



NATIONAL CENTER FOR
APPROPRIATE TECHNOLOGY

WSARE IPM Train the Trainer

Integrative Parasite Management: Sheep

Dave Scott, NCAT



Thanks to WSARE

Project EW 17-011

Integrated Parasite Management: Train the Trainer



Integrative Parasite Management



NCAT Photo: Dave Scott

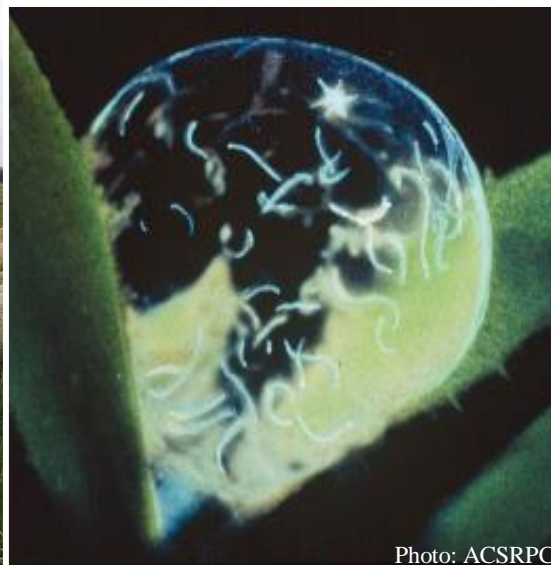


Photo: ACSRPC

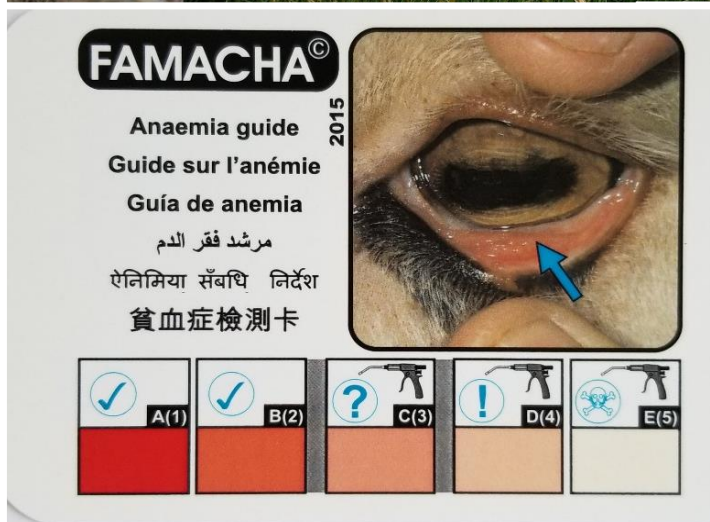


Photo: ACSRPC



NCAT Photo: Dave Scott



ATTRA Resources

- Regenerative Grazing
- Sheep Internal Parasites
- Much More!



ATTRA
SUSTAINABLE AGRICULTURE

ATTRA is a program of the National Center for Appropriate Technology

Visit us online at attra.ncat.org



ATTRA IPM Tip Sheets

- ATTRA>Livestock and Pasture>Cattle, Sheep, Goats...>
 - Parasite Management for Sheep on Irrigated Pastures
 - Frequently Asked Questions about Integrated Parasite Management
 - How Fecal Egg Counts Can Help You Fight Parasites
 - Why FAMACHA® Score?
 - Graze to Control Parasites
 - Simple Genetic-Selection Strategies to Manage



NCAT Photo: Dave Scott



State Sheep Extension

- Ask them!

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Utah Sheep Specialist

Dr. Chad Page

435-797-2152

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NCAT Photo: Dave Scott

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wormix.info

- American Consortium for Small Ruminant Parasite Control (ACSRPC)



Photos: ACSRPC



Sheep POTENTIAL

- Wean the weight of Mama!



NCAT Photo: Dave Scott

Can Cattle
Do It?

No!



Photo: Maggie Clark



Roadblock to Success: **Parasites!**



NCAT Photo: Dave Scott



Internal Parasites

- #1 health problem in sheep and goats in Irrigated Pasture
- Sheep and goats are the most susceptible livestock to internal parasites.
 - Close grazing
 - Graze near fecal pellets
 - Slow-to-develop immunity
- We can no longer rely on anthelmintic treatments alone to control parasites; a much more integrated approach is necessary.
 - Few anthelmintics are FDA-approved for sheep, even fewer for goats.
 - Anthelmintic resistance is real and increasing.
 - New drugs take a lot of time and money to develop and reach the market place (if ever).



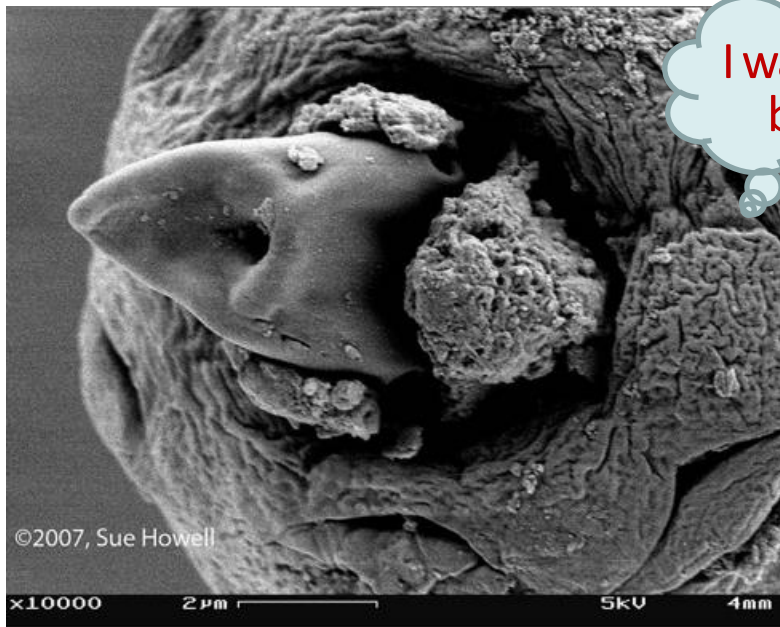
Photo: Joan Burke. ARS

anthelmintic = dewormer = anti-parasitic drug



Haemonchus contortus

- The Barber Pole Worm
 - A blood-sucking parasite (roundworm) that pierces the mucosa of the abomasum (ruminant “stomach”) and causes blood plasma and protein loss to the sheep, goat, or camelid.



I want your blood!

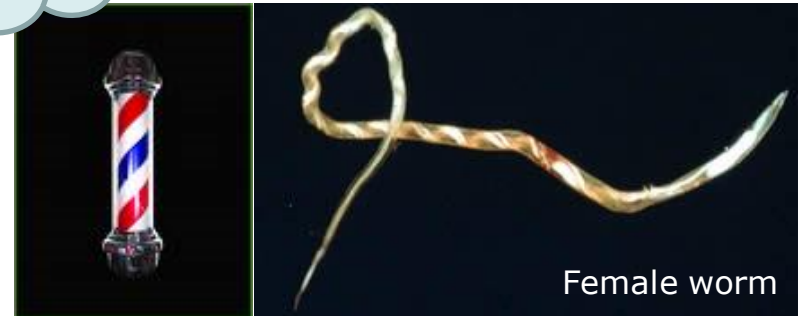


Photo: ACSRPC

0.05 ml blood per day

Photo: Sue Howell, University of Georgia



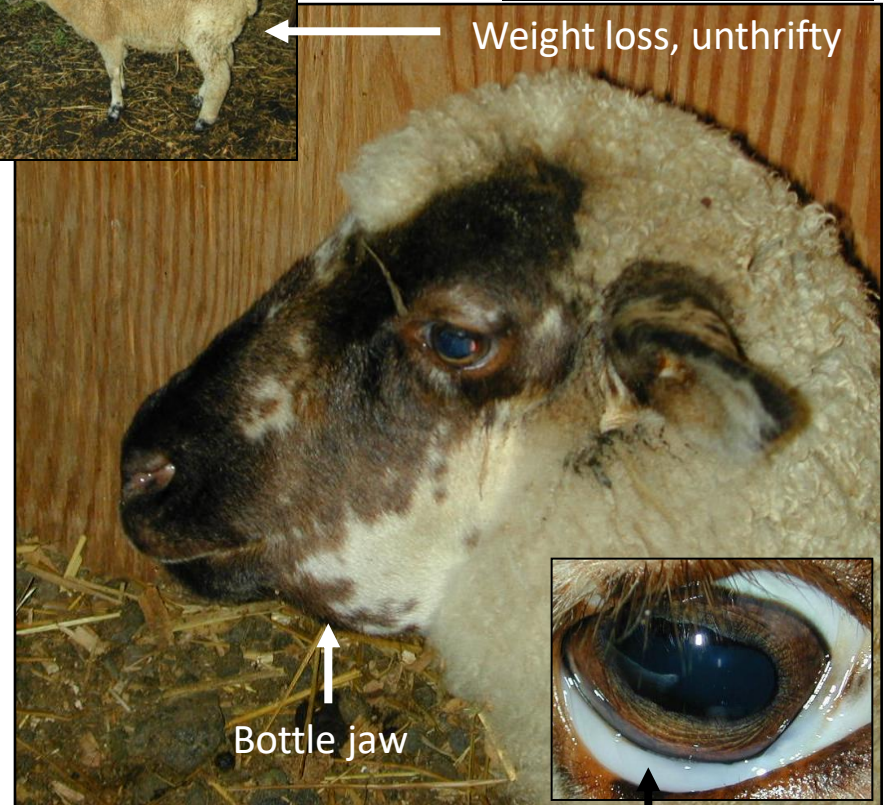
Barber Pole Worm

- Symptoms
 - Pale mucous membranes
 - Edema (bottle jaw)
 - NOT diarrhea (scours)
 - Ill thrift
 - Sudden DEATH
- Difficult to control
 - Short, direct life cycle
 - Prolific egg producer
 - Can go into “hypobiotic” (arrested) state during winter to survive
 - Can survive on pasture for a long time
 - Adaptable

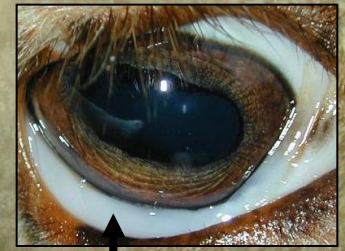
Rough hair coat



Weight loss, unthriftiness



Bottle jaw



Photos: ACSRPC

Pale membranes

The most common parasite in the West!



Other Gastro-Intestinal (Round) Worms (Strongyle Family)



Photos: ACSRPC

Ostertagia
Teladorsagia
Nematodirus

- Direct life cycles
- Burrow into the wall of the abomasum or intestines.
- Usually secondary in importance.
- Usually have an additive effect in mixed parasitic infections.
- Symptoms: scouring, weight loss, rough hair coat, ill thrift, poor appetite.



Coccidia= Protozoa

Eimeria sp.

- Normal inhabitant of ruminant's GI system



Photos: ACSRPC

Fecal samples may or may not be helpful in diagnosing disease

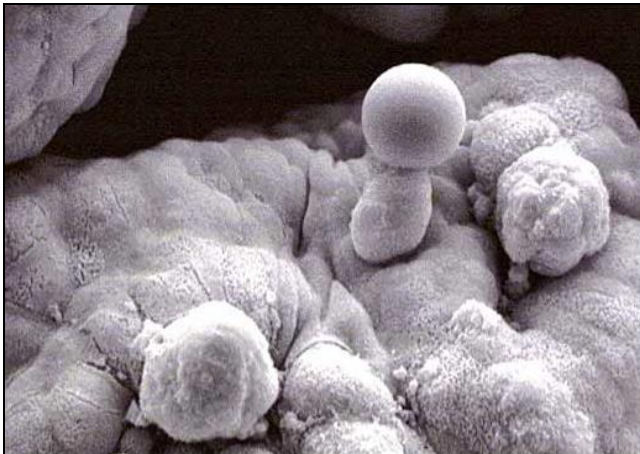
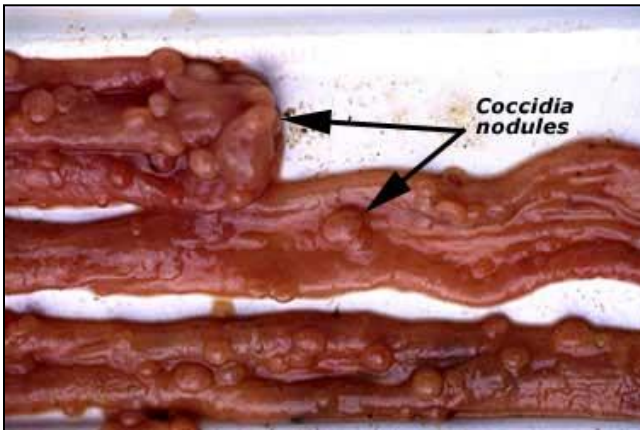
- Single-cell protozoa that damage the lining of the small intestines
 - Causes diarrhea that may be smeared with blood and/or mucous
 - Signs of disease occur ~17 days after infection (ingestion of oocytes)
 - Damage can be permanent
- Prevent with good sanitation and proper stocking.



Coccidia

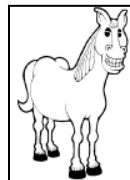
Eimeria sp. (species-specific)

- Normal inhabitant of ruminant's GI system



Photos: ACSRPC

- Can use additives in feed, mineral, or water to prevent clinical disease in groups of animals:
 - Lasalocid (Bovatec®)^{1,3}
 - Monensin (Rumensin®)^{2,3}
 - Decoquinate (Deccox®)^{1,2}
 - Amprolium (Corid®) in water
- Treat (individual animals) with Amprolium (Corrid)



¹ FDA-approved for sheep

² FDA-approved for goats

³ TOXIC to EQUINES!!!

How Do Sheep Get Infected with BP?

- Sheep + grazing (pasture) = worm infection
 - *L3's infective larvae ingested* → *L4's and adults suck blood*

80% of population

20% of population



Consider Host Resistance

Most susceptible

- Weaned lambs
- Orphan lambs
- Yearlings
- High producing females
- Late-born lambs and kids
- Geriatric animals



Less susceptible

- Mature animals
- Dry ewes
- Mature wethers
- Rams

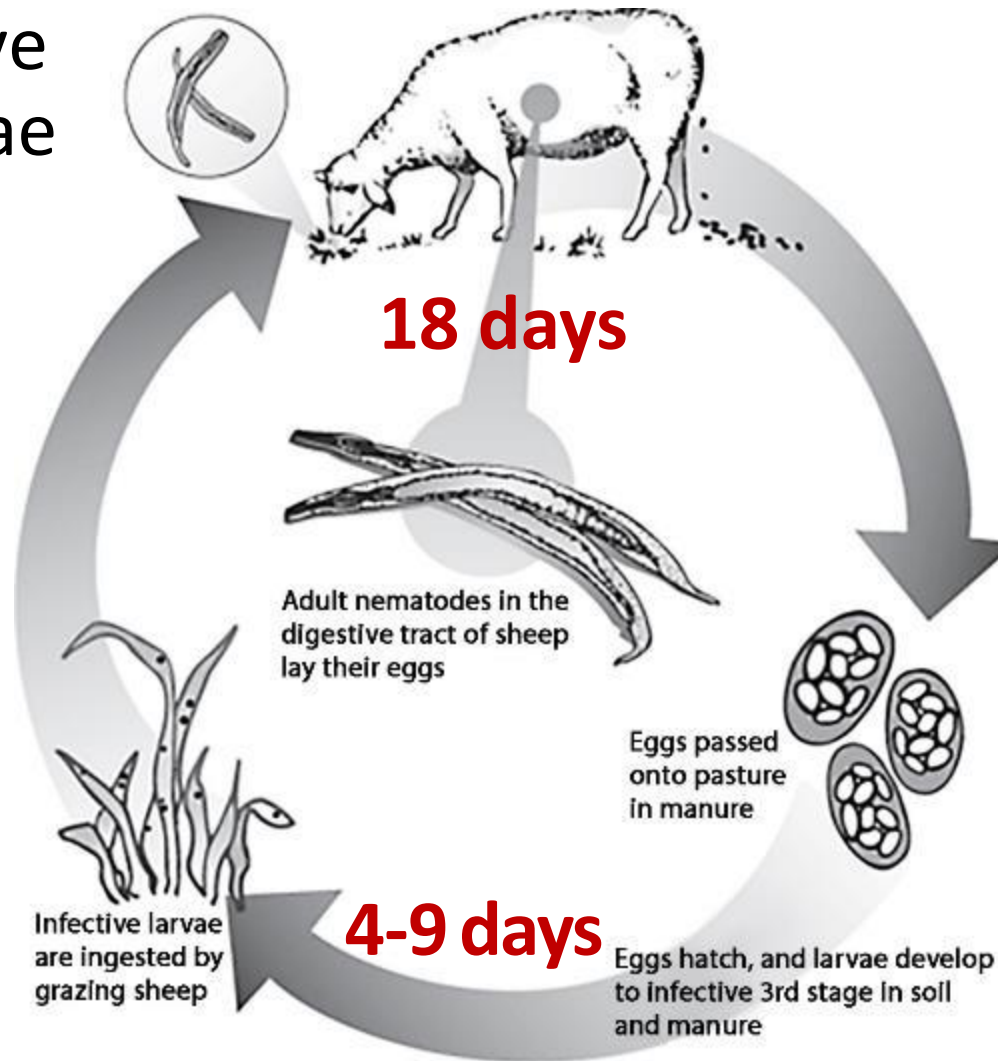


Photos: ACSRPC



Barber Pole Life Cycle

Infective
L3 larvae



Source: ACSRPC

Hypobiosis

Periparturient Egg Rise



Photos: ACSRPC

- Temporary loss of immunity to parasites at the time of parturition. Egg counts ↑
- Often coincides with hypobiotic F4 larvae resuming their life cycles in the spring.
- Dams are the primary source of infection to their offspring.
- Consider deworming with an anthelmintic that is effective against hypobiotic larvae.
- Increase protein in late gestation ration to counter egg rise.

How We Get into Trouble

- Each adult worm lays 5,000-10,000 eggs/day

One Ewe:

- 200 eggs per gram
- Ewe poops 4 lbs./day or 1,814 grams
- $1,814 \text{ grams} \times 200 = 362,000 \text{ eggs per day!}$



100 Ewes:

36.2 million eggs per day

100 ewes per acre=

700 eggs/square foot



How Do We Get Them?

- They are just there
- You may buy them....and....Parasite Resistance
- Dryland Range: Watch out for Riparian areas
- Rainfall/Irrigated: You are a nice target



NCAT Photos: Dave Scott

Genetics and Worms

- Two important traits: resistance and resilience

Resistance

- Ability of host to limit infection
- Assessed by fecal egg counts (FEC)

Resilience

- Ability of host to withstand challenge and/or infection, and thus maintain health and productivity.
- Assessed by blood hematocrit or packed cell volume (PCV) and estimated by FAMACHA[®] eye anemia score



NCAT Photo: Dave Scott

Parasite traits are moderately heritable – 20-40%



How Do You Know What Kind of Parasites Your Sheep Have?



NCAT Photo: Dave Scott

Fecal Egg Counts

- Differentiates between roundworms and cocci. This enables a treatment protocol
- Use in fecal egg count reduction test (FECRT)
- Use in selection of resistant sheep for flock replacements
- Provide data for National Sheep Improvement Program's Breeding Values
- Use in the DrenchRite Assay
www.wormx.info/drenchriteassay
- See the tipsheet, *How Fecal Egg Counts Can Help You Fight Parasites* <file:///C:/Users/monta/Downloads/fecaleggcounts-tipsheet.pdf>



FEC: What You See

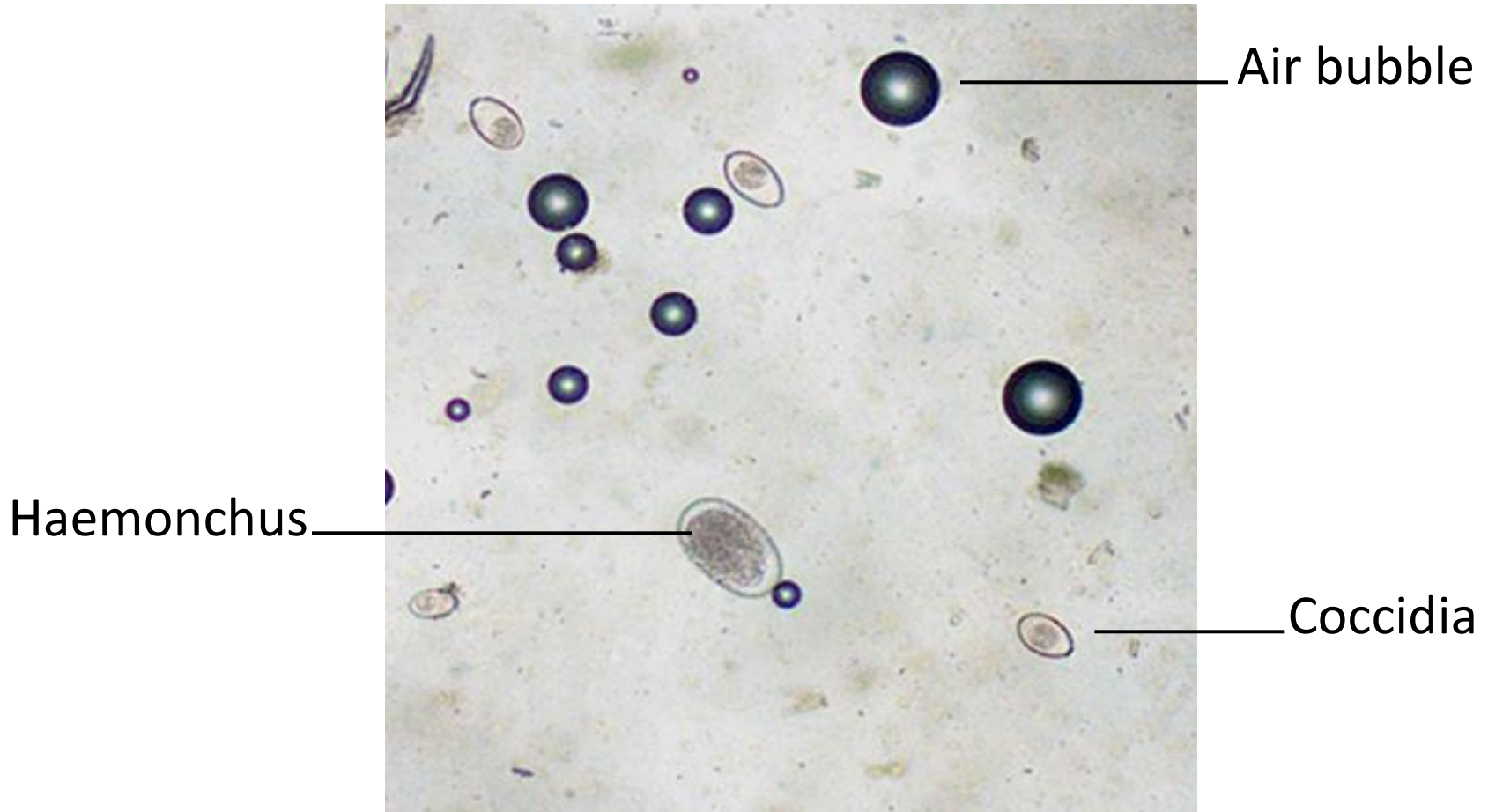


Photo: Dr. Bob Story, UGA College of Veterinary Medicine

Learn how to do your own McMaster's FEC

<https://www.youtube.com/watch?v=ZZQymZKehs&feature=youtu.be>



Integrated Parasite Management (IPM)

- Goal is **NOT** to create parasite-free animals
- It's normal for sheep and goats to have parasites
- Goal **IS** to prevent clinical disease and production losses



Tool #1: Deworming Strategy Tips

- Oral, Injectable
 - Use one dewormer until it stops working
 - Combination dewormers
 - Use correct dose
- Related:
 - Should I consider using LongRange™ dewormer for parasite control in small ruminants?

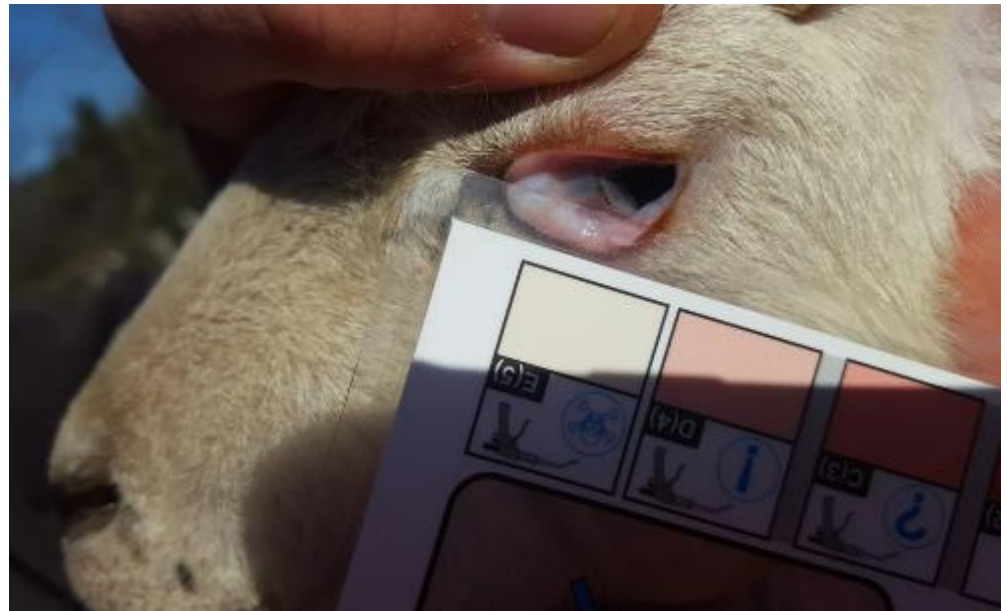


Photo: ACSRPC



Refugia

- Limit the EXPOSURE of dewormer to worms
 - LongRange???? A Trap!
- 70-80% of infection from 20-30% of ewes
- Dewormer only can kill 98% (At Best)
- Deworm infected sheep; LEAVE THE REST
- HOW?



NCAT Photo: Dave Scott

The Answer: FAMACHA

FAMACHA®

2015

Anaemia guide

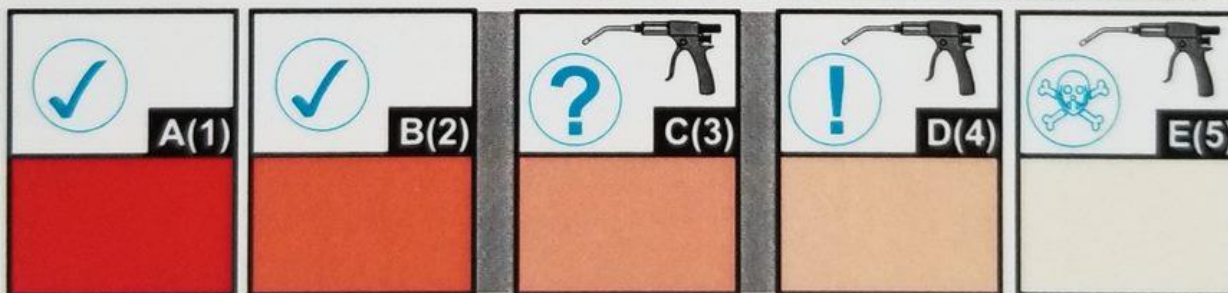
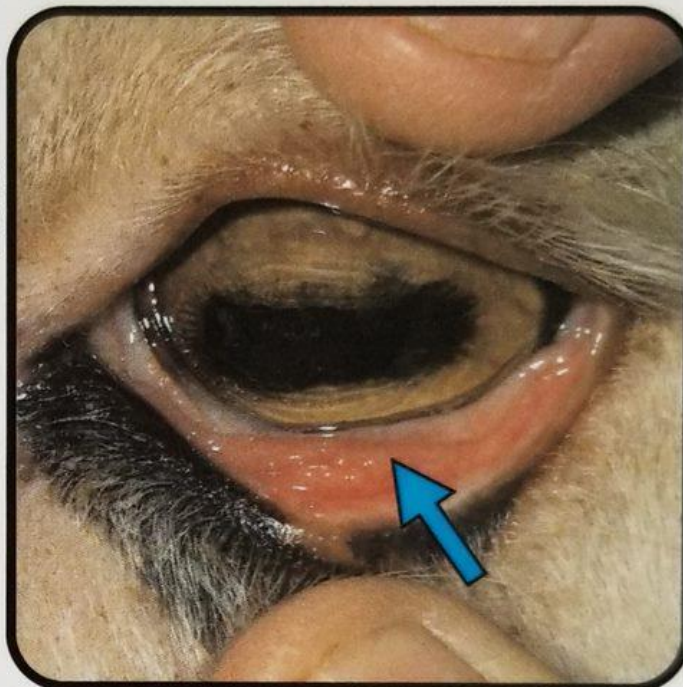
Guide sur l'anémie

Guía de anemia

مرشد فقر الدم

ऐनिमिया सँबधि निर्देश

貧血症檢測卡



Deworm F3, F4, F 5 – Leave the Rest



© Ken Kailing, GoodFood World

Selective
Deworming=
REFUGIA

Photo: Ken Kailing



But FAMACHA Takes Longer

- NO!
- Good Facilities= 125 sheep per hour
 - www.youtube.com/watch?v=qk9vtCnbhz4
 - You treat 20-30%
- Less Dewormer Cost!
- Remember : FAMACHA First! Then Deworm



Precautions

- Must know if anthelmintic is effective.
 - FECRT
 - DrenchRite®
- How often should you check animals?
 - Irrigated: depends upon your infection rate
- Always use card! Compare eye color to chart. Store your card in a dark place
- Should only be used by properly trained individuals; improper use can lead to death of animals.



Photos:ACSRPC

Drugs

- Dosage IS VERY Important!
- A valuable, limited resource that must be managed properly

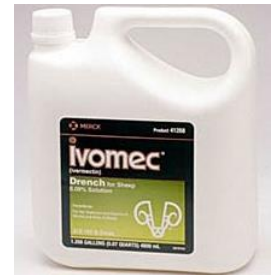


Photo Source: ACSRPC



Three Drug Families

Drugs kill parasites by starving them or paralyzing them

1. Benzimidazoles: Chemical name ends in “dazole”

1. Valbezan
2. Safeguard

2. Nicotinics

1. Prohibit

3. Macrolytic lactones

1. Ivermectin, Cydectin



Key Points: Lose one dewormer; lose all in its class
Do not alternate between dewormers!

Photo Source: ACSRPC

Albendazole

Valbazen® drench

- FDA-approved for sheep (7 day slaughter withdrawal)
- For control of:
 - Adult and 4th stage larvae of GI worms
 - Varying levels of activity against hypobiotic larvae
 - Adult and larval forms of lungworms
 - Heads and segments of tapeworms
 - Adult liver flukes
- Safe, but use restricted during pregnancy (1st 50 days)
- Widespread resistance across industry
- Fast animals to improve efficacy



Photo Source: ACSRPC

Fenbendazole

SafeGuard®, Panacur® drench

- For control of adult GI worms and L4 larvae
- Widespread resistance across industry
- Fast animals to improve efficacy
- Double dosage will kill heads and segments of tapeworms
- One of the preferred drugs for treating meningeal worm

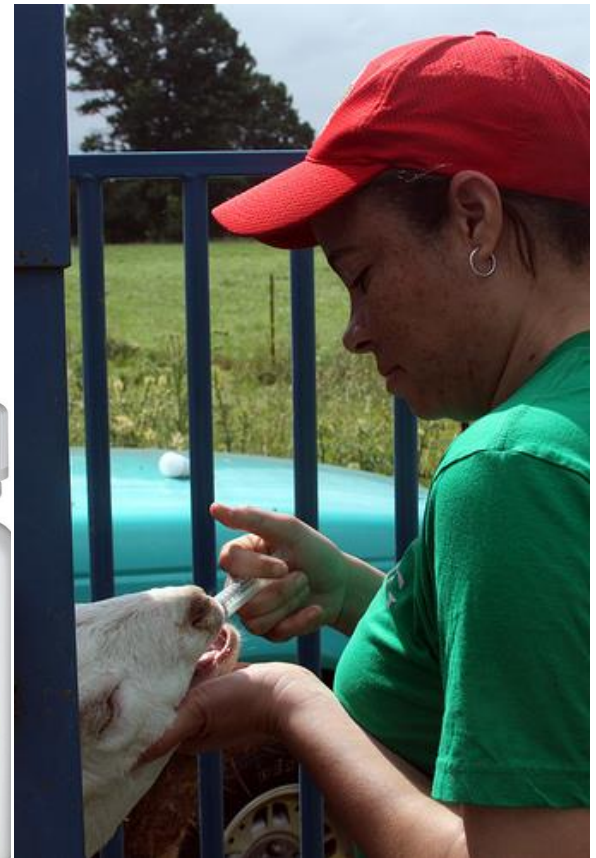


Photo: ACSRPC

Avermectins: Ivermectin

Ivomec® drench

- Introduced in the 1980's
- Drug of choice for meningeal worm
- For control of:
 - Adult and L4 larvae GI worms
 - Hypobiotic larvae
 - Adult and larvae lungworms
 - Larval stages of nosebot
- 11-day slaughter withdrawal
- Fast animals to improve efficacy



Photo Source; ACSRPC

Moxidectin

Cydectin® drench

- Newest drug (1997)
- For control of mature and L4 larval stages of GI worms
- 7-day slaughter withdrawal
- Similar to Ivermectin, but disrupts different chemical neurotransmitter
- May kill Ivermectin-resistant worms
- Due to similarity to Ivermectin, resistance will develop rapidly if it is overused



Photo Source: ACSRPC

Levamisole

Prohibit[®], Levasole[®], Tramisol[®] drench or oblets

- FDA-approved for sheep
(3 days slaughter withdrawal worm)
- For control of:
 - Adult and L4 larvae GI worms
 - Hypobiotic larvae (?)
 - Adult and larvae lungworms
- Probably the most effective anthelmintic
- Lowest margin of safety
 - Treat based on accurate weights
 - Administer orally.
 - Goats – 1.5x sheep dose



Photo Source: ACSRPC

Extra-label Drug Use

- Albendazole (Valbazen[®]), Ivomec[®] drench, Cydectin drench, and Levamisole (drench and bolus) are FDA-approved for sheep.
- Use of a product that is different from its label constitutes extra-label drug use and requires a veterinary prescription.

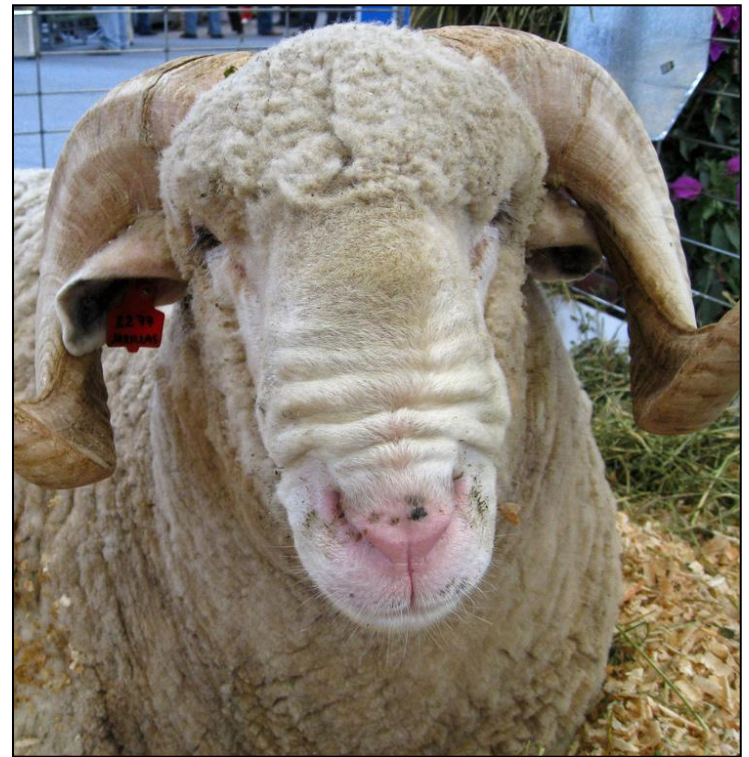


Photo: ACSRPC

Does My Dewormer Still Work?

- Fecal Egg Count Reduction Test
 - 10 sheep, FEC, deworm, wait 7-10 days, FEC
 - 95% kill = no resistance
 - < 60% = severe resistance
- DrenchRite Assay

www.wormx.info/drenchriteassay

(706) 542-0742

Leonor Sicalo Gianechini

leonor@uga.edu



Photo: Sue Howell, University of Georgia



Combination Dewormers

Table 1: Impact of using dewormers in combination on the efficacy of treatments.

The increases in efficacy are due to a simple additive effect as per the equation below:

Where D1 = efficacy of dewormer 1, D2 = efficacy of dewormer 2, D3 = efficacy of dewormer 3, C2 = efficacy of D1+D2, and C3 = efficacy of D1+D2+D3

$$C2\% = D1\% + (100-D1\%)*D2\%$$

$$C3\% = C2\% + (100-C2\%)*D3\%$$

Drug 1 (%)	Drug 2 (%)	Drug 3 (%)	Combination (%)
80	80		96
80	80	80	99.2
90	90		99
90	90	90	99.9
60	95		98
60	60	95	99.2
99	99		99.99
60	60	60	93.6
50	50	50	87.5
40	40	40	78.4

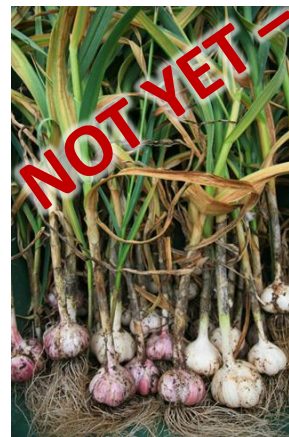
New!

Source: Worm Boss

Non-Chemical “anthelmintics”

- Diatomaceous earth
- Pumpkin seed
- Garlic
- Papaya
- Tobacco
- Wormwood
- Others

So far, efficacy of natural “anthelmintics” has not been proven under controlled, scientific experimentation. Experiments are continuing.



Photos: ACSRPC

Tool # 2- Grazing Strategy

- Remember: 80% of worm population is on pasture
- 35-40 days pasture rest
- Paddock grazing period 4 days
- 6-8 inch residual



NCAT Photos: Dave Scott

35 to 40 Days Pasture Rest

32 day June 2017



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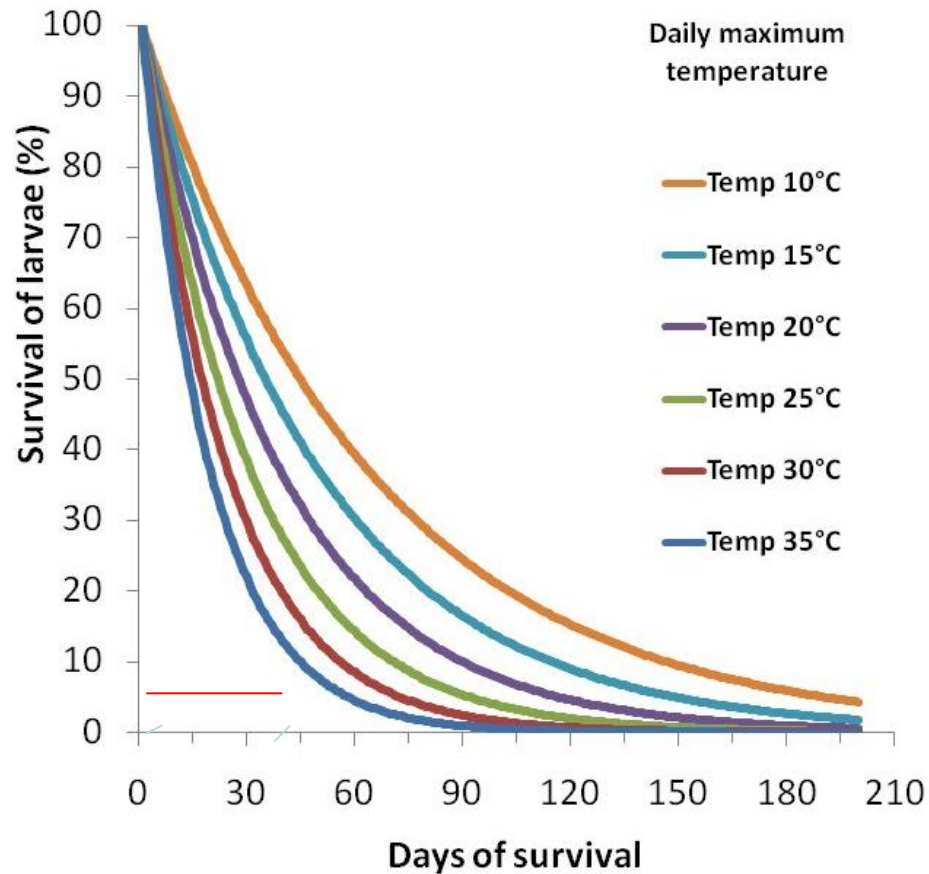
NCAT Photos: Dave Scott



42 day Aug 2019

Larval Survival

Survival of barber's pole worm infective larvae on pasture at various daily maximum temperatures and 60% relative humidity



Source: WormBoss



Hay

- Desiccates 80% of population (L3 infectious Larvae)



Photo: ACSRPC

Four Day (or Less) Paddock Periods

Parasite L3 Larvae Migration to Grass Stem

- Pellet to Stem Sprint
 - Barber Pole Worm: 4-9 Days
- Powered by Water
 - Rainfall or Irrigation
 - Dew will do it
- Move Sheep-
Leave the L3
Behind



NCAT Photo: Rich Myers

Exit with a Six Inch Residual

- L3 Larvae Max Out at 3-4 inches
- Six inches gives you some wiggle room



NCAT Photo: Dave Scott

6-8 Inch Residual



Photo: Pat Hansen

Too Little Residual



NCAT Photo: Dave Scott

Fenceline Weaning



NCAT Photo: Dave Scott

Less Stress = Less Barber Pole Infection

Graze Multiple Species

- Sheep and goats share the same internal parasites, but they are different from the parasites that affect cattle and horses.
- Cattle and horses “vacuum” sheep/goat pastures of infective worm larvae.



Photos: ACSRPC

Condensed Tannin Forages

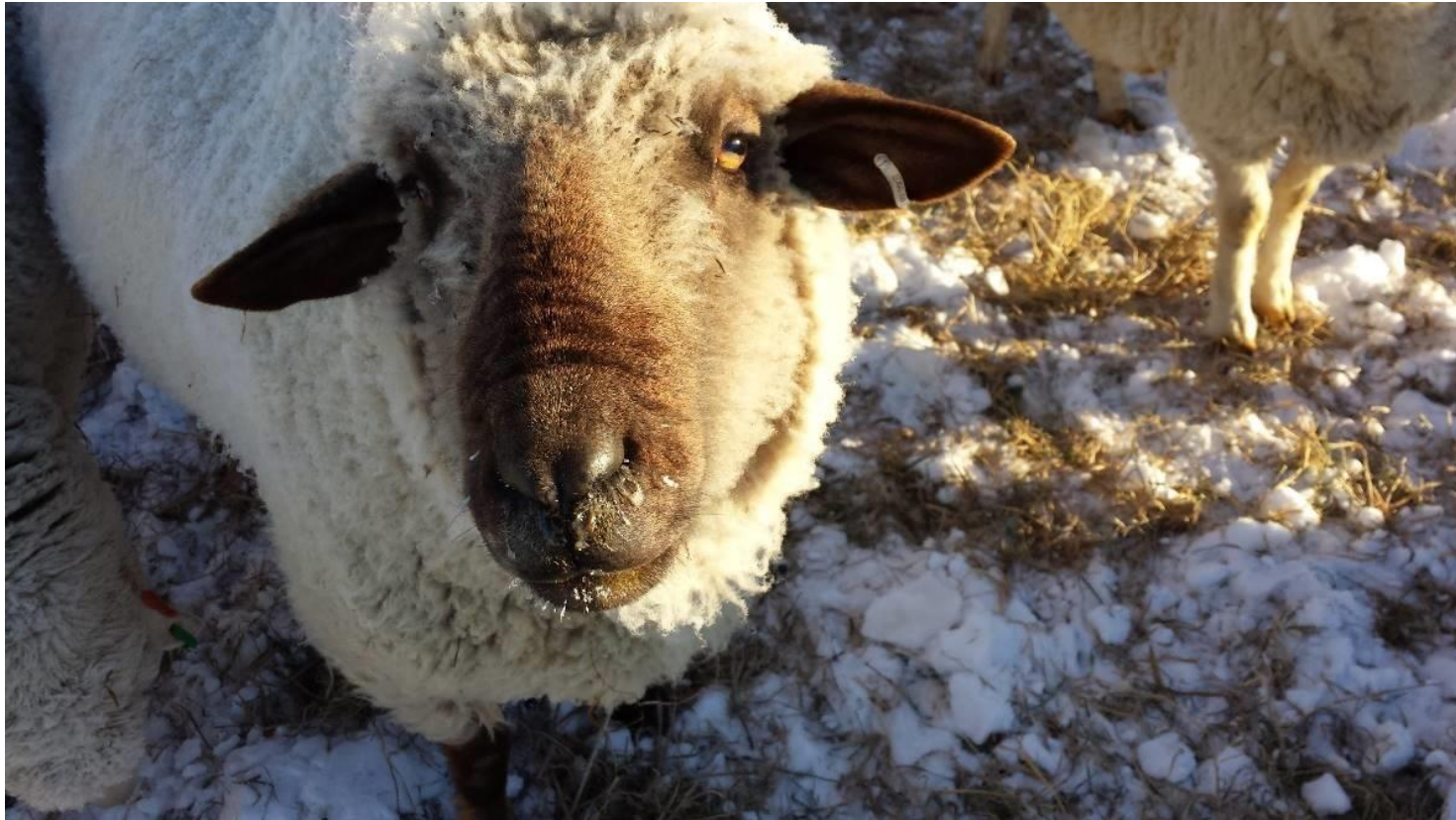
- Sanfoin
- Birdsfoot Trefoil
- Note: need 45 day rest, minimum (irrigated)



NCAT Photo: Dave Scott

Tool # 3 Cull!

FAMACHA Score 4&5



NCAT Photo: Dave Scott

Tool # 4: **Select!**

- Fecal Egg counts of replacement lambs
 - Platinum Plan
 - FEC at weaning and 2-3 weeks post weaning
 - Gold Plan
 - FEC 2- 3 weeks post weaning
 - Compare
 - Simple Genetic Selection Strategies To Manage the Barber Pole Worm <https://attra.ncat.org/product/simple-genetic-selection-strategies-to-manage-the-barber-pole-worm/>
- Note: you must have sufficient Parasite Challenge
 - 500 eggs per gram
 - 25% of sheep scoring F3 –F5



Tool # 4: **Select!**

- Select Replacement Dams
 - FAMACHA 1 & 2
- Replacements: FAMACHA 1 & 2
- Select Rams: ebv's = Katahdin, Polypay



NCAT Photo: Dave Scott

Building Parasite Resistance

- Select for Resistance and Resilience
- Why select for Resilience?
 - Reduces negative impacts on flock performance
 - Maintains survivability with high parasitic exposure
 - Provides animals that commercial producers need
- Why select for Resistance?
 - Focuses on the problem, rather than the symptom
 - Reduces pasture contamination
 - Provides long-term solution to the problem

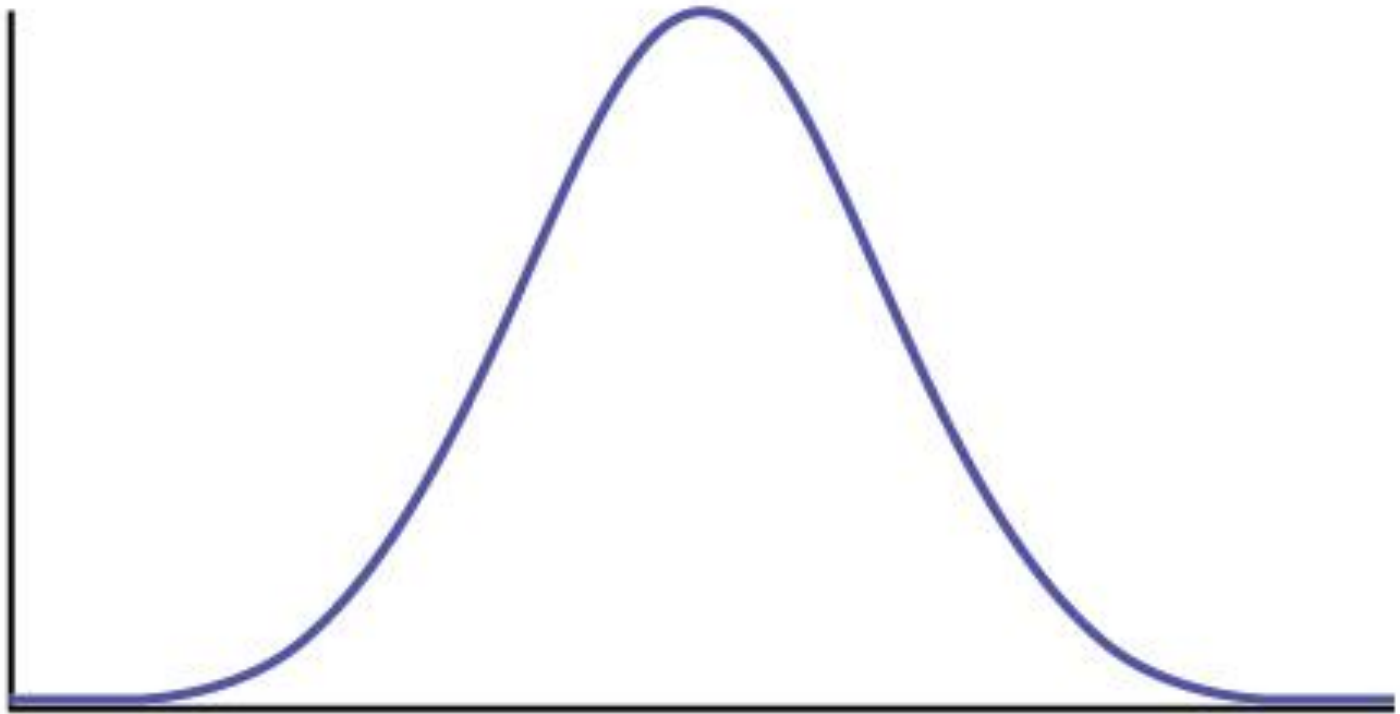


Selecting for Parasite Resistance

- Fecal Egg Counts
 - Can be done yourself
 - Provide a set of quantitative data
 - Are the most accurate to determine resistance (e.g. nutritional and environmental factors)
- Necessary Factors
 - Parasitic challenge (500 epg or higher)
 - Range of counts to determine a difference
 - Consistency in collection



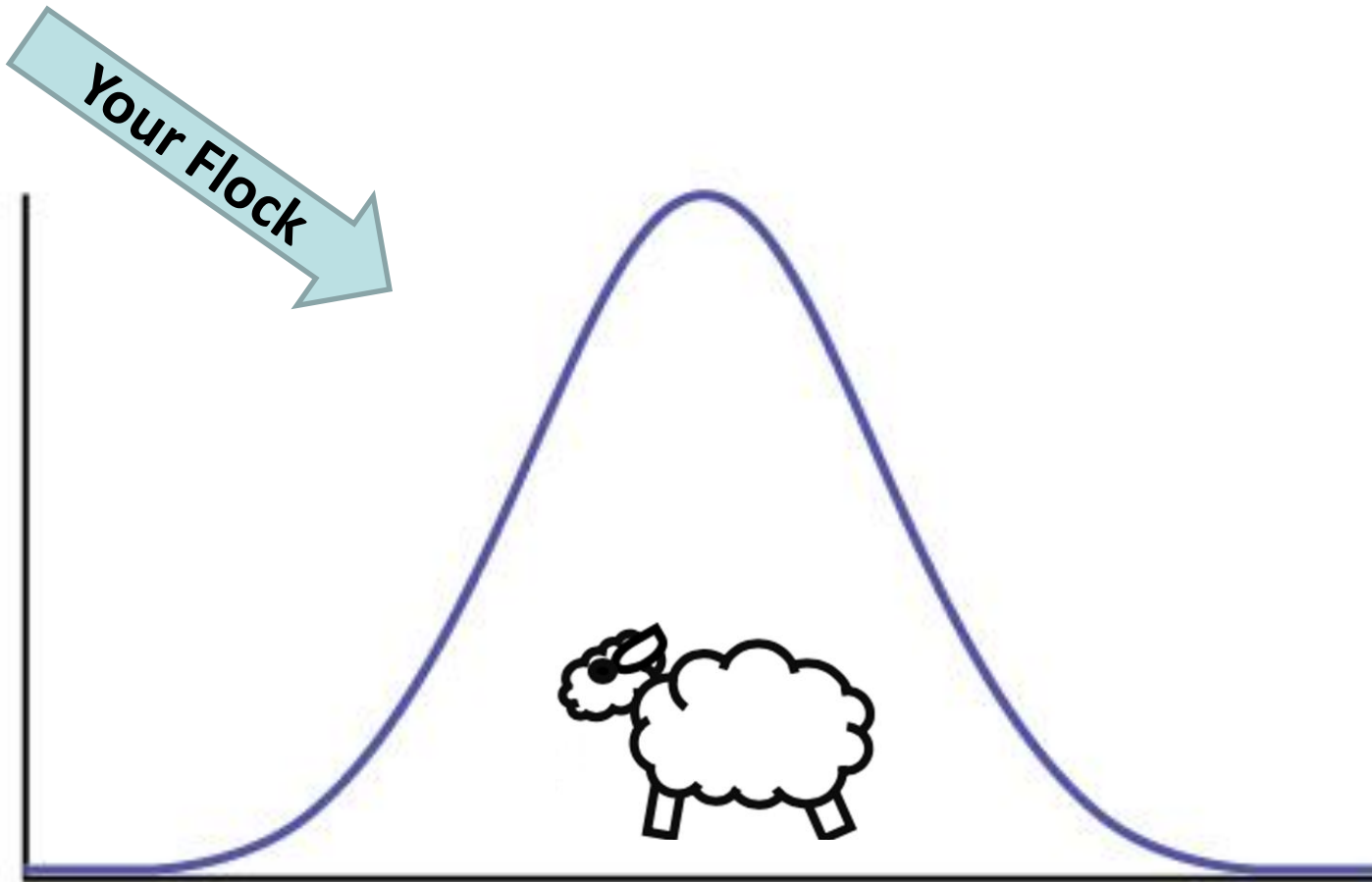
Estimated Breeding Values (EBV's)



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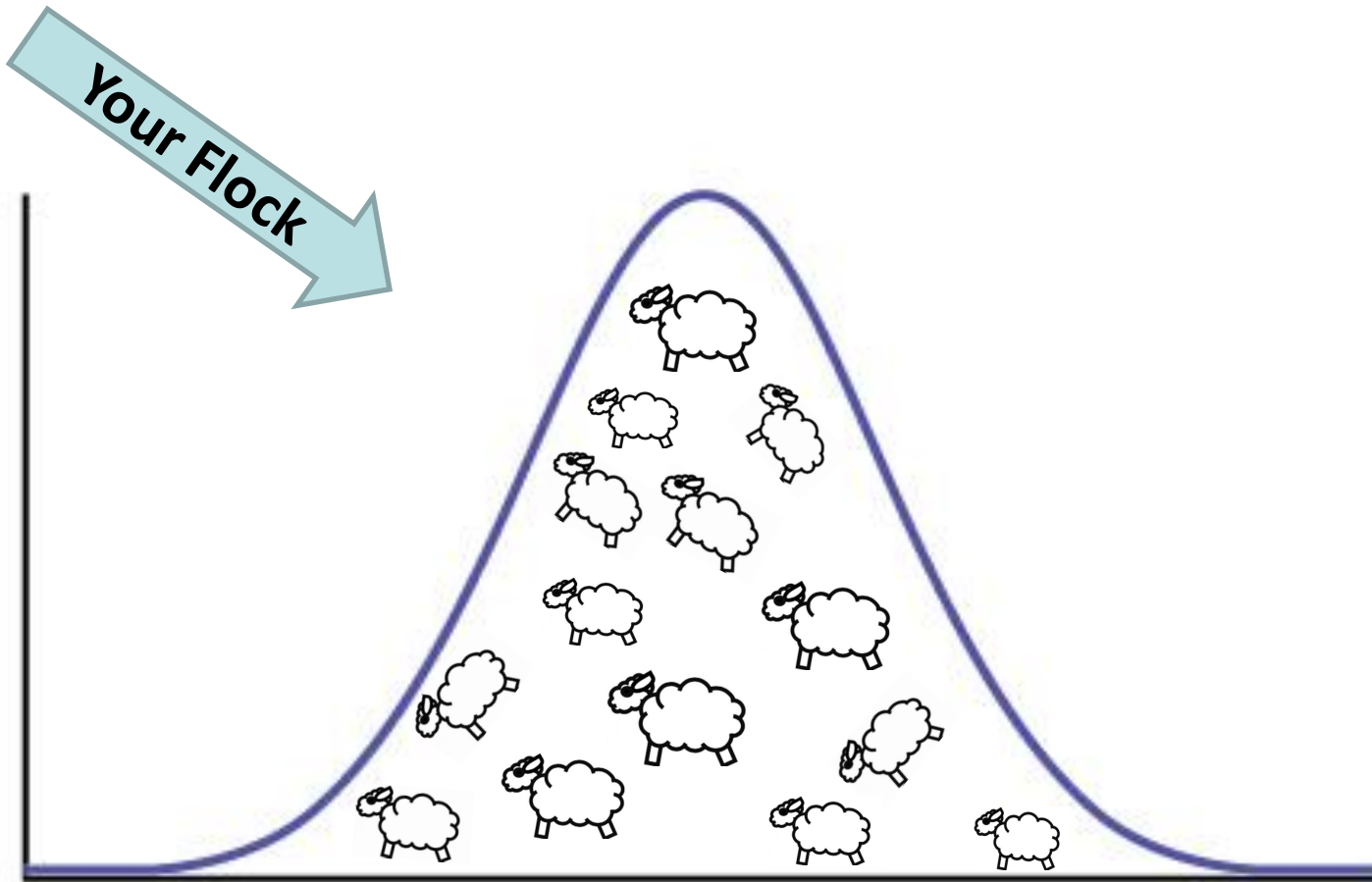


Estimated Breeding Values (EBV's)



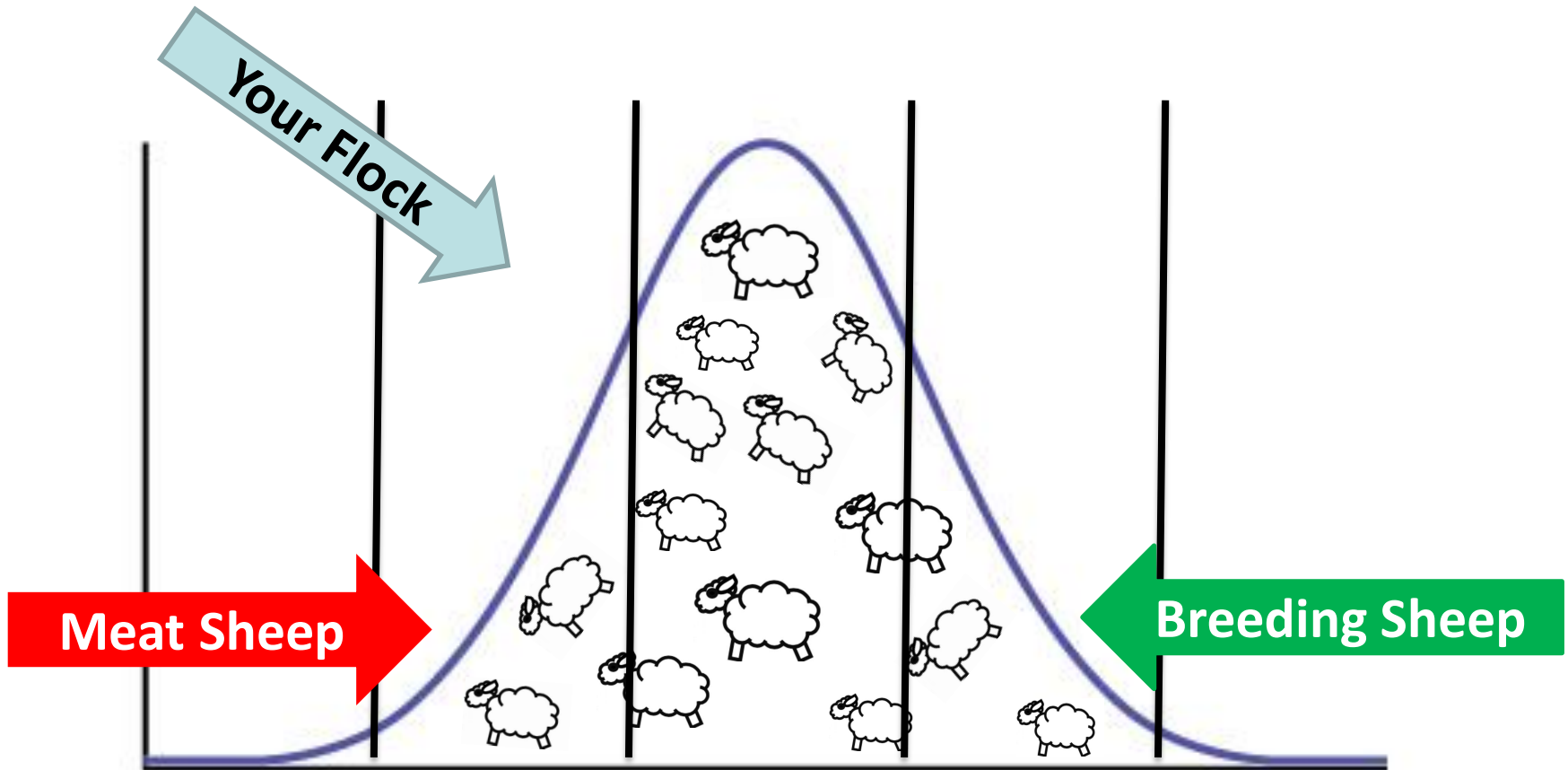
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Estimated Breeding Values (EBV's)



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Estimated Breeding Values (EBV's)



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Using EBV's

6401872020PTK015



Birth Weight (BWT)	0.087
Weaning Weight (WWT)	0.794
Maternal Weaning Weight (MWWT)	0.338
Post Weaning Weight (PWWT)	1.484
Yearling Weight (YWT)	1.391
Weaning Fecal Egg Count (WFEC)	-93.6
Post Weaning Fecal Egg Count (PFEC)	-98.62
Post Weaning Eye Muscle Depth (PEMD)	0
Post Weaning Fat (PFAT)	0
Number of Lambs Born (NLB)	0.091
Number of Lambs Weaned (NLW)	0.126
US Hair Index	105.74

6401872020PTK058



Birth Weight (BWT)	0.089
Weaning Weight (WWT)	1.47
Maternal Weaning Weight (MWWT)	1.08
Post Weaning Weight (PWWT)	2.256
Yearling Weight (YWT)	1.118
Weaning Fecal Egg Count (WFEC)	76.4
Post Weaning Fecal Egg Count (PFEC)	44.64
Post Weaning Eye Muscle Depth (PEMD)	0
Post Weaning Fat (PFAT)	0
Number of Lambs Born (NLB)	0.066
Number of Lambs Weaned (NLW)	0.094
US Hair Index	106.35

<http://nsipsearch.nsip.org/#!/search>



EBV's: Helpful Resources

- <http://nsip.org/nsip-resources-2/estimated-breeding-values/>
- <http://nsipsearch.nsip.org/#!/search>
- <https://www.wormx.info/genetics>
- [https://www.katahdins.org/wp-content/uploads/2016/02/blueprint for selection of parasite resistant sheep.pdf](https://www.katahdins.org/wp-content/uploads/2016/02/blueprint%20for%20selection%20of%20parasite%20resistant%20sheep.pdf)



Summary

- Can worms overwinter? How?
- Should I ever deworm without FAMACHA?
- Besides FAMACHA FIRST, what are the two most important deworming rules?
- What are the two most powerful, long term tools to manage the Barber Pole worm?



Questions?



NCAT Photo: Dave Scott

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