Internal Parasites of Arkansas Small Ruminants

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Agenda

- Who the parasites are
- Drug Overview
- Why parasite control is important
- Mitigation

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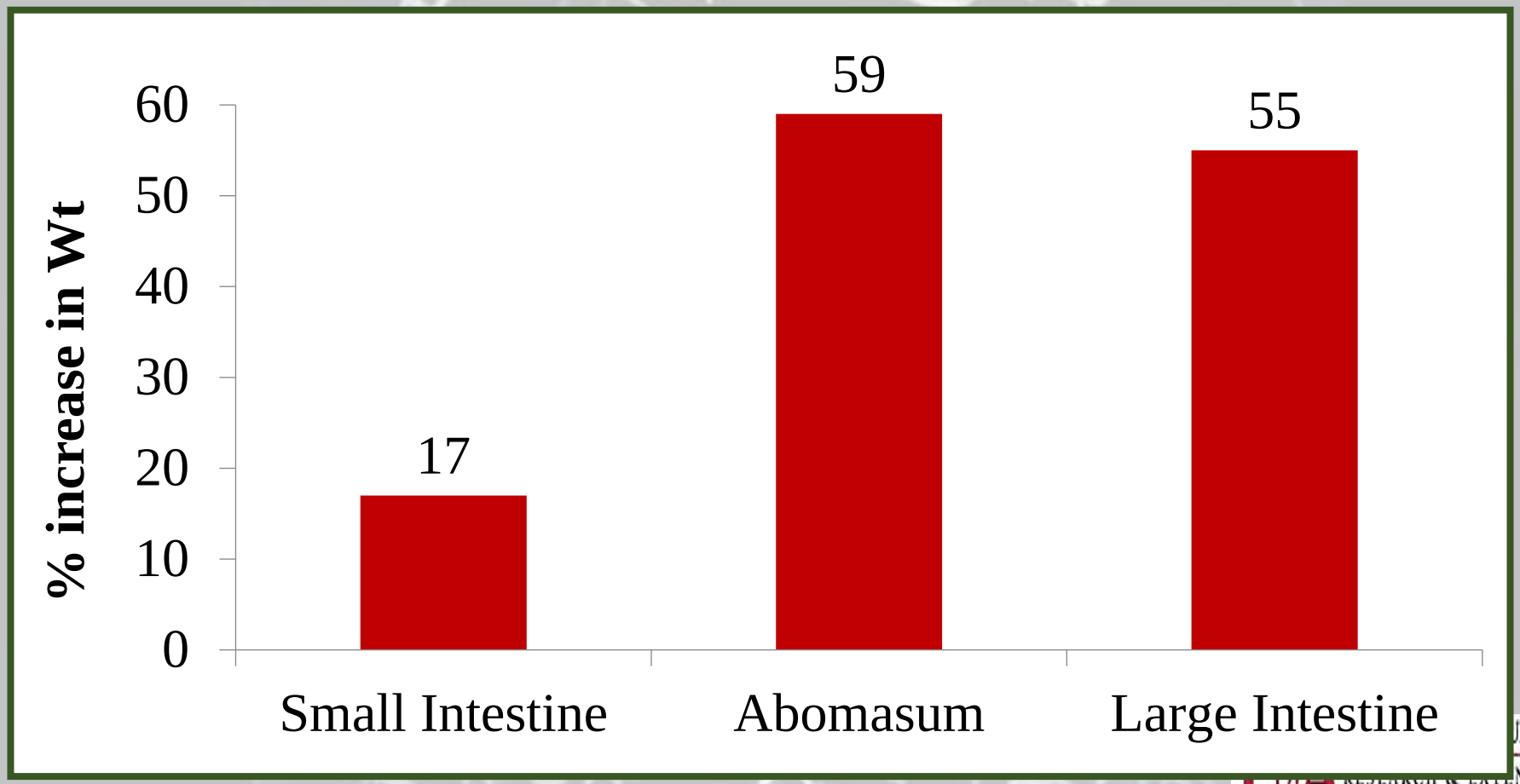
Changes of GI tract weight after infection in sheep

-Jacobson *et al*., 2009, *Vet Parasitology*, 161: 248-254



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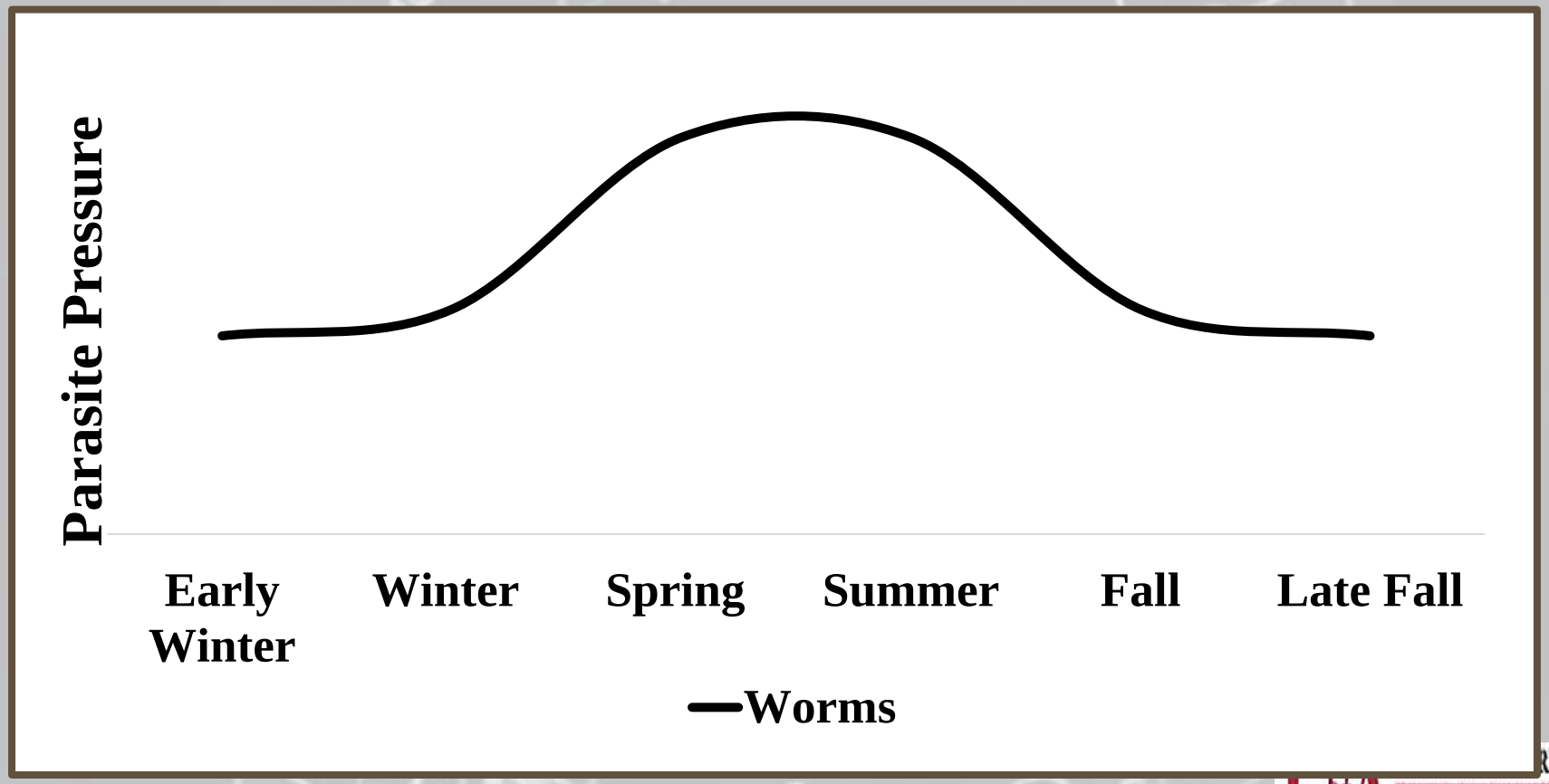
Small Ruminant Parasite Pressure Influenced by Season



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“Normal”, Upper-levels of Nematodes in Southern Small Ruminants

Nematode	Numbers
Haemonchus contortus **Adult**	50,000
EL_4	1,000,000
Trichostrongylus colubriformis	40,000
Nematodirus spp	30,000
Oesophagostomum columbianum **Adult**	5,000
EL_4	5,000
EPG	8,000

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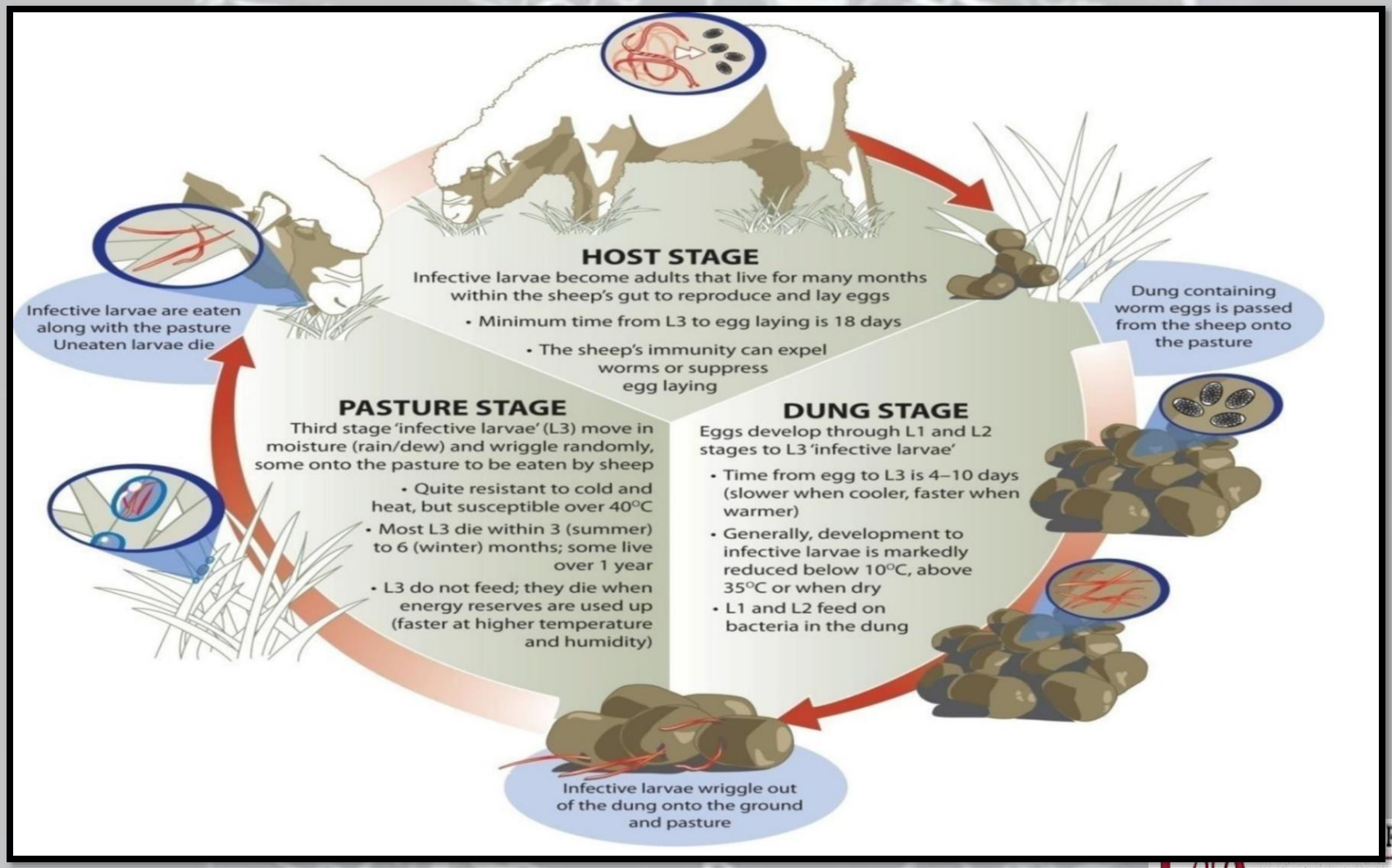
Typical Trichostrongyle Life Cycle



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The "Important" Nematodes

- ***Haemonchus contortus*** **("barber pole worm")**
- ***Trichostrongylus colubriformis*** **("bankrupt worm")**
- *Nematodirus spathiger* ("intestinal thread-necked worm")
- *Parelaphostrongylus tenuis* ("deer/brain/meningeal worm")

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Other "Important" Helminths

- ***Moniezia expansa*** **("sheep tapeworm")**
- *Taenia ovis* ("sheep measles")
- *Echinococcus granulosus/multilocularis* ("hydatid worm")
- ***Fasciola hepatica*** **("liver fluke")**

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Haemonchus contortus

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Haemonchus contortus

- Abomasal nematode primarily of small ruminants
- Voraciously hematophagic
- Hot weather worm (winter arrestment)
- Normal trichostrongyle life cycle

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Haemonchus contortus

- Exhibit extensive larval developmental arrestments and subsequent emergences
  - Spring Rise
    - Male and Female hosts
  - Periparturient Rise
    - Only Female hosts

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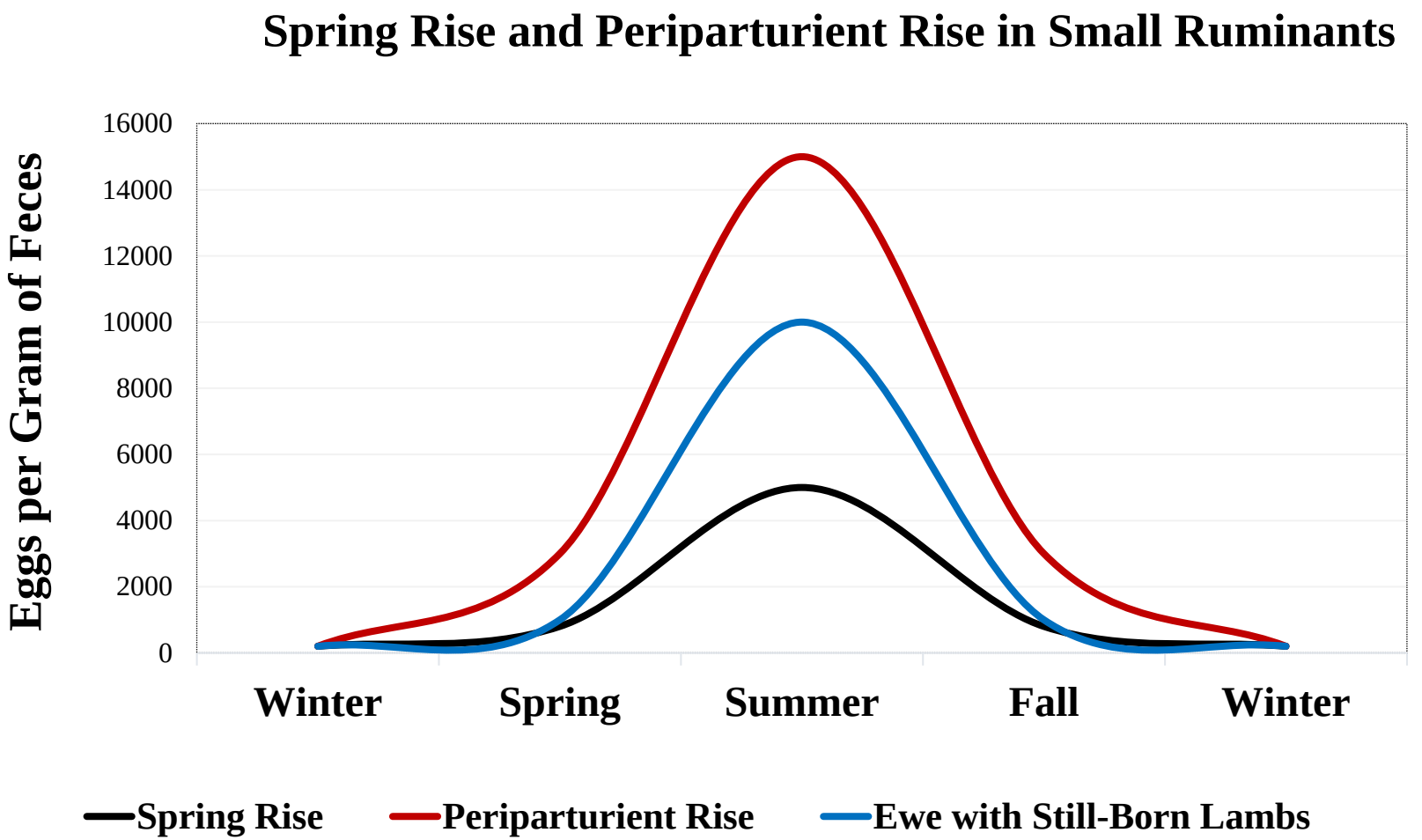
Haemonchus contortus



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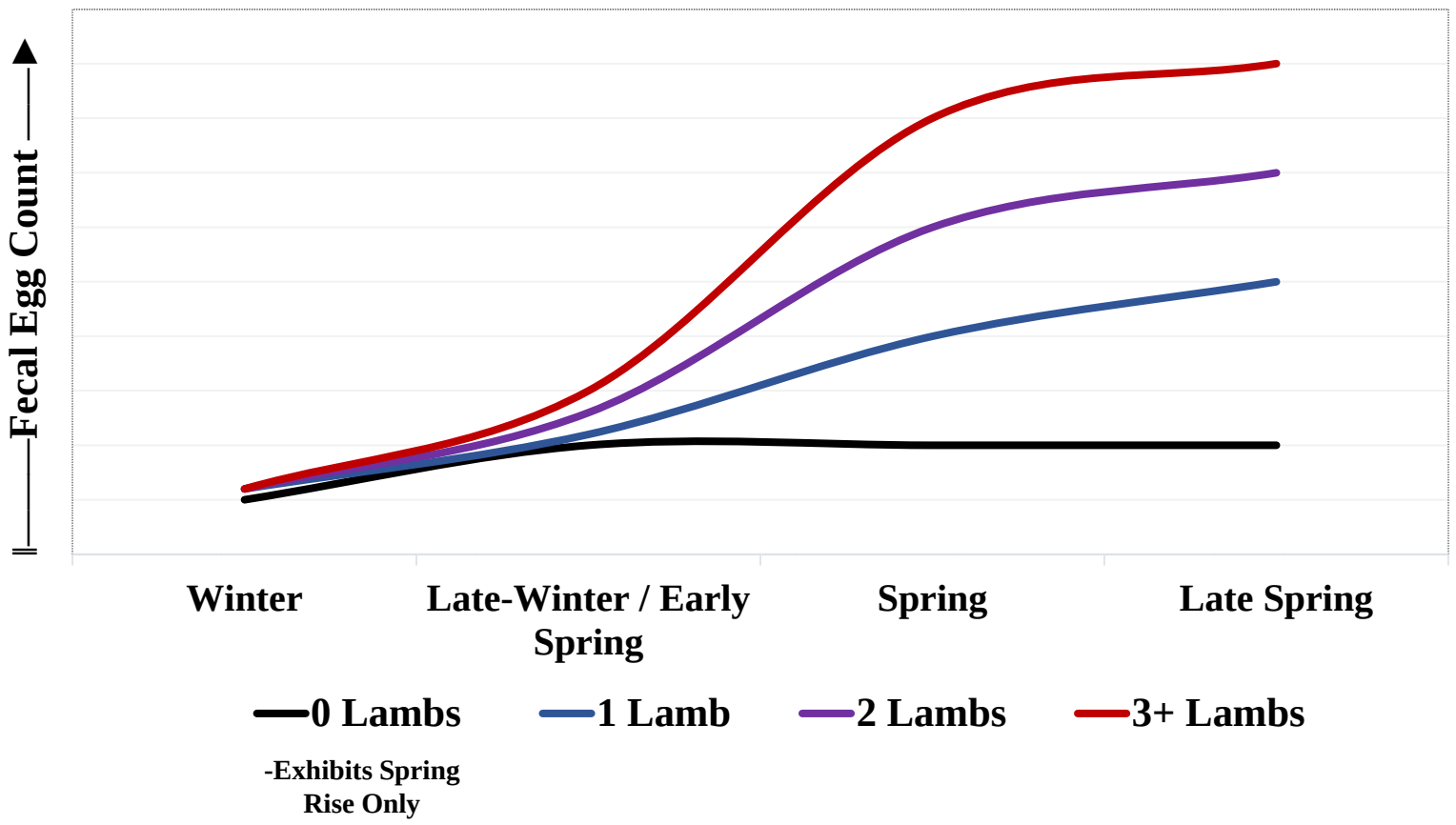
Haemonchus contortus



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Haemonchus contortus

- Highly fecund---~5000 eggs/day/female
- Highly pathogenic
- Prepatency= 18-21 days
- Patency= up to 8 months

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Haemonchus contortus

- Has displayed resistance to all classes of anthelmintics currently available
    - Especially Benzimidazoles and Avermectins
- Most likely *the* most important aspect of small ruminant production WW

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Signs of Haemonchosis

- **“Bottle Jaw” / “Hydrothorax” (Edema)**
- Anorexia
- Messy buttocks
- Poor weight gain
- **Pale mucous membranes**
- Weakness/Lethargy
- Unthrifty
- Poor wool/hair coat
- **Sudden death**

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Trichostrongylus colubriformis (100X)

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Trichostrongylus colubriformis

- Resides in the small intestine of primarily sheep
- Low reproduction
- Low pathogenesis
- Rides the “coat tail” of *Haemonchus* spp
- Still susceptible to most anthelmintics

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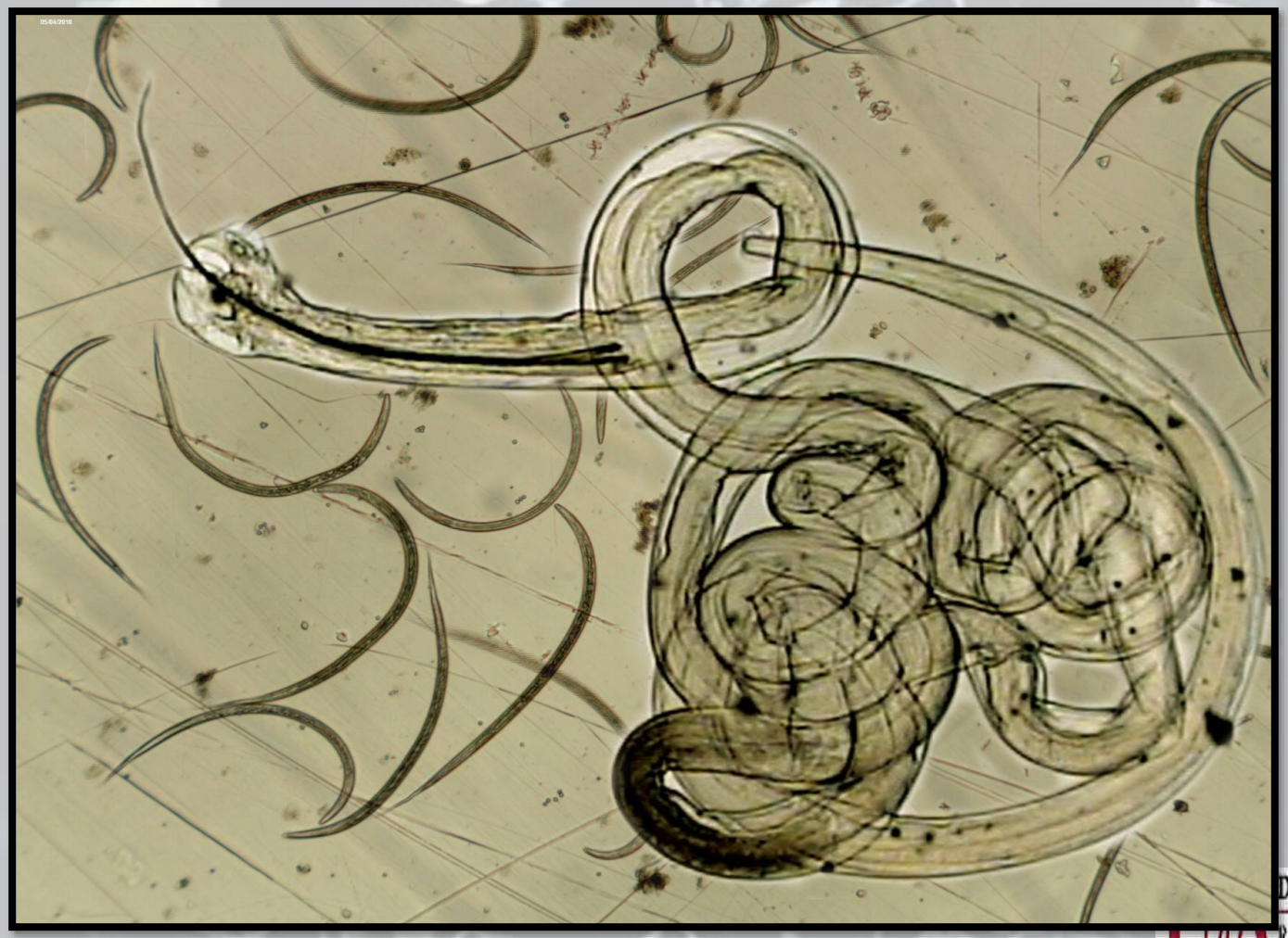
Nematodirus spathiger



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Nematodirus spathiger

- Cold-Weather worm that resides in the small intestine
- Persists on pastures ~2 years in absence of animals (infective egg)
- Severe non-bloody diarrhea--projectile
- Infections typically limited to younger animals

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Nematodirus spathiger

- Adults trigger Thigmokinetic Response in host animal
- Dose-Limiting Nematode for Avermectins
- Benzimidazoles still efficacious
- Infections typically limited to younger animals
- Still susceptible to most anthelmintics

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Parelaphostrongylus tenuis

- White-tailed deer is the primary host
- Gastropods except cattle act as accidental hosts
- Life cycle requires snails/slugs

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Parelaphostrongylus tenuis

- Drugs limited due to the worms being located beneath the blood-brain barrier
  - Ivermectin is commonly used, but does not cross the BBB
    - Might be effective against migrating larvae
  - Safeguard penetrates BBB, but has limited activity

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Parelaphostrongylus tenuis

- Steroids and Antiseizure drugs typically given with anthelmintics
- Some animals recover, some do not (with or without treatment)
- Prevention is difficult
    - Reduce and/or eliminate deer, snails and slugs from property

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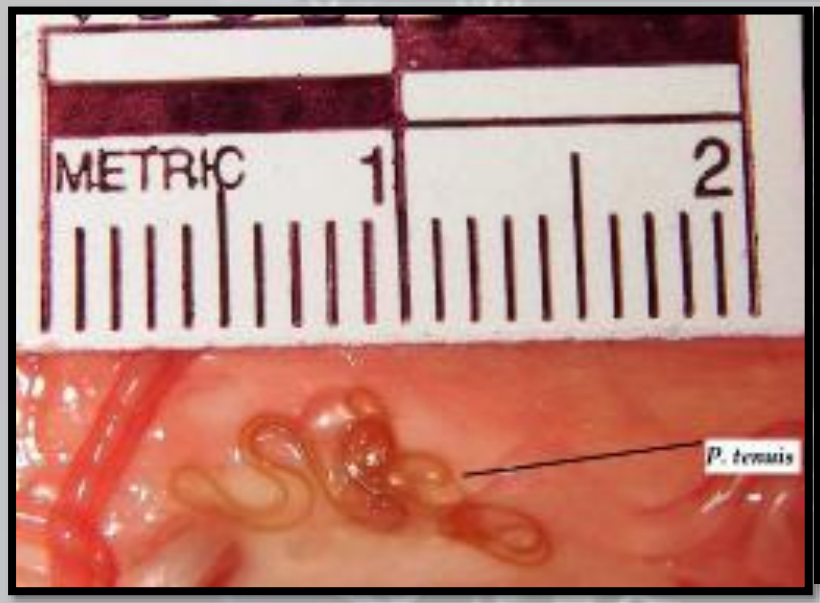

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Parelaphostrongylus tenuis

- Clinical signs
  - Trouble moving around
  - Mild stumbling
  - Knuckling and/or dragging toes of back end
  - General hind end weakness
  - Total paralysis
  - Sitting like a dog, or down and cannot get up

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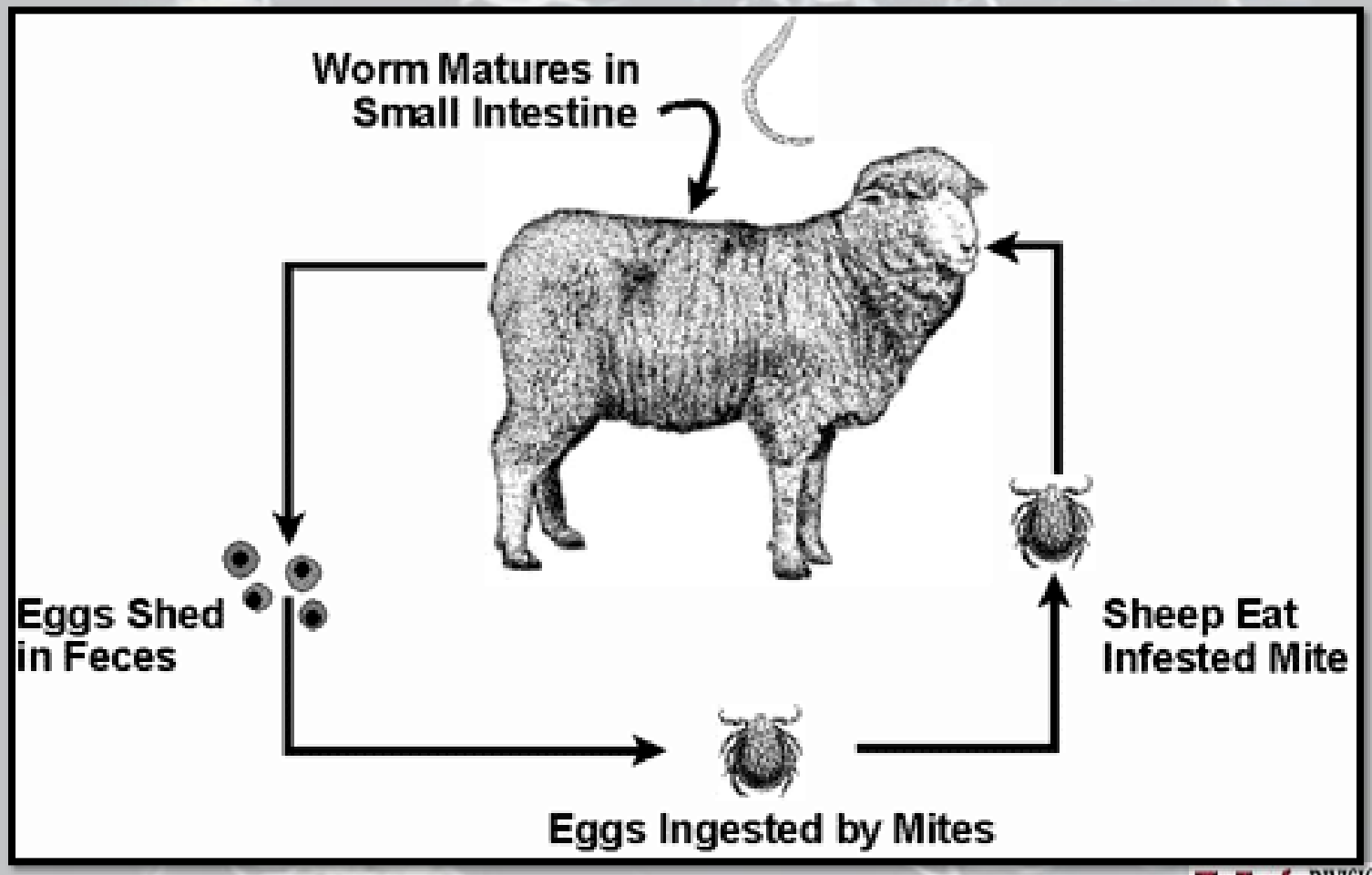
Tapeworm Life cycle



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Moniezia expansa

- Adults can reach 10 feet long
- Not too much of a concern in small ruminants
- Can cause impaction (RARE)

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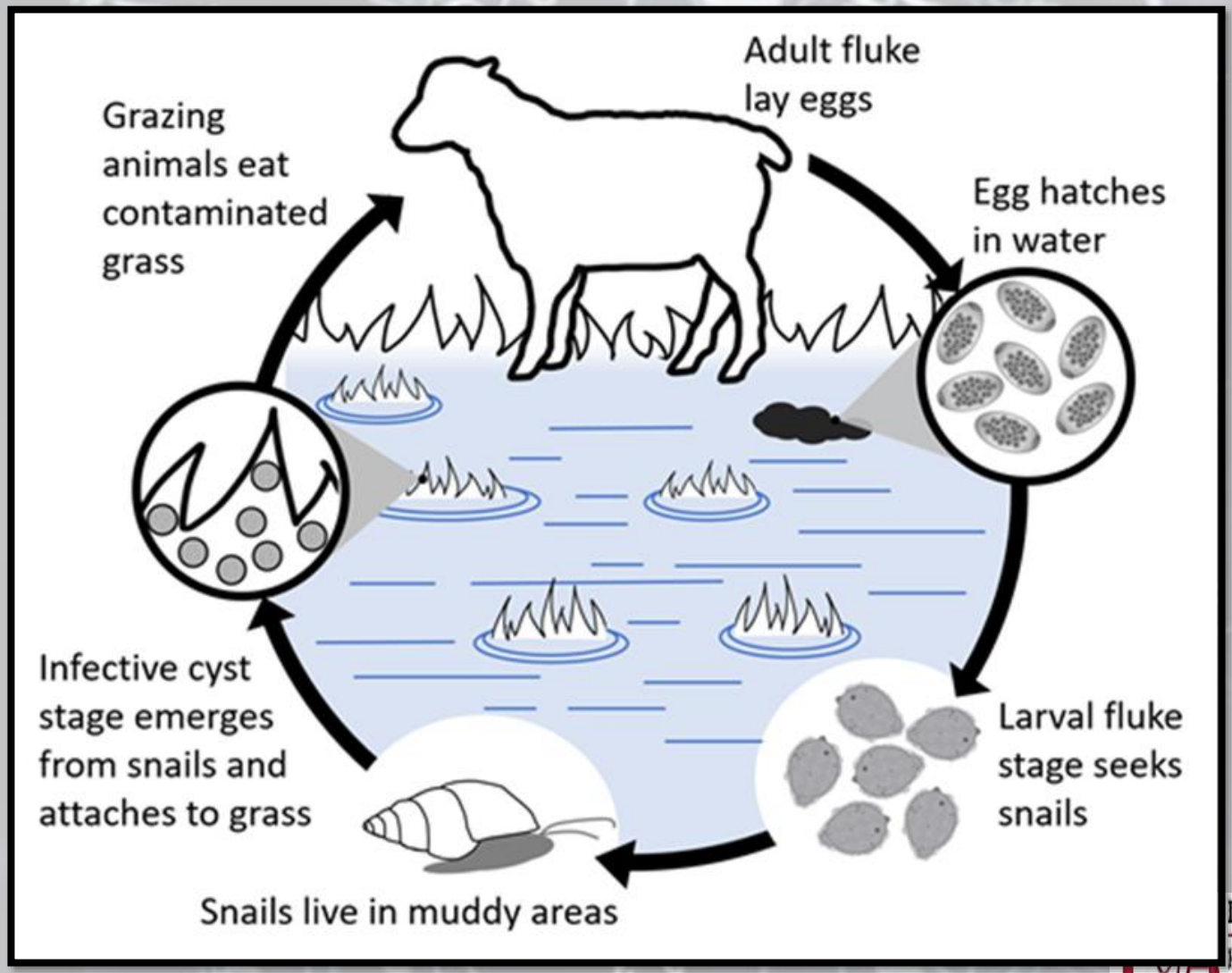
Fluke Life cycle



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Fasciola hepatica

- Grazing land must be at least partially aquatic for the majority of the year
- Most prevalent in east Arkansas, river bottoms, seep-pastures
- FEC to diagnose
- Flukicides to treat

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Fasciola hepatica

- Acute Fascioliasis
  - Not very common
  - Late summer (after drought, snails emerge from mud)
  - Liver hemorrhage (death in 2-7 days)
  - Condition compounded with presence on *Clostridium novyi* ("Black Disease")

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Fasciola hepatica

- Chronic Fascioliasis
  - More common form
  - Fibrotic liver and harden bile ducts ("pipe-stem liver")
  - Anemia develops
  - Jaundice
  - Progressive cirrhosis
  - Progressive condition loss

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Fasciola hepatica

- Control
  - Treat infections
  - Eradicate rabbits and deer from pastures (fuel life cycle)
  - Eliminate standing water/fence off wet areas

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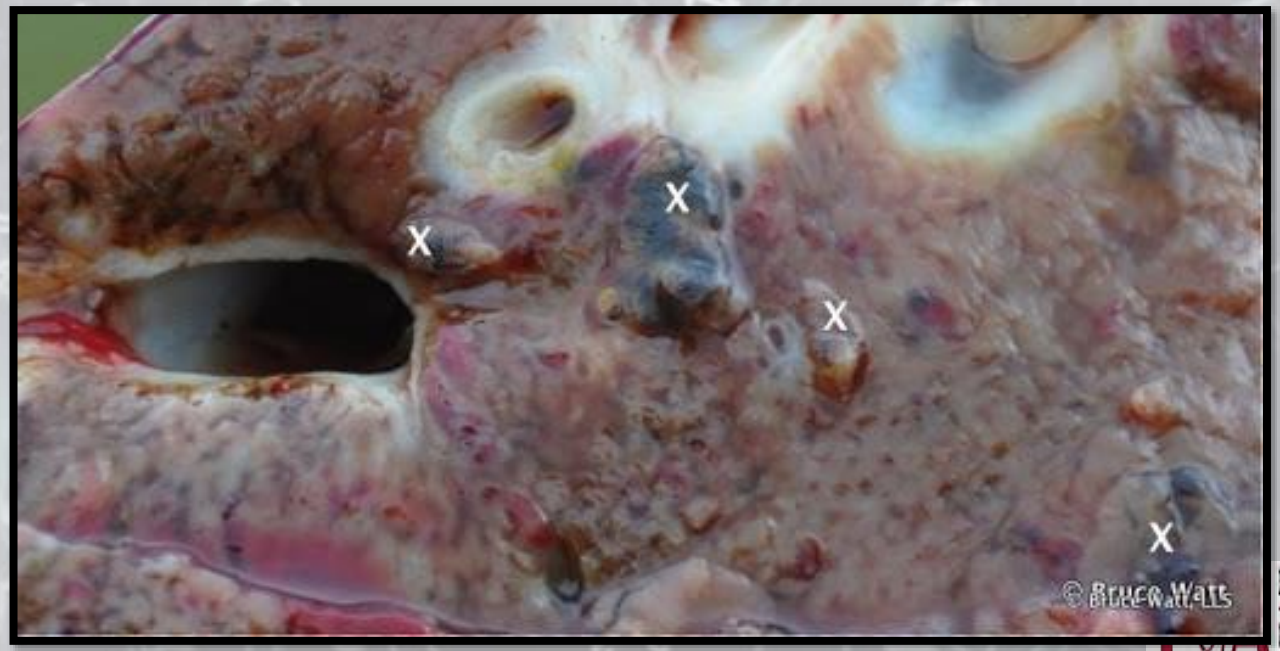

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Anthelmintics

Class of Compound	Molecule(s)	Trade Names	Comments
Imidazothiazole	**levamisole**	***Prohibit** **Levasol** **Tramisol**	• Limited spectrum of activity • Requires suspension in water • Does help address ML resistance • Possible problem with availability and administration • Somewhat toxic

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Anthelmintics

Class of Compound	Molecule(s)	Trade Names	Comments
Milbemycin (macrocyclic lactone)	**moxidectin**	**Cydectin**	▪ Use only oral formulation ▪ ML resistant strains of *Haemonchus* ▪ Moxidectin > avermectins for efficacy….usually
Sulfonamide	**clorsulon**	**Ivomec Plus** **Noromectin Plus** **SparMectin Plus**	▪ Combined with MLs in "plus" preparations for adulticidal flukicide activity

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Anthelmintics

Class of Compound	Molecule(s)	Trade Names	Comments
Benzimidazole	fenbendazole oxfendazole albendazole	Safeguard Synanthic Valbazen	• All have oral formulations, but fenbendazole has several feed grade forms • BNZ resistant strains of *Haemonchus* and *Trichostrongylus* • Albendazole indicated for adult flukes • Valbazen can cause early-term abortions in small ruminants

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Anthelmintics

Class of Compound	Molecule(s)	Trade Names	Comments
Avermectin (macrocyclic lactone)	ivermectin doramectin eprinomectin	Ivomec Dectomax Eprinex	• Pioneer and generic preparations of ivermectin • Appears (to me and Arkansas worms) that generic preparations are not as efficacious as the pioneer • Topical and injectable formulations • ML resistant strains of *Haemonchus*

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Anthelmintics approved for sheep and goats in USA

Active Ingredient	Chemical Class	Proprietary (Brand) Name	Species
Thiabendazole	**Benzimidazole**	Thibenzole®	Sheep and goats
		Omnizole®	Sheep and goats
		E-Z-EX Wormer Pellets®	Sheep and goats
		Equizole®	Sheep and goats
		TBZ 200 Medicated Feed Premix	Sheep and goats
Morantel tartate	**Nicotinic Receptor Agonist**	Rumatel® 88	Goats
Albendazole	**Benzimadzole**	Valbazen®	Sheep and goats
Fenbendazole	**Benzimidazole**	Panacur®	Goats
		Safe-Guard®	Goats and wild sheep (Rocky mountain bighorn sheep) Not approved for use in domestic sheep
Levamisole	**Nicotinic Receptor Agonist**	Ripercol L®	Sheep
		Tramisol®	Sheep
		Levasol®	Sheep
Ivermectin	**Macrocyclic Lactone (Avermectin)**	Ivomec®	Sheep
Moxidectin	**Macrocyclic Lactone (Milbemycin)**	Cydectin® Oral Drench	Sheep

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What makes parasites successful?

- Highly reproductive *(Haemonchus)*
  - **~5000** eggs/day/female nematode
  - **100** female nematodes **x 5000** eggs = **~500,000** eggs/day/ewe on pasture
  - **10** ewes = **~5 million** eggs on pasture/day
  - Results in ~**50,000** infective L_3 on pasture every day

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What makes parasites successful?

- Survivability
  - **On pasture:**
    1. Fecal pellet protection
    2. Shell/Sheath protection
    3. Resistant to weather conditions
    4. Motility and reactivity
       - Hydrophilic
       - Negatively Geotropic

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What makes parasites successful?

- Survivability
  - **In the animal:**
    1. Seasonal and Intra-burden arrestments
    2. Ability to “dodge” the host immune system
    3. Ability to quickly develop resistance to drugs
    4. Ability to “change” the way the drugs affect worms
    5. STAYING NON-CLINICAL

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What makes parasites successful?

Mistakes at the farm level

1. Administering the wrong dose rate (mg/kg)
2. Treating at the wrong time of year
3. Treating too much (*Refugia*)
4. Too much reliance on drugs

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What makes parasites successful?

- Drug “problems”
    1. Selection for resistance
    2. Pioneer vs Generic
    3. Product storage

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Mitigation Through Management Practices

- Implementation of Deworming Strategies
  - Fecal Egg Counts (FEC)
  - Fecal Egg Count Reduction Tests (FECRT)
  - “Smart Drenching”
  - FAMACHA Scoring

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Mitigation Through Management Practices

- Non-Chemical Approaches
  - Rotational Grazing
  - Alternate-Species Grazing
  - Copper Oxide Wire Particles (COWP)
  - Condensed Tannins
  - Dung Beetles
  - *Duddingtonia flagrans*

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Mitigation Through Management Practices

- Non-Chemical Approaches
  - Increase Protein Intake
  - Increase Minerals Intake
  - Reduce Stress
  - Prevent Overstocking
  - Repair water tank leaks

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Fecal Egg Counts

- McMaster Technique vs Direct Flotation
- Should always conduct FECs before administering any anthelmintic
  - This will allow for the reduction of “blanket treatments” to take care of worm challenges

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Fecal Egg Counts

- FEC will reduce the incidence of anthelmintic resistance on operations
- Should be conducted as frequently as possible
- “20%:80%” Rule

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Fecal Egg Count Reduction Test (FECRT)

- Used to determine resistance status of various drugs on a given farm

"Guidelines"

1. Conduct Fecal Egg Counts (FEC) before treatment (Day 0 or before)
2. Treat with a single drug/chemical
3. Conduct FEC two weeks after treatment

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Fecal Egg Count Reduction Test (FECRT)

- Things to consider:

  1. Only include animals in the test that have appropriate FECs—treating an animal with only 3 EPG will be pointless/harmful

  2. At the end of 2 weeks, pull fecal samples from the **same animals** that were evaluated on day 0

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Fecal Egg Count Reduction Test (FECRT)

- 28 day post-treatment FEC can be helpful
- <95% efficacy is resistant status
- Assess all dewormers and keep thorough records

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"Smart Drenching"

- Proper dosage
  - **Weigh ALL animals**
  - Weight tapes are better than "eye-balling" it
- Proper deworming strategy
  - Know the life cycle
  - Don't deworm when worm is inhibited

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“Smart Drenching”

- Record deworming history
- Practice good biosecurity
- Learn the resistance status of any given operation
    - FECRTs (it’s not a “one-and-done” process)

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“Smart Drenching”

- Use drugs until they are ineffective
    - **That being said, limit your parasite populations to chemical exposure** (maintain a wide/big *Refugia*)
- Repeat dosing (**if necessary**)
- Practice good pasture management

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FAMACHA

- "FAfan-MAlan CHArt"
- Used to assess blood loss associated with *Haemonchus* spp
- Ranks paleness of mucous membranes
- Good tool, but shouldn't treat based solely on FAMACHA scores

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FAMACHA

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Alternate Species Grazing

- Grazing alternate species of animals subsequently after one another, or simultaneously, in order to “clean” pastures
- Can potentially reduce infective parasites on pasture
- Works especially well when species are monogastrics and ruminants

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Rotational Grazing

- Fencing off small sections of a larger field in order to control the forage levels within each small paddock
- Keeping pasture above 4-6 inches reduces the possibility of animals consuming infective larvae from the forage
- Keeping pastures lush can potentially make it difficult for the infective larvae to reach the tops of the grass

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Copper Oxide Wire Particles (COWP)

- Used to kill **only** the existing adult infection in the abomasum
- Does not work on subsequent reinfection
- Can safely use on sheep once or twice a year
- Not bioavailable like Copper Sulfate

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Condensed Tannins

- Forages that have a direct anthelmintic effect on gastrointestinal parasites
    - Damages cuticle and digestive tissues of parasites
- Bitter taste
- Goats more tolerant/accepting

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Condensed Tannins

- *Sericea lespedeza*
- Pine bark
- Birds foot trefoil
- Sainfoin
- Forage Chicory
- Sorghum

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Dung Beetles

- Helps break up the life cycle of parasites
- Eating or moving feces will reduce overall horn and face fly populations (added bonus)
- Can increase overall pasture health by increasing nutrient availability
- **Avermectins kill dung beetles**

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Duddingtonia flagrans

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Duddingtonia flagrans

- Biological control
- *Nematophagus* fungi
- Fungal spores are fed as top dress daily (per os)
- Reduce the overall nematode larvae on the pasture where the animals are defecating
- Spores are activated when larvae become active and form a “lasso” around each larva

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Questions?

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