Cockroach IPM in schools

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What are cockroaches?

- Insects in the Order Blattodea
  - gradual metamorphosis
  - flattened bodies
  - long antennae
  - shield-like pronotum covers head
  - spiny legs
- Over 3500 species worldwide
- 5 to 8 commensal pest species
Medical Importance of Cockroaches

- Vectors of disease pathogens
  - Food poisoning
  - Wound infection
  - Respiratory infection
  - Dysentery
- Allergens
  - a leading asthma trigger among inner city youth
Health issues

- Carriers of disease pathogens
  - Mycobacteria, *Staphylococcus, Enterobacter, Klebsiella, Citrobacter, Providencia, Pseudomonas, Acinetobacter, Flavobacter*
- Key focus of health inspectors looking for potential contaminants and filth in food handling areas
Cockroaches are Everywhere

- No school is immune
  - Shipments
  - Visitors
  - Students
Cockroach allergies

- 37% of inner-city children allergic to cockroaches (National Cooperative Inner-City Asthma Study)
- Increased incidence of asthma, missed school, hospitalization
- perennial allergic rhinitis
Not all cockroaches are created equal
Four major species of cockroaches

- German cockroach
- American cockroach
- Oriental cockroach
- Smoky brown cockroach
- Others
  - Turkestan cockroach
  - brown-banded cockroach
  - woods cockroach
German cockroach, *Blatella germanica*
German cockroach life cycle

10 days
Egg case

30 days
Nymphal hatch

6 nymphal instars in 60 days

from Ross & Mullins 1995
German cockroach

- $\frac{1}{2}$ to $\frac{5}{8}$” long (13-16 mm)
- High reproductive rate
  - 30-40 eggs/ootheca
  - 2 months from egg to adult
- Do not fly
- Found indoors in warm, moist areas in kitchens and bathrooms
German cockroach nymphs

- 5-6 molts to reach adulthood
- early instars remain close to crevices
- feed on feces of older cockroaches (coprophagy)
German cockroach habitat areas
German vs Asian cockroach

- Similar in appearance to the German cockroach, microscopic differences.
- Only 2 months from egg to adult
- Adult's fly
- Found outdoors in leaf litter and attracted to lights at night
Brown-banded cockroach, *Supella longipalpa*

- 1/2” long (11-14 mm)
- Moderate reproductive rate
  - 3-9 months from egg to adult
  - 14-18 eggs per ootheca
- Female glues egg capsule to ceilings, beneath furniture
- Adults do not fly
- Found indoors throughout house, esp. warmer sites
Cockroach family Blattidae

- *Blatta orientalis* -- Oriental cockroach
- *Shelfordella (=Blatta) lateralis* – Turkestan cockroach
- *Periplaneta americana* -- American cockroach
- *Periplaneta australasiae* -- Australian cockroach
- *Periplaneta brunnea* -- Brown cockroach
- *Periplaneta fuliginosa* -- Smokybrown cockroach
Smokybrown Cockroach
Smoky-brown cockroach, *Periplaneta fuliginosa*

- 1 ¾” long, uniform dark brown (white banding in 1st instar nymph)
- Slow reproduction
  - 20-28 eggs/ootheca
  - 12 months from egg to adult
- Principally outdoor habitats
  - woodpiles, trees, attics and soffits
Oriental Cockroach
Oriental cockroach, *Blatta orientalis*

- 1 ¼” long
- Dark red brown to black, short wings
- Slower reproduction
  - 16 eggs/ootheca
  - 1-2 years from egg to adult
- Cooler sites close to ground
  - Water meter boxes
  - Sewers
  - Crawl spaces
American cockroach

*Periplaneta americana*
American Cockroach

- 1 ¾” long, reddish brown with pale edge on pronotum
  - Slower reproduction
    - 14 eggs/ootheca
    - 9-24 months from egg to adult
  - Sewers, basements, furnace rooms, attics.
  - Strong flier
Turkestan cockroach

- 1.2 inches-long
- Sexually dimorphic
  - Males reddish brown with crème-colored wing bar and incomplete ring around pronotum
  - Females blackish with crème-colored wing bar, vestigial wings
- Emerging pest, mostly SW US, competes with Oriental cockroach
cockroach harborage sites
Most Common Breeding Sites for Cockroaches

• German: Kitchen & Bathroom
• Asian: Outdoor leaf litter
• Brown banded: Throughout structure
• Oriental: Basements
• American: Sewers, wall voids, attics, mechanical rooms
• Smoky-brown: Tree holes and palm trees
Behavioral and Physiological Traits

- Avoidance of light and air movement
- Grooming
- Aggregation
- Prefer high humidity
- Cockroaches are “Cryptobiotic”
  - 67% of cockroaches gathered in 4.8 mm space
What signs to look for when inspecting for roaches
What can glue boards tell you

[Image of glue boards with insects]
Roach staining – extreme conditions
Staining on ceiling and light fixture
Non-Chemical Control Measures
Water Sewer Lined with Water
Sewage Line when Dried Out Over Time
Anatomy of a Drain

Organic material deposited inside wells

Flow of water

Floor level

Side well
Simple practices = Large Benefits
Roaches can be flushed out with a heat source.
Roaches can be vacuumed up
Sanitation matters in IPM

- Survival Triangle
- Vacuuming, sticky traps, bait, equally effective in controlling German cockroach populations
- Use of a flushing agent before vacuuming increased population reduction and removal of hard-to-reach gravid females
Building Features and Employee Practices

- Movement of pests can be done without staff knowing they are part of the problem.
- Education is equally important in an IPM program.
Effective control measures

- Caulk and seal harborages
- Eliminate, reduce, separate water and food resources
- Bait and dust harborage areas identified by sticky traps
- Apply residual sprays to harborages
Cockroach control: Baiting

• Contain a slow-acting insecticide combined with a food attractant.

• Roaches find and ingest the bait and crawl away to die.

• Non-exposed roaches may succumb as well after indirectly ingesting trace amounts of toxicant expelled in the sputum and feces of exposed individuals.
How baits work

- Mortality, premature egg case drop, lower hatch rate
- Necophagy (consumption of dead)
- Coprophagy (consumption of feces)
Key to success with baits is proper placement

- German cockroaches include under/around sinks and toilets; behind refrigerators, dishwashers, and stoves; near trash containers; and inside cabinets and storage areas
- Ready-to-use plastic bait stations are convenient, gel-type baits applied with a syringe often are more versatile and efficient.
- Syringe makes it possible to inject many small pea-sized dabs of bait into cracks, corners, edges and other places where roaches reside.
- Cockroaches are not drawn to baits from long distances; they come upon them during their foraging activities.
  - More dabs of bait put out, the more likely they are to be found and eaten. More than a dozen placements alone may be necessary to treat corners and edges in cabinets under a kitchen sink
How to apply baits

• Use in or near all suspected harborages
• Many small placements better than a few large placements
• Consider use of straws, temporary stations to place baits
• Must be out of reach of people, children
• Don’t skimp on quantity
• Store properly
Aerosol sprays

- “fumigation”
- ULV best for penetration into voids
- Often highly repellent to cockroaches
- Supplement to residual sprays, dusts only
Liquid residual sprays

- Three main types
  - Broadcast
  - Spot
  - Crack & crevice
- Baseboard sprays ineffective for German cockroach
- Repellent types less effective
  - Pyrethroids
  - Carbamates (propoxur)
Dusts

• Technical insecticide sprayed on dust base
• Allows penetration into voids and cracks
• Easily picked up on insect cuticle, transferred to aggregation partners
• Problems?
• Cyfluthrin, deltamethrin, boric acid, silica aerogel
Dusts ingested through grooming
Insect growth regulators

• Disrupt growth process through mimicking of natural hormones
  • Pyriproxifen (Nylar®, Archer®)
  • Hydroprene (Gencor®, PointSource®)
Cockroach coping strategies

- Avoid spray residues (repellency)
- Physiological resistance
- Behavioral resistance
  - Distaste for bait attractants
  - Bait avoidance
Cockroach resistance to baits
How to deal with resistance

- Behavioral resistance: Switch bait attractants
  - Bait station
  - Gel baits
  - powders
- Insecticide resistance: Switch active ingredients
  - Rotation must be among different chemical classes
- International Resistance Action Committee provides listing of chemical classes of insecticides
  http://www.irac-online.org/modes-of-action/
IRAC mode of action chart
http://www.irac-online.org
# Current cockroach baits

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Active ingredient</th>
<th>Type</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advion Roach Bait Gel</td>
<td>Indoxacarb 0.6%</td>
<td>Gel</td>
<td>22A oxadiazines</td>
</tr>
<tr>
<td>Advion Bait Arena</td>
<td>Indoxacarb 0.5%</td>
<td>Station</td>
<td>22A oxadiazines</td>
</tr>
<tr>
<td>Avert® Dry Flowable</td>
<td>Abamectin B1 0.05%</td>
<td>Powder</td>
<td>6 avermectins</td>
</tr>
<tr>
<td>Avert® Cockroach Gel Bait</td>
<td>Abamectin B1 0.05%</td>
<td>Gel</td>
<td>6 avermectins</td>
</tr>
<tr>
<td>Alpine</td>
<td>Dinotefuran</td>
<td>Gel</td>
<td>4A neonicotinoids</td>
</tr>
<tr>
<td>Maxforce FC Magnum</td>
<td>Fipronil</td>
<td>Gel</td>
<td>2B phenylpyrazoles</td>
</tr>
<tr>
<td>Invict Gold</td>
<td>Imidaclorpid 2.15%</td>
<td>Gel</td>
<td>4A neonicotinoids</td>
</tr>
<tr>
<td>Vendetta® Plus</td>
<td>Abamectin 0.05% + pyriproxyfen 0.5%</td>
<td>Gel</td>
<td>6 avermectins + 7C pyriproxyfen</td>
</tr>
<tr>
<td>Combat®</td>
<td>Hydramethylnon 2%</td>
<td>Station</td>
<td>20A hydramethylnon</td>
</tr>
<tr>
<td>Advance®</td>
<td>Dinotefuran</td>
<td>Station</td>
<td>4A neonicotinoids</td>
</tr>
<tr>
<td>Advance® Cockroach Gel bait</td>
<td>Dinotefuran 0.5%</td>
<td>Gel</td>
<td>4A neonicotinoids</td>
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</table>
Rotate baits every 3-6 months
Successful IPM strategies for cockroach control

- Sanitation (reduce food and water)
- Harborage reduction
- Multiple control tactics
  - IGRs
  - Residual insecticides
  - Use of multiple bait formulations at adequate density (4-5 stations per 100 ft²)
  - dusts
  - Trapping?
- Effective monitoring/identification of harborages
Tips for insecticide use against cockroaches

- Immature cockroaches tend to stay close to harborage
  - Good inspection will reveal harborage areas
  - Apply near or in harborage areas

- Avoid drips, spray-back, drift
  - Clean up excess
  - Use crack and crevice tips

- Read and follow label directions

- Choose the right formulation for the surface to be treated
No substitute for hard work
# Inspections and thresholds

<table>
<thead>
<tr>
<th>Ave. # cockroaches per zone</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>1-2</td>
<td>Bait stations; check sanitation</td>
</tr>
<tr>
<td>3-6</td>
<td>Spot treat c&amp;c; add or replace baits; review sanitation</td>
</tr>
<tr>
<td>7-15</td>
<td>Thorough bait and c&amp;c application; revisit in two weeks</td>
</tr>
<tr>
<td>15+</td>
<td>Close facility; conduct thorough c&amp;c inspection and sanitation improvement;</td>
</tr>
</tbody>
</table>
For more information or to share