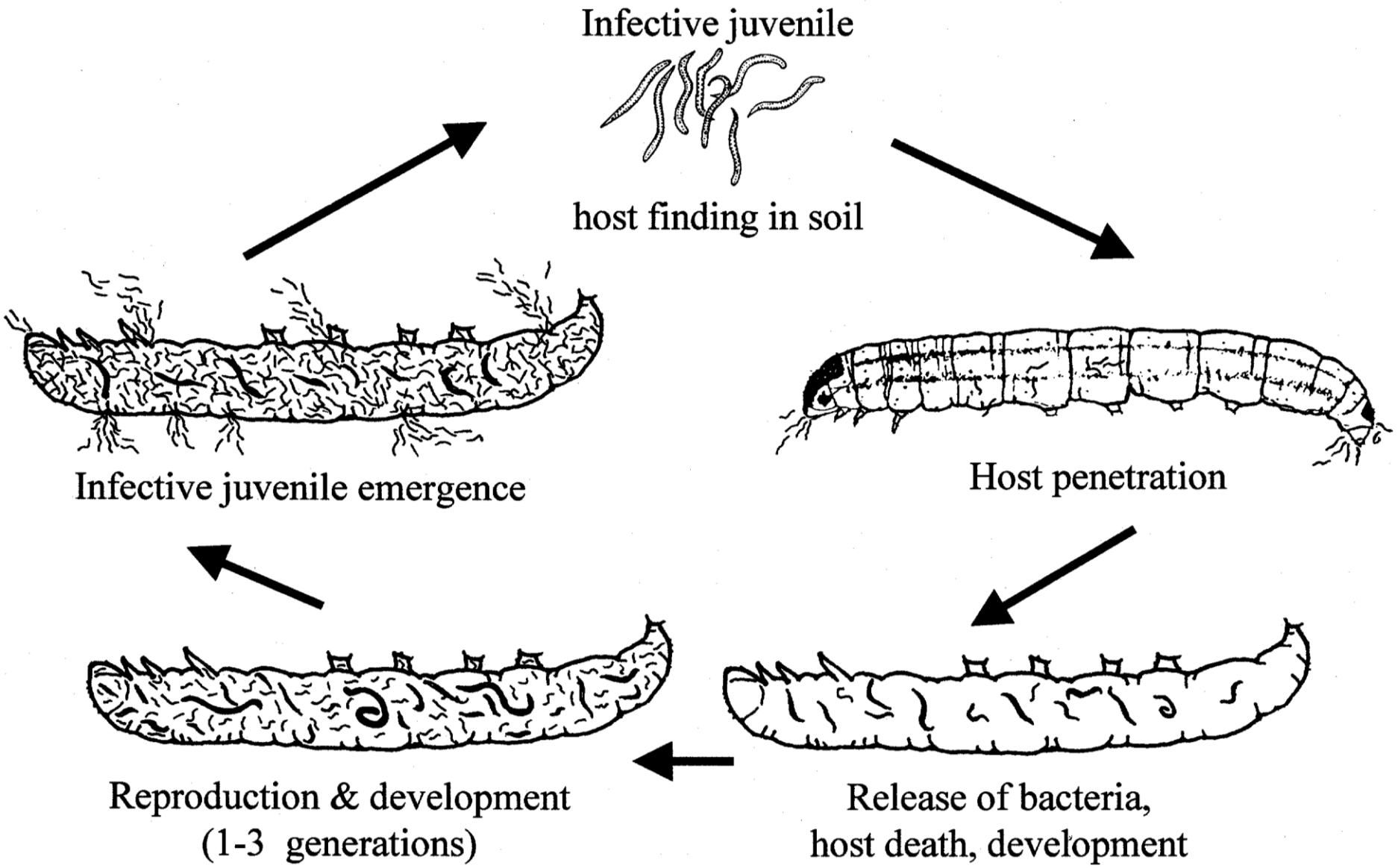
Beauveria bassiana
(chinch bug)

Entomopathogenic nematodes (EPN)

- obligate lethal parasites of insects
- mutualistic association with bacteria
- > 80 *Heterorhabditis* & *Steinernema* species
- host searching capacity
- host range +/- broad
- ease of production
- recycling capacity

Infective juvenile nematodes

Entomopathogenic nematode life cycle



EPN Infections

Nematode products for US turf market

Nematode	Targets[1]	Product (Producer)
Steinernema carpocapsae	BCW, SWW, AW, BB, Fleas	Millenium (Becker Underwood), Carpsanem (Koppert), Ecomask (BioLogic)
Heterorhabditis bacteriophora	WG, BB	Nemasys G (Becker Underwood), Terranem NAm (Koppert), Heteromask (BioLogic)

[1]BCW = black cutworm; SWW = sod webworm; AW = armyworm
BB = billbugs; WG = white grubs

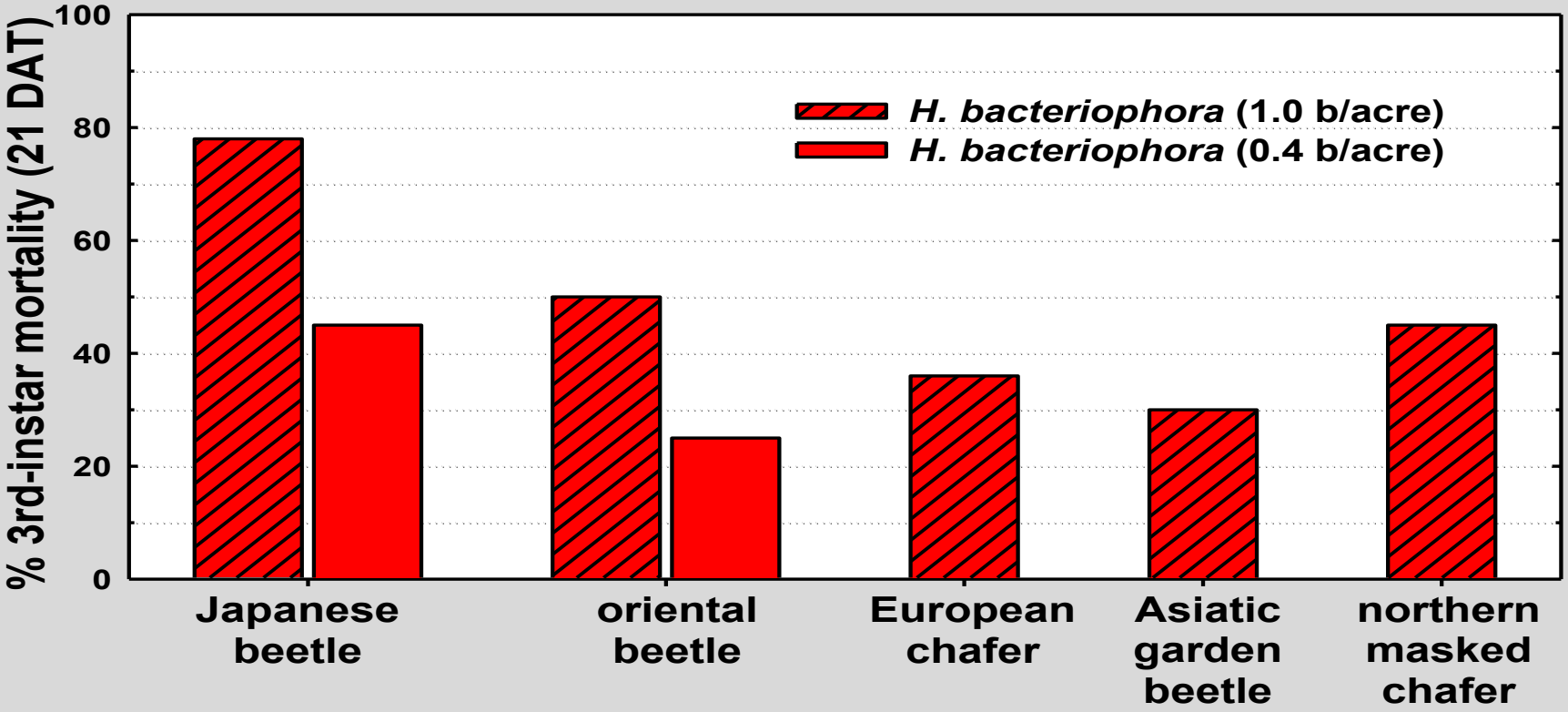
Nematode products – Sources and Pricing

Producer	Contact/ Distributor	Product / Price per 1 billion (~1 Acre)
Becker Under-wood	(www.beckerunderwood.com)	Millenium (Sc) / $160 Nemasys G (Hb) / $280
Koppert	www.koppert.com	Carpsanem (Sc) / $347 Terranem-NAm /(Hb) $261
BioLogic Company	www.biologicco.com	Ecomask (Sc) / bulk? Heteromask (Hb) / $2,000

White grub species and EPN efficacy

Summary of multiple field experiments

Applications around mid-September

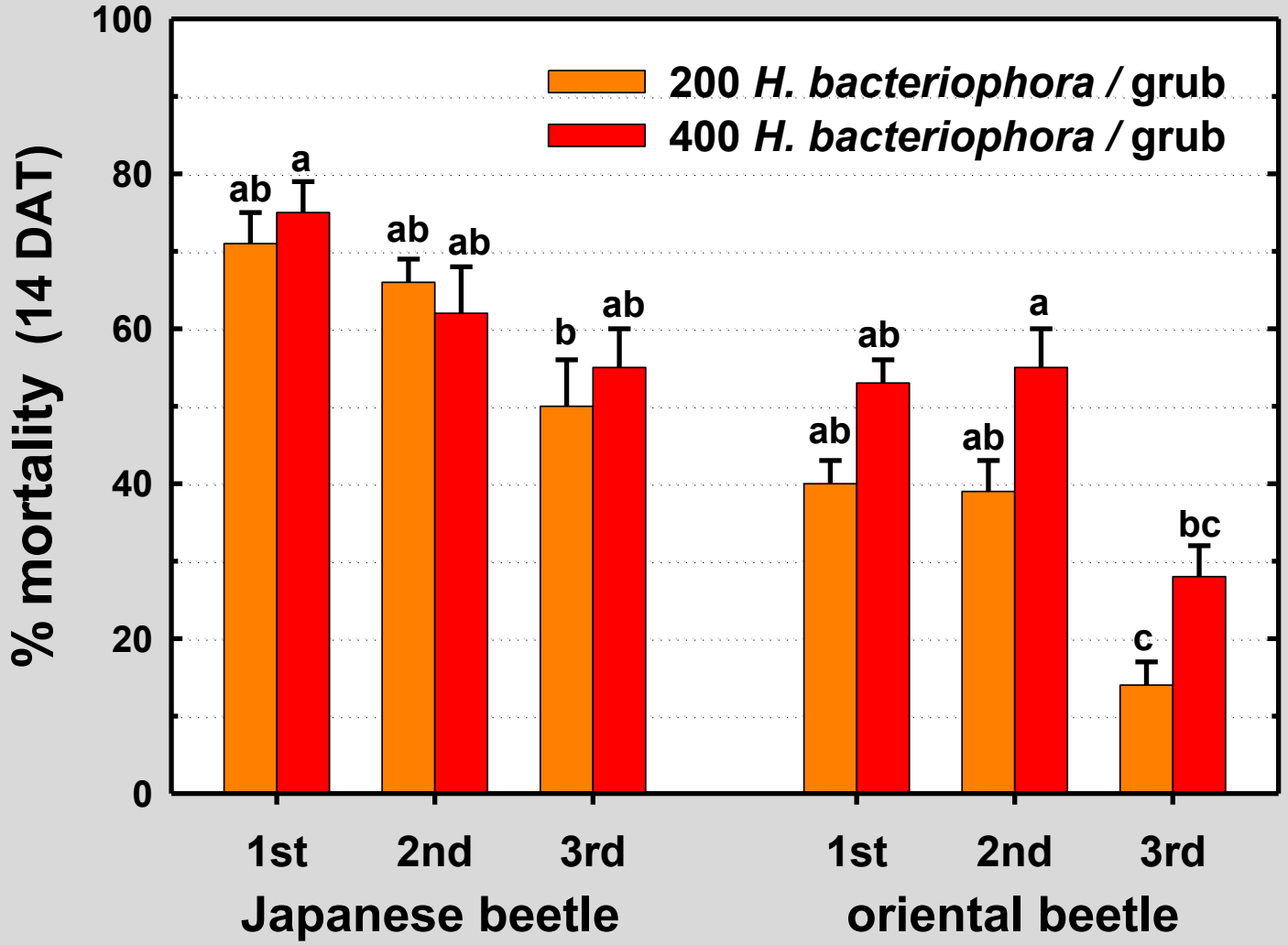


- ***JB control feasible.***
- ***Other species less susceptible. 2 b/acre necessary?***
- ***Earlier applications vs. younger stages?***

Koppenhöfer & Fuzy 2003, Cappaert & Koppenhöfer 2003

White grub larval stage and EPN efficacy

Lab test: 1 grub / 1-oz cup



Koppenhöfer & Fuzy 2004

Japanese beetle
1-year Life Cycle

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Nematode: *Heterorhabditis bacteriophora*
Application timing: Early August to early October
Optimal timing: mid-August to early September (L1+L2)

RUTGERS
New Jersey Agricultural Experiment Station

Turf Insect Fact Sheets

http://njaes.rutgers.edu/pubs/

→ Gardening and landscaping → 'Lawns' or 'All gardening and landscaping fact sheets.'

FS1007 - sod webworms

FS1008 - hairy chinch bug

FS1009 - white grubs

FS1013 - black cutworm

FS1014 – nematodes (plant-parasitic)

FS1015 - billbugs

FS1016 - annual bluegrass weevil (Hyperodes)

FS013 - ants

FS0025 - moles