

Integrated Parasite Management Strategies for Sheep Producers

ASI Let's Grow Webinar

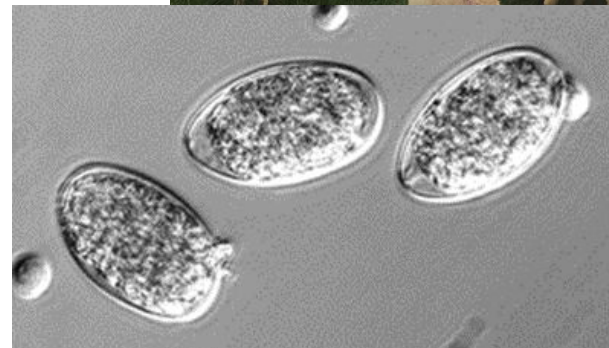
May 24, 2022

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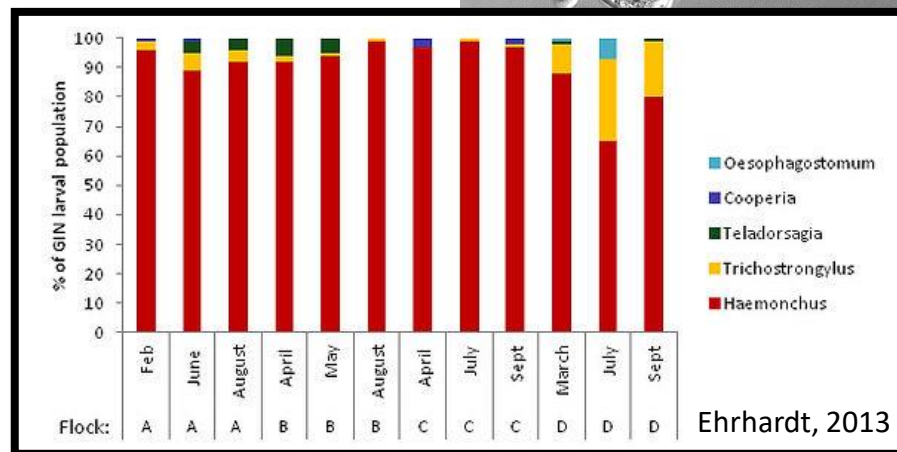
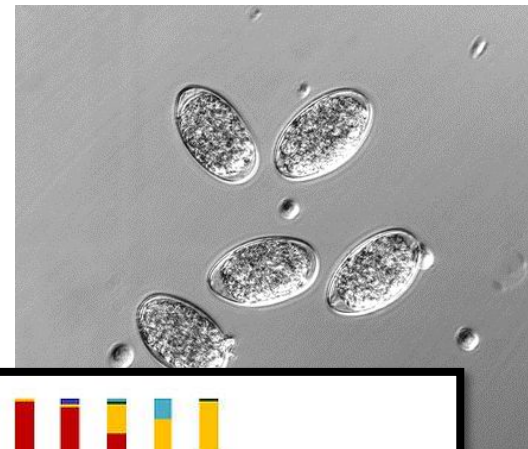
Parasite Challenges

- Superfamily Trichostrongyloidea (**Strongylid nematodes**)

- *Haemonchus contortus*
- ~~*Teladorsagia circumcincta* (*Ostertagia*)~~
- *Trichostrongylus* species
- *Cooperia*
- *Nematodirus*

- Protozoan parasites

- *Eimeria* (coccidia)



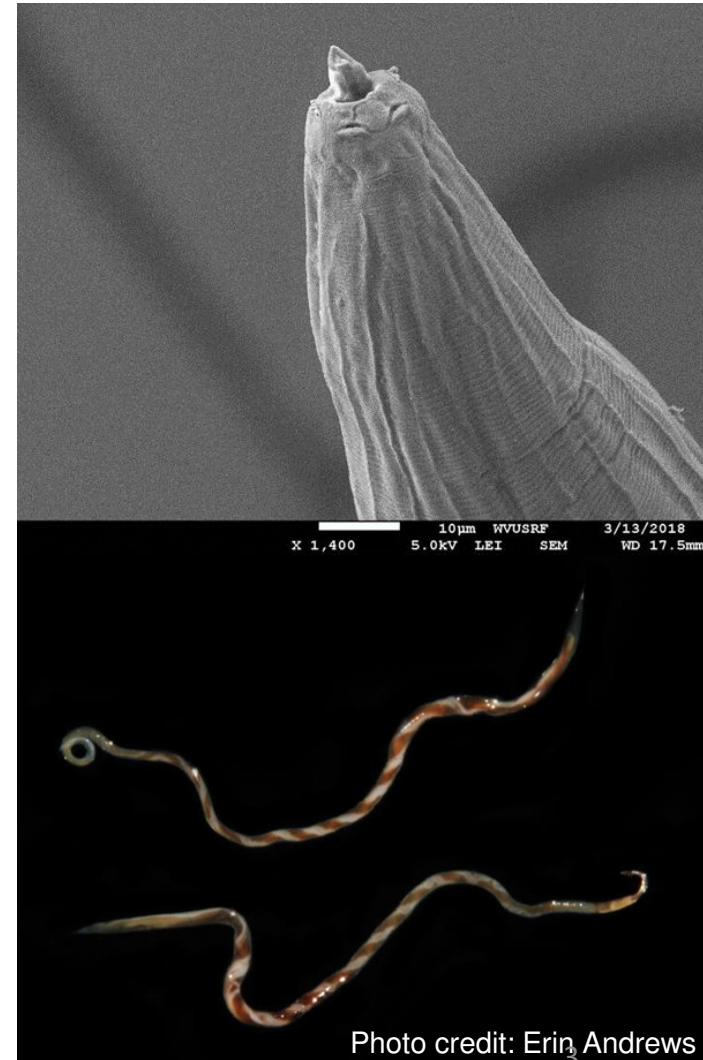
Survey of GIN population in Upper Midwest

The Worm of Concern

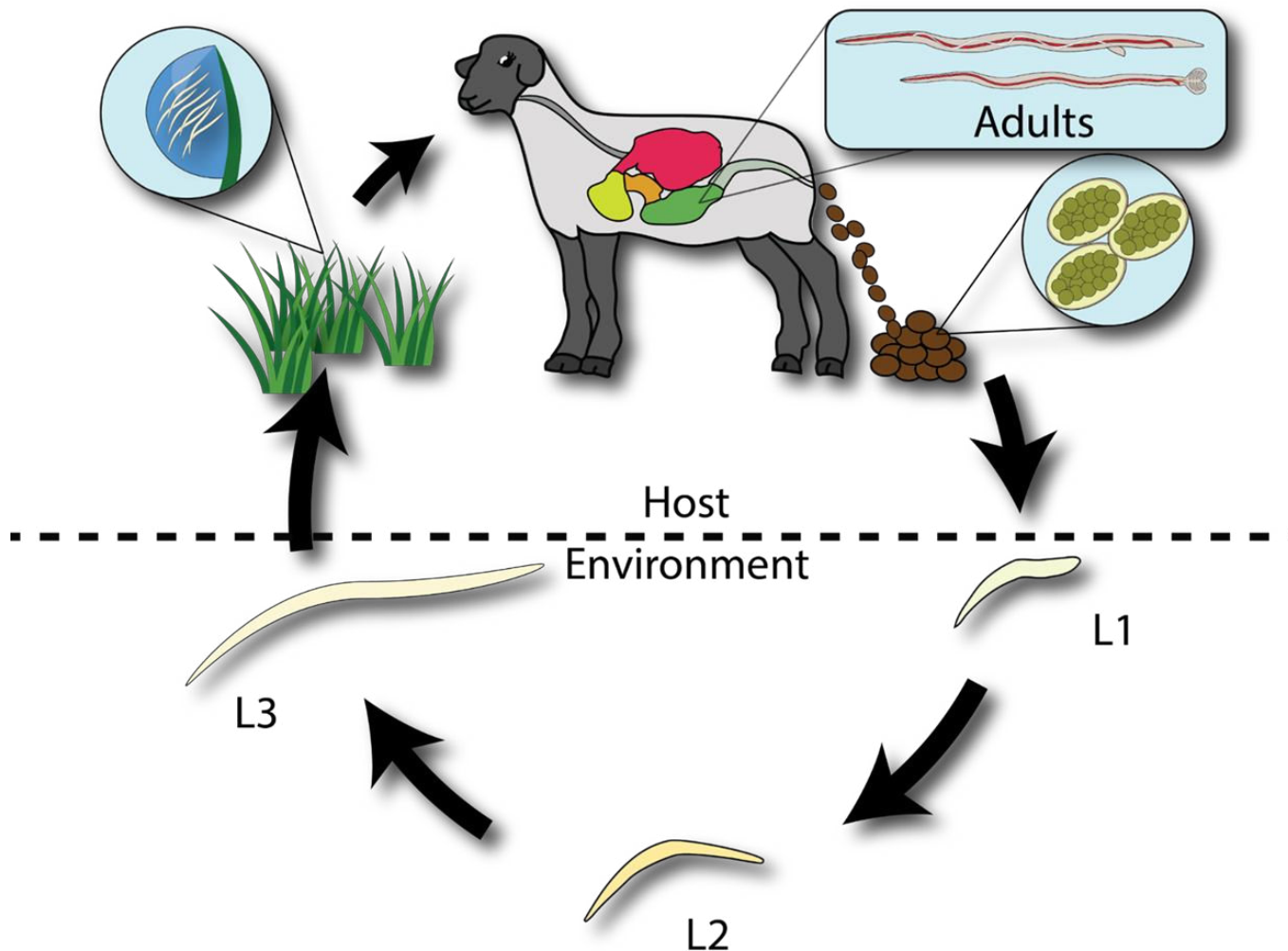
Haemonchus contortus

(Barber Pole Worm)

- Blood feeder
- Anemia, decreased performance and death of infected individuals
- Highly prolific
- Millions of dollars in economic losses annually (Sackett et al., 2006)



Life Cycle



21 days

7-14 days
(highly variable)



***H. contortus* does not bind to epithelial surface of the abomasum! Must swim to maintain position!**

Hypobiosis

- Parasite survival tool for times when environmental conditions are unfavorable for external development (winter, drought, etc.)
- Larvae arrest their development at the L3/L4 stage inside the host
- Resume development to maturity when “signals” suggest environmental conditions more favorable
 - Immune signals, hormones (Gutiérrez-Amézquita et al., 2017)
 - Not well understood

Identifying the Problem

“You can’t select (or improve) something that you do not measure”

- **Make data-driven decisions**
- **What traits can we measure to determine parasitism?**



Deworming Records

- **Pros:** Easy, simple records to keep
- **Cons:** Do not know actual parasite burden
- What animals are dewormed?
 - Are the same animals needing multiple treatments?
- When do you deworm?
- What dewormers do you use for treatment?



How are you determining who to deworm?

How do you know your dewormers are effective?

FAMACHA Scoring

- Assess anemia status based on mucus membrane color around eye
- More parasitized animals will have paler coloration (more anemic)
- Positives
 - Easy, on-farm assessment
- Negatives
 - Only relevant for *Haemonchus contortus* infections
 - Somewhat subjective



Photo credit: URI



Use for targeted selective treatment

5-Point Check

| No. | Point | Indicator | Which parasite(s)? |
|-----|-------|-------------------------|---|
| 1 | Eye | Paling | Barber pole worm, liver fluke, coccidia |
| 2 | Back | Body condition score | All |
| 3 | Rear | Dag score/fecal soiling | Brown stomach worm, hair worm, thread worm, nodule worm, coccidia |
| 4 | Jaw | Bottle jaw | Barber pole worm, liver fluke |
| 5 | Nose | Nasal discharge | Nasal bots |

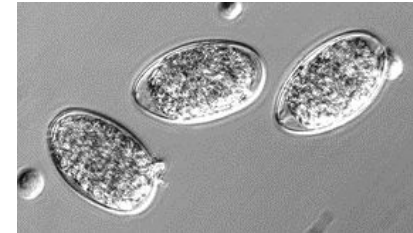


Burke and Miller, 2015

Use for targeted selective treatment

How do you know if your dewormers are effective?

- Fecal Egg Counts (FEC)
 - Measure of the number of strongylid parasite eggs in 1 gram of fecal matter
 - Can't distinguish strongylid parasites by egg
 - Larval culture required for speciation
- FEC Reduction Test
 - Measure FEC at time of deworming and again 10-14 days later => Should have > 95% reduction
- Measuring adult worm burden would be great but not practical



Fecal Egg Count

- Quantitative, objective measurement!
- Measures true resistance rather than resilience
- Valuable selection tool for improving parasite resistance in a flock
- Related to the number of adult worms in gut



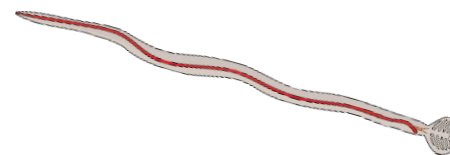
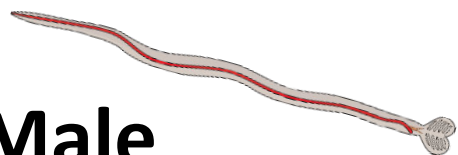
www.wormx.info/lowcostfec

So why not just use a dewormer?

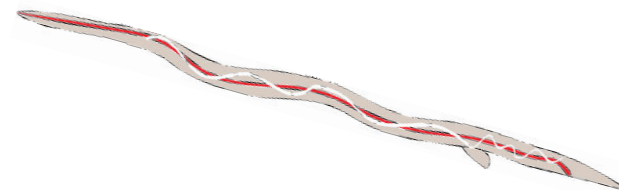
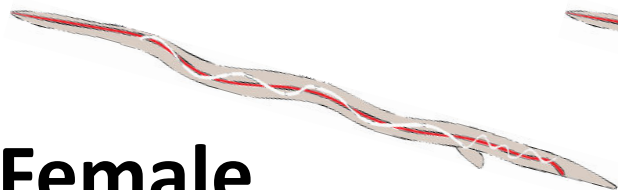
Resistant

Susceptible

Resistant



Male



Female

“What doesn’t kill you makes you stronger”

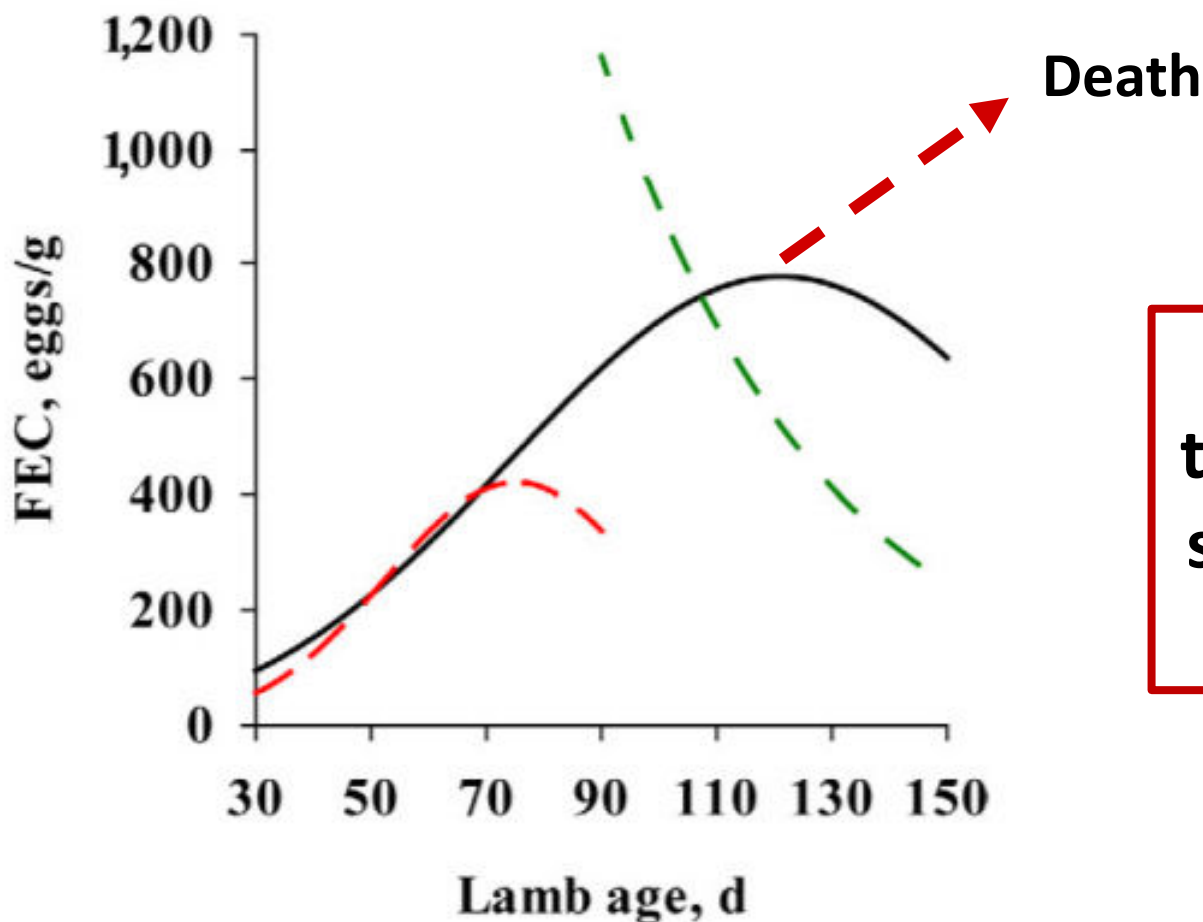
So why not just use a dewormer?

- Only three chemical classes of dewormers
- Resistance has developed to ALL three classes
(Howell et al., 2008)
- Don't count on chemical treatment

| Benzimidazoles | Macrocyclic Lactones | Nicotinics |
|--------------------------------------|--------------------------|--------------------------|
| Fenbendazole (Safeguard, Panacur) | Ivermectin (Ivomec) | Levamisole (Prohibit) |
| Albendazole (Valbazen) | Moxidectin (Cydectin) | Pyrantel |

Once resistance has developed to one dewormer in a class, generally all dewormers in that class will be ineffective

Who is Most Susceptible



Twins and triplets are more susceptible than singles

Determine Corrective Actions

- No single tool or method is the golden ticket
- Rather, a combination of multiple tools and methods is the best solution to managing parasitism => many tools in the toolbox

➤ **INTEGRATED PARASITE MANAGEMENT**



Integrated Parasite Management

Environment

- Grazing Management
 - Forage height/rotation
 - Stocking rate
 - Tannin-containing forages
 - Multi-species grazing
- Supplementation Rate

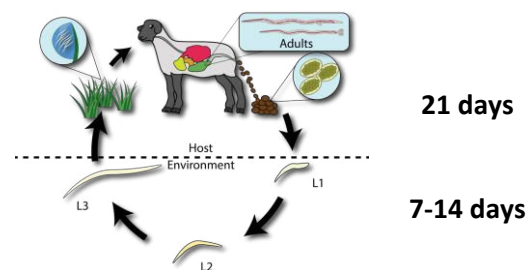
Animal

- Targeted treatment
- Combination treatments
- Copper oxide wire particles
- Genetic selection

Select several tools for your parasite management toolbox

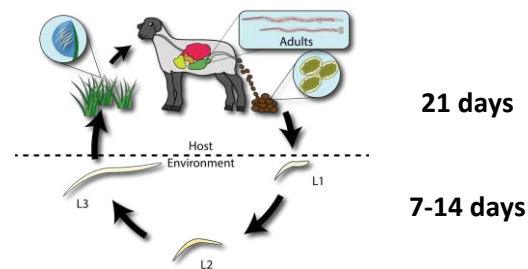
Grazing Management

- Understand parasite life cycle
- Use temporary fencing to minimize animal exposure to infective (L3) larvae
- Rotate animals to new pasture regularly
 - Every 3-5 days
- Avoid overgrazing
 - 90% L3 in the first 4" forage
(Santos et al., 2012; Amaradasa et al., 2010)
 - If in doubt, move them
 - Not only is this good for parasite mitigation but also good for forage health



Grazing Management

- Stocking density
 - Adjust according to grazing time and forage height
- Adequate Rest Period
 - For parasite management, the longer the better (45+ days)
 - As length of rest period increases, forages may become mature and quality decreases
 - Balance forage quality and parasite management
 - Use pasture for hay production

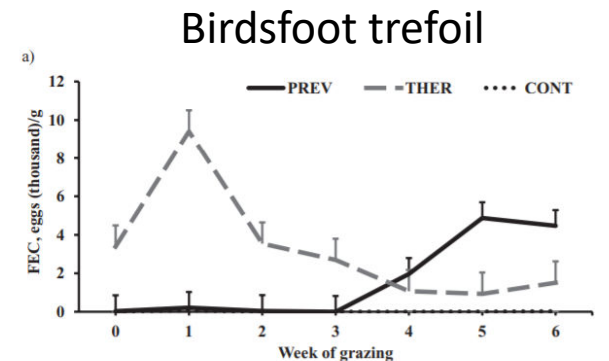


Forage Selection

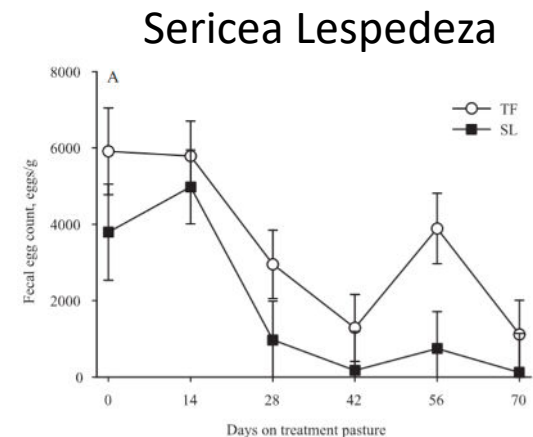
- Utilize tannin-containing forages
 - Birdsfoot trefoil
 - Sericea Lespedeza
- Tannins improve protein availability for the animal
 - Bind protein at high pH, release at low pH
 - Minimize microbial degradation



Photo credit: Joan Burke

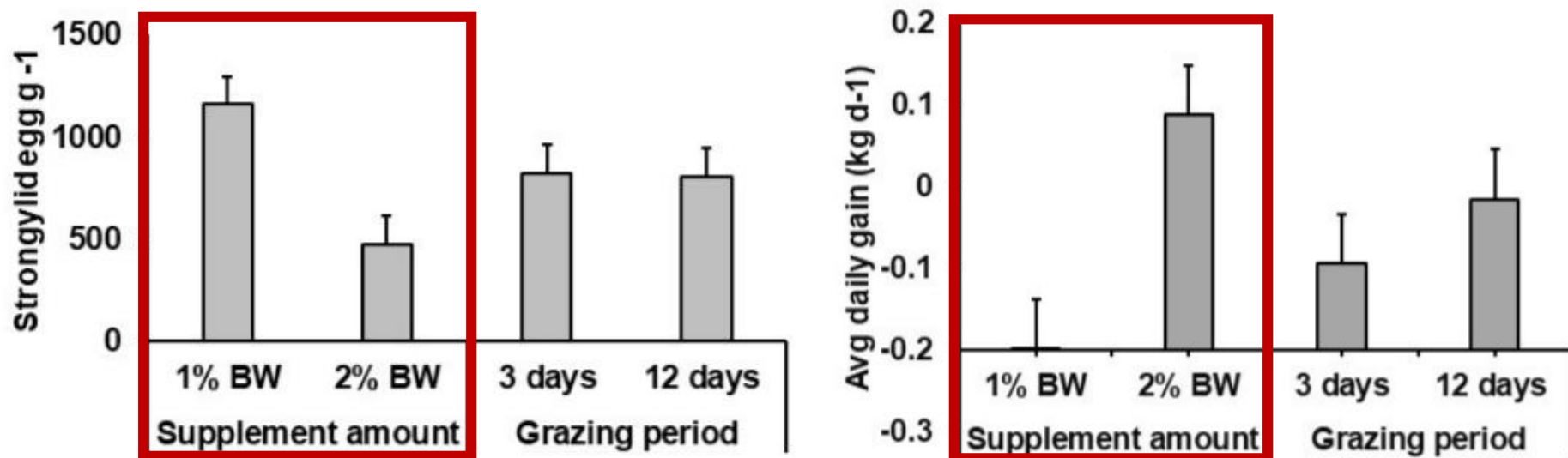


Mata-Padrino et al., 2018



Burke et al., 2012

Supplementation Rate



Crawford et al., 2020

Increasing supplementation decreased fecal egg count and increased average daily gain

Mixed Species Grazing

- In theory, opportunity for multi-species grazing for parasite management exists, but data is limited
- Many parasites are species specific
 - Sheep and goat parasites won't infect cattle
 - Sheep, goats, llamas, alpacas and deer can share worms
- Co-grazing or rotating species in pastures may limit pasture larval burden



Photo credit: Johnny Rogers

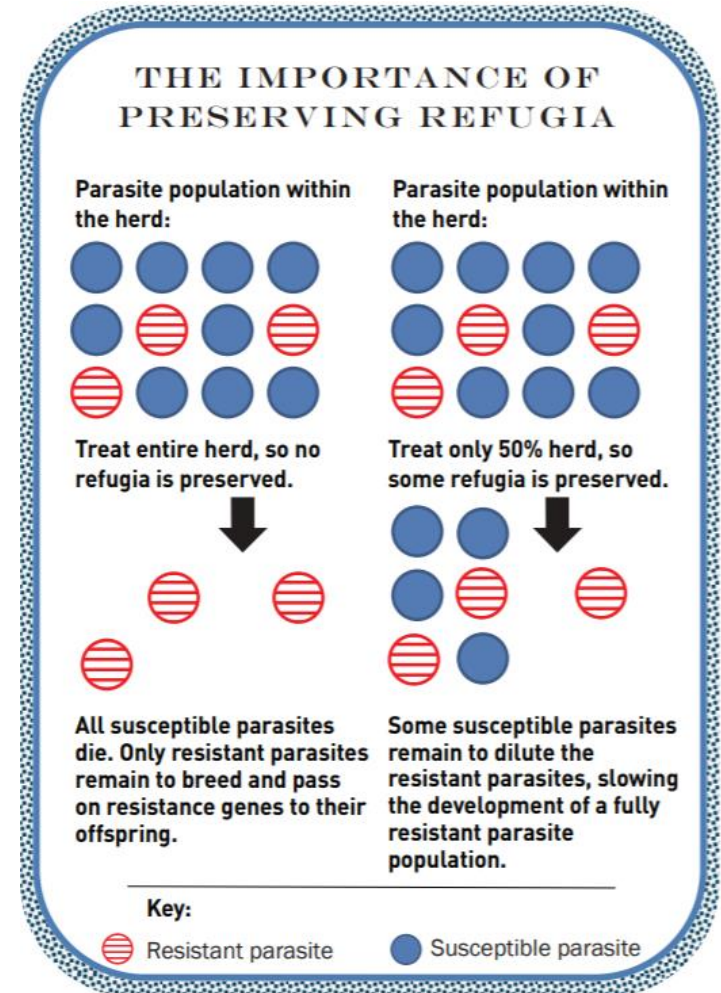
Targeted Selective Treatment

- Implement FAMACHA scoring and 5-Point check to determine which animals need treatment
- **ONLY** treat those that need it => Maintain refugia
- Using FAMACHA scoring, treat:
 - FAMACHA ≥ 4
 - FAMACHA score 3 with poor body condition



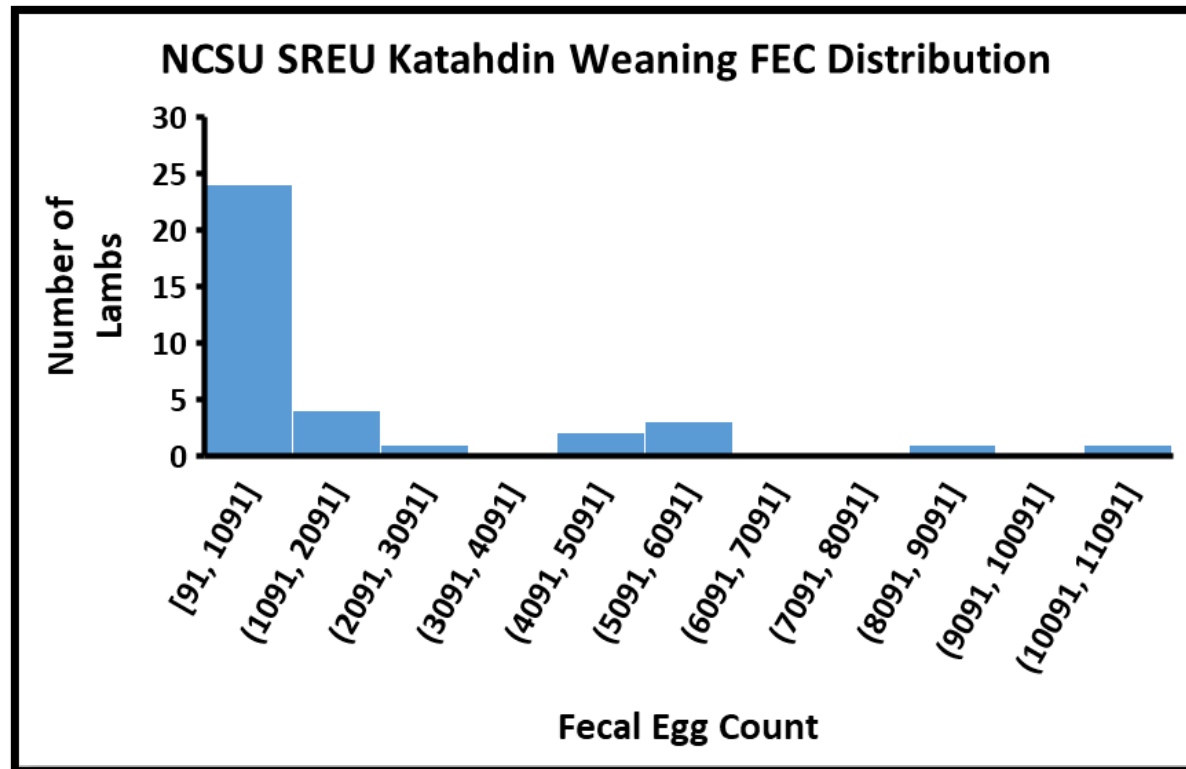
Maintain Refugia

- By only treating a small portion of the animals in a flock, some parasites remain in the population that are susceptible to the dewormer treatment (“refugia”)
- Allows propagation of susceptible genetics in parasite population
- Treatment remains effective



70/30 Rule

70% of the parasites are carried by 30% of the sheep or goats



Proper Drenching

- Provide full dosage using appropriate drench gun
- Read the label!
- Goats generally require higher dosages than sheep
- Use a scale to determine accurate weight

Charts

[Dewormer chart for camelids](#); Lisa Williamson, DVM, University of Georgia and Michael Pesato, Mississippi State University [October 2021].

[Dewormer chart for goats](#); Ray Kaplan, DVM, PhD, University of Georgia and Michael Pesato, Mississippi State University [October 2021].

[Dewormer chart for sheep](#); Ray Kaplan, DVM, PhD, Lisa Williamson, DVM, MS. University of Georgia and Michael Pesato, Mississippi State University [October 2021].

<https://www.wormx.info/dewormers>

Combination Dewormer Use

- Choose one dewormer from each class
- Drench with each dewormer at labelled dosage in sequence => Do **NOT** mix dewormers together
- Consult veterinarian due to extra-label use
- Targeted Selective Treatment

| Benzimidazoles | Macrocyclic Lactones | Nicotinics |
|--------------------------------------|--------------------------|--------------------------|
| Fenbendazole (Safeguard, Panacur) | Ivermectin (Ivomec) | Levamisole (Prohibit) |
| Albendazole (Valbazen) | Moxidectin (Cydectin) | Pyrantel |

Copper Oxide Wire Particles

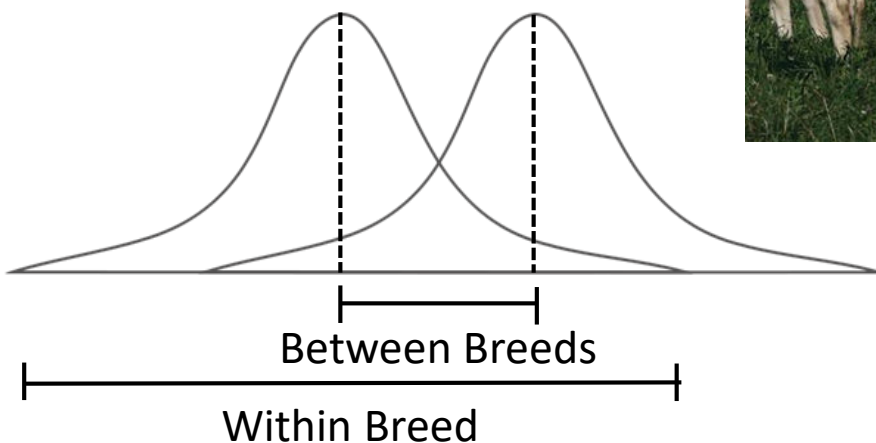
- Copper in small doses can be given to sheep
- Particles are packaged in gelatin capsules
 - 0.5-1 g per lamb
 - 1-2 g per ewe
- Negative impacts on adult *Haemonchus* survival
- Effective treatment method
 - Only use on FAMACHA > 3

[www.wormx.info/
copper-oxide-
wire-particles](http://www.wormx.info/copper-oxide-wire-particles)



Genetic Variation in Parasitism

- Between breeds
 - Parasite Resistant
 - Parasite Susceptible
- Within breed

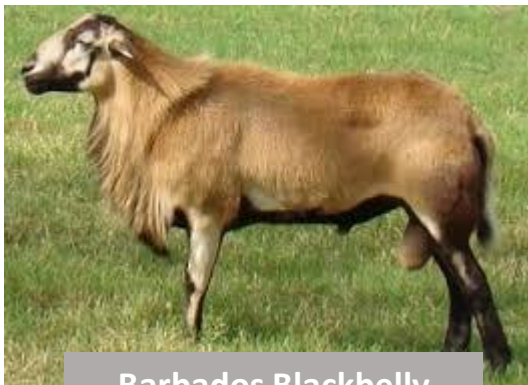


Genetic Variation in Parasitism

Resistant



Susceptible



Selection Tools

- Phenotypic Selection
 - FAMACHA Records
 - Deworming Records
 - Identify repeat offenders
 - **Fecal Egg Counts**
 - Identify those that actually have the worms!
- Implement good culling practices
 - Identify the 30% that carry 70% of the worms



Table 1. Selection traits for resistance and resilience to parasites

| | Range of values | Advantages | Disadvantages |
|-----------------------------------|-----------------|---|---|
| Deworming history | Yes-No | Easy | Marginal impact Selects more for resilience |
| Bottle jaw | Yes-No | Easy | Marginal impact Selects more for resilience |
| Body condition score (BCS) | 1-5 | Easy to perform | Not specific for identifying worm resistance or resilience since other factors can reduce BCS Need to be careful not to select against highly productive females which may have reduced BCS. |
| FAMACHA® eye anemia score | 1-5 | Easy to perform More accurate than above criteria Better correlation with FEC | Also selects for resilience Animals with low FAMACHA® may still be shedding a lot of eggs. Training required |
| Fecal egg count (FEC) | 0 to 25,000+ | Greater variability in data enables more accurate selection Selects for resistance rather than resilience. Best way to identify resistant (or susceptible) animals. | Labor intensive Most expensive |

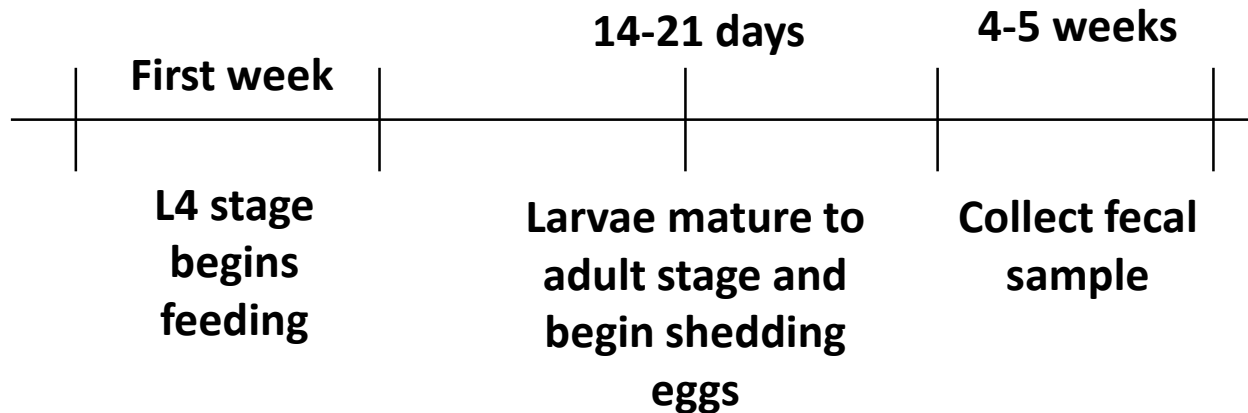
Adapted from Kathy Bielek, Blueprint for selecting resistant sheep: a shepherd's perspective (2017)

Sheep need to be challenged!

- After larval exposure, it takes 3 weeks before FEC (prepatent period)
- Time FEC collection for 4-5 weeks after known parasite exposure (goal for at least 500 EPG average)



L3 Larvae
(Infective stage)



Sheep/goats can die suddenly of acute haemonchosis with no FEC

Selection Tools

- Records
 - Phenotypic selection
- Estimated Breeding Values (EBV)
 - Quantitative selection
 - Measure of individual genetic merit
 - Combines:
 - Individual performance
 - Pedigree information
 - Progeny data
 - Genomic data (Katahdins)



Selection Tools

- Records
 - Phenotypic selection
- **Estimated Breeding Values (EBV)**
 - **The best tool in the toolbox**



Estimated Breeding Values (EBV)

- Predictor of genetic merit
- Numerical representation of genotype
- Simplify selection practices
- More accurate than:
 - Raw performance data
 - Adjusted performance data
 - Ram tests



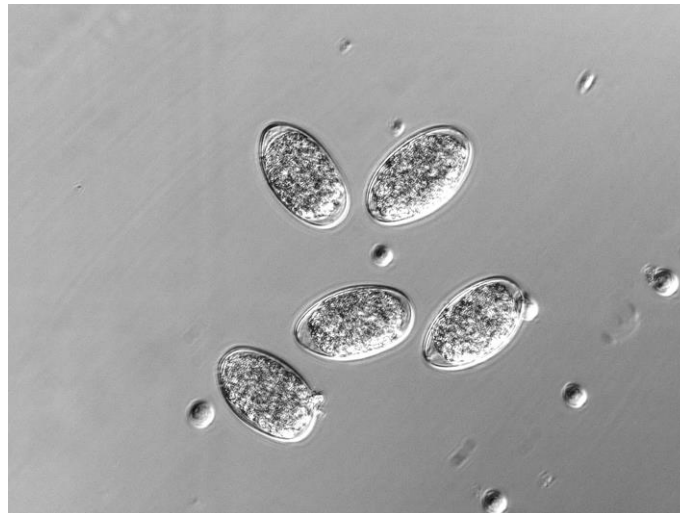
Phenotype = **Genotype** + Environment



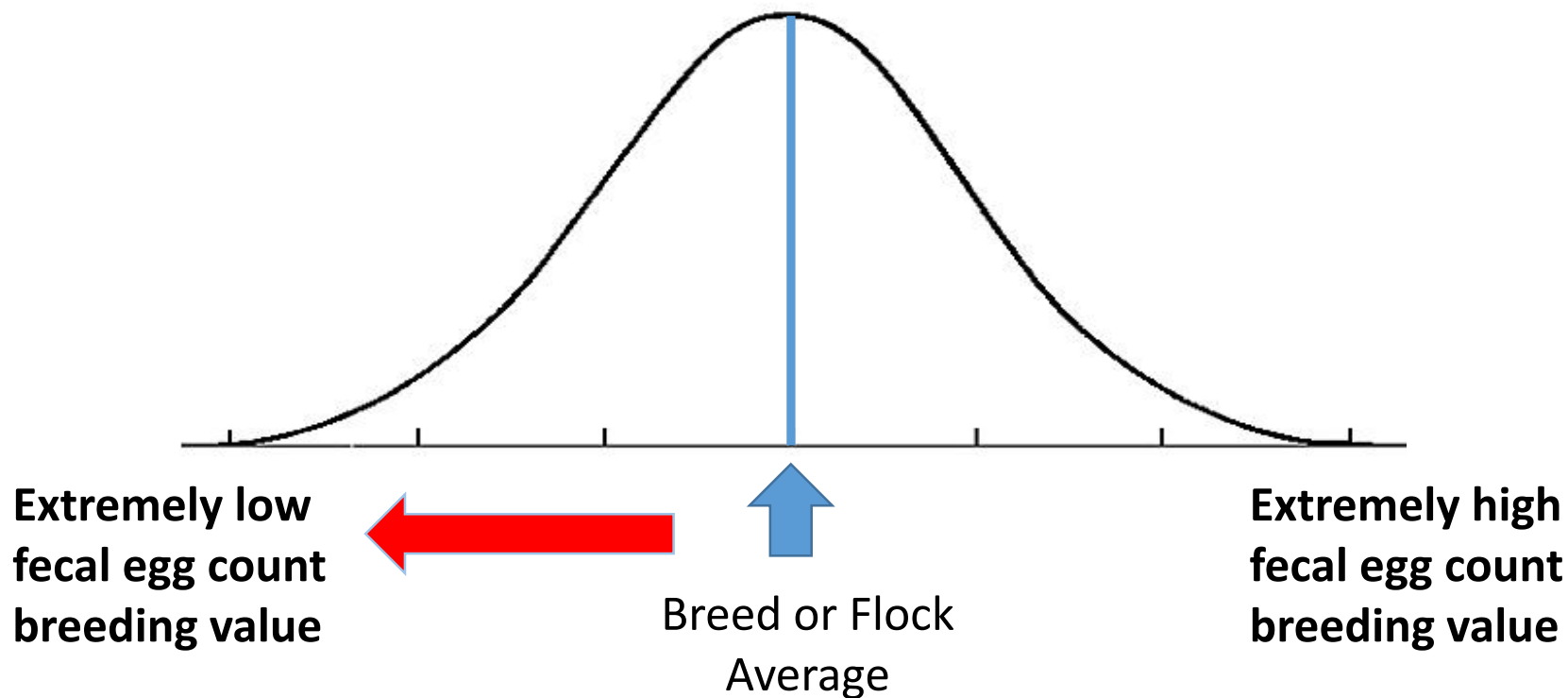
Phenotype = **Breeding Value** + Environment

Fecal Egg Count EBV

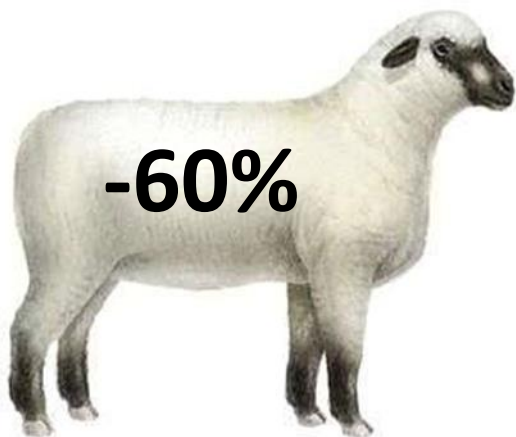
- Developed at Virginia Tech in the early 2000's
- FEC heritability: 20-25% (moderate)
- Reported as a PERCENT CHANGE
- Negative values are GOOD
 - Indicates the genetic potential to reduce FEC



Selection for Parasite Resistance

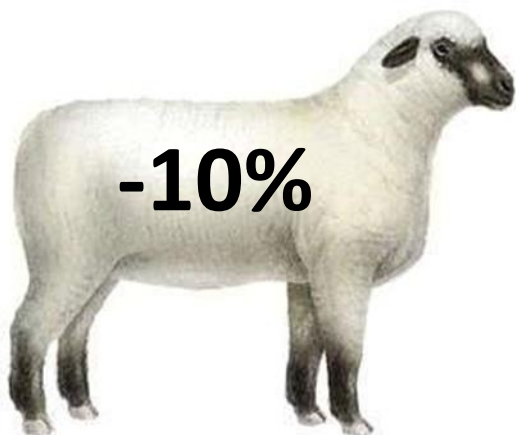


Fecal Egg Count EBV



-30%

$EPD = (\frac{1}{2})EBV$



-5%

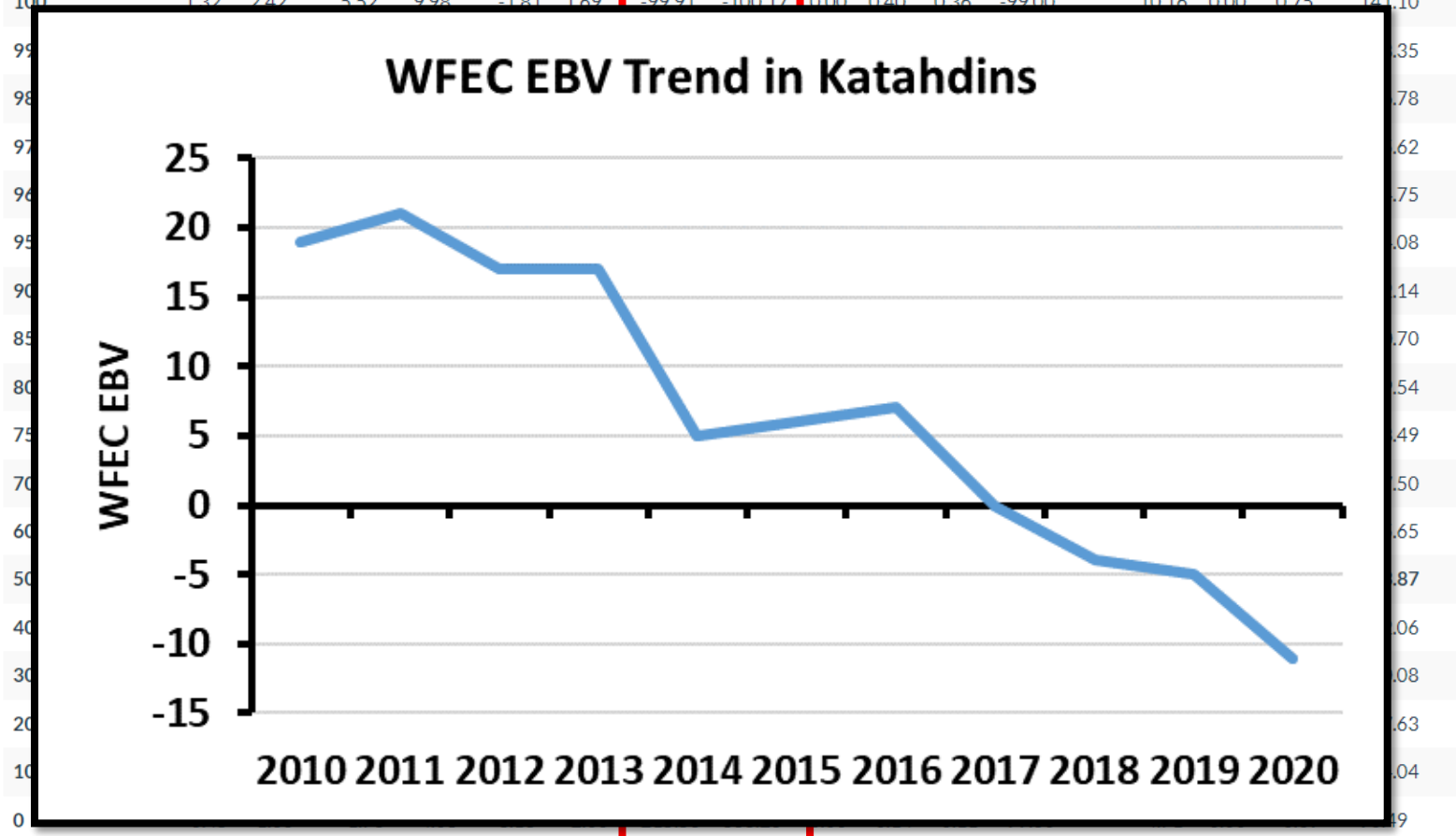
**Expected FEC difference
between lambs sired by
these rams is 25%**

Katahdin Percentile Report

May 2022

2021-2022 born lambs with genetic linkages

| Percentile | BWT | MWWT | WWT | PWWT | PFAT | PEMD | WFEC | PFEC | PSC | NLB | NLW | US Hair Index | YWT | HWT | MBWT | SRC\$ Index |
|------------|------|------|------|------|-------|------|--------|---------|------|------|------|---------------|-------|------|------|-------------|
| 100 | 1.32 | 2.42 | 5.52 | 9.98 | -1.81 | 1.69 | -99.91 | -100.17 | 0.00 | 0.40 | 0.36 | -99.00 | 10.16 | 0.00 | 0.75 | 141.10 |



| Units | kg | kg | kg | kg | mm | mm | % | % | cm | % | % | | kg | kg | kg | |
|-----------------|------|------|------|------|------|------|------|------|----|------|------|------|------|----|------|------|
| Number of Lambs | 9154 | 9154 | 9154 | 9154 | 2375 | 2375 | 4972 | 4972 | 0 | 8893 | 8893 | 9154 | 9154 | 0 | 9154 | 9016 |

BioWorma[®]

- Fungus (*Duddingtonia flagrans*) that disrupts parasite life cycle at larval stage in feces
- Does not treat infection inside sheep
- Lowers pasture larval burden and opportunities for reinfection

| Bodyweight (lb.) | BioWorma Dose (oz) | Cost/head/day |
|------------------|--------------------|---------------|
| 50 | 0.05 | \$0.10 |
| 100 | 0.1 | \$0.20 |
| 200 | 0.2 | \$0.40 |



Confinement Housing

If parasite infection cannot be managed on pasture, lambs can be moved to confinement housing

- GI nematode parasites cannot complete lifecycle in dry lot environment (removes chance for reinfection)
- Consider increased costs of buildings, feed, labor and potential improvement in animal performance



Create a Plan

- What is practical?
- What can be implemented on your farm?
- Use a **combination** of different methods

Parasite Management Plan for NCSU Small Ruminant Unit

1. Select rams based on FEC EBV and measure FEC in lambs
2. Rotate pastures frequently and minimize overgrazing
3. Only treat animals when absolutely necessary
4. Provide nutritional supplementation/confinement housing during high stress/susceptible times

Evaluate Results

- Continue to monitor parasites
 - FAMACHA Scoring
 - 5-Point Check
 - Fecal Egg Counts
 - Deworming Records
- Use **DATA** to make decisions
 - Are metrics improving?
 - Yes => keep to the plan
 - No => explore other options, add tools to the toolbox



Questions



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