Control of Barberpole Worm in Small Ruminants

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Overview

- Biology of *Haemonchus contortus*
- Understanding drug resistance
- Concept of “Smart Drenching”
- FAMACHA – concepts and practice
- Non-chemical approaches

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Background To The Problem

- Abomasal and intestinal worms are the most important pathogens of sheep and goats
- Worm control has relied almost exclusively on the frequent use of anthelmintics
- Prevalence of multi-drug resistance is extremely high

We Created Our Own Problems

- Parasitologists recommended strategies that maximized benefits of treatment, but ignored resistance issues
- Over-use of anthelmintics
  - Therapeutic vs. prophylactic
  - Loss of common sense approaches
- We are at risk of having no effective anthelmintics to use in the near future
  - “We have what we have”
  - > $200 million to develop new drug

A Fresh Approach Is Needed

- Frequent application of dewormers is no longer a viable approach
- Effective dewormers must be thought of as an extremely valuable and limited resource
- Reduced chemical and non-chemical approaches are needed
- Southern Consortium for Small Ruminant Parasite Control group formed (http://www.wormx.info)

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Gastrointestinal Nematodes (Worms) of Small Ruminants

Major pathogens:

- ***Haemonchus contortus* (southeast US)***
- ***Trichostrongylus colubriformis***
- ***Teladorsagia (Ostertagia) circumcincta***
- ***Trichostrongylus axei***

Less important genera:

- ***Cooperia***
- ***Nematodirus***
- ***Oesophagostomum***
- ***Trichuris***

Haemonchus contortus
(Barber Pole Worm)

- Sheep, goats, deer, exotic ruminants
- Blood-sucking worm
  - highly pathogenic
  - anemia
  - hypoproteinemia -- “bottle jaw”

- Most important worm parasite in sheep/goats raised in warm/wet environments (Southern US and during summer in Northern US)

Anemia

Bottle Jaw

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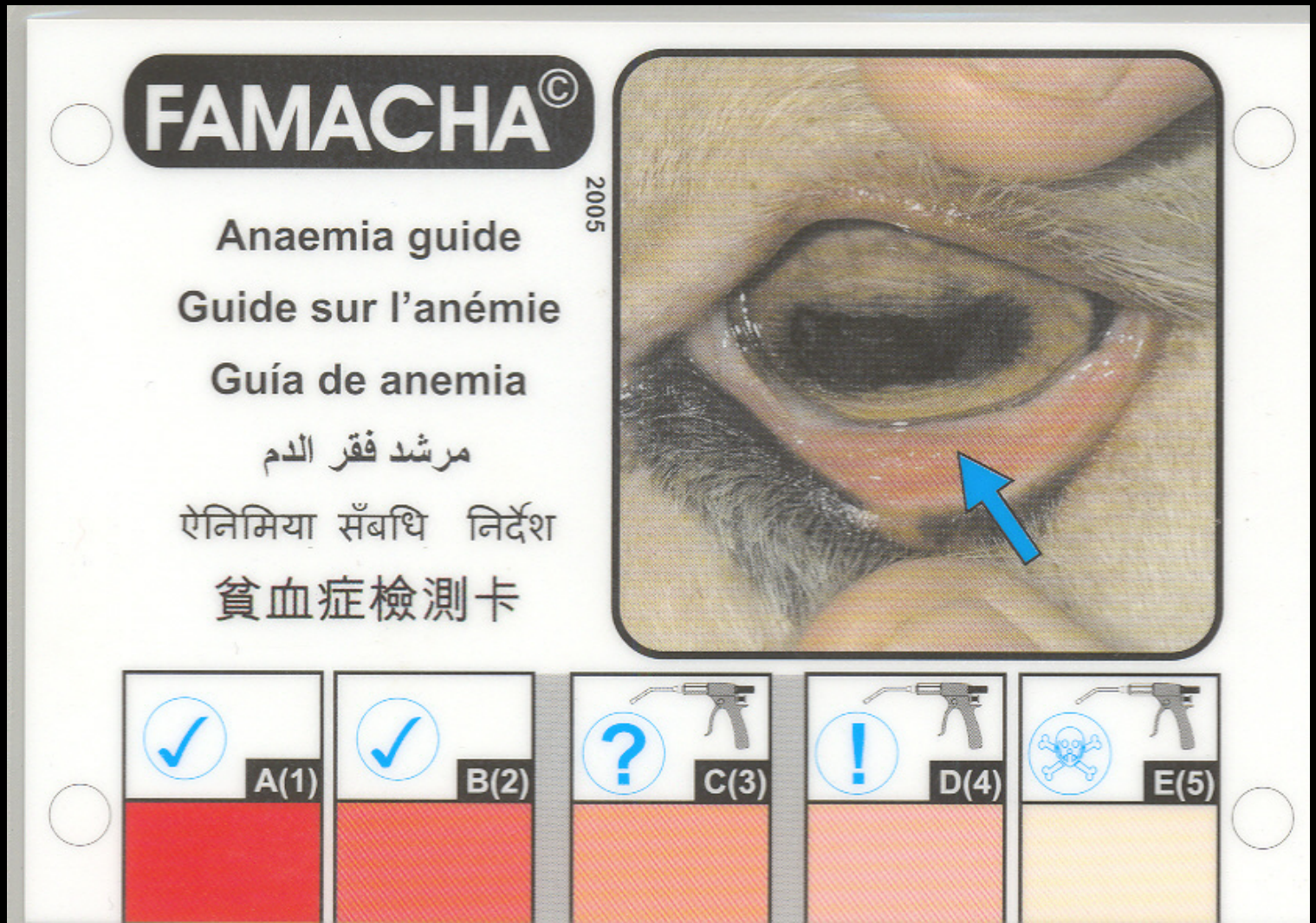
FAMACHA CARD



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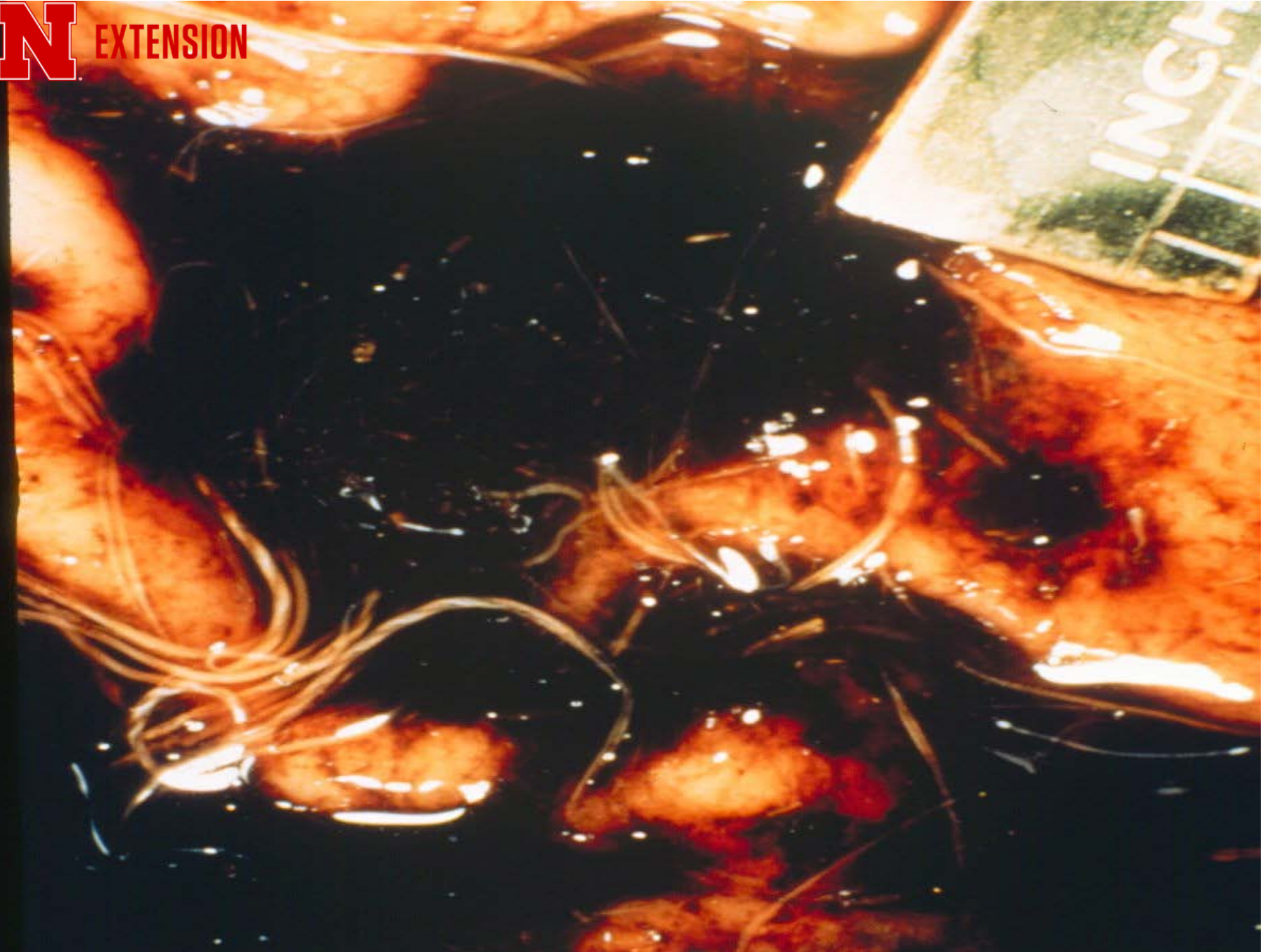
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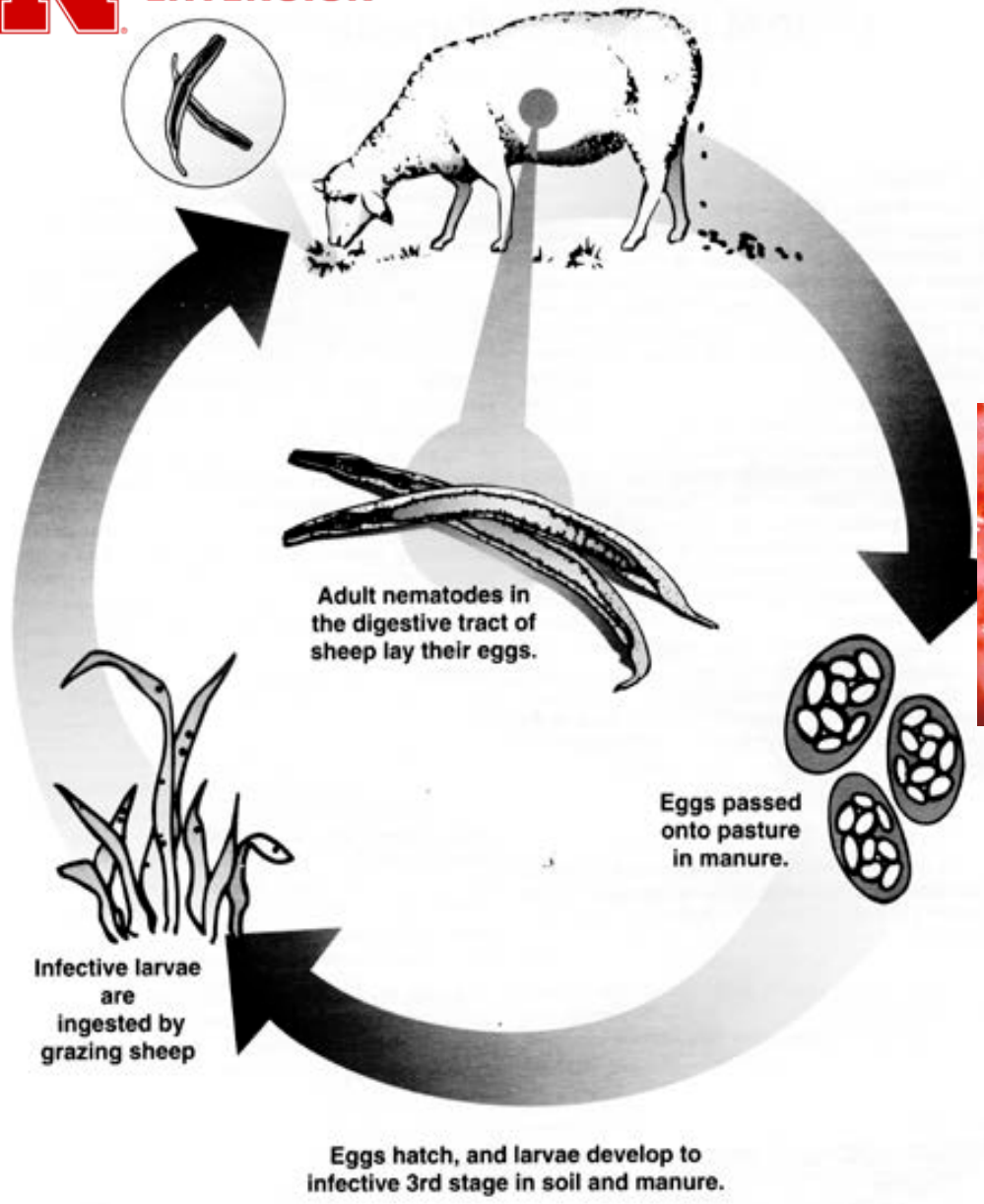
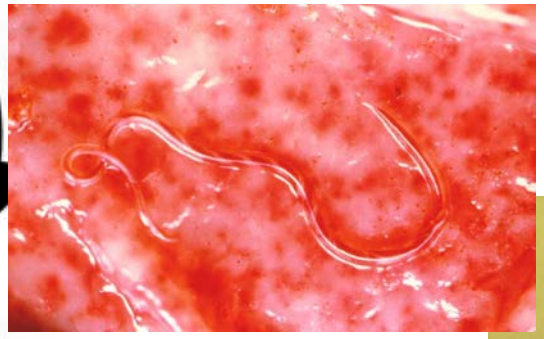
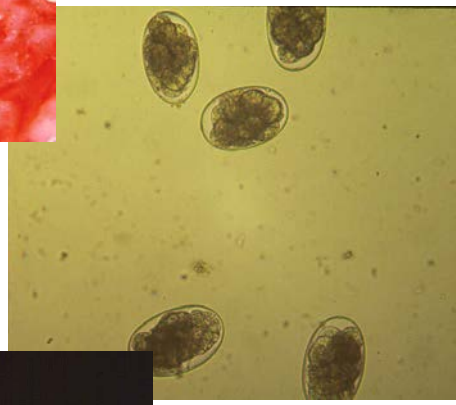
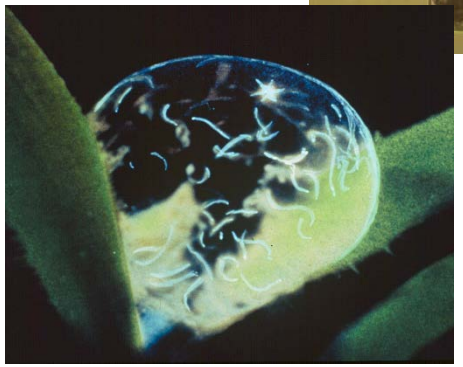
Life Cycle of *H. contortus*









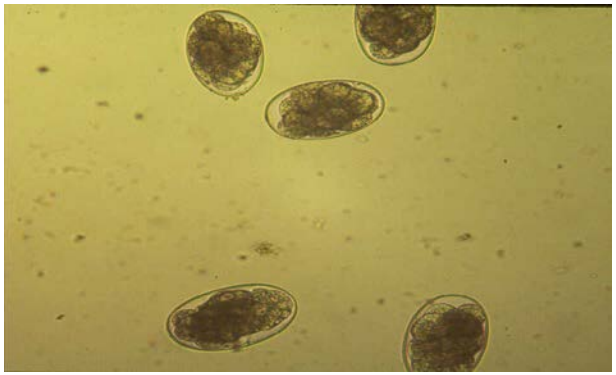
http://www.ext.vt.edu/pubs/sheep/410-027/figure1.html

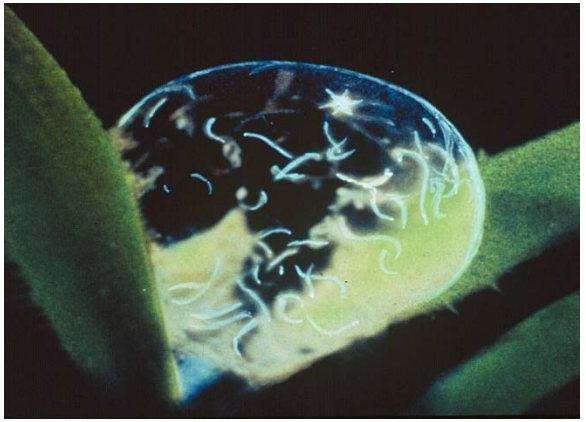
Why is *H. contortus* such a problem?

- Evolved in tropics
  - thrives in warm/wet climates
- Long transmission season - southern US
- Short life cycle -- less than 3 weeks
- Goats acquire only partial immunity
- Immunity is slow to develop in sheep
  - Immunity wanes around the time of lambing (Peri-parturient rise)

H. contortus Fecundity

- ~ 5,000 eggs per day
  - 300 worms → 1.5 million epd/animal
  - 30 goats/sheep → 1 billion eggs over 3 wks





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Effect of a constant temperature on egg and larval survival of *Ostertagia*

Temperature	Egg Survival	L_3 Survival
14° F	6 weeks	6 weeks
34	46 weeks	>52 weeks
39	50 weeks	>52 weeks
68	No data	42 weeks
77	No data	30 weeks
86	No data	18 weeks
95	No data	10 weeks
104	24 hours	2 days
113	12 hours	8 hours
122	4 hours	1 hour

Anthelmintic Resistance

- The ability of worms in a population to survive treatments that are generally effective at the recommended dose rate
- Considered a major threat to the current and future control of worm parasites of small ruminants

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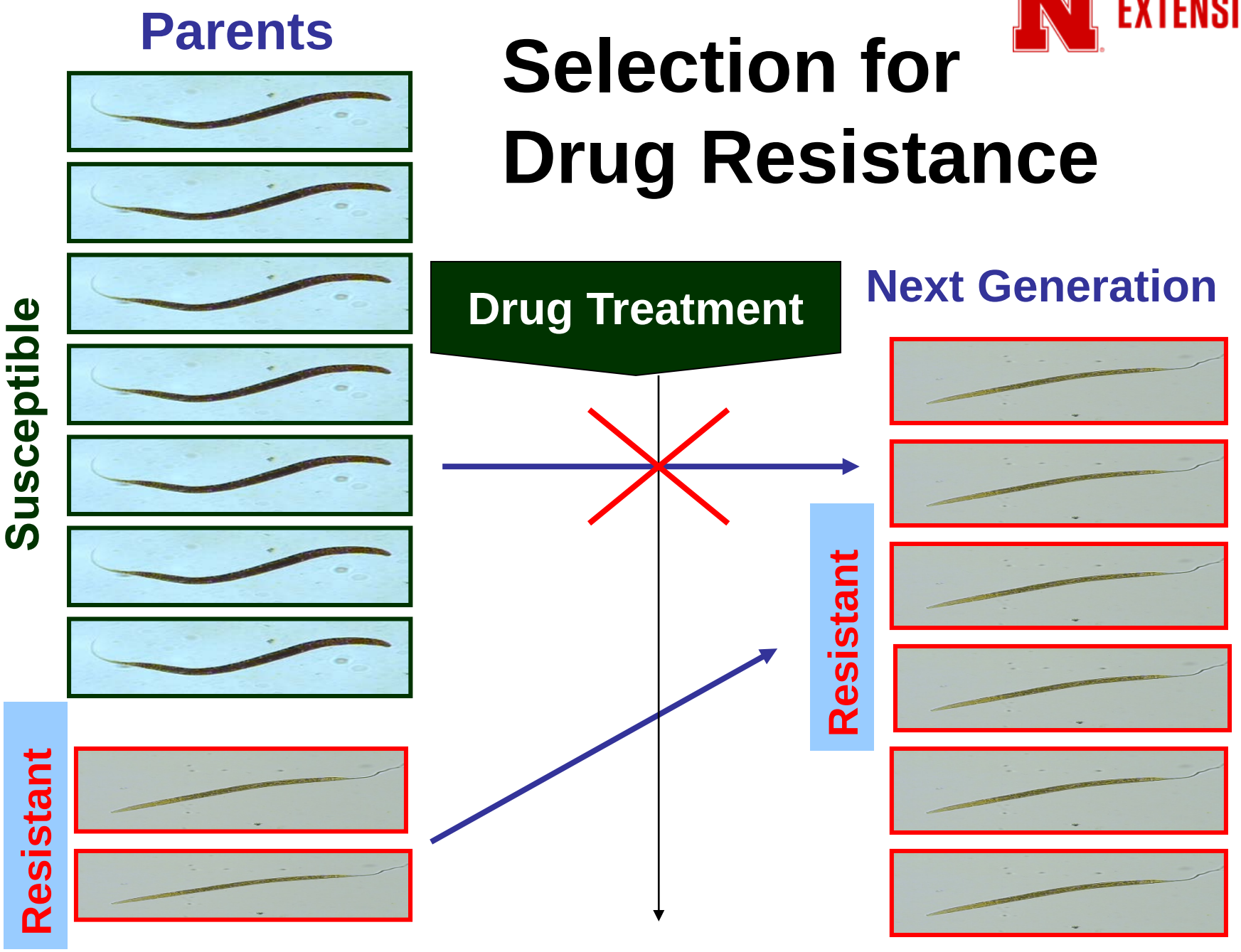
Development of Drug Resistance

- Treatment eliminates worms whose genotype renders them susceptible
- Worms that are resistant survive and pass on their “resistant” genes
- Resistant worms accumulate but are undetected until treatment fails
- Clinical definition = <95% reduction in FEC

Selection for Drug Resistance



What Causes Resistance to Dewormers?

- Treatment at frequent intervals (more than 3 treatments per year)
- Treating all animals at same time leaves no refugia
- Treating and moving to clean pasture results in no dilution of resistant worms
- Under dosing leads to survival of worms with low level of resistance

Refugia

- The proportion of the population that is not selected by drug treatment or is “in refuge” from drug
- Provides a pool of susceptible genes and dilutes resistant genes in that population
- Until recently, overlooked as the most important component of drug resistance selection

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Resistance is Inevitable

- **Natural biological consequence of drug treatment**
- **What can we do? Rate of selection for resistance can be greatly reduced by 'Smart Drenching' and selective treatment or FAMACHA, which will preserve drug efficacy for as long as possible**

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Why Doesn't it Seem As Bad As it Sounds?

- Not all worms on farm are resistant
- Killing some worms may relieve disease symptoms
  - Removing 50% of worms will result in clinical improvement
  - Animals require treatment again very soon
- Eventually most worms become resistant and treatment fails – animals may die

Classes of Anthelmintics (Dewormers)

Drug Class	Trade Names
Benzimidazole	Safeguard/ Panacur Synathic/ Benzelmin Valbazen*
Imidazole/ Pyrimidine	Levasole/ Tramisol Rumatel StrongidT
Macrolide	~~Ivomec~~ Dectomax Eprinex Cydectin**

*Do not use in first trimester pregnancy

**Minimize use to preserve efficacy

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Anthelmintic Choices for *Haemonchus*

- **Ivermectin – least effective of all drugs**
- **Albendazole – high prevalence of resistance**

  Withold feed and re-dose for improved efficacy – do not use in first 3 wks of pregnancy

  More effective than fenbendazol
- **Levamasole – low prevalence of resistance**

  Weigh goats – watch for toxicity

  Do not use in debilitated animals or during last 3 wks of pregnancy in goats

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Anthelmintic Choices for *Haemonchus*

- **Moxidectin (Cydectin) – resistance becoming common where used frequently**
  - **Same mechanism of killing as ivermectin**
  - **Ivermectin-resistant worms are also moxidectin-resistant**
  - **How used will determine how long it will remain effective**
  - **Treatment of choice for severely clinically ill animals if no resistance**
  - **Must be used carefully and with prevention of resistance as a goal**

Commonly used dewormers in goats (Oral route of administration only)

Dewormer	Approval	Dosage/100 Lbs	Withdrawal Time: Meat	Withdrawal Time: Milk
Fenbendazole (Safeguard/Panacur)	Approved	2.3 ml	14 days	4 days
Morantel tartrate (Rumatel)	Approved	1 ml / 10 lbs	30 days	0 days
Albendazole (Valbazen)	Extra-label	8 ml	7 days	5 days
Levamisole (Levasol, Tramisol)	Extra-label	12 ml	10 days	4 days
Ivermectin (Ivomec for Sheep)	Extra-label	24 ml	14 days	9 days
Moxidectin (Cydectin)	Extra-label	4 ml	23 days	56 days

Source: Meat Goat Production Handbook

Extra label use requires a veterinarian-client-patient relationship and an appropriate medical diagnosis has been made by the veterinarian.

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What Does All This Mean For The Small Ruminant Industry?

- **Anthelmintics can no longer be thought of as a management tool to maximize animal productivity – they are extremely valuable and limited resource**
- **Control of *Haemonchus* must be practiced with an eye to the future**
- **Reality is that effective long-term control of *Haemonchus* will only be possible if anthelmintics are used intelligently with prevention of resistance as a goal**

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Case in Point

- **Malaysia and South America – some farms reporting TOTAL anthelmintic failure with 20% death losses yearly. Future of small ruminant industries is threatened**
- **Many farms in the southeastern US are down to their last drug**

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Diagnosis of Resistance

- Laboratory – DrenchRite
  - Dr. Ray Kaplan's lab (UGA)
  - 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
  - Fecal egg count reduction test
    - Labor intensive

"Smart Drenching"

- **An approach whereby we use the current state of knowledge regarding:**
  - **Host physiology**
  - **Anthelmintic pharmacokinetics**
  - **Parasite biology**
  - **Dynamics of selection for resistance**
  - **Resistance status of worms on the farm**
- **To develop strategies that maximize the effectiveness of treatments while also decreasing the selection of drug resistance**

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Components of a Smart Drenching Program

- Know the resistance status of the flock/herd
- Sound pasture management
- Keep resistant worms off the farm
- Administer the proper dose
- Utilize host physiology
- Selective treatment - FAMACHA

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Recommendations for Pasture Management

- **DECREASE STOCKING RATES**
- **Provide browse-type forages**
- **6 weeks between rotations**

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Other Pasture Recommendations

- **Use dilution strategies – mix two or more species on same or rotate pastures between different species**
- **Forage height**
  - Most larvae crawl only 2 inches from the ground
  - Don’t let animals graze pastures too short
- **Fix water leaks around troughs**
- **Avoid grass in pens**
- **Fence off moist areas**

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Do Not Buy Resistant Worms

- All new additions should be quarantined and aggressively dewormed upon arrival
- Deworm with 3 anthelmintics from different drug classes
- Should remain in quarantine for 10 – 14 days – perform FEC to confirm no eggs

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Use Proper Dose and Administration

- Ensure proper dose is delivered
- Goats metabolize drug much more rapidly than other livestock – require higher dosage
  - Rule of thumb -- goats should be given a dose **1.5 to 2 times** higher than for sheep or cattle
    - Levamisole 1.5 X, all others 2X
- Administer all available drugs orally - pour-ons are absorbed poorly
- Drugs should be stored properly

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Use Proper Technique

- Critical that the full dose lodges in the rumen
- Drench should be delivered over the tongue into the pharynx/esophagus
- If drench is delivered to the mouth, the esophageal groove can be stimulated to close and much drench will bypass the rumen (where it is needed), drug will be absorbed too fast for shorter duration, leading to reduced efficacy

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Utilize Host Physiology to Maximize Drug Efficacy

- Restrict feed intake for 12 - 24 hours prior to treatment and/or repeat dose in 12 hours
  - 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

Selective Treatment

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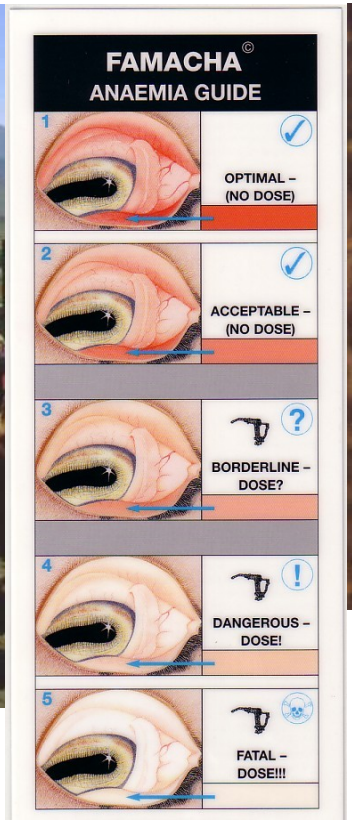

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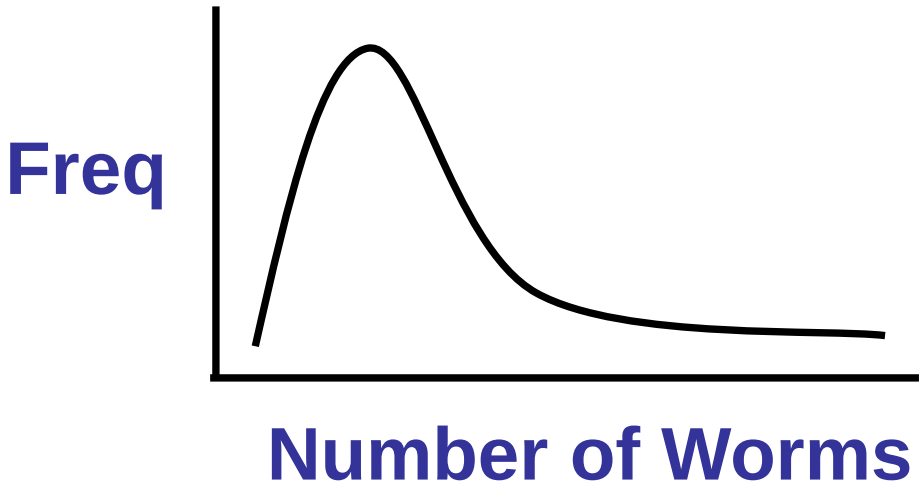
Concept Behind Selective Treatment

- **Parasites are not equally distributed in groups of animals**
  - **20-30 % of animals harbor most of worms and are responsible for most of egg output**



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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

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How Do We Achieve Selective Treatment?

- The FAMACHA© system – technique for the assessment of *Haemonchus contortus* and need for treatment
- Developed in response to emergence of resistance in South Africa
- Method of selective chemotherapy which leads to a large reduction in the number of deworming treatments, decreasing the rate of resistance

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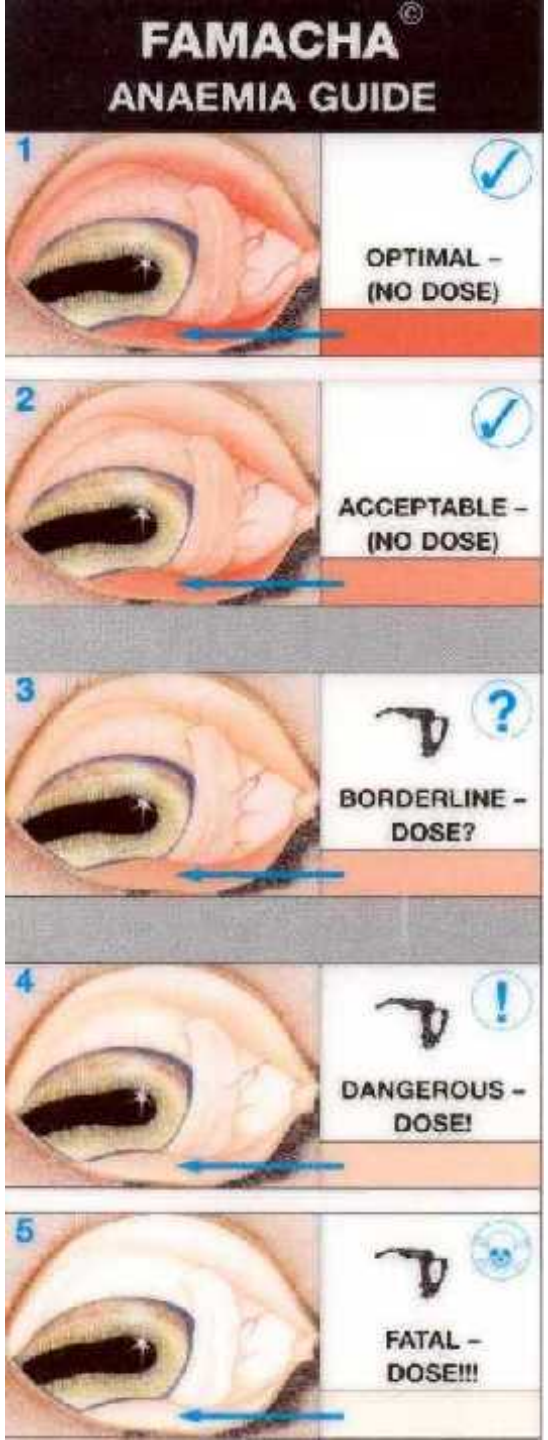
How Does FAMACHA work?

- **Since primary impact of *H. contortus* is anemia, one can indirectly measure parasite burden (and need for treatment) by measuring anemia**
- **Only useful where *H. contortus* is the primary parasite**



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

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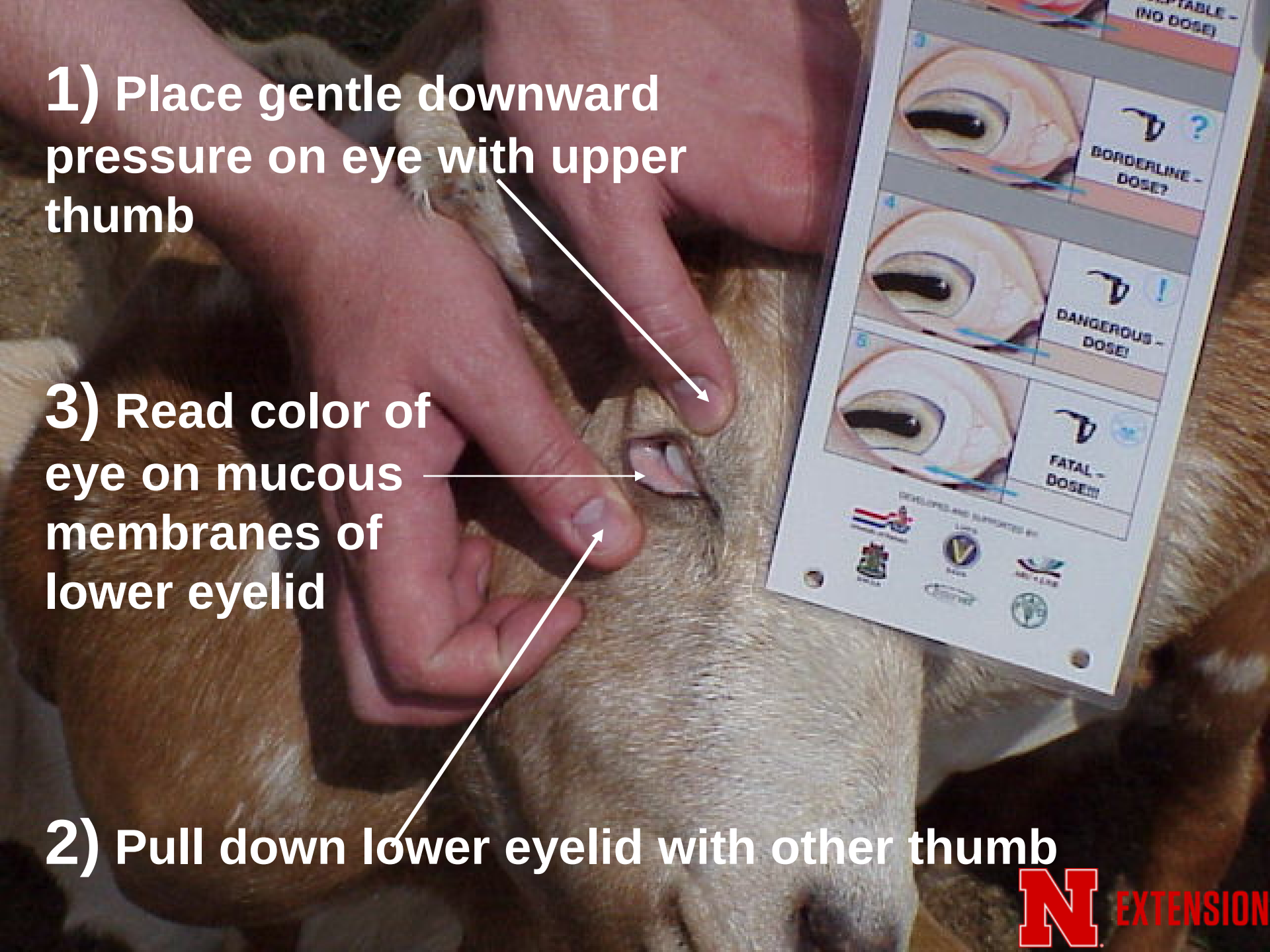
1) Place gentle downward pressure on eye with upper thumb
3) Read color of eye on mucous membranes of lower eyelid
2) Pull down lower eyelid with other thumb
BORDERLINE – DOSE?
DANGEROUS – DOSE!
FATAL – DOSE!!!
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- Examine in sunlight
- Open as shown - for a short time only
- Look at color inside lower eyelid

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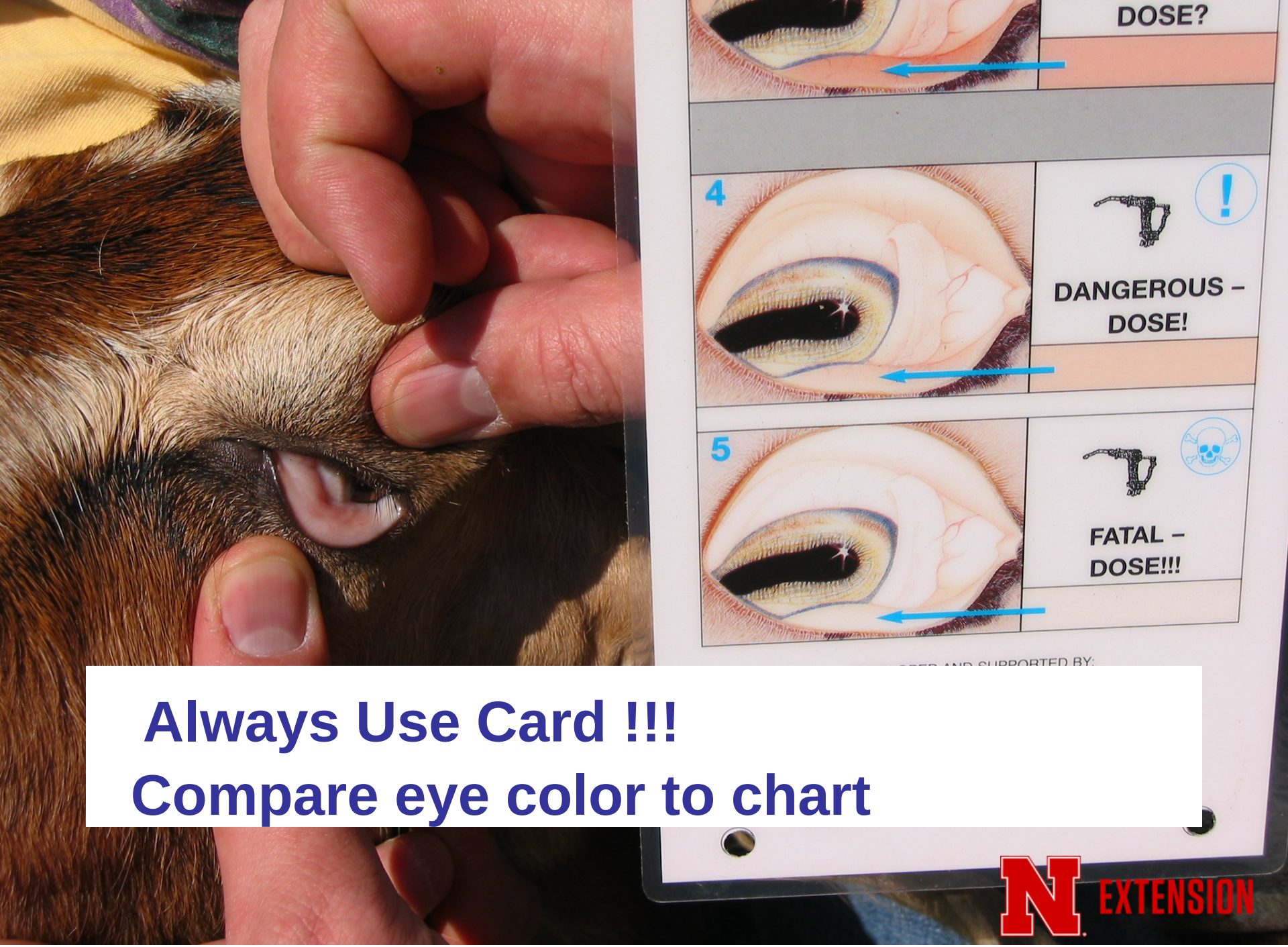

Always Use Card !!!

Compare eye color to chart

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Using FAMACHA

- Use as a guide to determine which animals to treat
- Reduces number of treatments and should reduce development of resistance

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Other Advantages

- Identify animals that need treatment most often
  - These are the ones contaminating the pasture for others in the herd/flock
  - Cull these and improve genetics of resistance of the herd/flock
  - Resistance/resilience to parasites is moderately heritable (0.3 – 0.4)

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Treatment Decisions using the FAMACHA© System

- Examine at least every 2 – 3 weeks at beginning of “worm” season; every 4 – 6 wks during cooler times of year
- Examine weekly during critical periods
- Treat animals scoring 4 or 5
- Treat peri-parturient ewes/does and young lambs/kids scoring 3

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Other Considerations

- **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**

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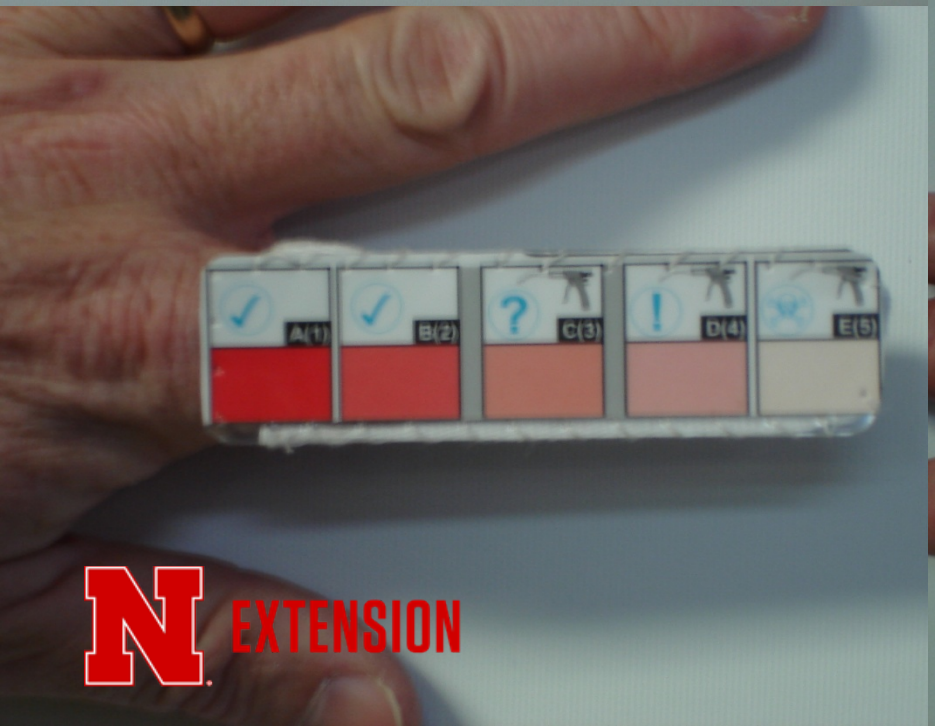
FAMACHA©
A(1)
B(2)
C(3)
D(4)
E(5)


FAMACHA©
A(1)
B(2)
C(3)
D(4)
E(5)


A(1)
B(2)
C(3)
D(4)
E(5)


FAMACHA©
Anaemia guide
Guide sur l'anémie
Guia de anemia
A(1)
B(2)
C(3)
D(4)

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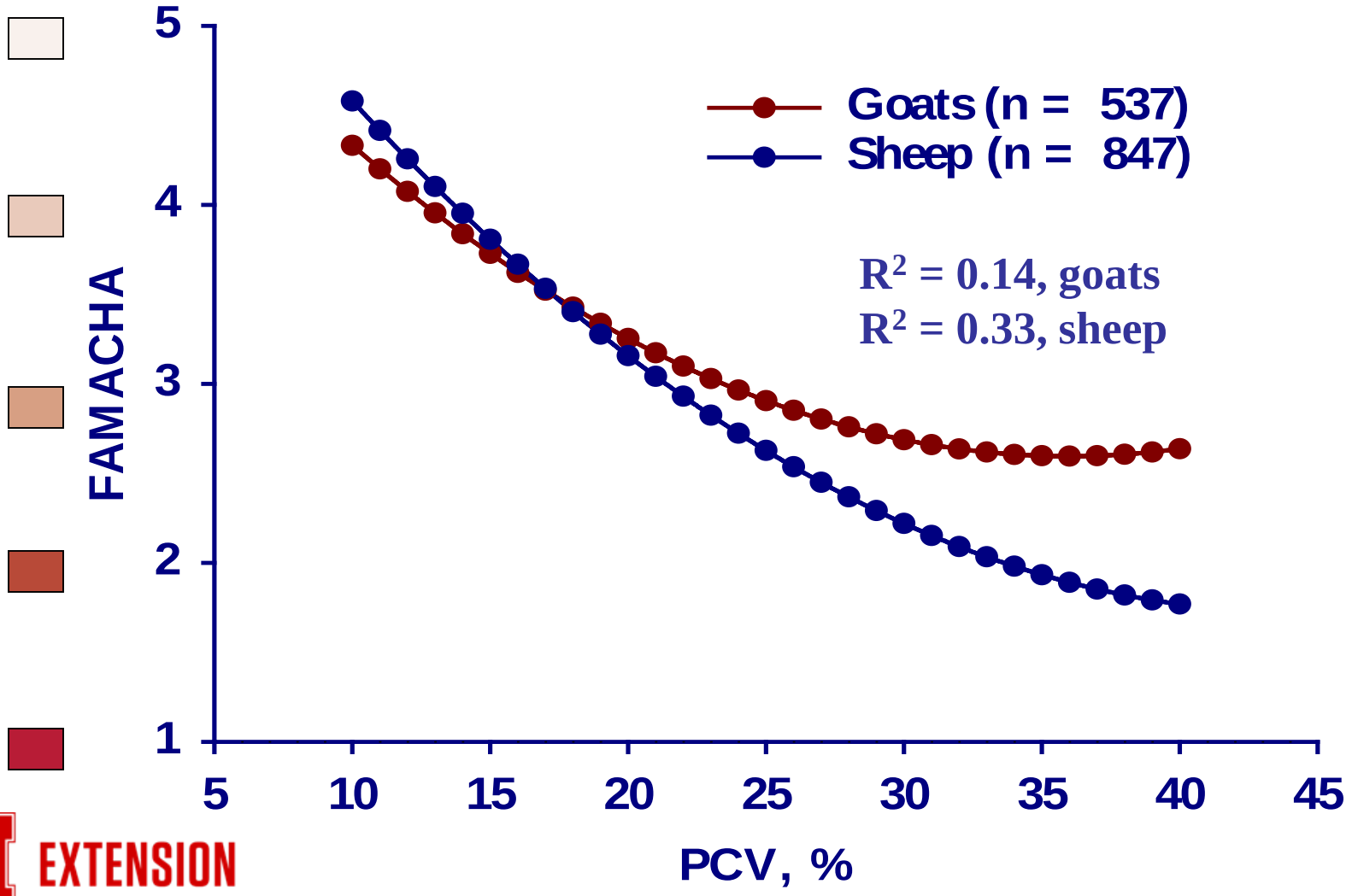
Predictability of PCV in goats and sheep



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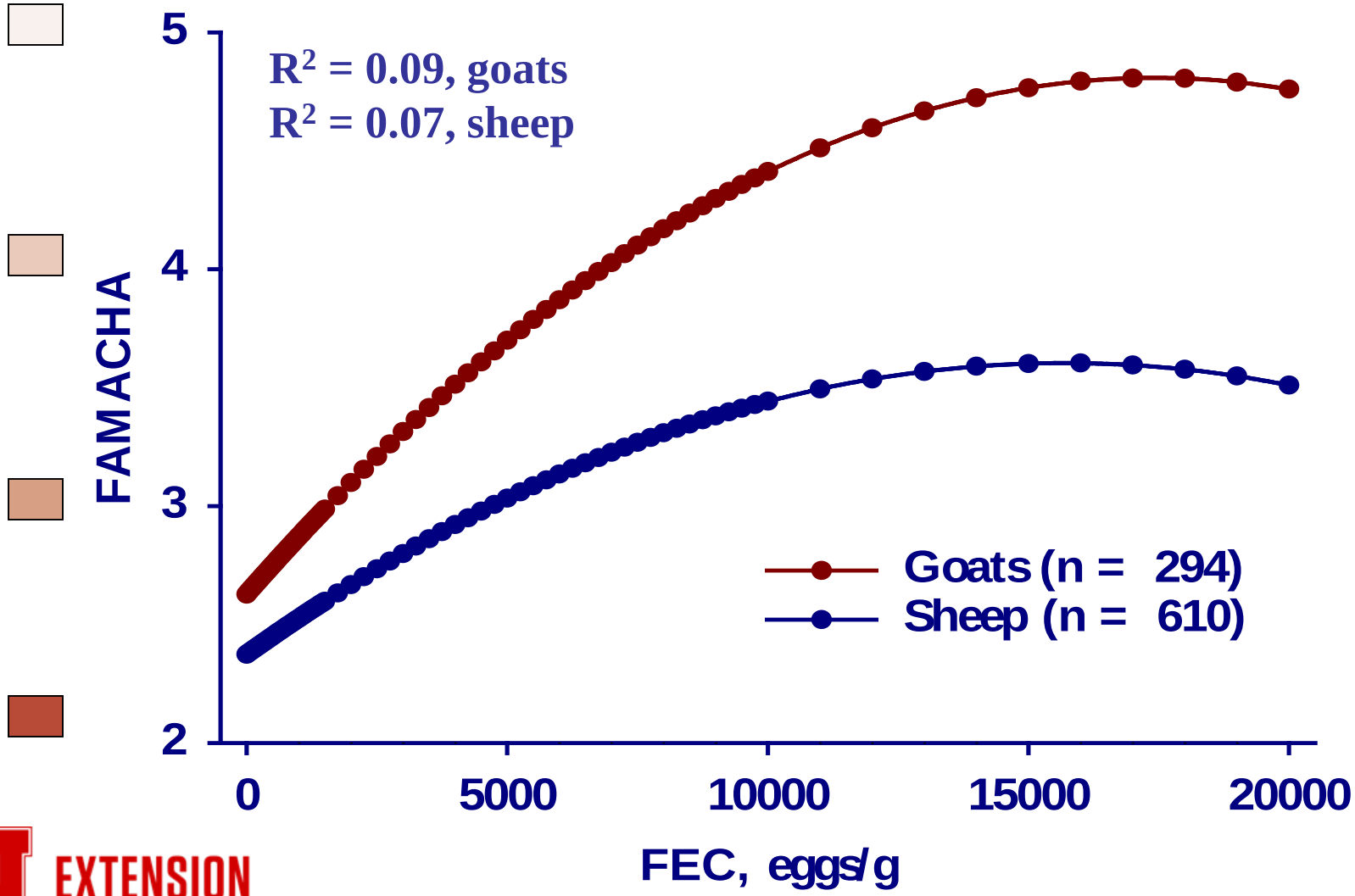
Predictability of FEC in goats and sheep



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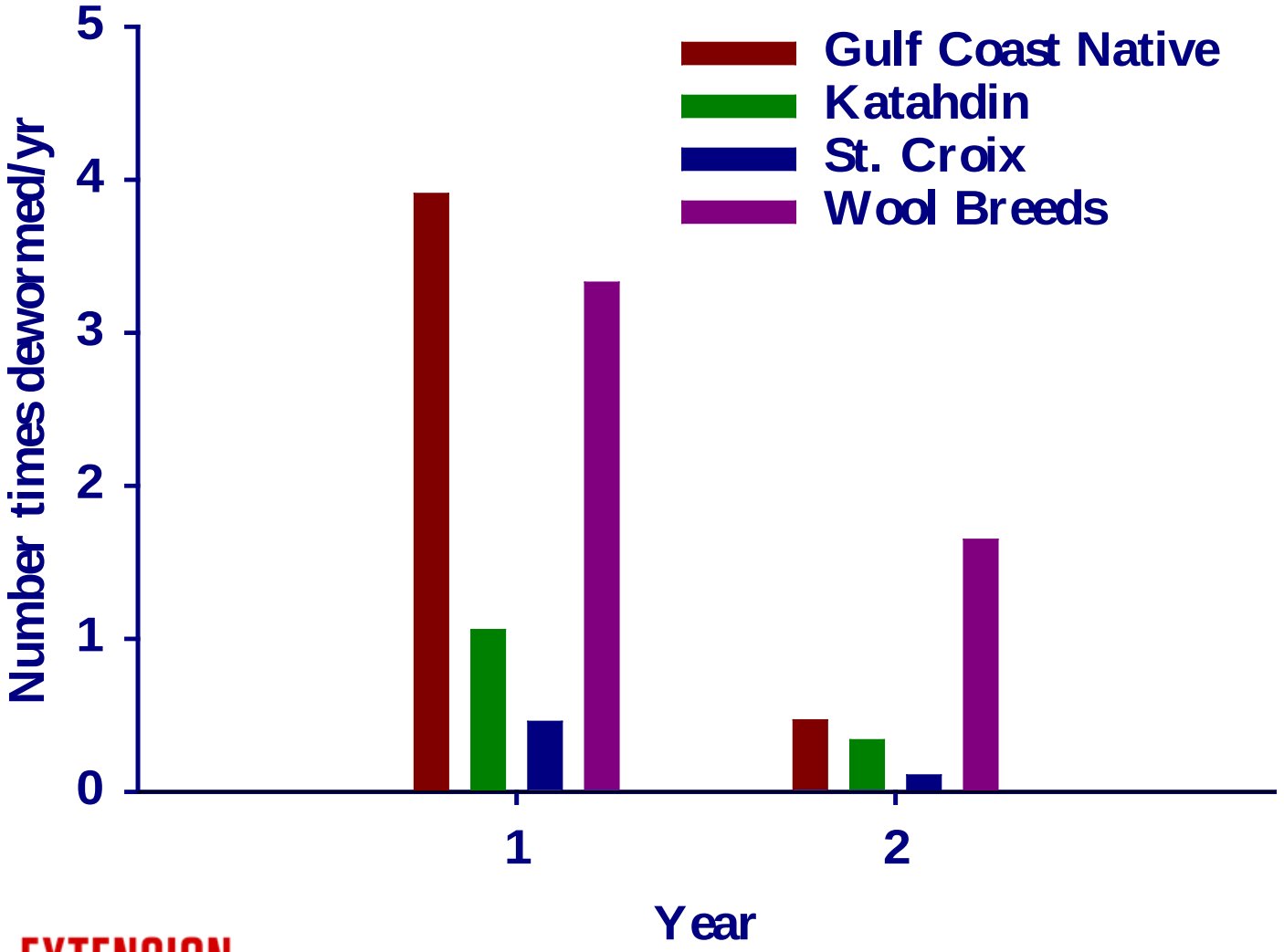
Change from two or more dewormings/yr for all to deworm as needed



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Number of dewormings per year using the FAMACHA system

	Year 1		Year 2	
Breeds	Minimum	Maximum	Minimum	Maximum
Gulf Coast Native	2	6	0	3
Katahdin	0	4	0	2
St. Croix	0	3	0	1
Wool Breeds	0	8	0	5

Other Recommendations

- Keep records!
- Animals can be tagged each time treatment necessary
- Maintain an integrated management-based approach for worm control
- Use where back-up assistance is available from trained professional
- Only properly trained individuals should apply FAMACHA system

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Other Causes of Anemia

- Other parasites
- Nutritional deficiencies
- Other diseases
- Color appears lighter in shade/barn
- Other causes of redness include environmental conditions and other diseases

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Where Do I Get FAMACHA Cards?

- Only properly trained individuals can purchase the cards through sanctioned training workshops
- Through a veterinarian, extension agent, animal professionals (all must have proper training)
- Information at famacha@vet.uga.edu

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Other Sustainable Methods of Control

- Use of resistant breeds
- Condensed tannin-rich forages
- Nutrition
- Copper oxide (abomasal worms)
- Vaccines

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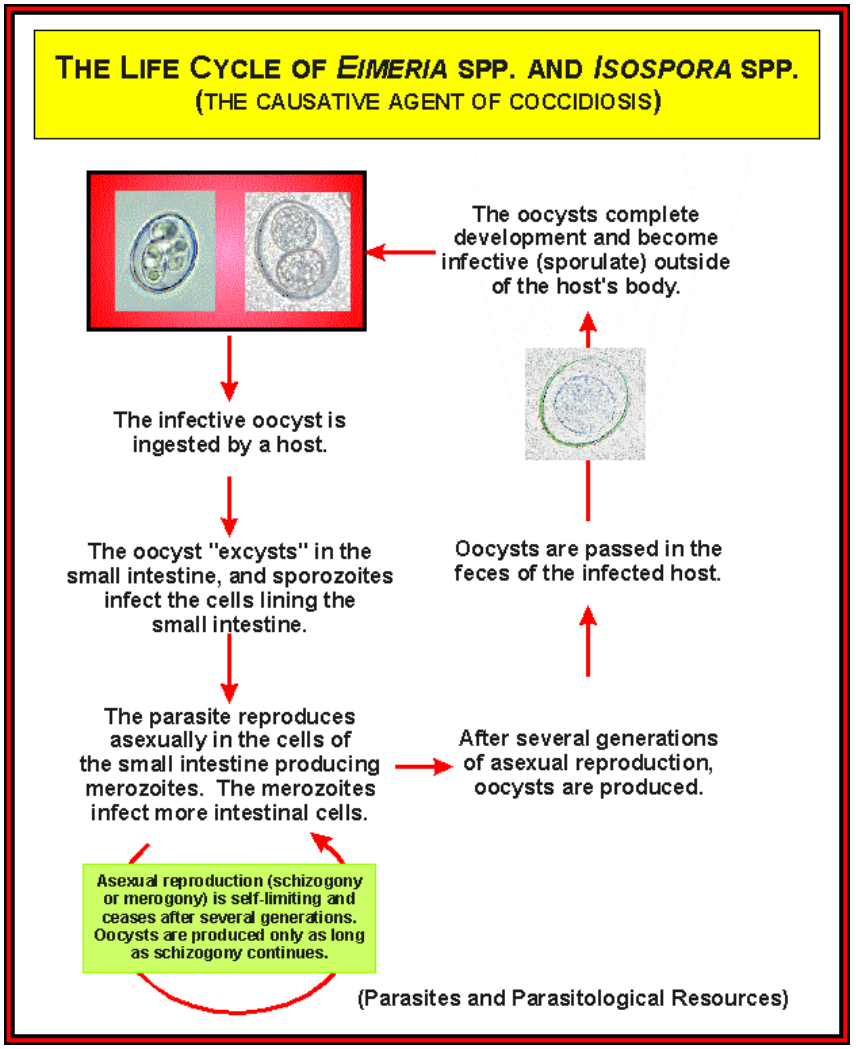
Other Internal Parasites

- Lung worm
- Coccidia
- Liver fluke
- Tape worm



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Use of Resistant Breeds

EXTENSION

Use of Tannin rich forages

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Browse is important to parasite control

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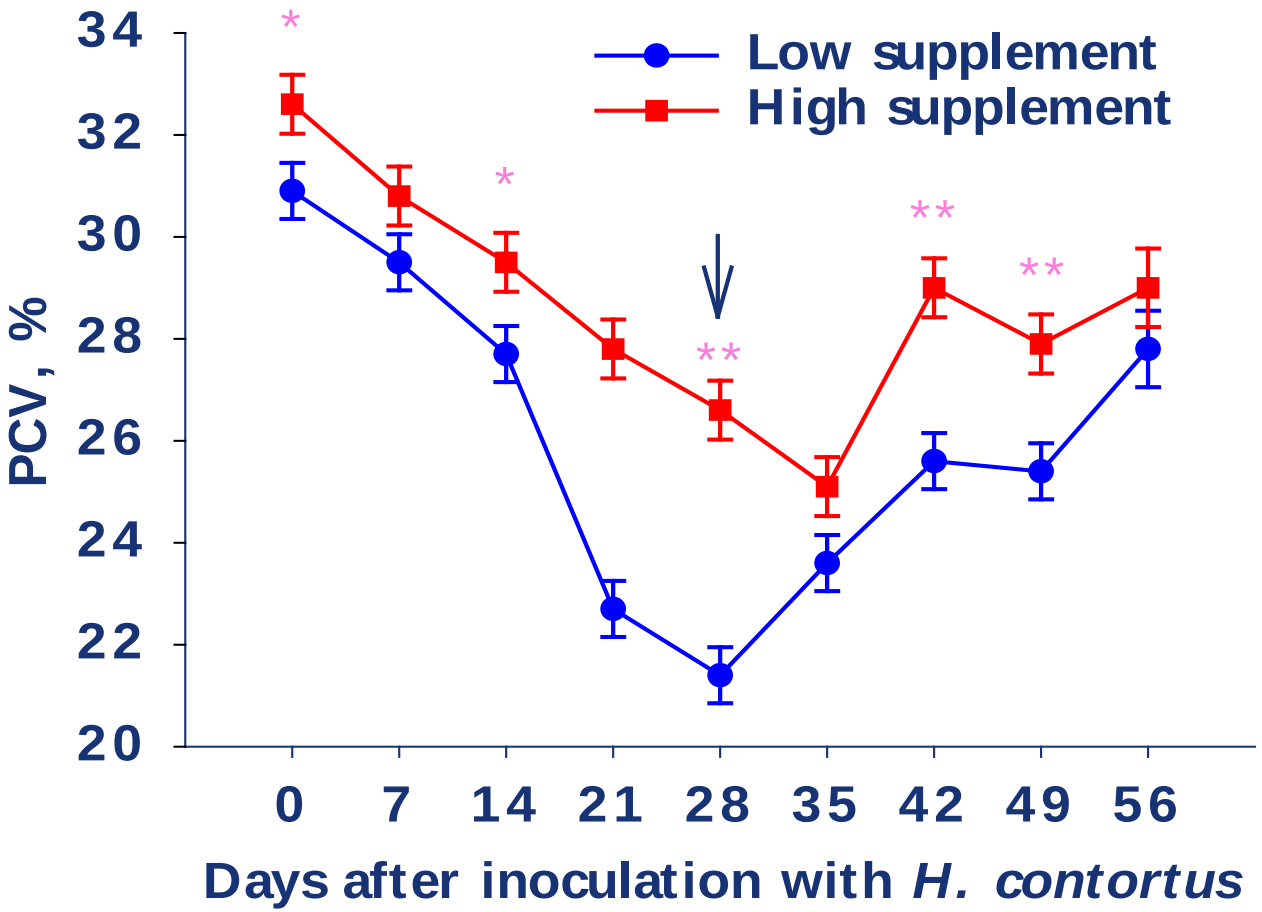
Nutrition

Effect of supplement on PCV



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Diet – Complete Ration

37% corn
16% wheat middlings
14% sbm
13% cottonseed hulls
10% alfalfa pellets
4% molasses
4% soybean hulls
1% calcium carbonate
0.5% sodium chloride
0.5% ammonium chloride
0.15% vitamin premix
27.5 mg/kg lasalocid

Control: 0.25% calc carb
MS: 74.9 mg/kg sodium molybdate, 0.21% sodium sulfate, 0.25% calcium carbonate

Fed at 2.2 lbs/d; Free choice bermudagrass hay and water

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Use of Oxidized Copper

Purchase copper boluses from Copasure©
Information may be found at
www.attra.ncat.org/attra-pub/copper_wire.pdf
Should not be the only control method used.

Trace element bolus

Copper oxide wire particles (COWP)

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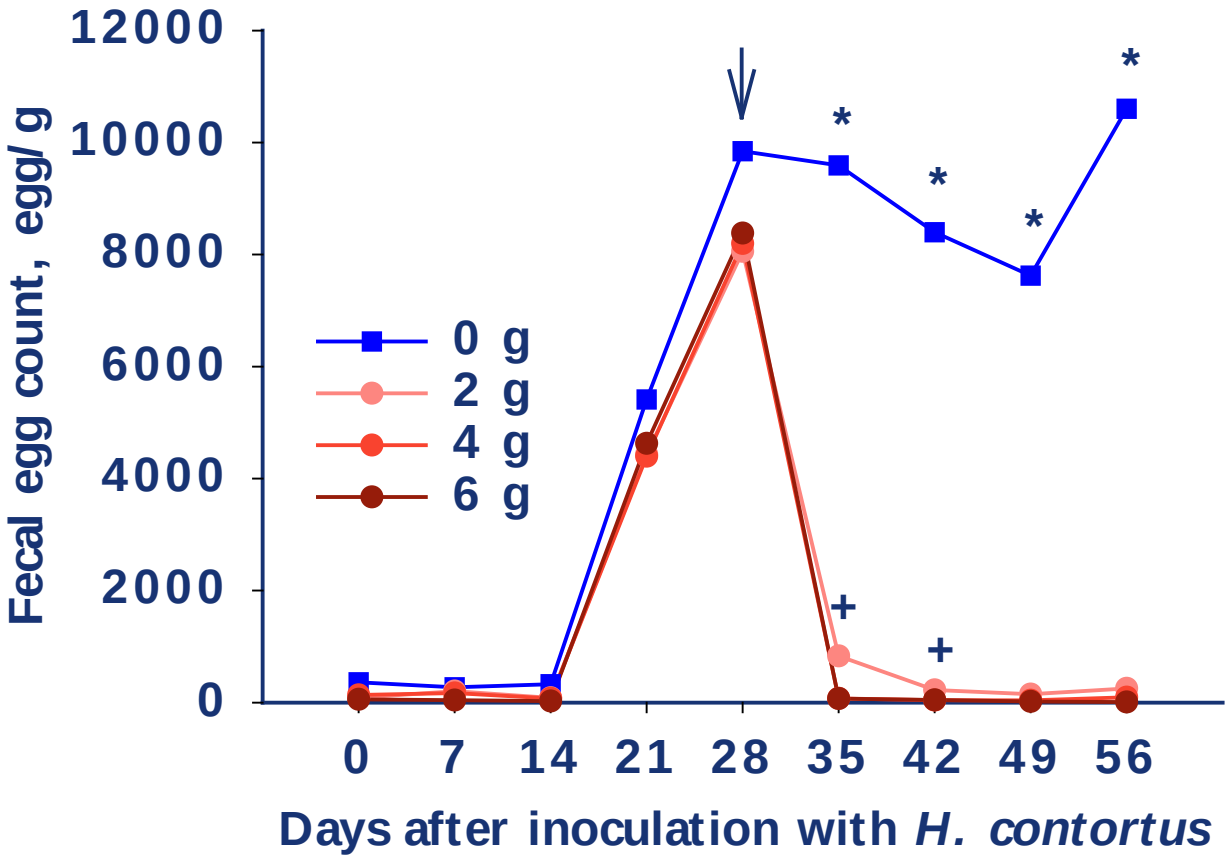
Effect of COWP on FEC



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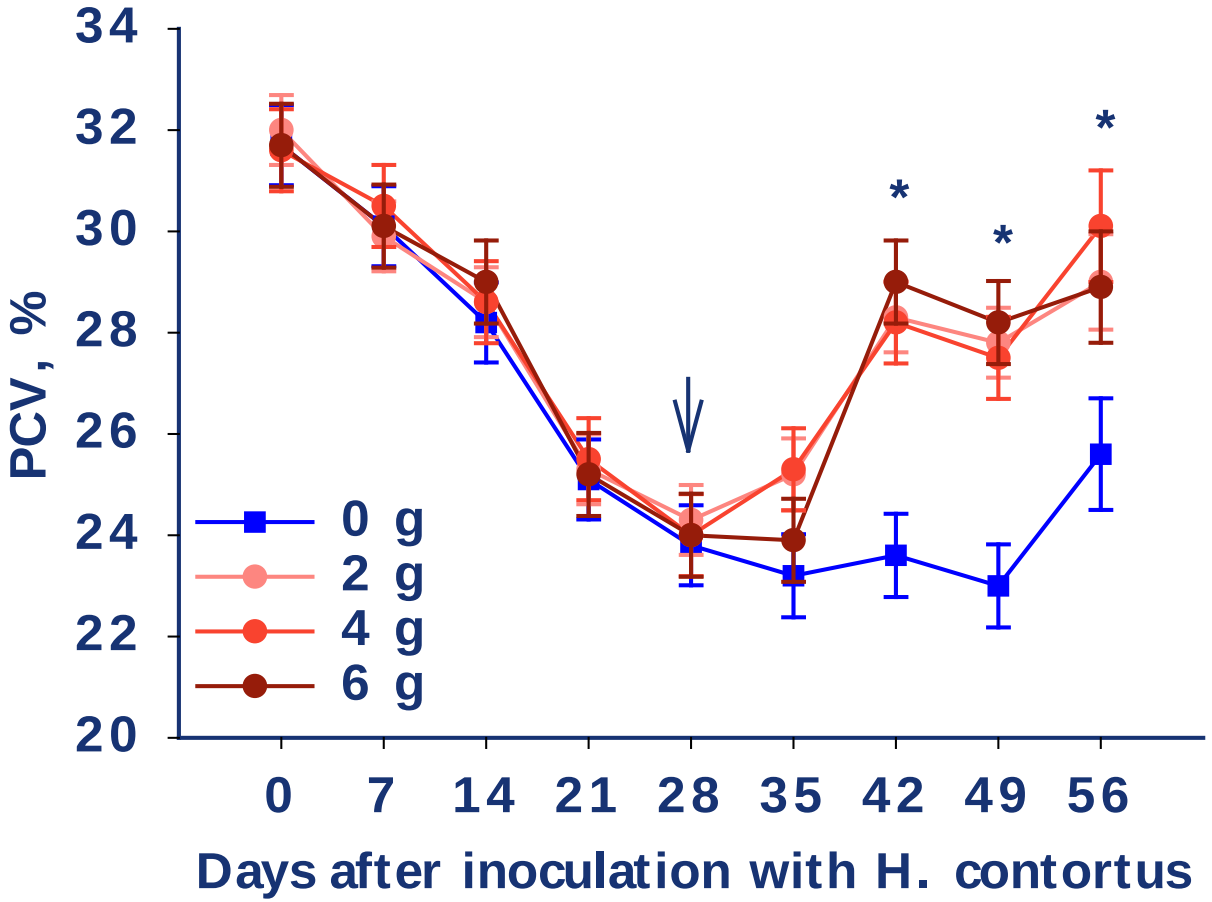
Effect of COWP on PCV



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