Pesticides and Animal Health

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Outline

- Flea biology
- Flea associated diseases in animals & humans
- Flea control products
- Flea control strategy
Flea Life Cycle

- *Ctenocephalides* spp. are of greatest medical concern
- *C. felis felis* most common species
  - >92% in dogs
  - > 97% in cats
- *Pulex irritans*
  - Human flea
Flea Life Cycle

- Adult flea
- Eggs (95%)
- Larvae
- Cocoon (5%)
Flea Life Cycle

- In most households *C. felis felis* takes 3-4 weeks to complete its cycle
- Extremes of 12-174 days have been recorded
Flea Life Cycle

- Adult flea begins feeding within minutes of landing on host
- Female flea begins egg production 24-36 hours after first blood meal
- Reproduction will continue for over 100 days
- Peaks of 40-50 eggs per day
Flea Life Cycle

- Under environmental conditions that allow for 21 days life cycle:
  - One mating female flea who lays 20 eggs per day, 50% of which hatch females, can be responsible for an infestation of > 20,000 adults and more than 160,000 pre-adult forms in just 60 days
Outline

- Flea biology
- **FLEA ASSOCIATED DISEASES IN ANIMALS & HUMANS**
- Flea control products
- Flea control strategy
Flea & Animal diseases - Flea Allergy Dermatitis
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Flea Allergy Dermatitis
Flea & Animal diseases - Flea Allergy Dermatitis
Flea & Animal diseases - Iron deficiency anemia
Flea & Animal diseases

- *Dipylidium caninum* (tapeworm)
Flea & Human diseases

- Flea allergy dermatitis (FAD)
Flea & Human diseases

- Cat-scratch disease (*Bartonella henselae*)
Cat Scratch Disease (CSD)

- *B. henselae*, gram negative bacterium
- Cats are inapparent carriers
- *C. felis* is the primary arthropod vector
- Fleas acquire infection when taking a bloodmeal from a bacteremic animal
- They then shed the infectious organisms in their feces
Cat Scratch Disease (CSD)

- Bacteria are transmitted between animals and from animals and humans by inoculation with contaminated flea feces
  - Via an open wound, such as a scratch or bite
- First noticed as erythema or pustule at the site of the scratch, or bite
  - Occurs 7-10 days following exposure
Cat Scratch Disease (CSD)

- Patient may also experience a fever and mild headache
- Common feature is regional lymphadenopathy, which may last several months
- Atypical symptoms include encephalitis, retinitis and endocarditis
Cat Scratch Disease (CSD)

- Immunocompromised patients
  - Typically present with systemic bartonellosis
  - Manifests as bacillary angiomatosis (growth of blood vessels on external skin surface) and bacillary parenchymal peliosis (hepatitis)

- Veterinary professionals
  - 7.1% are seropositive for *Bartonella* spp.
Flea & Human diseases

- Murine typhus (*R. typhi*)
Murine typhus

- *Rickettsia typhi*, Gram-negative bacterium
- Maintained primarily in rodent reservoirs
- Transmitted to humans through an intermediate flea vector
  - Most commonly the rat flea (*Xenoplyylla cheopis*)
  - Alternate transmission cycles involve opposums, domestic cats and cat fleas
Murine typhus

- *Rickettsia felis*
  - Thought to be cause of human illness clinically similar to murine typhus
  - May circulate among opossums and cats in concert with *R. typhi*
  - *C. felis felis* is considered to be the primary vector and reservoir
Murine typhus

- Infected fleas pass the organism to progeny through transovarial transmission
- Cats serve as mechanical vehicle and bloodmeal source to support flea population
- Little documentation of cats developing clinical illness associated with infection
Murine typhus

- Probably cause human infection following inoculation of abraded skin with infectious flea feces.
- Accumulation of infectious flea feces within rodent nests increase risk of inhalation routes of exposure to *R. typhis*.
Murine typhus

- Fever, headache, chills, malaise
- Onset typically 6-14 days after exposure to reservoir animals and fleas
- Maculopapular rash develops in > 50%
- Respiratory, gastrointestinal and neurologic involvement common
- *R. felis* cases report similar presentation
Flea & Human diseases

- Plague (*Yersenia pestis*)

Plague

- *Yersinia pestis*, G-negative coccobacillus
- Endemic in the western USA, Asia, Africa and South America
- Circulates in US primarily among rock squirrels, ground squirrels, chipmunks and other wild rodents
Plague

- Rodent fleas are the principal means of transmission among rodents and to humans
- Humans may also become infected through exposure to tissues, secretions or respiratory droplets of infected animals
Plague

- Fleas become infected after feeding on mammal host harboring bacteria
- Rodents become infected when bitten by infected fleas
- Cats become infected by flea bites or by consumption of infected rodents
Plague

- Cats are highly susceptible to plague
  - Can transmit infection directly to humans via scratches, bites and respiratory secretions
  - Can indirectly contribute to human infection by transporting infected fleas or rodent carcasses into the home
Plague

- Life-threatening illness
- Bubonic plague most common presentation
  - Results from cutaneous exposure
  - Presents as painful, severely inflamed lymph nodes, known as a bubo
  - Fever, headache, extreme exhaustion
  - Clinical signs seen within 2-10 days of exposure
Plague

- Without prompt antibiotic therapy, infection will spread via bloodstream to lungs
  - May then spread person-to-person through respiratory droplets
- Primary or secondary pneumonic plaque is fatal within 3-4 days without appropriate treatment
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- Flea biology
- Flea associated diseases in animals & humans
- FLEA CONTROL PRODUCTS
- Flea control strategy
Flea Control Products

- **Mechanism of action**
  - Acetylcholine receptor agonist
  - Na+ channel modulator
  - Cl- channel modulator
  - GABA inhibitors
  - Insect growth regulators

- **Method of administration**
  - Topical (monthly)
  - Oral (daily, monthly)
Mechanism of action

Acetylcholine Receptor Agonist (nAchR)
Mechanism of action - Acetylcholine Receptor Agonist

- Imidacloprid
- Dinotefuran
- Nitenpyram
- Spinosad
Mechanism of action

Na+ channel Modulator

Nerve Potential Propagation
Mechanism of action - Na+ channel Modulator
Permethrin
Mechanism of action
Cl- channel Modulator - SEL
Mechanism of action - Cl-channel Modulator

Selamectin
Mechanism of action

Gama amino-butyric acid (GABA) inhibitor
Mechanism of action - GABA inhibitor

Fipronil
Flea Control Products-Insect Growth Regulators (IGRs)

1. Methoprene
2. Pyriproxifen
3. Lufenuron

{ Juvenile Hormone Analogue }
Flea Control Products - Juvenile Hormone Analogues
Outline

- Flea biology
- Flea associated diseases in animals & humans
- Flea control products

**FLEA CONTROL STRATEGY**
Flea Control Strategy

- Treat ALL animals
- Maintain prevention throughout the year
- During peak season, may increase frequency to q2-3 weeks
- Alternate between products with different mode of action
- TREAT THE ENVIRONMENT
Flea Life Cycle

- Adult flea
- Eggs: 95%
- Larvae: 5%
- Cocoon
Mechanism of action - 
Acetylcholine Receptor Agonist

- Imidacloprid
- Dinotefuran
- Nitenpyram
- Spinosad
Mechanism of action - GABA inhibitor

Fipronil
Conclusion

- Flea infestation: common problem in pets
- Causes FAD, anemia and vector for animal & human diseases
- Many flea control products with different mode of action
- Need to treat both pet and environment
Thank you

- Dr. Ben Tham
- Dermatology colleagues