IPM IS KNOWLEDGE

IPM Is Cost Effective, Environmentally Safe, and Benefits Everyone

What is the question we don’t ask first?

What is a degree day, what does it mean, and how do we determine how many degree days have occurred?

What was the mode of action for the older chemistries and what was the problem with it?

Compare/contrast new insecticides with older ones
Why doesn’t throwing money at a problem always solve it?

How can a knowledge of the activity of a previous life stage, such as the adult, help you manage the damaging larval stage?

Discuss the Desert Mountain problem and solution

How has the more narrow spectrum of control of today’s modern insecticides impacted the turfgrass ecosystem and the issues we face in turf pest management?

Which do you think is the easiest to manage….surface feeding or soil insect pests?
Cutworm Damage

Black cutworm
Agrotis ipsilon (Hufnagel)

Cutworms feed at night

BCW Life Cycle
- Overwinters as a pupa in soil
- Adults emerge from Mid-March to May
- Lay ~1200 eggs on tips of grass
- 6 to 7 larval instars then pupate
- Can have 4 or 5 generations
Black Cutworm Moth

Soapy water flush: 1oz (30ml) of Joy in 2 gal of water

Pheromone traps for adults

Eggs are laid on tips of grass blades

- Mowing removes 80-90% of eggs!
- More than half the eggs on clippings survived to hatch!

Larvae were tracked crawling as far as 70 feet in a single night!!

Managing cutworms

- Dispose of clippings well away from putting greens and tees
- Treat 20' buffer zone around greens to control reservoir population
- Pyrethroids (e.g., DeltaGard, Tempo, Scimitar, TalstarOne) provide excellent (>90%) control
- Use spray, not granules, withhold watering overnight

Microbial control of the Black cutworm (Agrotis ipsilon) in turfgrass using a naturally occurring baculovirus
Black Necrotic Spots

Cutworm having a really bad day

Agrotis ipsilon multicapsid nucleopolyhedrosis virus (AgipMNPV)

Prospects for Golf Courses

> Reside in thatch layer
> Frequent irrigation and mowing
> Aerification

Baculoviruses good for biocontrol....

> Not harmful to vertebrates or plants
> Narrow host range
> Highly pathogenic
> Have occlusion bodies
> Can be used in conventional spray equipment

Baculovirus Mode of Action

Infection Phase

Terminal Phase

Replication
Virus Field Test 2003

1. High rate
2. High rate + irrigation
3. Low rate
4. Control: (distilled water)

F = 4.09; df = 4, 18; P < 0.2

What is the speed of kill?

AgpMNVP Field Trial 2003

Mortality from virus (%)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>Low</th>
<th>High</th>
<th>High + Irr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>0</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Are different instars equally susceptible to virus infection?

Observations indicate that virus infection may delay development in early instar larvae
**Instar Susceptibility**

- 1st instar: \( F = 24.36, \text{df} = 5, 20; P < 0.0001 \)
- 3rd instar: \( F = 34.90, \text{df} = 5, 20; P < 0.0001 \)
- 5th instar: \( F = 7.37, \text{df} = 5, 20; P < 0.001 \)

**Will virus infection stop caterpillar feeding?**

**Reduction in Feeding Results**

- Two-sample T Test: \( P < 0.002 \)

**How easily can AgiMNPV be transmitted from dead to healthy larvae?**

- 0, 1, 3, or 6 dead larvae added to turf cores
- Left for 4 days
- 20 healthy larvae added to each core

**AgiMNPV Horizontal Transmission**

- Control, 1 Larva, 3 Larva, 6 Larva
- \( F = 13.0, \text{df} = 3, 12; P < 0.01 \)
AgipMNPV Field Trial 2004

Houston Oaks GC
Paris, KY

**Conclusions**

Crude virus formulations give adequate control

Takes 1wk for larvae to die

Does not provide sufficient reduction in feeding

Inoculate for prolonged suppression

**How long will virus provide control?**

- Spray plots at 21d, 14d, 7d, 1d
- Implant rings all on same day
- Let caterpillars feed for 6 days

**Cutworms Move in From Edge of Green**
CUTWORM, ARMYWORM

<table>
<thead>
<tr>
<th>Insecticide and Formulation</th>
<th>Amt Per 1000 sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthene, T, T&amp;O</td>
<td>1.2 to 2.4 oz.</td>
</tr>
<tr>
<td>Turplex</td>
<td>see label</td>
</tr>
<tr>
<td>Talstar, F, GC G form also available</td>
<td>0.18 to 0.25 fl oz.</td>
</tr>
<tr>
<td>Sevin 80 WSP and baits</td>
<td>0.75 to 1.5 oz.</td>
</tr>
<tr>
<td>Dursban 4, 2 ES, 90 WP, Pro</td>
<td>1 ½ fl oz</td>
</tr>
<tr>
<td>Deltagard G</td>
<td>see label</td>
</tr>
<tr>
<td>entomogenous nematodes</td>
<td></td>
</tr>
<tr>
<td>Mach 2 3 SC, 1.5 G</td>
<td>1.5 fl oz and 1 lb.</td>
</tr>
<tr>
<td>Scimitar WP, CS, GC, Battle</td>
<td>3.4 – 7 ml /1000 Sq. ft</td>
</tr>
<tr>
<td>Conserve SC</td>
<td>0.25 to 1.25 fl oz.</td>
</tr>
<tr>
<td>Proxol or Dylox 80 SP</td>
<td>1.5 to 3 oz</td>
</tr>
</tbody>
</table>

Black Cutworm

Minimum Development Threshold - 50°F
Begin Degree Day Accumulation - First Significant Moth Flight

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Degree Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg Hatch</td>
<td>Light Leaf</td>
<td>90</td>
</tr>
<tr>
<td>1st - 2nd Instar</td>
<td>Feeding</td>
<td>91 - 311</td>
</tr>
<tr>
<td>3rd Instar</td>
<td>Feeding</td>
<td>312 - 364</td>
</tr>
<tr>
<td>5th Instar</td>
<td>Feeding</td>
<td>365 - 430</td>
</tr>
<tr>
<td>6th Instar</td>
<td>Feeding</td>
<td>431 - 640</td>
</tr>
<tr>
<td>Pupa - Adult</td>
<td>Cutting Stops</td>
<td>641 - 989</td>
</tr>
</tbody>
</table>

Fall Armyworm Eggs on Leaf of Ornamental Plant, Not Turf

Fall Armyworm Moth

Fall Armyworm

Larvae feed for 28 days
Fall Armyworm Pupa In Soil

Fall Armyworm Damage

5 - 10 Larvae / Sq. Yd.

Fall Armyworm Pupae Under Sod

Armyworm Damage Starting At House

Armyworms on the March
Armyworms
- Rapid invasion/sharp line
- Hide only when large
- Often found near lights
- Watch for birds
- Use soapy water
- New turf areas/edge effect
- Chewed leaves

Traps Cannot Predict Outbreaks

Don’t mow or Irrigate for 24 hours

FALL ARMYWORM

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<tr>
<td>Dursban Pro</td>
<td>1 ½ fl oz</td>
</tr>
<tr>
<td>Talstar, Tempo, Scimitar,</td>
<td>0.18 – 2.5 fl oz</td>
</tr>
<tr>
<td>Deltagard, Battle</td>
<td></td>
</tr>
</tbody>
</table>
Most Severe in Newly-Sprigged, Sodded, or Seeded Areas

Deltagard G
Dursban 4 E, 2 E, 5 G, ProSevin 80 WSP
Talstar F, GC form also available
DiPel Turplex
Orthene, T, T&O
Conserve SC
Proxol, Dylox 80 SP

Sod Webworm

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<tr>
<td>Orthene, T &amp; O</td>
<td>0.5 to 1 oz</td>
</tr>
<tr>
<td>Turplex</td>
<td>0.5 fl oz</td>
</tr>
<tr>
<td>Talstar F, GC form also available</td>
<td>0.18 to 0.25 fl oz</td>
</tr>
<tr>
<td>Sevin 80 WSP</td>
<td>2.5 to 3 oz</td>
</tr>
<tr>
<td>Dursban 4 E, 2 E, 5 G, Pro</td>
<td>1 1/2 fl oz</td>
</tr>
<tr>
<td>Deltagard G</td>
<td>2 to 3 lb/1000 ft</td>
</tr>
<tr>
<td>Scimitar WP and (CS, GC)</td>
<td>3 – 6 gm and 3.4 – 7 ml</td>
</tr>
<tr>
<td>DiPel</td>
<td>1 to 2 lb/A</td>
</tr>
<tr>
<td>Conserve SC</td>
<td>0.25 to 1.25 fl oz</td>
</tr>
<tr>
<td>Proxol, Dylox 80 SP</td>
<td>1.5 to 3 oz</td>
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Chinch Bug Damage to St. Augustinegrass
Southern Chinch Bug

Resistance to southern chinch bugs in St. Augustinegrass

Floratam
Floralawn
FX 33
FX 13

Bermudagrass Mite Damage

Bermudagrass Mites Are Almost Microscopic

Management Strategies

- Cultural Practices
  irrigation, fertility
- Physical Control
  mowing, irrigation
- Chemical Control
  dicofol (kelthane)
Billbug Infestation

Billbug facts?
- Overwinter in all stages
- Multiple generations per year
- Attacks all species of turfgrass
- Probably more troublesome than we realize
- Adult activity picks up in March/April
- Lots of adult activity in the fall
- Damage first appears as yellow spots
**How Do We Control?**

- Control Adults or Grubs?
- Control Both?
- Treat in Spring?
- Treat in Fall?
- Split Applications

**Billbug**

<table>
<thead>
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<th>Insecticide and Formulation</th>
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<td>Talstar F, GC G form also available</td>
<td>0.25 to 0.5 fl oz</td>
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<tr>
<td>Dursban 50 WSP Pro</td>
<td>1 ½ fl oz</td>
</tr>
<tr>
<td>Deltagard G</td>
<td>2 to 3 lb/1000 ft</td>
</tr>
<tr>
<td>Merit 75 WSP</td>
<td>6.4 oz / acre</td>
</tr>
<tr>
<td>Scimitar WP, C5, GC and Battle</td>
<td>6 gm/1000 sq ft</td>
</tr>
</tbody>
</table>