Bugs that Bite: Vector Arthropods and How to Avoid Them

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Women in Ag Webinar

*Some slide from Dr. Michael J. Raupp
Why talk about vector arthropods?

- Nuisance
- Vectors for disease
  - Humans, Pets & Livestock
  - Money & Time
    - > $712 million year
- In the News
  - Disease
  - Insecticide control having non-target effects
- Ecosystem
  - Food
  - Population control
Talk outline

• Mosquito
  • Biology
  • Prevention
  • Disease

• Tick
  • Biology
  • Prevention
  • ID
  • Disease
Mosquitoes

• >180 Species in USA
• 89 Found in Mid-Atlantic Region (PA-GA)
• Type of Fly
• Wide variety of
  • Habitats
  • Feeding hosts
  • Flight range
    • 200 yards - 20 miles
Mosquito Biology: Life Cycle

- 4 to 14 days depending on temperature
- Overwinter as either adults or eggs
- Lay 300+ eggs each blood meal
- Larva live in water
  - 1 teaspoonful
  - Stagnant pools
Mosquito Biology: Adults

• Feed on nectar
• Live up to 100 days
• Only females bite
  • Protein for egg
• Feed for up to 4 minutes
• Feeding
  • Inserts proboscis
  • Finds a blood vessel
  • Releases saliva
    • Anticoagulant, Pathogen
Preventing Mosquito Bites:

• You can’t prevent them all
• Personal Protection
  • Clothing
  • Repellents
• Reduce exposure
• Reduce population
  • Reduce breeding ground
  • Reduce adult resting area
  • Bio or Chemical Control
Mosquito: Personal Protection

- Long trousers & long sleeves
- Wear lose-fitting clothing
- Use repellents
  - DEET
  - Picaridin or Icaridin
  - Oil of lemon eucalyptus (Organic)
- Reapply according to label directions
- Put on sunscreen first
- Never under clothing
Mosquito Vapor Repellents

- Limited range
- Good for camping not daily use
  - Citronella candle
    - 5’x 5’
  - ThermaCell Mosquito Repeller
    - 15’x15’
    - Butane-powered heating element
    - Allethrin - pyrethroid
  - Off! Mosquito Lamp
    - 10’x10’
    - Metofluthrin – pyrethroid
Mosquito Repellent: The Bad

• No plants that keeps mosquitoes away
• Bug zappers
  • Kill beneficial
  • Attracts but doesn’t kill
• Mosquito traps
  • Attracts to yard
Preventing Mosquito Bites: Pets

• Disease
  • Heartworm
  • West Nile Virus
  • Myxomytosis
  • Eastern and Western equine encephalitis

• Talk with your veterinarian
• DO NOT use DEET, tea tree oil, pennyroyal, or d-limonine
  • caused weakness, paralysis, liver problems and seizures in pets

• Read the label instructions
  • Dog only or Cats only
Preventing Mosquito Bites: Farm Animals

- Talk with your veterinarian
  - Vaccines
- Fans in barns and stable
- Remove damp vegetation from barn and stable
- Reduce standing water in pasture
- Fly sheets or blanket
- Sprays and baths
- Insecticide-impregnated nets
Reduce Mosquitoes Population Using Biological Control

- Fish
  - Feed on larvae ( +100 /day )
- Insects & Spiders
  - Feed all life stages
- Bacterium
  - *Bacillus thuringiensis*
- Release of sterile males mosquitoes
How do GMO Mosquitoes Work?

- Sterile Male Method
  - 1950’s used eliminate screw-worms
  - Release of male insects carrying a lethal gene so offspring don’t survive

- GMO Mosquitoes have a new gene that makes tTAV protein
  - Not found in mosquito saliva
  - Controls its own binding site, creating a positive feedback loop
  - Ties up cells machinery prevents other genes from being expressed
  - Causes the insect death
Reduce Mosquitoes Population Using Chemical Control

- Broadband Insecticide
  - Kill beneficial insect if apply during day time
  - Provide temporarily control
    - Several hours - days
    - Break down over time, especially in rain

- Sprays Threshold
  - Landing rate - 3 mosquitoes landing on person within a 2-minute period

- Contact your State Mosquito Control Program for list suggest of pesticides and control limitations

- Oil of citronella
- Pyrethrins
  - Permethrin
  - Bifenthrin
  - Etofenprox
  - Resmethrin
  - D-phenothrin

- Organophosphate
  - Malathion

- Insect Growth Regulator
  - Pivot 10
Reduce Mosquitoes Population by Eliminate Breeding Ground

• Any water that is standing for four days can be a breeding site for mosquitoes
  • Prevent water from collecting
  • Check and remove standing or stagnant water
  • Change water in pet dish and bird baths every other day
Eliminate Breeding Ground: Preventing Puddles around Buildings

• Collect rain water
  • Rain barrels & Rain gardens
  • Drainage pipes
• DO NOT over water
• DO NOT over fertilizer
• Fill in low spots
• Maintain your Septic Tanks
Eliminate Breeding Ground: Pastures

- Prevent mud
  - Rotate pastures
  - Laying down straw
- Keep animals off the pasture when the soil is very soft.
- Change water in small animal troughs and buckets 2-3 times a week
- Large troughs (>150 gallons)
  - Mosquito dunks, pond bubbler or fish
Eliminate Breeding Ground: Field

• DO NOT over irrigate (water gone within 24 hours)
  • Reduces yields
  • Encourages weed growth
  • Decrease soil quality
• Check and fix leaking irrigation piping
• Prepare land so that slopes are uniform and drainage is good
• Remove water on plastic mulch
• Install and maintain well-designed ditches
• Keep weeds down around fields, ponds, and ditches
  • adult resting and mating areas
Mosquitoes Disease

“Damn it Jim I’m a Entomologist not a Doctor”
Mosquitoes Disease

- Chikungunya virus
- Dengue fever
- Dog heartworm
- Eastern equine encephalitis
- Malaria
- St. Louis Encephalitis
- West Nile virus
- Western equine encephalitis
- Venezuelan equine encephalitis
- Yellow Fever
- Zika Virus
Dog Heartworm

- Cause by a parasitic roundworm *Dirofilaria immitis*
- Mosquitoes intermediated host
- Dogs primary host
- Infecting the pulmonary artery
  - Decreases blood to the lungs
- Preventative measures are the best way to control
- No symptoms or signs of illness for 6-9 months
  - Cough and easily become exhaustion
  - Severe weight loss, fainting, coughing up blood
Eastern Equine Encephalitis (EEE)

• Triple E or Sleeping Sickness
• Virus
• Infects: Equine species, dogs, pigs, bats, reptiles, amphibians, rodents & Humans
• Birds are a reservoirs
• Cause severe inflammation in the brain

Go, Balasuriya & Lee. 2014
Eastern Equine Encephalitis (EEE)

- Animals signs of infection within 2-5 days
  - High fever
  - Depression and changes in behavior
  - Impaired vision
  - Muscle twitches
  - Head pressing behaviors
  - Inability to swallow
  - Paralysis and convulsions
- Survival rates of horses infected with WEE is 70-80%.
- Vaccines are available for horses.

- Humans signs of infection within 4-10 days
  - Fever
  - Chills
  - Body and joint aches
  - Headache
  - Disorientation
  - Tremors, seizures and paralysis.
Zika

- Flaviviridae virus from Zika forest of Uganda 1947
- 1970-80’s detected in India, Indonesia, Malaysia and Pakistan
- Outbreak in Pacific Island of in 2007 & French Polynesia in 2014
- 2016 Outbreaks in South American due to Asia strain
Zika in the USA

- As of April, 2017
- Total: 5,234
  - Locally acquired mosquito-borne cases reported: 223
    - Southern Florida (217)
    - Brownsville, Texas (6)
  - Travel-associated cases reported: 4,935
  - Sexually transmitted: 46
  - Guillain-Barré syndrome: 13
  - Infants born with birth defects: 38
Zika

• Transmitted
  • Mosquitoes
  • Unprotected Sex
    • Possibly >45 Days after infection
  • Blood transfusions
  • Mother-to-Baby

• Most people (80%) will have no symptoms

• Flu/cold symptoms for 5-7 days

• Associated with a raise in cases of Microcephaly and Guillain-Barré syndrome
West Nile Virus

- 60 species are known to carry
  - Asian tiger mosquito
- Between 1999 - 2014 in USA
  - 41,762 cases & 1,765 deaths
- 2,038 cases in 2016 in US
- Can lead to West Nile Encephalitis
West Nile Virus

• Birds are a reservoirs
• Infects: wide range of mammals
• Humans
  • 70-80% - do not develop any symptoms
  • 20% - flu like symptoms
  • <1% virus infects the central nervous system (encephalitis)
• Horse are susceptible to infection
  • 2016- 374 cases
  • Symptoms similar to EEE
  • Vaccine for horses
Resources:
- MDA Mosquitoes Control
- Centers for Disease Control and Prevention
- National Institutes of Health

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Ticks Biology

• Arachnids
• Obligate blood-feeders
• >90 species in USA
• 5 species of ticks found in Maryland
• Hard ticks and Soft ticks
  • All 5 in MD are hard.
• Small
  • Adult = poppy seed
Tick Life Cycle

• Life Stages
  • Egg
  • 6-legged larva
  • 8-legged nymph
  • Adult

• Multi-year life span
• Overwinter in all stages
• 3 Blood meal during life time
• Differ on number and type of host
Ticks & Winter

• Blacklegged (deer) tick adults are not killed by freezing temperatures.

• Active on days when temperatures are above freezing.

• More likely to happen if the ground is thawed and the temperature is above freezing.
  • Below freezing: takes too much energy to move their muscles
  • Above freezing: move their muscles
Tick Biology Feeding Habits

• Find host by “Questing”
  • Waiting on tips of grasses
  • Hold first pair of legs outstretched
  • When a host brushes them, they quickly climbs aboard

• NO flying or jumping or falling

• 3 part sheath and spine sword mouth

• Tick feed for 3-7 days
Tick Biology Feeding Habits

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Ticks & Disease-causing Pathogens

- Most are not born carrying disease-causing pathogens
- Infected by feed on an infected host
- Transmit the pathogen when feeding on a new host
- 36-48 Hours to transmit pathogen
Ticks & Disease-causing Pathogens

• 36-48 Hours to transmit pathogen*
  • Pathogen is in the gut
  • Moves to the bloodstream once start feeding
  • Move to into its salivary glands
  • Move in to Host

*Most Pathogens
Tick Personal Protection

• Wear long pants and long sleeves
• Tucking your shirts into pants, and your pants into socks
• Wear clothing treated with the tick repellent *permethrin*
• Check for ticks after being in tick habitat
  • Children & Pets
Tick Personal Protection

• Use DEET open skin
  • Sunscreen first
  • Never underclothing
  • DO NOT USE ON PETS
• Lint roller brush
• Shower when possible
• Throw clothes in a hot dryer for 5-10 minutes *before* washing to kill any lingering ticks that may be attached to work clothing
Tick Prevention: Around Your Home

• Removing tick habitats
  • Mowed grass
  • Remove leaf litter along forest edges
  • Avoid overwatering
  • Cedar mulch

• Restrict tick migration
  • 3-ft barrier of wood chips or gravel between lawns and wooded areas
  • Remove brush, plants and leaf litter around your home (6-inch)
  • Keep playground equipment, decks, and patios away from forest edges
  • Limit wildlife
Tick Prevention: Environmental Reduction

• Excluding Deer
  • Deer fence
  • Applying deer repellents

• Reduce rodent habitat
  • Stack wood neatly and in a dry area
  • Don’t overstock bird feeder & clean up fallen seed

• Mouse-targeted devices such as tick-tubes along forest borders.

• Pro Bio-control
  • Cats, Snakes, Bird of prey
Tick Control for Farms

- Keep weeds down around edge of fields
- Don’t plant right up to forest edge
  - 4-5 ft gap
- Ear tags or repellent on animals
- Vaccinated animals for vector diseases
- Exclude wildlife (living and dead)
  - Move dead animals out of fields
Tick Prevention: Chemical

• 2 weeks – 3 months
• Liquid or granular applications
  • Bifenthrin
    • lethal to fish
  • Permethrin
    • lethal to bees
  • 2-undecanone
  • Nootkatone (organic)
  • Diatomaceous earth
How to Remove a Tick

• Remove it as soon as possible.

• DO NOT USE
  • Vaseline, liquid soap, cotton ball or touch it with a hot match

• USE
  • Fine-tipped tweezers to grasp the tick close to your skin. Pull the tick’s body away from your skin.

• It’s ok if the tick’s head or mouthparts remain in the skin

• Stick tick on clear tape and place in freeze
Tick ID

ID using Scutum

- **Female Ixodes scapularis** (Blacklegged tick or Deer tick)
- **Female Amblyomma americanum** (Lone Star tick)
- **Female Rhipicephalus sanguineus** (Brown Dog tick)
- **Female Dermacentor variabilis** (American Dog tick)
<table>
<thead>
<tr>
<th>Species</th>
<th>Transmitted Diseases</th>
<th>Scutum Pattern</th>
<th>Larval, Nymph, Adult Male and Adult Female (Not to scale)</th>
<th>When it’s Active</th>
<th>Habitat</th>
</tr>
</thead>
</table>
| American dog tick                   | - Rocky Mountain spotted fever  
- Tularemia  
- Tick paralysis                        | ![Image]        | ![Image]                                                      | Adults: April- early August  
Nymphs: May - July  
Larvae: April - September           | Found in areas with little or no tree cover. |
| Black-legged tick or Deer Tick      | - Lyme disease  
- Anaplasmosis  
- Babesiosis  
- Powassan disease                         | ![Image]        | ![Image]                                                      | Adults: all year  
Nymphs: May-August  
Larvae: July-September              | Mostly found in deciduous forest.  
Distribution relies greatly on that of its reproductive host (white-tailed deer) |
| Brown dog tick                      | - Rocky Mountain spotted fever  
- Canine ehrlichiosis  
- Canine babesiosis                          | ![Image]        | ![Image]                                                      | Adults: all year  
Nymphs: all year  
Larvae: all year                  | Prefer to feed on dogs.  
Sometimes found in homes.          |
| Lone star tick                      | - Human ehrlichiosis  
- Tularemia  
- Southern tick-associated rash illness  
- Meat allergy                               | ![Image]        | ![Image]                                                      | Adults: April- late August  
Nymphs: May- early August  
Larvae: July- late September        | Found mostly in woodlands with dense undergrowth and around animal resting areas. |
| Gulf Coast tick                     | - *Rickettsia parkeri* spotted fever                                            | ![Image]        | ![Image]                                                      | N/A                                    | Found in grass prairies and coastal uplands.  
Not very common in Maryland. |

Pictures and information from University of Rhode Island Tick Encounter Resource Center (http://www.tickencounter.org/) and University of Florida (http://entnemdept.ufl.edu)
Tick Diseases

“Damn it Jim I’m a Entomologist not a Doctor”
Common Tick Vector Diseases in the United States

- Lyme
- Rocky Mountain spotted fever
- Tick paralysis
- Meat allergy
- Babesiosis
- Southern tick-associated rash illness
- Anaplasmosis
- Tularemia
- Powassan disease (virus)
- Tick-borne relapsing fever
- Canine ehrlichiosis & Canine babesiosis
Tick Paralysis

• Caused by a neurotoxin produced by a female tick
  • Feeding 5-7 days
  • Affects the nervous system

• Humans (children), Dogs, Cats, Livestock

• Once the tick is removed, symptoms usually diminish rapidly

• Symptoms develop within 2–7 days
Lyme Disease

• Multi-systemic disease
• Caused by bacterium *Borrelia burgdorferi*
• Most widespread vector-borne disease in the USA
  • 20,000-30,000 people diagnosed per year in US
• Vectored by the black-legged tick and western black-legged tick.
Lyme Disease Symptoms

• 30-50% of people don’t get the Bull’s eye rash
• After initial infection, it does not appear to circulate in the blood
• Pathogen found in many tissues and organs including the skin, joints, heart, brain, bladder and other sites
Post-treatment Lyme Syndrome (PTLS)

- Lingering symptoms of fatigue, pain, or joint and muscle aches at the time they finish treatment.
- > 6 months
- Result of residual damage to tissues and the immune system that occurred during the infection
- Treat the symptoms using the best tools available
Rocky Mountain Spotted Fever

- Bacteria: *Rickettesia rickettsia*
- American Dog tick and Brown Dog tick
- Rare in MD
- Symptoms 2-14 days
  - Fatal is not treated
  - Infects the lining of blood vessels
    - Bleeding and clotting in the brain
- Treated with antibiotics

**Symptoms**
- Fever
- Rash (small pink dot on arms and legs)
- Nausea
- Vomiting
- Headache
- Abdominal pain
- Muscle pain
Babesiosis

- Protozoan - *Babesia*
- Black-legged/ Deer Tick
- Parasitize red blood cell
- More common in domesticated animal than humans
- Symptoms within 1-6 weeks
- Last week to months
- Treated with Medication

**Symptoms**
- Fever
- Fatigue
- Chills
- Nausea
- Vomiting
- Headache
- Reduced Appetite
- Depression
- Enlarger liver and spleen
Resources:

- University of Rhode Island Tick Encounter Resource Center (http://www.tickencounter.org/)
- Centers for Disease Control and Prevention
- National Institutes of Health
- The Connecticut Agricultural Experiment Station
Meat Allergy

• Lone Star Tick
• Allergy to mammal meat
  • Beef, pork, lamb, goat, whale and seal
• Your body see meat as a threat, causes an immune response
• No treatment

Symptoms
• Hive or Rash
• Diarrhea
• Nausea
• Stomach cramps
• Vomiting
• Headache
• Stuffy nose
• Anaphylaxis
Tularemia

• Caused by the bacterium *Francisella tularensis*

• Animals and humans
  • Rabbits, hares, and rodents

• Tick or butchering or touching an infected animal

• Treated successfully with antibiotics, can be life-threatening is not treated

Symptoms

• Skin ulcer at the bite site
• Swelling of regional lymph glands
Gulf Coast Tick

- Found in grass prairies and coastal uplands
- Not very common in Maryland
- Disease Transmits:
  - *Rickettsia parkeri* spotted fever
Brown Dog Tick

• Prefer to feed on dogs but will occasionally feed on humans

• Active
  • Adults: all year
  • Nymphs: all year
  • Larvae: all year

• Disease Transmits:
  • Rocky Mountain spotted fever
  • Canine ehrlichiosis
  • Canine babesiosis
American Dog Tick/ Wood Tick

- Found in areas with little or no tree cover
- Active
  - Adult: April – Early August
  - Nymphs: May-July
  - Larvae: April- September
- Disease Transmits:
  - Rocky Mountain spotted fever
  - Tularemia
  - Tick paralysis
Lone Star Tick

• Found mostly in woodlands with dense undergrowth and around animal resting areas

• Active
  • Adults: April- late August
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• Disease Transmits:
  • Human ehrlichiosis
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  • Southern tick-associated rash illness
  • Meat allergy
Black-legged Tick / Deer Tick

- Mostly found in deciduous forest
- Distribution relies greatly on the distribution of its reproductive host, white-tailed deer.
- Active
  - Adults: all year
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- Disease Transmits:
  - Lyme disease
  - Anaplasmosis
  - Babesiosis
  - Powassan disease
Lyme Disease Host

• Black-legged Tick - Vector
  • Nymph stage
• White footed mouse – Disease reservoir
  • Larval tick preferred host
• Deer - Adult host
  • Tick populations are much lower in the absence of deer