Strategies to Minimize Resistant Internal Parasites on your Farm

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Background To The Problem

- Gastrointestinal worms are major pathogens of small ruminants
- Worm control has relied almost exclusively on the frequent use of anthelmintics (dewormers)
- Dewormer resistance is now common
  - A fresh approach to control is needed
- American Consortium for Small Ruminant Parasite Control Group Formed (2001)
Gastrointestinal Worms of Small Ruminants

Abomasum:
- *Haemonchus contortus* (southeast US)
- Teladorsagia circumcincta
- *Trichostrongylus axei*

Small intestine:
- *Trichostrongylus colubriformis*
- Cooperia
- Nematodirus

Large intestine:
- *Oesophagostomum*
- *Trichuris*
**Haemonchus contortus**
(Barber Pole Worm)

- **Blood-sucking worm**
  - Highly pathogenic
  - Hypoproteinemia - “bottle jaw”
  - Anemia → Death

- **Most important worm parasite** in small ruminants raised in warm/wet environments
  - Southeastern US year round
  - Seasonal summer – rest of US
Life Cycle of *H. contortus*

- Adult nematodes in the digestive tract of sheep lay their eggs.
- Eggs passed onto pasture in manure.
- Infective larvae are ingested by grazing sheep.
- Eggs hatch, and larvae develop to infective 3rd stage in soil and manure.

http://www.ext.vt.edu/pubs/sheep/410-027/
Why is *H. contortus* such a problem?

- **Long transmission season** - southeastern US
- **Very fecund** - 5-10,000 eggs per day
- **Short life cycle**
  - 4-5 weeks
- **Immunity wanes** – ewes parturition/lactation
- **Spring** = pasture contamination
- **Immunity is slow to develop** – lambs
  - 4-6 months of age
Teladorsagia/Trichostrongylus (Bankrupt Worms)

- Abomasum/Small intestine
- Thrives in cool/wet climates
- Short transmission season – Summer, most of US
- Destroys mucosal cells and disrupts function
- Anorexia, diarrhea, reduced weight gain or weight loss
  - Decreased production not necessarily death = “bankrupt”
- Immunity wanes – ewes parturition/lactation
  - Spring = pasture contamination
- Immunity is slow to develop – lambs
  - 4-6 months of age
Background to the Problem

- Age of modern anthelmintics
- Parasitologists recommended strategies that maximized benefits of treatment
  - Ignored resistance issues
- Over-reliance on anthelmintics
  - Therapeutic vs. prophylactic
  - Loss of common sense management-based approaches
Anthelmintic Resistance

- The ability of worms to survive treatments that are generally effective at the recommended dose rate
- Treatment eliminates worms whose genotype renders them susceptible
  - Worms that are resistant survive and pass on their “resistant” genes
- Resistant worms accumulate and finally treatment failure occurs
  - Natural biological consequence of drug treatment
Selection for Drug Resistance
Where Did We Go Wrong
What Actually Causes Resistance

- Treatment at frequent intervals
  - Many farms > 6 Tx per year
- Treating all animals at same time
  - No refugia
    - The proportion of the population that is not selected by drug treatment
    - Provides a pool of susceptible genes
      - Dilutes resistant genes in that population
    - Overlooked as the most important component of drug resistance selection
- Treating and moving to clean pasture
  - No dilution/refugia
- Under dosing
  - Worms with low-level resistance survive
When to Suspect Resistance

• When FEC remain high or clinical signs persist following treatment
  – One must also rule out other possibilities
    • An inadequate dose of drug was administered
      – Underestimated weight
      – Drug was spilled/spit-out
    • Activity of the drug is reduced
      – Beyond its expiration date
      – Stored improperly
Diagnosis of Resistance

- **Laboratory – DrenchRite**
  - Dr. Ray Kaplan’s lab (UGA) - $450
  - Only one test needed per farm
  - One pooled fecal sample from 10 animals
  - All 3 major drug classes tested in assay

- **Veterinarian in the field -- simple on-farm anthelmintic trial**
  - Fecal egg count reduction test
    - FEC at treatment and again 7-10 days later
McMaster Fecal Egg Count

- Quick, easy to perform
- Should be part of routine services offered
- Slides available from:
  - Chalex Corp.
    5004 – 228th Ave. SE
    Issaquah, WA  98029
    425-391-1169
    FAX 391-6669
What Does All This Mean For The Small Ruminant Industry

- Anthelmintics can no longer be thought of as a management tool to be relied on to improve animal productivity
- **Reality** = effective long-term control of worms (specifically *Haemonchus*) will only be possible if anthelmintics are used intelligently with prevention of resistance as a goal
Anthelmintics

- **Benzimidazoles**
  - Albendazole (Valbazen)
  - Fenbendazole (Safeguard, Panacur)
  - Oxfendazole (Synanthic)

- **Imidazothiazoles**
  - Tramisol, Levasol, Rumatel

- **Macrocyclic Lactones**
  - Ivermectin (Ivomec)
  - Doramectin (Dectomax)
  - Moxidectin (Cydectin)
  - Eprinomectin (Eprinex)

- **2 new classes coming (??)**
  - Amino Acetonitrile Derivatives (AAD) - Monepantel (Zolvix)
  - Spiroindole - Derquantel (Startect)
Prevalence of Resistance

- **H. contortus**
  - Common
  - Benzimidazoles (Valbazen, Panacur, Safeguard), Ivermectin (Ivomec) and Doramectin (Dectomax)
  - Lowest level of resistance
  - Levamisole (Levisol, Tramisol)
    - Not available anymore
  - Becoming widespread rapidly
  - Moxidectin (Cydectin)

- **Teladorsagia/Trichostrongylus**
  - Drenchrite – *Trichostrongylus*, but small percentage of population
  - No documentation for *Teladorsagia*
“Smart Drenching”

• Use Proper Dose and Drenching Technique
  – Ensure proper dose is delivered over back of tongue
  – Critical that the full dose lodges in the rumen
  – If drench is delivered to the mouth rather than over the back of the tongue
    • Can stimulate closure of the esophageal groove with much of the drench bypassing the rumen
      – Faster drug absorption
      – Shorter duration
      – Efficacy is reduced
“Smart Drenching”

- Administer all drugs orally
  - Pour-ons are absorbed poorly
  - Injectable moxidectin (long withdrawal time)
- Combinations
  - Different classes (together/sequentially)
- Restrict feed intake for 24 hours prior to treatment
  - Once in the rumen, the duration of drug availability is largely dependent on the flow-rate of the digesta
    - Decreasing digesta transit leads to an increase in drug availability and efficacy
Do Not Buy Resistant Worms

• All new additions should be **quarantined and aggressively dewormed** upon arrival
  – Deworm with at least 2 anthelmintics with different mechanisms of action (different class)
    • Moxidectin and albendazole, for example
  – Should remain in **quarantine for 10 - 14 days**
    • Perform FEC to confirm minimal or no eggs are shed
  – If quarantine is not possible:
    • Treat with at least 2 anthelmintics and confine to pens for a minimum of 48 hours following treatment
Selective Treatment
Concept Behind Selective Treatment

- Worms are not equally distributed in groups of animals
  - 20-30% of animals harbor most of the worms
- Responsible for most of egg output and thus pasture contamination
Impact of Selective Treatment on Refugia

- The more of the population that is in refugia, the slower the rate with which resistance develops.
- Selective treatment significantly increases the percent of the population in refugia.
How Do We Achieve Selective Treatment

• The FAMACHA© system
  – Technique for the assessment of *Haemonchus contortus* infection
    • Indirectly evaluate worm burden by level of anemia
The FAMACHA© System

- Eye color chart with **five color categories**
- Compare chart with color of mucous membranes of sheep or goat
- Classification into one of five color categories:
  - 1 – not anemic
  - 5 -- severely anemic
• Examine in sunlight
• Open as shown - for a short time only
• Look at color inside lower eyelid
  • Match to color on card
Keep records

FAMACHA ANEMIA RECORD

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- Counted
- Counted and Treated
- Bottle Jaw - Treated

Ray M. Kaplan, DVM, PhD
FAMACHA Anemia Record
5/30/03
Integrating the FAMACHA© System

- **Start examining at two week intervals** in the spring
  - Treat categories 4 and 5
- **Go to one week intervals as necessary during** *Haemonchus* “season”
- In cooler times of year every 4 to 6 weeks may be sufficient
- If >10% of flock/herd in categories 4 and 5, consider treating 3s as well
- Examine especially animals which lag behind the flock/herd
- Check for animals with “bottle jaw” and treat these, regardless of whether they look anemic or not
Selective Treatment
Teladorsagia/Trichostrongylus

- FEC
  - Vet or do your own
  - Make sure it is quantitative technique
- Body condition score
- Dag (dirty butt) score
  - Diarrhea
- Reduced weight gain
- Weight loss
- Bottle jaw
Alternative Methods for Worm Control
Breeding for Resistance

- Select resistant individuals (FEC/PCV/FAMACHA) and cull susceptible animals
- Use resistant breeds for crossbreeding (Commercial)
  - Sire effect
- Long term process, but will be rewarding
Copper-oxide Wire Particles

- *Haemonchus* only
- Marketed for copper deficiency
  - Copasure and Santa Cruz Animal Health
- Potentially toxic in sheep
- Selective treatment for individuals
  - FAMACHA
- Copper sulfate added to feed does not work
  - May work better as a drench
Condensed Tannin Plants

- **Sericea lespedeza**
  - **Forage** that grows relatively well in SE US
  - Establishment as pasture may fit some operations
  - **Hay or pellets** may be suited for many other operations
  - Has effect on *Haemonchus* and coccidia
Worm-trapping Fungi

- *Duddingtonia flagrans*
  - Affects all worm larvae in feces
  - Feed daily with supplement
  - Primary objective is to clean up pasture
  - Long term results
    - Maybe 2-3 years
  - US registration (?)
Integrated Strategy

• Use **FEC, FAMACHA, etc.** for monitoring infection level
  – **Cull** high infection individuals – resistance selection
  – **Deworm individuals** as necessary
    • Effective drug – smart drenching
    • Copper oxide wire particles
    • **Sericea lespedeza**

• **Management**
  – Stocking rate, mixed species grazing, dry lot, pasture spelling, etc.

• **Weather conditions**
  – Warm/wet = increased worm problems
  – Cold/dry = decreased worm problems

• **Future (??)**
  – **Worm-trapping fungus**
American Consortium for Small Ruminant Parasite Control

ACSRPC.org
Questions ???

- bottle jaw

Images of sheep and a person examining a sheep's eye and feet.