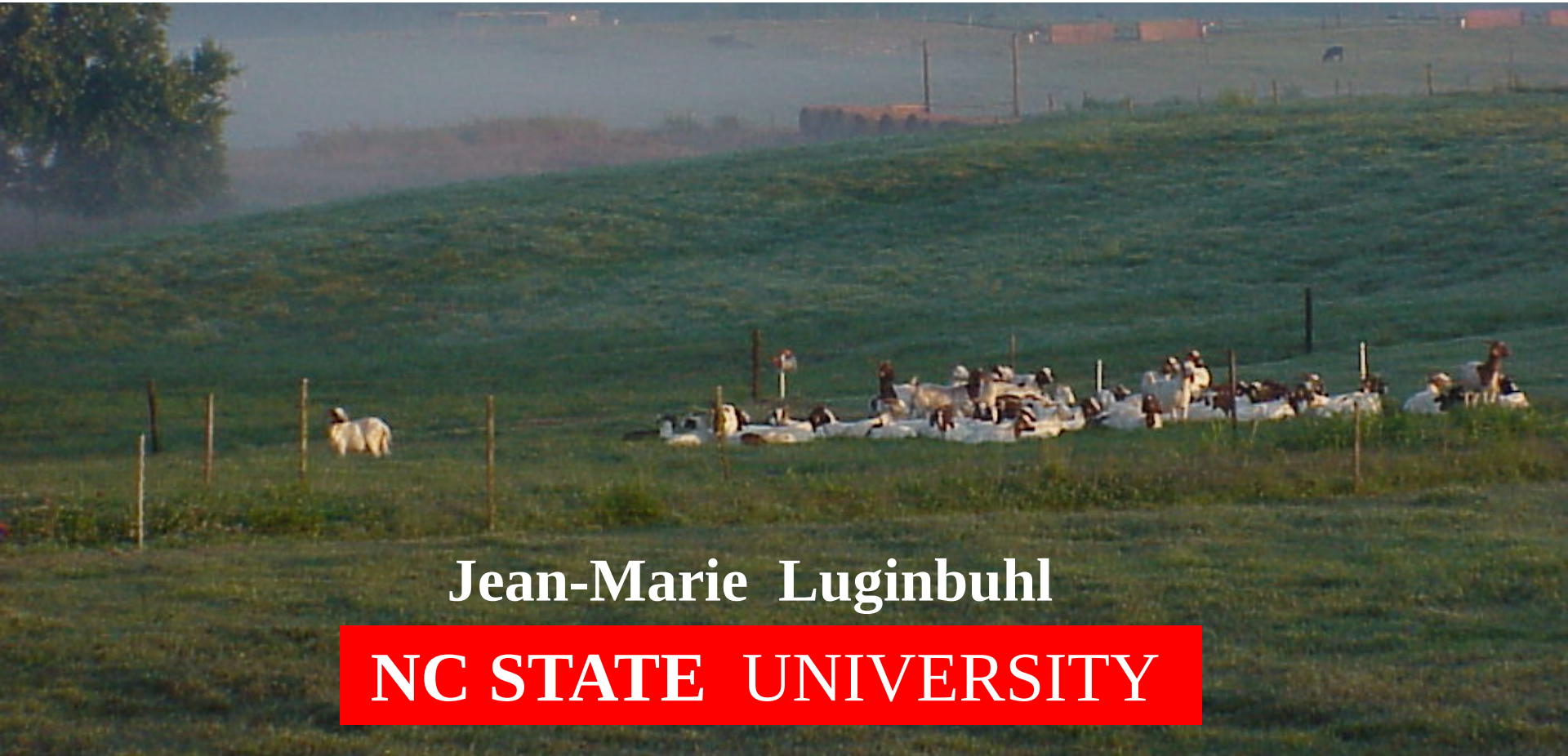
Integrated GI Parasite Management Program

Goal is not to create parasite-free animals. It is normal for sheep and goats to have parasites.

Goal is to prevent clinical disease and production losses



Jean-Marie Luginbuhl

NC STATE UNIVERSITY

Outline

- Part I
  - Worm biology
  - Management tips and alternatives
- Part II
  - Selective treatment: FAMACHA
- Part III
  - Anthelmintics (dewormers)
  - Traditional dewormers and some alternatives
  - How to use dewormers
  - Susan's 10 commandments
- Hands-on FAMACHA with animals

Internal Parasites

#1 health problem of small ruminants

- Sheep and **goats** are the most susceptible livestock to internal parasites.
- Few dewormers are FDA-approved for sheep, even fewer for goats.
- Dewormer resistance is increasing.
- If new drugs are developed, it will be a long time before they might be available.
- We can no longer rely on dewormer treatments alone to control parasites; a more integrated approach is necessary.

Anthelmintic = Dewormer = drug to kill GI parasites

Primary Gastrointestinal Nematodes of Small Ruminants

- Small intestine
  - Trichostrongylus *colubriformis* [black scour worm]
  - Nematodirus
  - Oesophagostomum
- Large Intestine
  - Trichuris [Whipworm]
- Abomasum
  - Teladorsagia (Ostertagia) [brown stomach worm]

- Burrow into the wall of the abomasum or intestines.

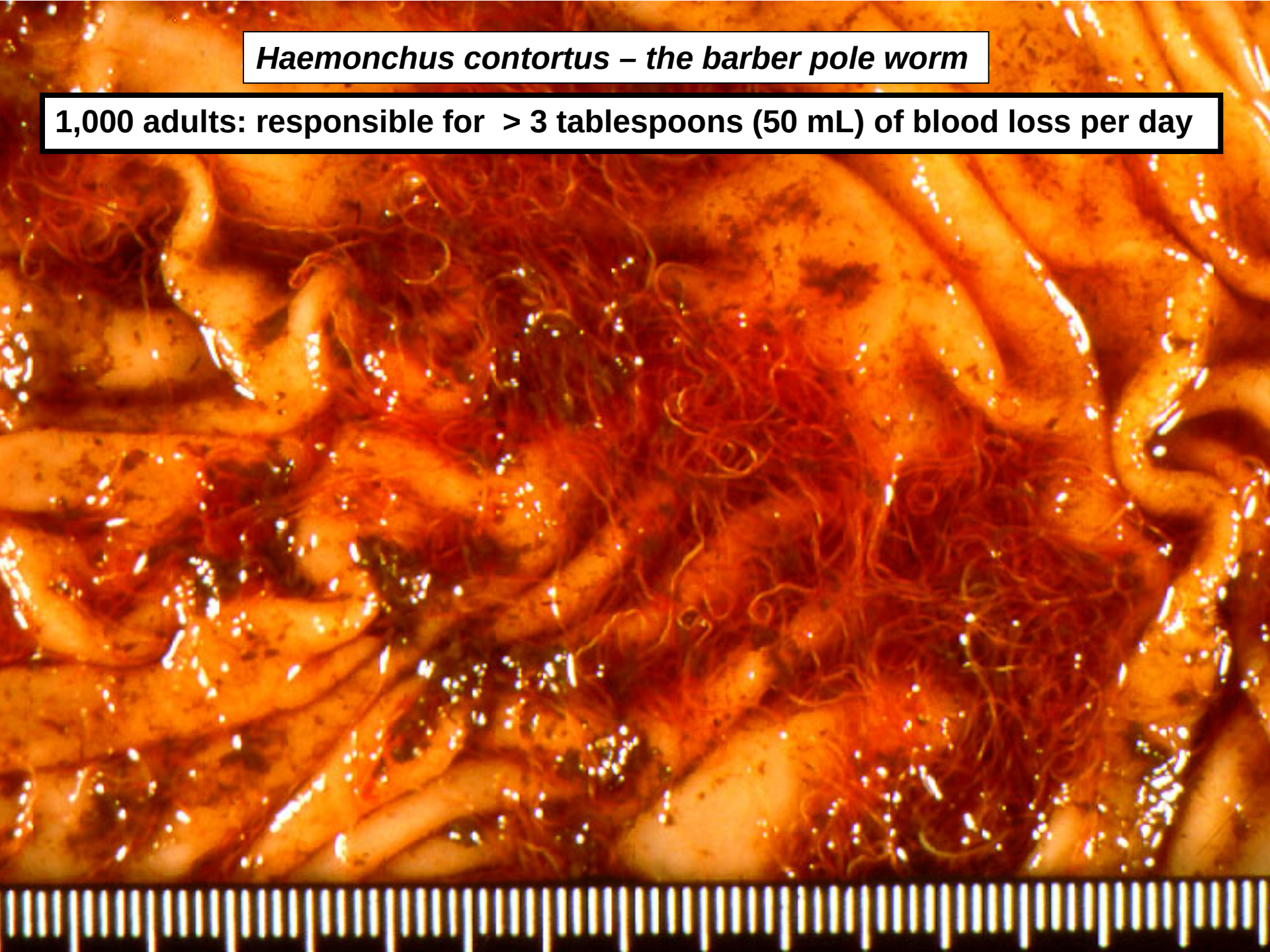
→ Usually <u>secondary</u> in importance.

→ Usually have an <u>additive</u> effect in mixed parasitic infections.

- <u>Symptoms</u>: scouring, weight loss, rough hair coat, ill thrift, poor appetite.

Abomasum
Haemonchus contortus
[Barber Pole Worm]

- Literally a blood sucking worm
- Preys on the weak, young, pregnant, or lactating animal
- Very prolific – one adult female can produce 5000 eggs per day
- Developing resistance to all classes of dewormers
- PUBLIC ENEMY NUMBER ONE for small ruminant farmers


Haemonchus contortus – the barber pole worm
1,000 adults: responsible for > 3 tablespoons (50 mL) of blood loss per day

Haemonchus contortus (Barber Pole Worm)

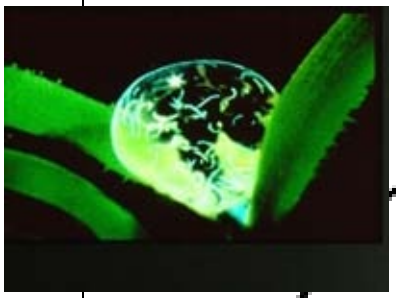
Symptoms

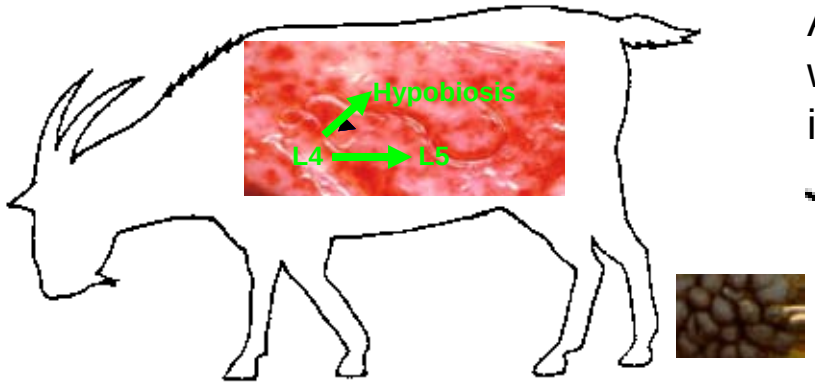
- Pale mucous membranes
- Edema (bottle jaw)
- Not diarrhea
- Weight loss, unthrifty?
- DEATH

Is difficult to control because . . .

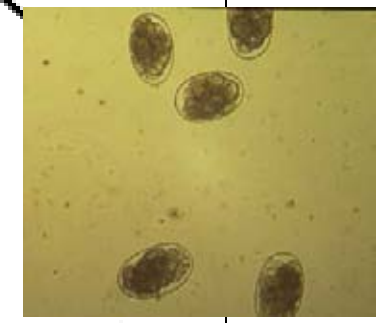
- Short, direct life cycle (21 days)
- Can go into "hypobiotic" (dormant) state inside animals during winter
- Survives on pasture for a long time (L3 "sheath")
  - ➢ Adaptable

Haemonchus - Life Cycle





Adult worms lay eggs which are then passed in feces



Prepatent period = time from ingestion to passing eggs = 15 days

L1 larvae develops inside the egg

L1

Hatches & molts 1-2 days later into L2

L2

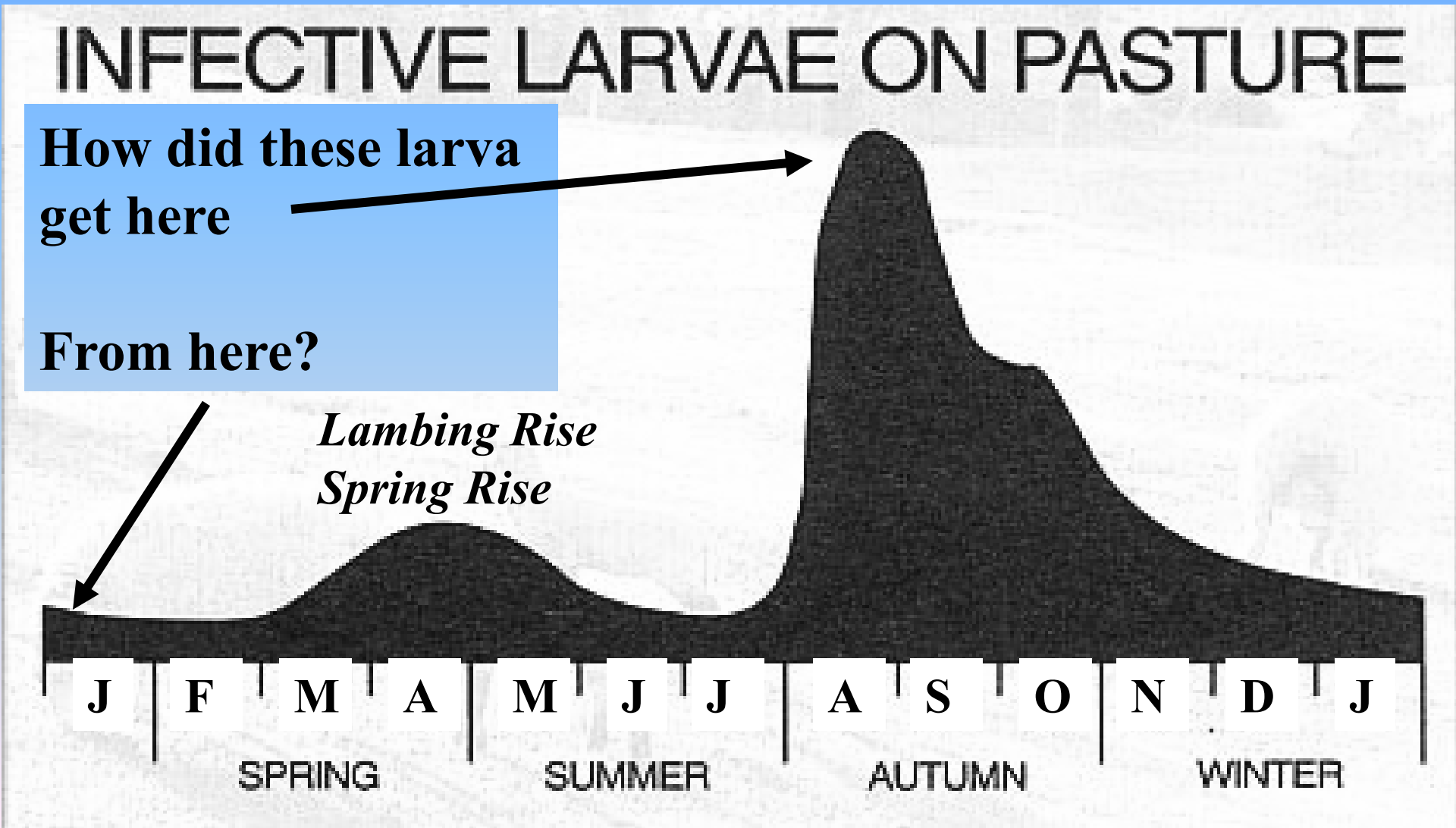
Molts into infective L3 stage 3-4 days later

L3

16° C/60° F, high moisture

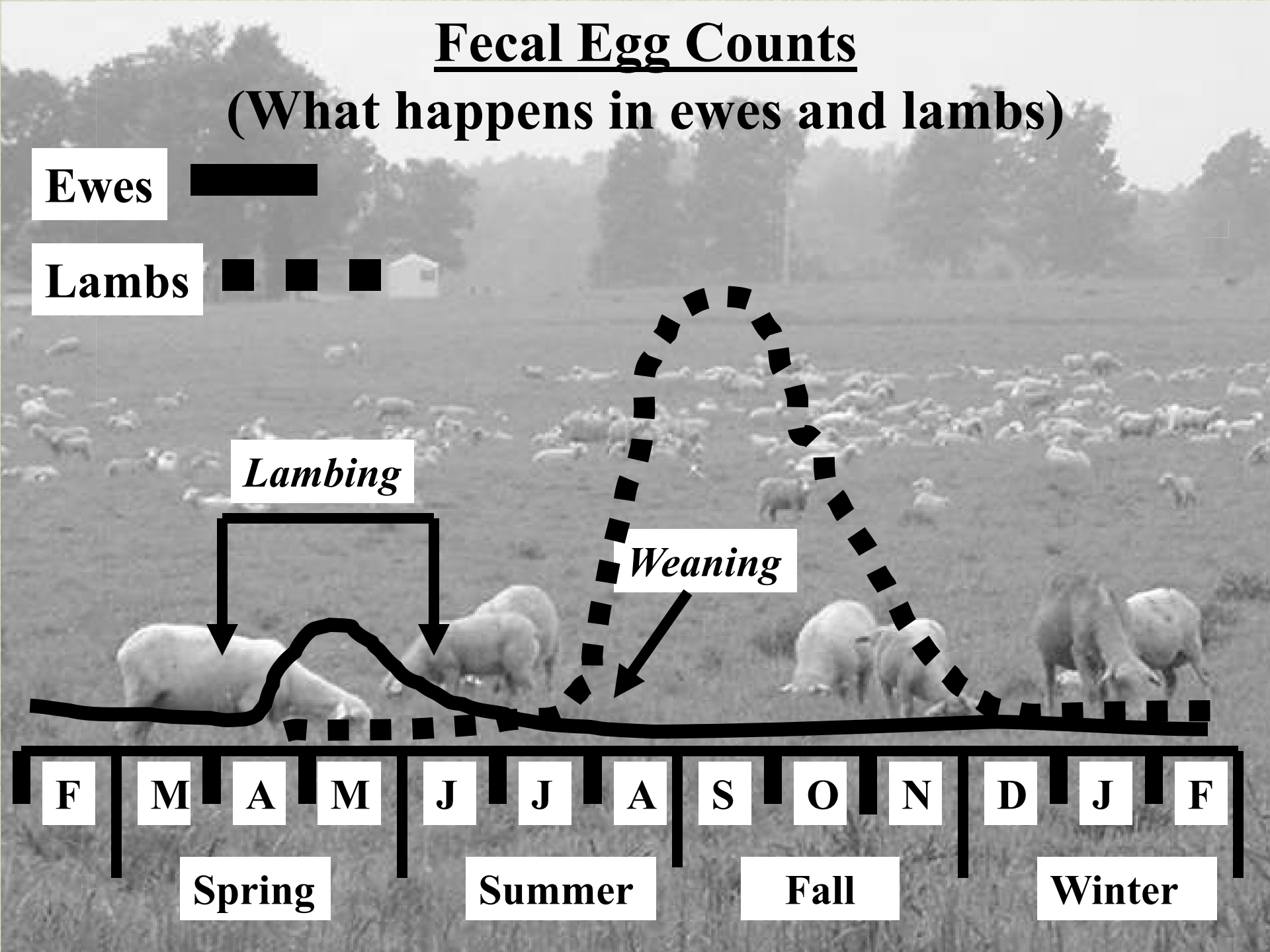
When Are Larva On Pasture A Problem?
Why & How Do Seasonal Increases Occur?

(If No Treatment)



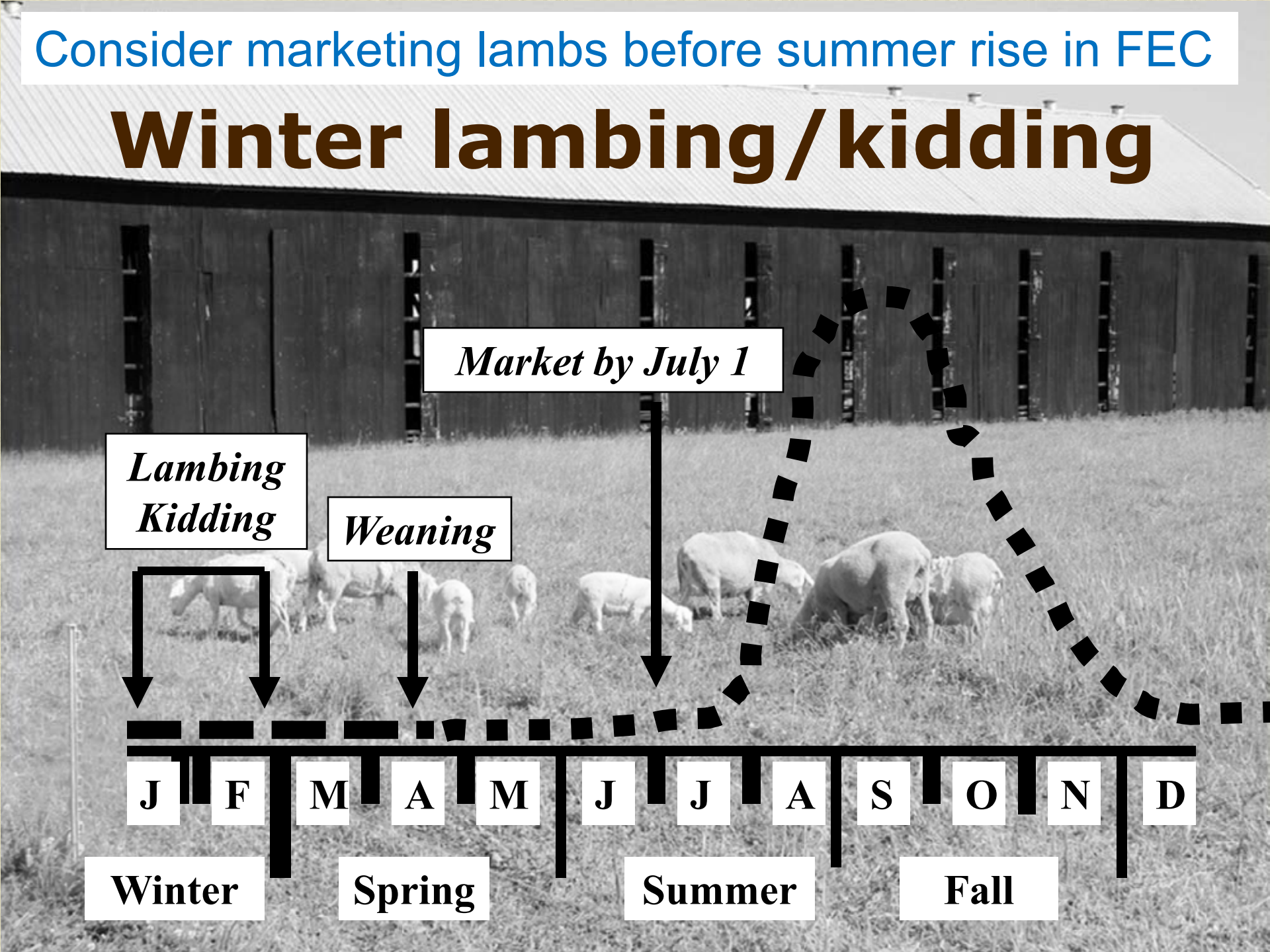
Fecal Egg Counts

(What happens in ewes and lambs)



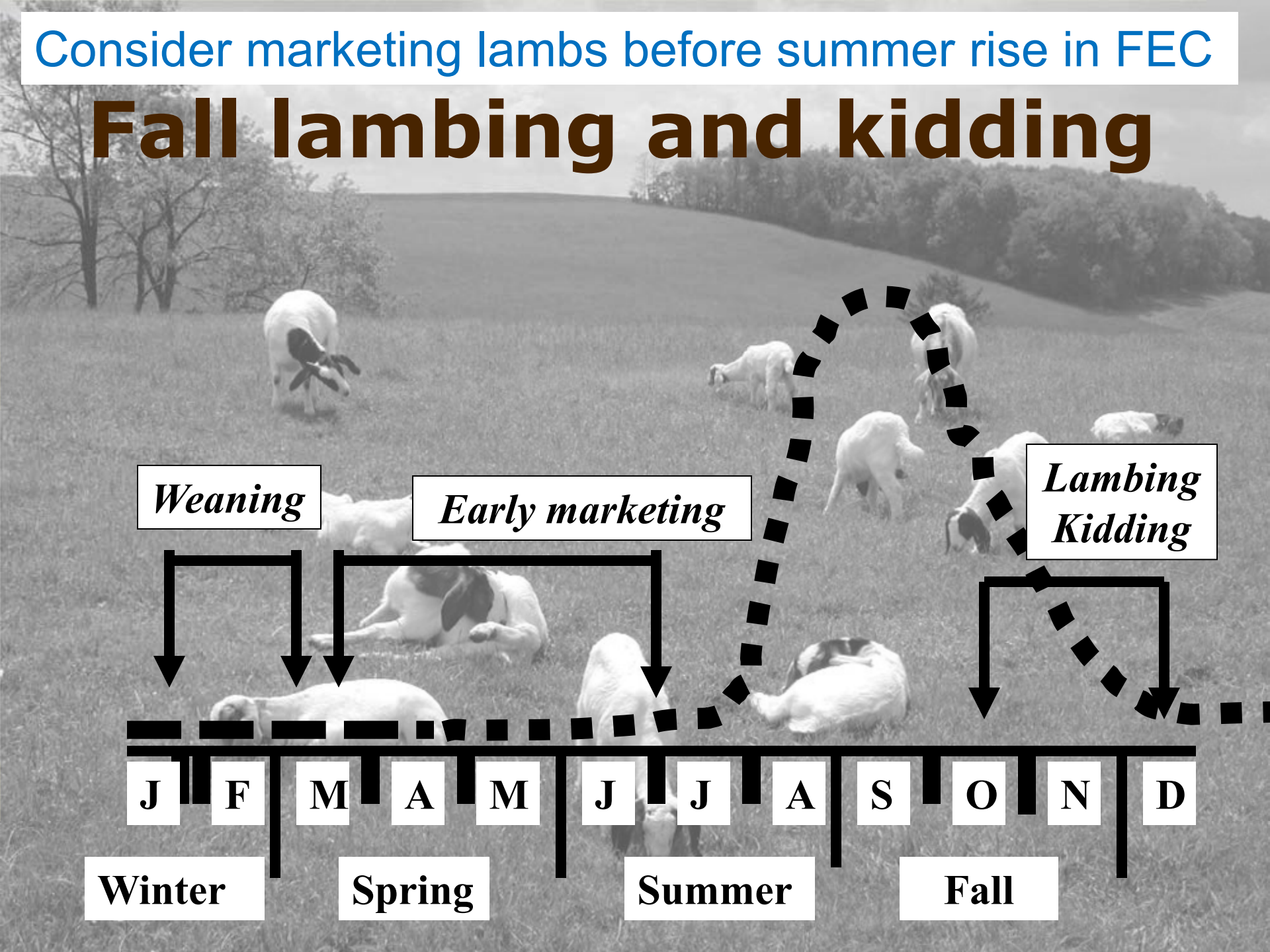
Consider marketing lambs before summer rise in FEC

Winter lambing/kidding



Consider marketing lambs before summer rise in FEC

Fall lambing and kidding



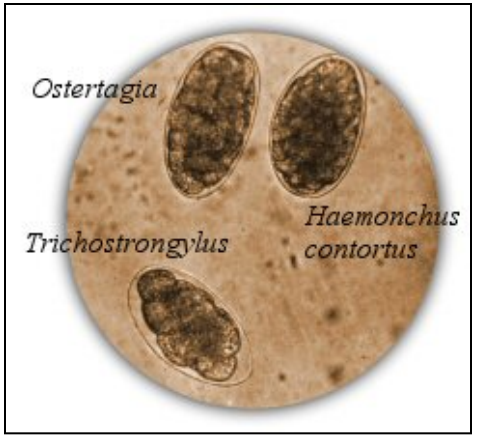
Why is *H. contortus* Such a Problem ???

- Evolved in tropics
  - thrives in warm/wet climates
- Long transmission season in southern states
- Short life cycle (~21 days)
- Goats acquire only partial immunity
- Immunity is slow to develop in sheep
  - Kids and Lambs are highly susceptible
  - Immunity wanes around time of kidding/lambing

How do you know what kind of worms your sheep or goats have?

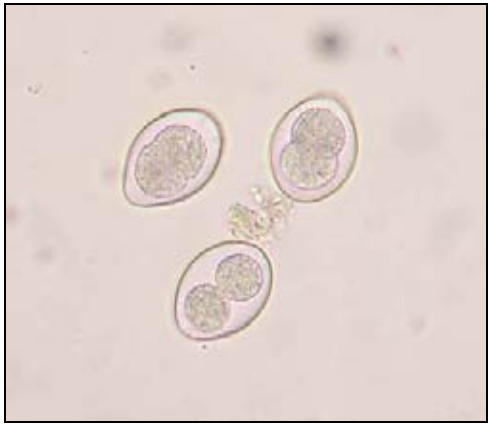
Parasite identification

1) Fecal flotation or egg count
   - ✔ Can differentiate between *strongyle* (stomach), tapeworm, and coccidia eggs.
   - ✖ Can't differentiate between most *strongyle* (stomach) worm eggs. eggs (except *Nematodirus*)
   - ☞ Meningeal worms do not pass eggs, larvae are expelled in feces, need slugs and snails as intermediate hosts



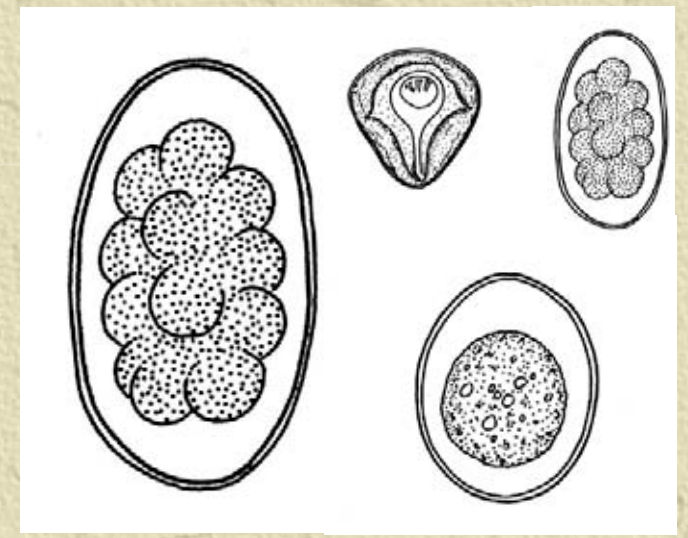
- ☞ Do-it-yourself
- Public lab
- Diagnostic lab
- Private lab
- Veterinarian

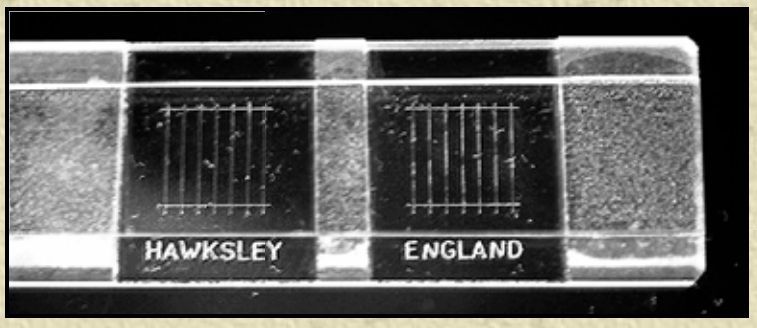
Moniezia spp (tapeworm).



Eimeria spp (coccidia).

Fecal Egg Counting





Qualitative Analysis

- Shows presence or absence of eggs
- Identify egg types
- Shows general trends in egg numbers.

Quantitative Analysis

- Shows specific number of eggs per gram of feces (epg)
- Uses known quantity of feces and flotation solution.

Fecal Egg Counting

What you need

- Microscope (min. 100x)
- Flotation solution
- Mixing vial
  - Mixing vial and strainer for qualitative analysis
  - Calibrated mixing vial and syringe for quantitative analysis
- Slides
  - Regular slides and cover slips for qualitative analysis.
  - McMaster egg counting slide for quantitative analysis

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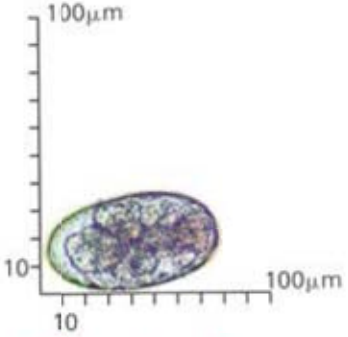
Guide to Internal Parasites of Ruminants

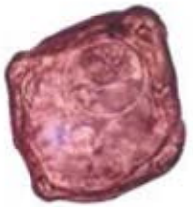
Sponsored by Intervet—providers of Panacur®/Safe-Guard® to the livestock industry.



Ostertagia
(brown stomach worm)

Cooperia
(small intestinal worm)

Moniezia
(tapeworm - sheep)



Moniezia
(tapeworm - cattle)

Bunostomum
(hookworm)

Haemonchus
(barberpole worm)

Nematodirus
(threadneck worm)

Trichostrongylus
(bankrupt worm)

Oesophagostomum
(nodular worm)

Trichuris
(whipworm)

Strongyloides
(threadworm)

Coccidia
(a protozoan that causes coccidiosis)

Dictyocaulus
(lungworm)

Mite Egg - 1/4 actual size
(contaminant - often mistaken for worm eggs)

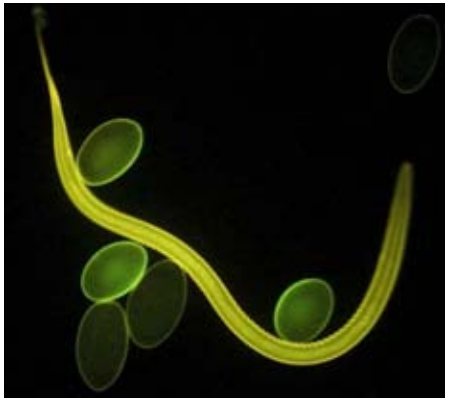
D H Bliss and W G. Kvasnicka, the compendium, April 1997

Stomach worm identification

2) Fecal coproculture / larvae ID
   - Differentiate between *strongyle* (stomach) worms (*H. contortus, Teladorsagia, and trichostrongyles*)
     - University of Georgia (Dr. Ray Kaplan's lab)

   ☞ Can take test one step further to determine anthelmintic (dewormer) resistance -- larval development assay (LDA) or DrenchRite® test.

3) Lectin-staining test (new)
   - Determine percent of *Haemonchus contortus* eggs in sample.
     - Oregon State University
     - University of Georgia



Parasite Dewormers

- CLASS OF DRUG
  - Ivermectin
  - Moxidectin
  - Morantel
  - Levamisole
  - Fenbendazole
  - Oxifendazole
  - Albendazole
- TRADE NAME
  - Ivomec
  - Cydectin
  - Rumatel, Positive Pellet, Strongid
  - Levasol, Tramisol
  - Prohibit
  - Safeguard, Panacur
  - Synantic
  - Valbazen

Management Tips

Periparturient egg rise

- Temporary loss of immunity to parasites at the time of parturition. Egg counts ↑
- Often coincides with hypobiotic (dormant) larvae resuming their life cycles in the spring
- Dams are the primary source of infection to their offspring

- Consider deworming with an anthelmintic effective against hypobiotic larvae (valbazen, ivomec, panacur, safeguard, synantic) at kidding
- Increase protein in late gestation ration to counter egg rise

Selective Treatment

- FAMACHA©
  - For *H. contortus* only
  - (barber pole worm)

- For other GI worms
  - FEC (fecal egg count analysis)

Management Tips

- To greatly reduce pasture contamination in the spring
  - Treat during mid-winter (December or January or February) to destroy dormant larvae in the GIT of goats

Management Tips

- Dewormers effective against dormant larvae
  - Avermectin – Ivomec
  - Fenbendazole – Panacur, Safeguard
  - Albendazole – Valbazen
  - Oxfendazole - Synantic

Management Tips

Do NOT buy resistant worms

- All new additions should be quarantined and aggressively dewormed upon arrival
- Deworm with 3 dewormers from different drug classes
  - Moxidectin (cydectin), levamisole (prohibit), and albendazole (valbazen) upon arrival
  - Follow recommendations about use of dewormers
- Should remain in quarantine for 10 - 14 days
  - Perform FEC to confirm that no eggs are shed
- Place animals onto pasture

Management Tips

- **80:20 rule**
  Approximately 20 percent of the herd/flock sheds most (~80 percent) of the GIT parasite eggs
- **Cull animals that regularly show signs of heavy worm infestation**
- These animals may re-infest your entire herd/flock on a regular basis
- **Culling worm-susceptible animals will increase herd/flock resistance and reduce pasture contamination**

Comparison of Genetic and Non-genetic Control Strategies

Strategy	Reduction in FEC's
Genetic Selection	69%
Protein supplementation	35%
Strategic deworming	28%
Experimental vaccine	0%

Australia, 2002

- Monitor sheep, run in the plots after the end of the experiment had lower FEC's when run in the plots previously grazed by supplemented sheep (35%) or selected sheep (46%).
- The largest and most persistent effect on FEC's and worm contamination of pasture was achieved by genetic selection.

Management Tips

- Put weanlings and lactating animals on cleaner pastures
- Separate growing animals from older animals
  - younger animals are more susceptible

Additional Management Tips

- Fix water leaks around tanks
- Avoid grassy pens
- Fence off moist areas

⇨GIT nematode larvae thrive under moist, shady and warm conditions

Nutritional Management

- Animals on a high plane of nutrition and in better body condition are better able to withstand worm burdens.
- Nutrition in early pregnancy (fat stores) can affect the immune response to internal parasites.
- Sheep receiving higher levels of protein prior to lambing have lower fecal egg counts.
- Supplementing grazing lambs with protein has been shown to reduce fecal egg counts.

Nutritional supplementation is most likely to be beneficial when pregnant females and young animals are below optimal body condition at a time when pasture quality and/or quantity is limited.

"Zero" grazing

bedded pens, dry lot with no green vegetation, slatted floors

- Sheep/goats put in confinement or dry lot do not usually get re-infected with GIT worms.
- Coccidiosis could still be a problem, if preventative measures are not taken.
  - Good sanitation
  - Proper feeders
  - Coccidiostats

"Resistant" Breeds

Some sheep and goat breeds are more resistant to worms.

Sheep

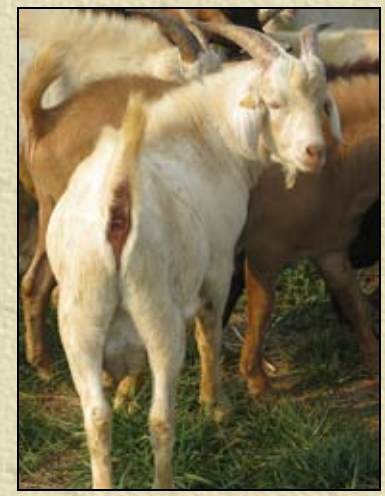
- Gulf Coast Native
- Hair sheep
  - St. Croix
  - Barbados Blackbelly
  - Katahdin

NOT

- Traditional wooled breeds

Maybe

- Dorper
- Royal white
- Other breeds?



Goats

- Spanish/Brush
- Myotonic/Tennessee Fainting goat
- Kiko

NOT

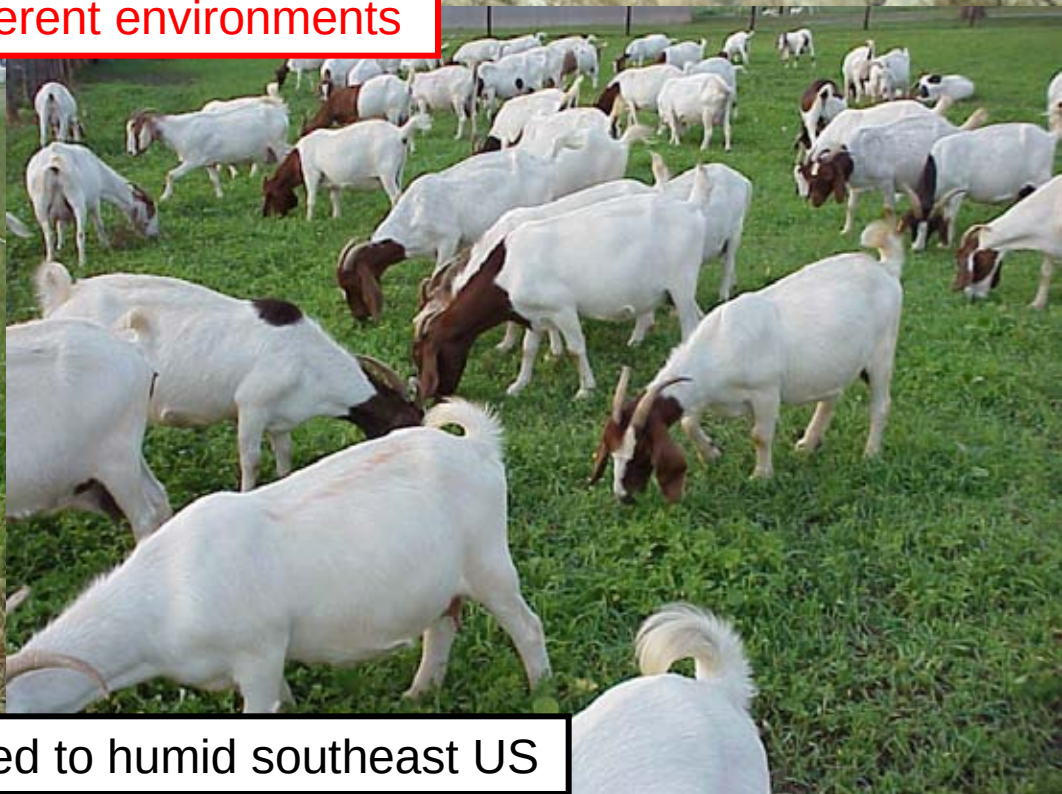
- Boer goats
- Dairy goats
- Angora goats

?

- Pygmy
- Savannah

Boer goats in South Africa

Strikingly different environments



Boer goats imported to humid southeast US

“Resistant” Breeds

Myotonic

Kiko

Spanish

“Resistant” Breeds

Katahdin

St. Croix

Gulf Coast native

Graze multiple species

- Sheep and goats share the same internal parasites, but they are different from the parasites that affect cattle and horses.
  - Except barber pole worm in young calves
- Producers who graze multiple species of livestock report fewer parasite problems.
- Cattle and horses "vacuum" sheep/goat pastures of infective worm larvae.
- There are other benefits to mixed species grazing, such as complimentary grazing habits.

Leader-Follower System

INRA Research Station – Guadeloupe West Indies

Goats average daily gain increased when grazed with cattle

Use of "clean or safe" pastures

- A pasture that has been renovated with tillage.
- A pasture that has not been grazed by sheep or goats for the past 6 to 12 months.
- A pasture that has been grazed by horses and/or cattle for the past 6 to 12 months.
- A pasture in which a hay or silage crop has been removed.
- A pasture that has been rotated with row crops.
- Pasture that has been burned

Cleaner, safer pastures are a more realistic goal for most producers.

Pasture Rest and Rotation

- Pasture rotation is a recommended strategy for controlling internal parasites because it allows the use of safe or safer pastures.
- BUT, intensive rotational grazing may not help to reduce parasitism unless rest periods are long enough.
- However, in an intensive rotational grazing system, animals have access to high quality forage (protein and energy) that boosts the immune system
- In a rotational grazing system, ideally, sheep/goats should not be returned to the same pasture for 2 to 3 months.

Population Demographics of Gastrointestinal Nematodes

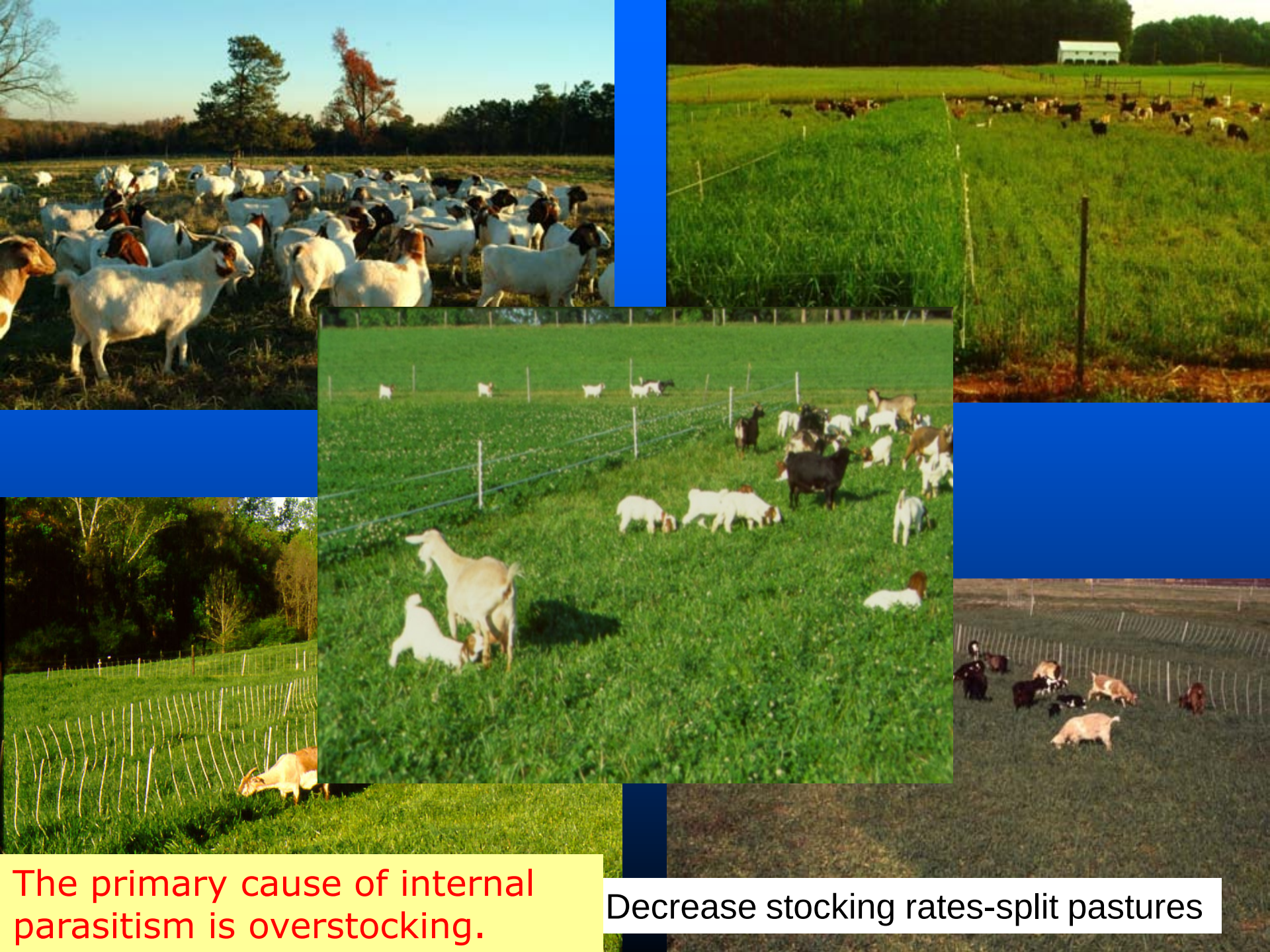
Haemonchus contortis	May-June	July-September
How long before high pasture infectivity?	**3 weeks[1]**	**2 weeks[1]**
When are the highest levels of pasture infectivity?	**5-9 weeks**	**3-9 weeks**
How long until low levels of pasture infectivity?	**3 months**	**3 months**

[1] Earlier if high temperatures coincided with rain.

Patterns of *Ostertagia circumcincta*, *Trichostrongylus* spp. and *Cooperia curticei* were basically similar to *H. contortis*. *Strongyloides papillosus* larvae emerge within 2 weeks on pasture and survival is short. *Nematodirus* larvae took a lot longer to emerge on pasture than the other trichostrongylids.

Utrecht University (Netherlands) 1999-2003

<u>Research conclusion</u>: Only a small number of farms can use evasive grazing as the only method of parasite control. For most farms, evasive grazing needs to be combined with other pasture control strategies.



The primary cause of internal parasitism is overstocking.

Decrease stocking rates-split pastures

Smart Pasture Management

- Limit to 3 - 7 goats or sheep per acre
- Less is better

CEFS organic unit
Integration of goats in vegetable rotation system

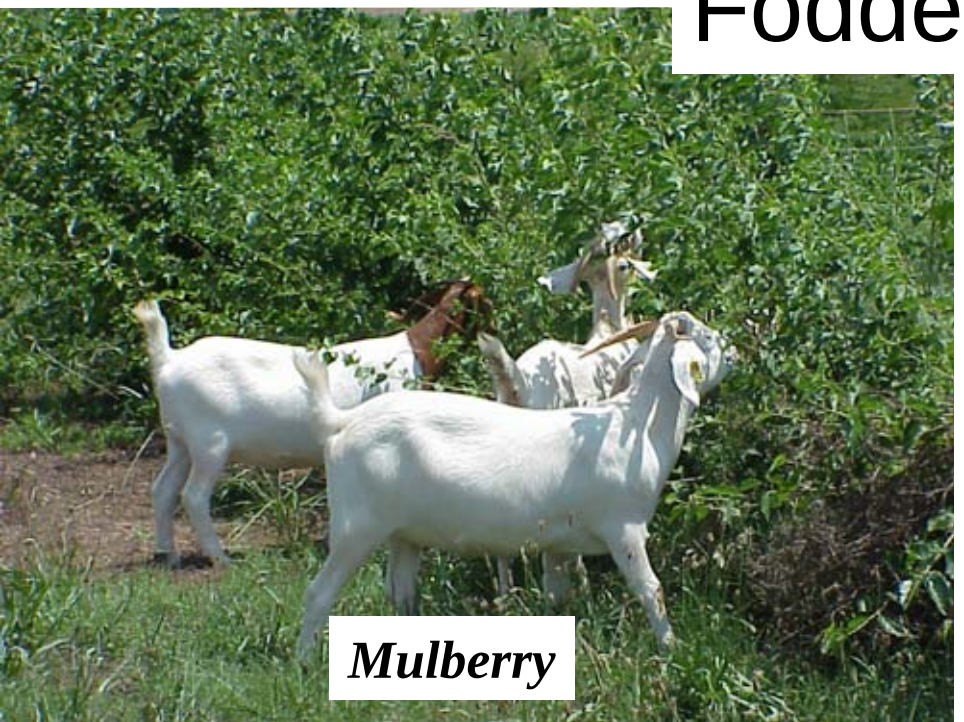
Alternative Forages

- Livestock that browse have fewer parasite problems
- Livestock grazing tall-growing forages will have less parasite problems.
  - ➪ *80% of parasites larvae live in the first 2-3 inches of the vegetation from the soil surface*
- Grazing tanniferous forages may reduce the effects of parasitism

Fodder trees

Black locust

Honey Locust



Mulberry

Mimosa

Woodlot Browsing

Chicory, birdsfoot trefoil, and sericea lespedeza have all been shown to reduce fecal egg counts and/or inhibit larval development.

Sericea lespedeza

Lespedeza cuneata **(high tannin variety)**

- **Warm season legume that grows in acidic soils with low fertility and tolerates drought well.**
- **Fed as . . .**
  - **Fresh forage**
  - **Loose or ground hay**
- **Goats readily eat it**
- **Sheep will eat it**
- **For control of barber pole worm only**

Field Set-up for Lespedeza Study

Plot size: 0.12 ha

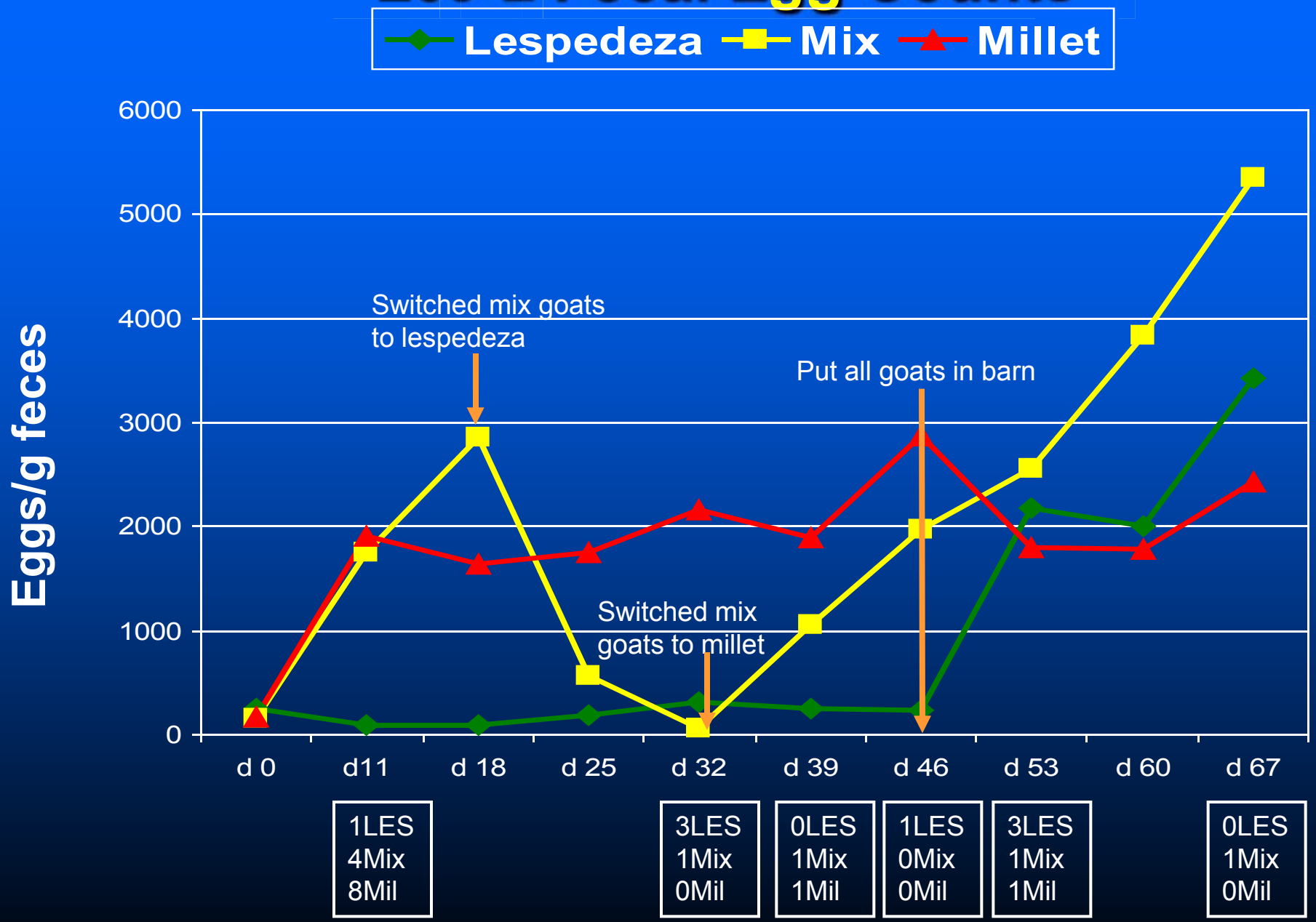
Grazing treatments

Sericea lespedeza (SL)

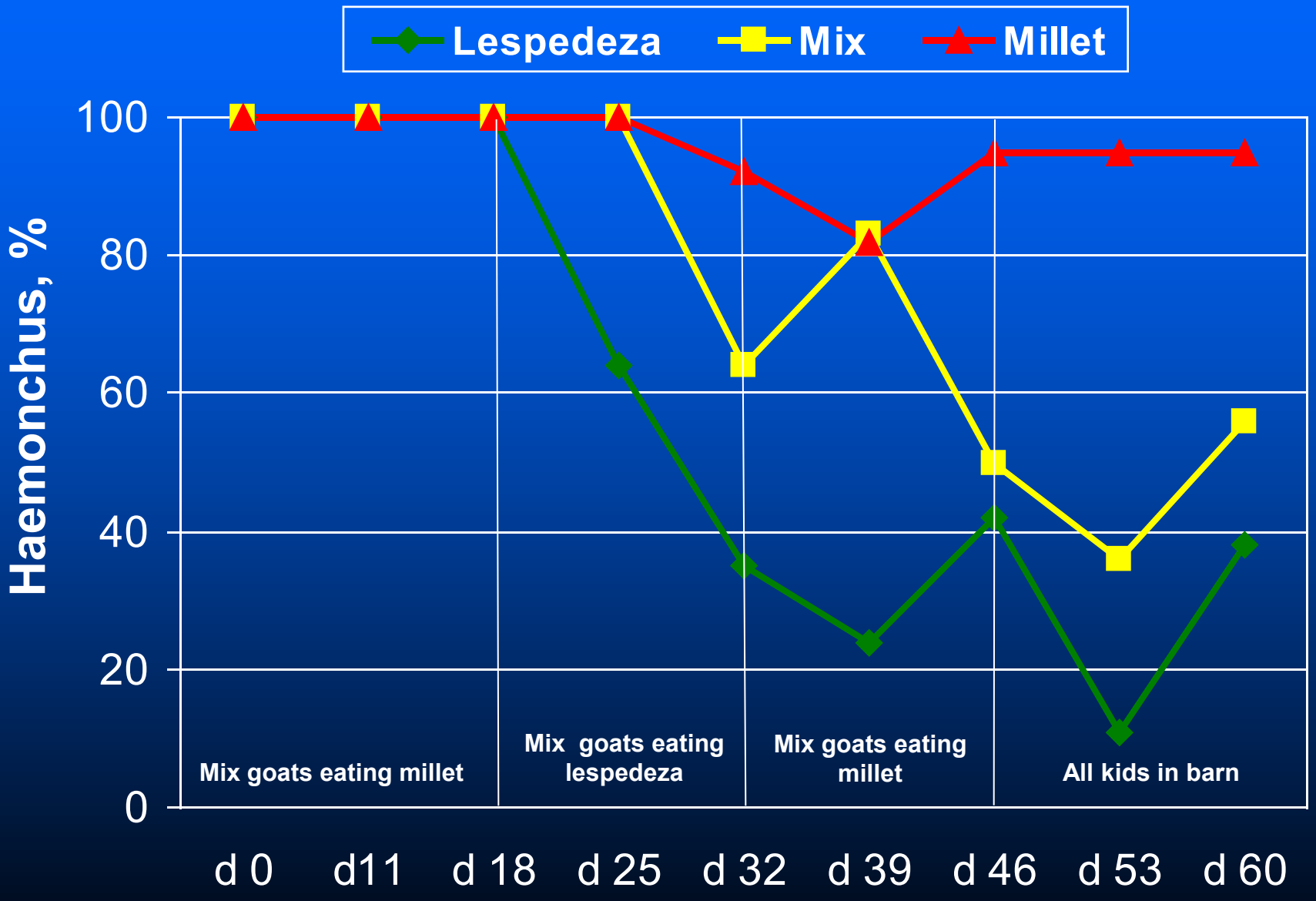
PearlImillet (PM)

Alternating PM-SL-PM

L09-2 Fecal Egg Counts



L09-2 Larval Identification
Gaps from 100% are Trichostrongylus



Trichostrongylus (Black Scour Worm)

- Burrow into the wall of the abomasum (destroy stomach).
- Symptoms: scouring and weight loss, ill thrift; appetite?

Field Set-up for Lespedeza Study

Plot size: 0.12 ha

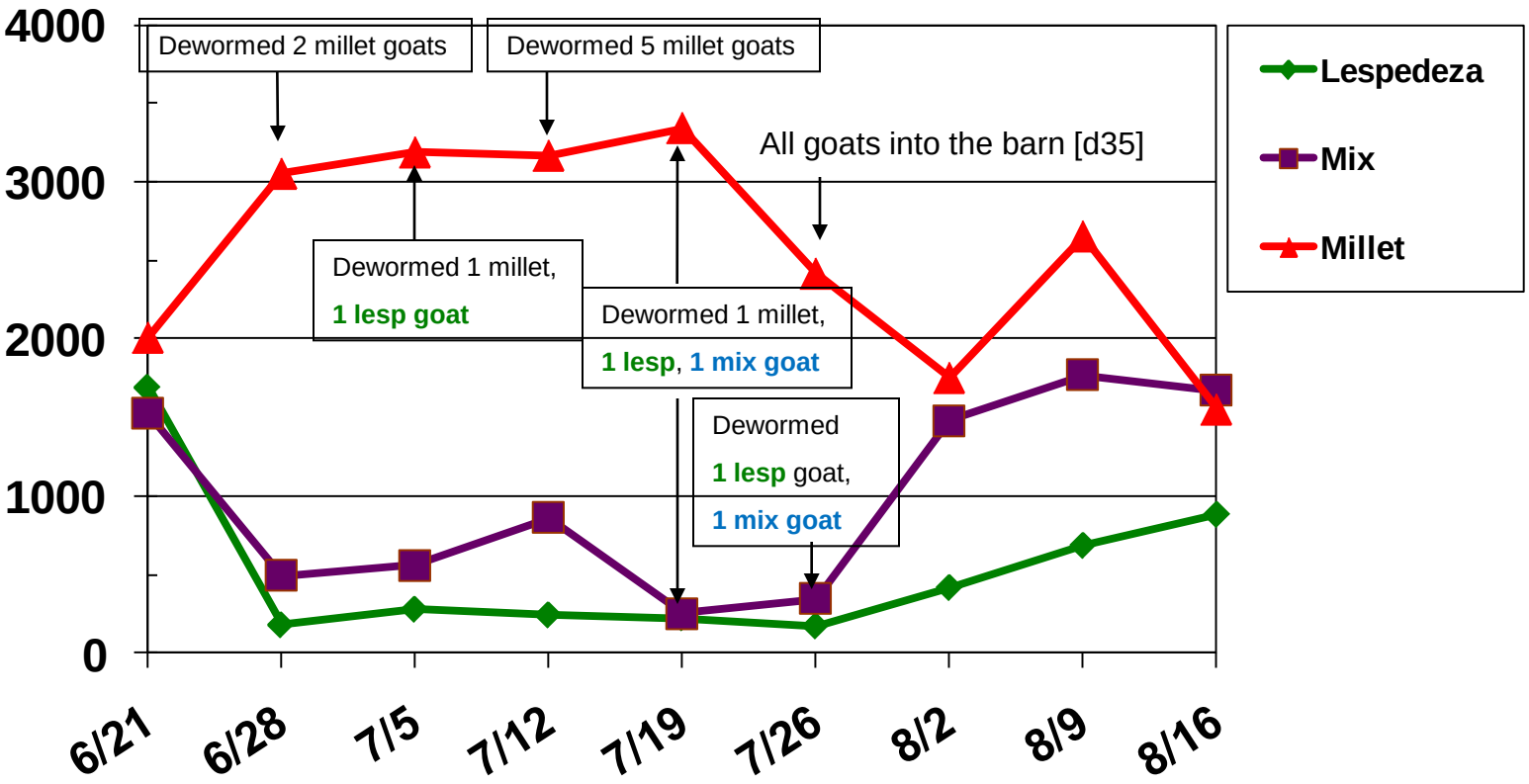
Grazing treatments

Sericea lespedeza (SL)

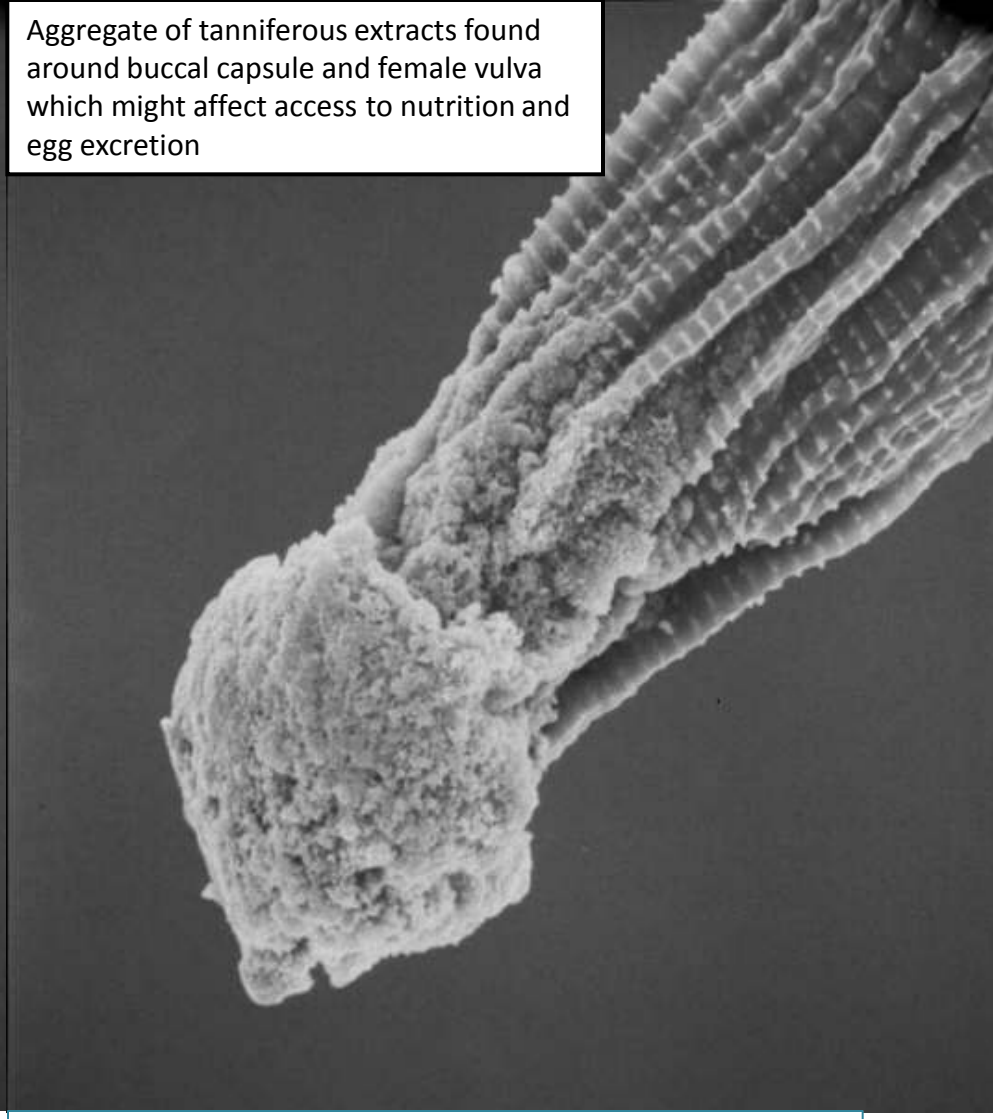
PearlImillet (PM)

Free choice SL and PM

L10 – 3 Fecal Egg Counts



Adult *H. contortus* worm: control



Aggregate of tanniferous extracts found around buccal capsule and female vulva which might affect access to nutrition and egg excretion

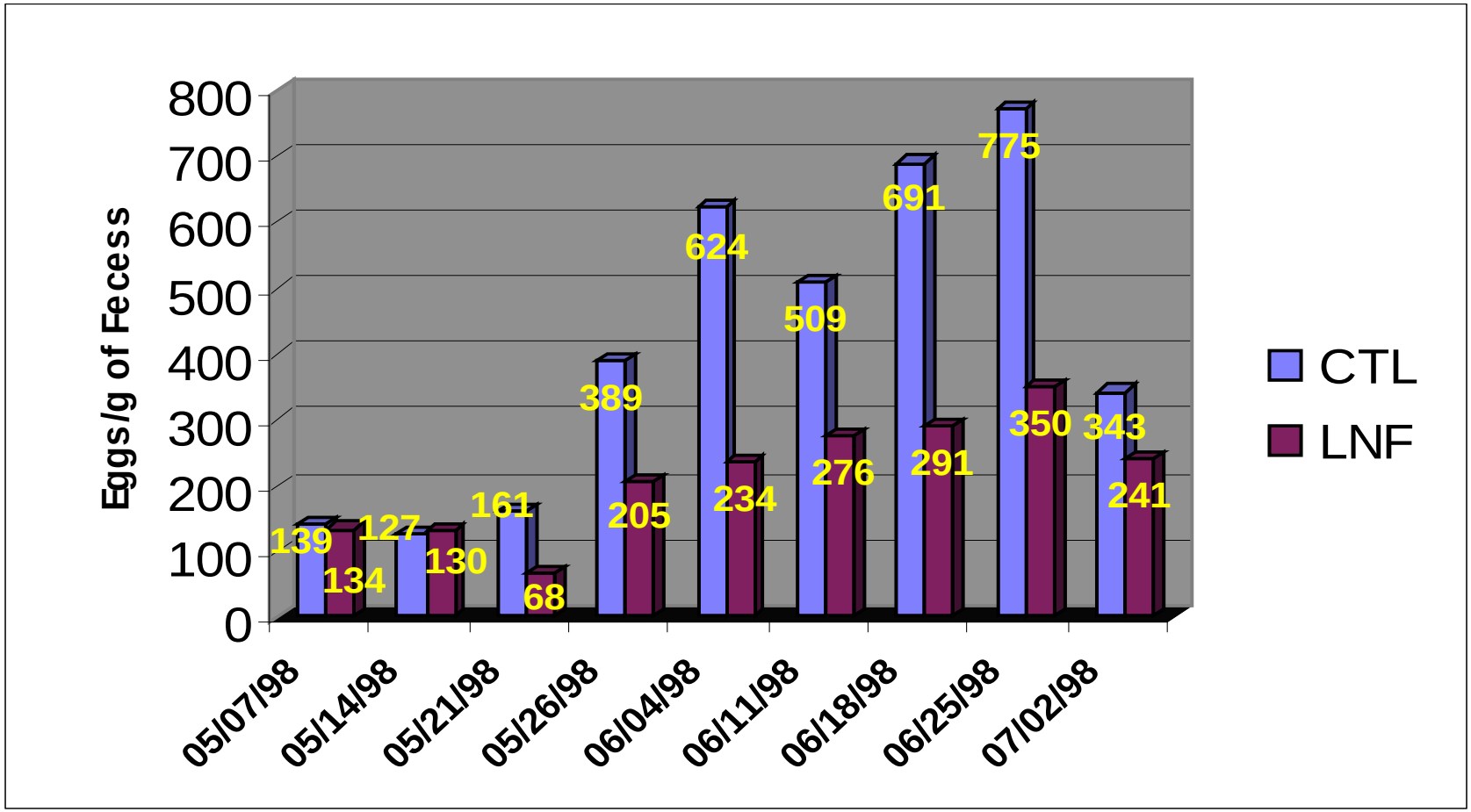
Adult *H. contortus* worm: tzalam extracts

Adult *H. contortus* were in contact with tzalam tanniferous extracts for 24 hours in vitro. Same effects were seen with sainfoin, a temperate legume.

Credit: Mrs Martinez Ortiz de Montellano

Effect of liquid N fertilization on Trichostrongyle fecal egg count of grazing goats - Trial 1

SPRING



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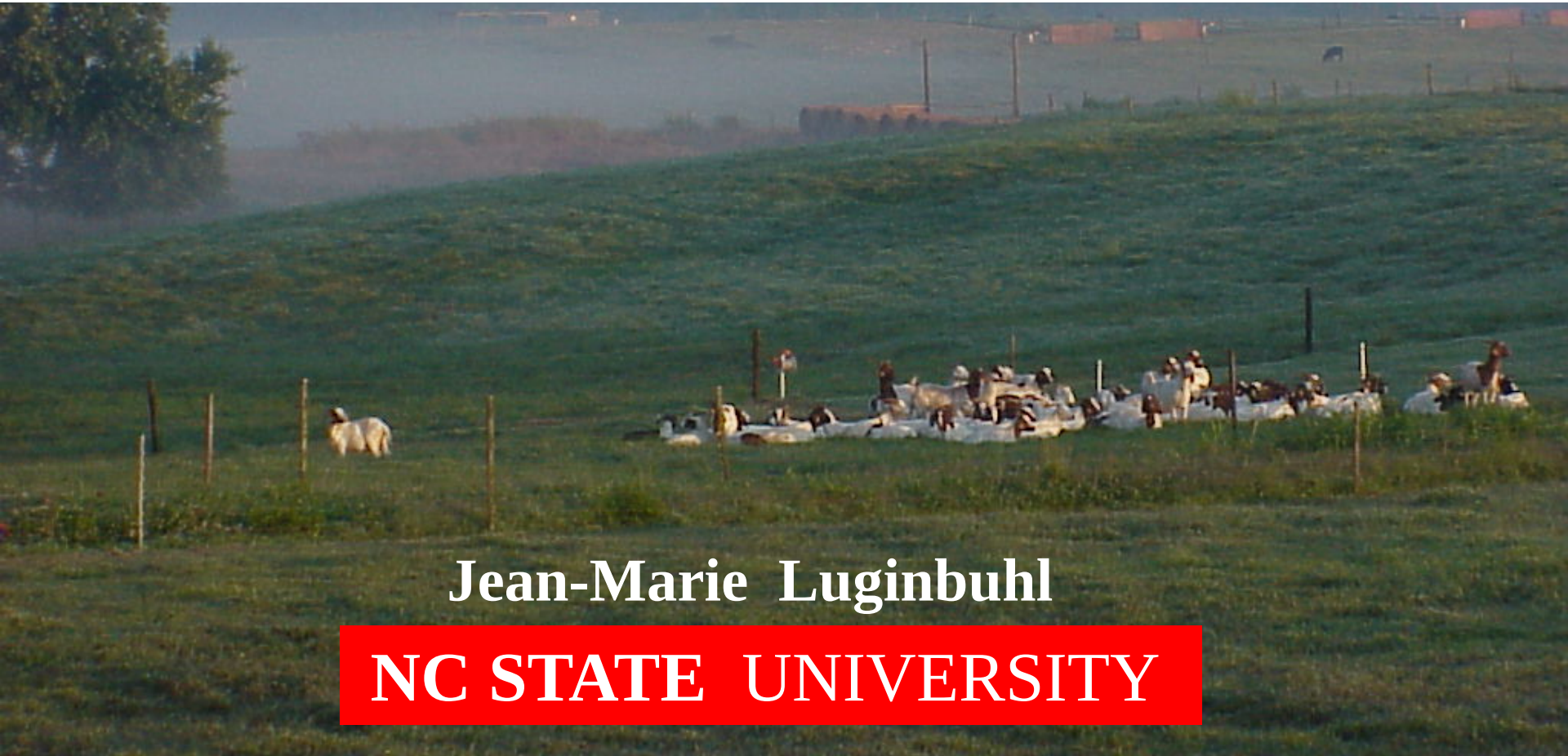
Goal is to prevent clinical disease and production losses

Part II



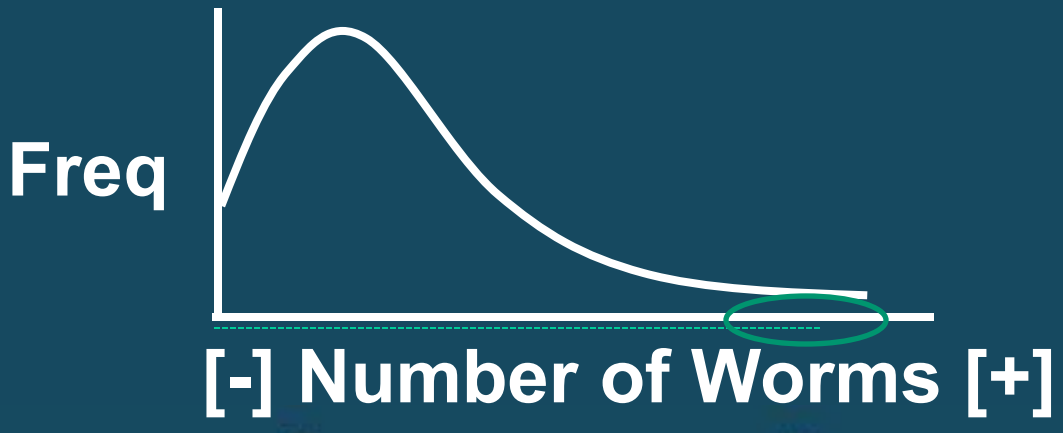
Jean-Marie Luginbuhl

NC STATE UNIVERSITY

So, how do we easily determine which animals to treat?

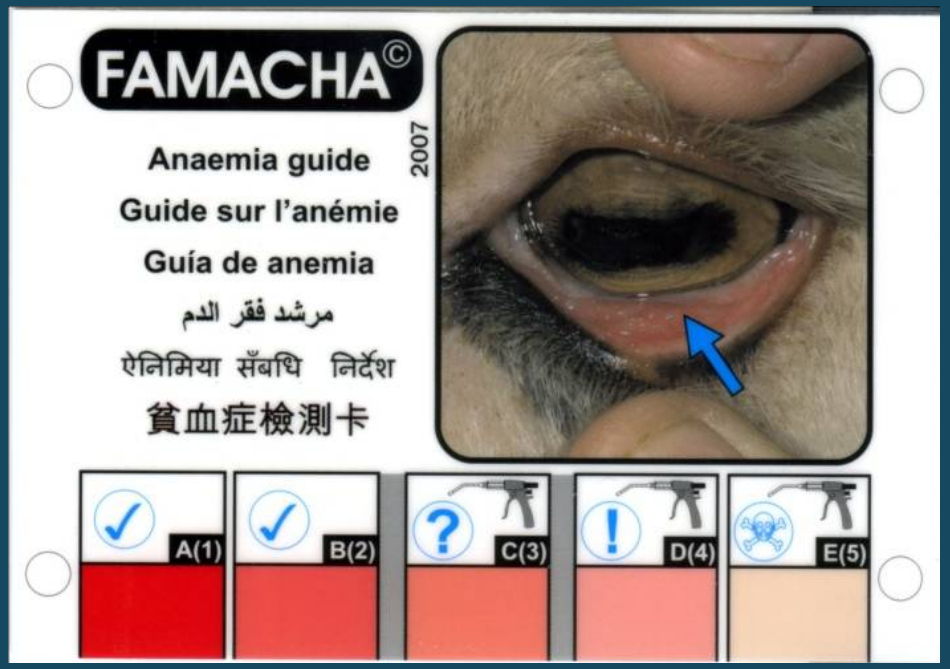
Concept Behind Selective Treatment

- Parasites are not equally distributed in groups of animals (80:20 % rule)
  - 20 % of animals harbor most of worms
    - Few animals are responsible for most of egg output

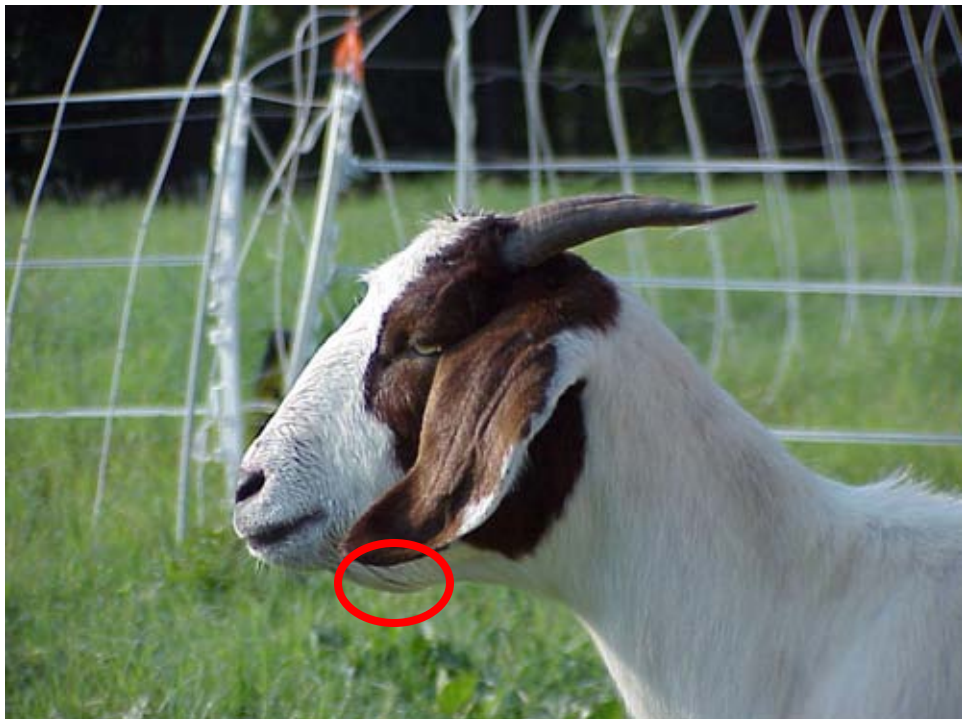


Selective Treatment

- FAMACHA©
  - For *H. contortus* only
  - (barber pole worm)
- For other GI worms
  - FEC



Anemia



Bottle jaw

1) Place gentle downward pressure on eye with upper thumb

2) Pull down lower eyelid with other thumb

3) Read color of eye on mucous membranes of lower eyelid


FAMACHA©
Anaemia guide
Guide sur l'anémie
Guía de anemia
مرشد فقر الدم
ऐनिमिया संबंधि निर्देश
貧血症検測卡
A(1)
B(2)
C(3)
D(4)
E(5)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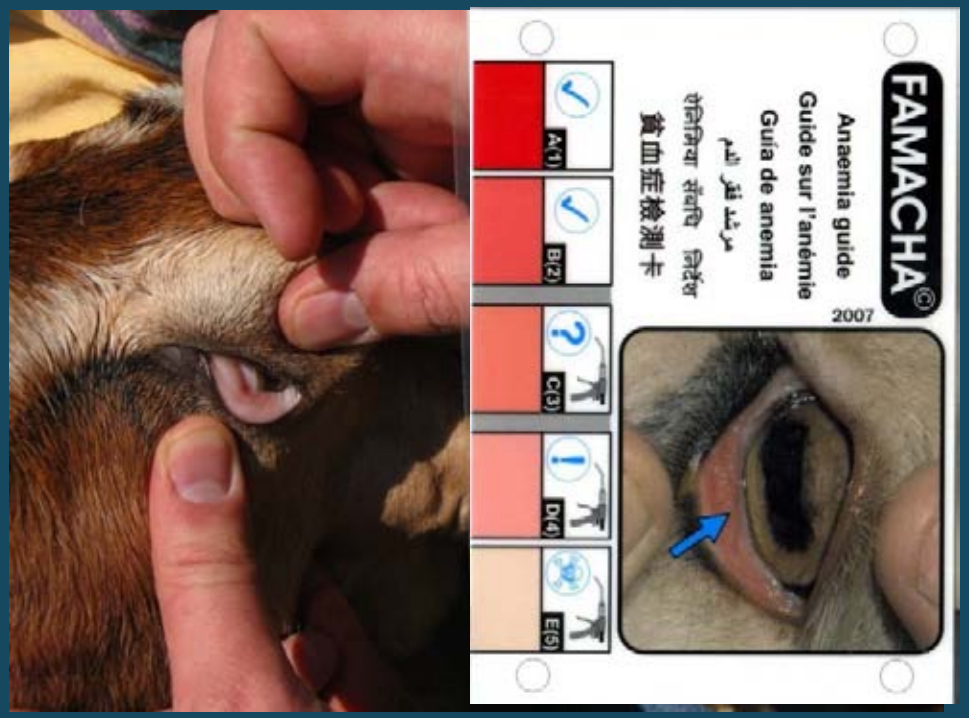
FAMACHA©
Anaemia guide
Guide sur l'anémie
Guia de anemia


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

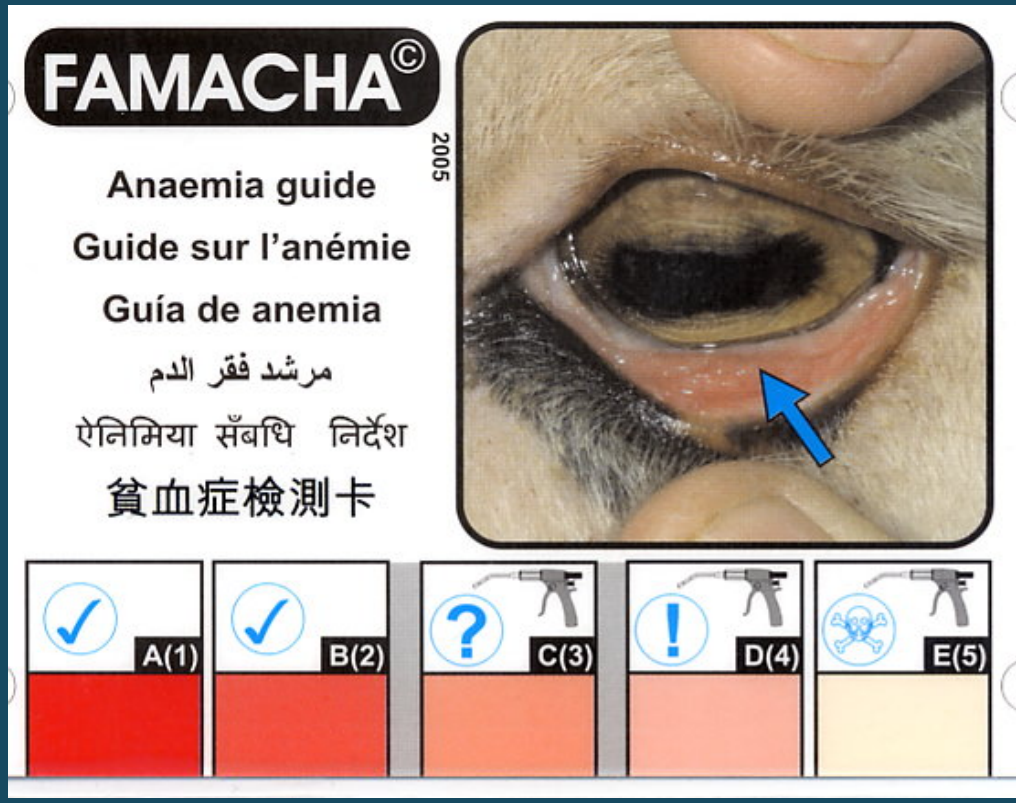
FAMACHA© System “rules”

- Score using the chart
- Evaluate in bright light (sunlight)
- Be quick
- Score both eyes
- Use higher score if eyes differ



What Do I Do With The Results?

- ***Always*** treat goats and sheep in categories **4** and **5**
- Don't treat **1's** and **2's**
- When should you treat the **3's**?



Animals in Category 3

- Treat when
  - >10% of herd scores in categories 4 or 5
  - Young animals
  - Ewes/does (pregnant or lactating)
  - Animals in poor body condition
  - If any concern about animals general health and well being

How Often Do I Monitor

- **If <10% of the herd/flock scores in categories 4 or 5:**
  - Re-examine in **2 weeks** if it is *Haemonchus* "season" (warm, moist conditions)
  - In dry or cool times of year, every **4-6 weeks** is probably sufficient
  - More often at first to be safe – with experience you will learn what the proper intervals are for your farm

How often…

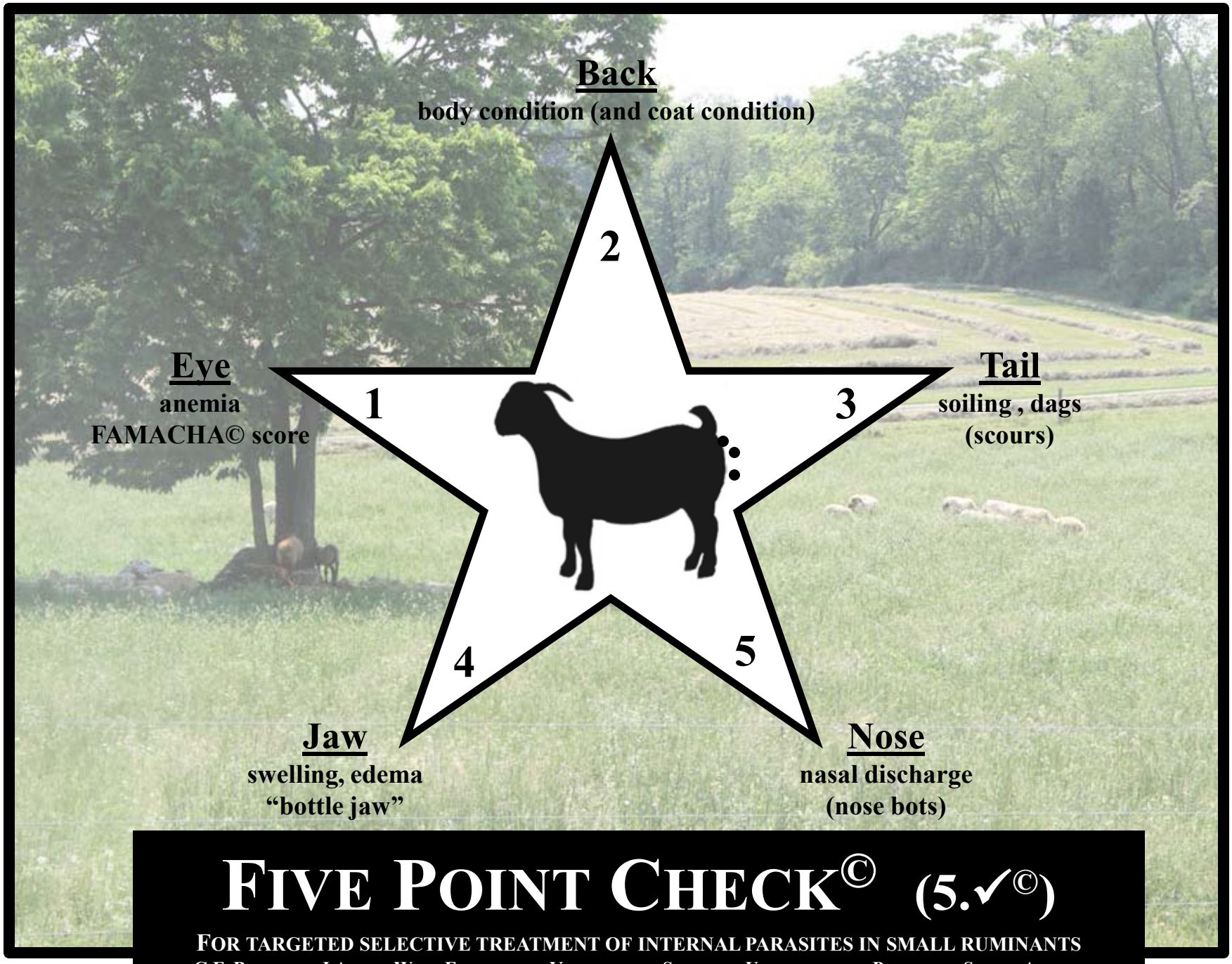
- **If >10% of flock/herd scores in categories 4 and 5:**
  - Recheck weekly
  - Treat the 3's
  - Change pastures (if possible)

Precautions

- FAMACHA© only applicable where *Haemonchus* is the main worm causing clinical disease
- Conjunctival redness can be caused by eye disease, environmental irritants, and systemic disease

Precautions….

- **Don’t use it as a sole criteria for whether or not to drench**
  - If you see other symptoms such as bottle jaw, you know you need to drench
  - Look at all available signs
    - Body condition score
    - Coat condition
    - Consistency of feces
    - Tail soiling
    - Heat/exertion intolerance



FIVE POINT CHECK© (5.✓©)

FOR TARGETED SELECTIVE TREATMENT OF INTERNAL PARASITES IN SMALL RUMINANTS

G.F. BATH AND J.A. VAN WYK, FACULTY OF VETERINARY SCIENCE, UNIVERSITY OF PRETORIA, SOUTH AFRICA

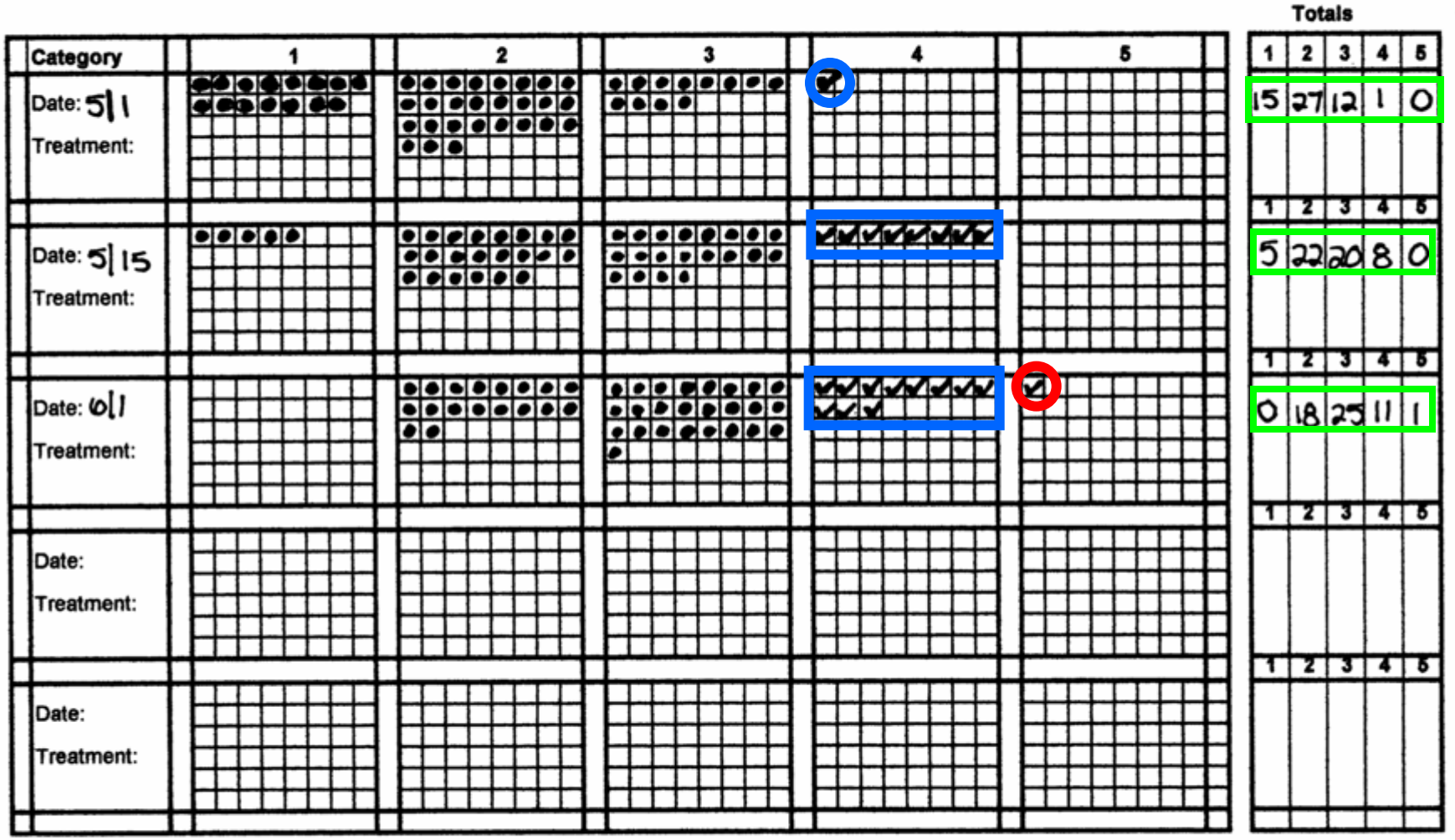
The Famacha Card

- Store in dark place when not in use
- Replace card after 12 months' use
- Keep a spare card in a light protected place

Old form

FAMACHA ANEMIA RECORD

Group ID:_____



● Counted

✔ Counted and Treated

× Bottle Jaw - Treated

New Form

Can put goat ID in each cell

FAMACHA ANEMIA RECORD

Group ID:

	FAMACHA SCORES																TOTALS				
Category	**1**				**2**				**3**				**4**				**5**				**1**	**2**	**3**	**4**	**5**
Date June 1																									
Treatment Safeguard																									
Date July 22																									
Treatment safeguard																									
Date																									
Treatment																									

Where Do I Get FAMACHA Cards?

- Only trained individuals can purchase the cards through sanctioned training workshops
  - Through a veterinarian, extension agent, animal professionals (all must have proper training)
- Cards are copyrighted
- Information at famacha@uga.edu
- www.scsrpc.org
  - website contains excellent information

Questions ???

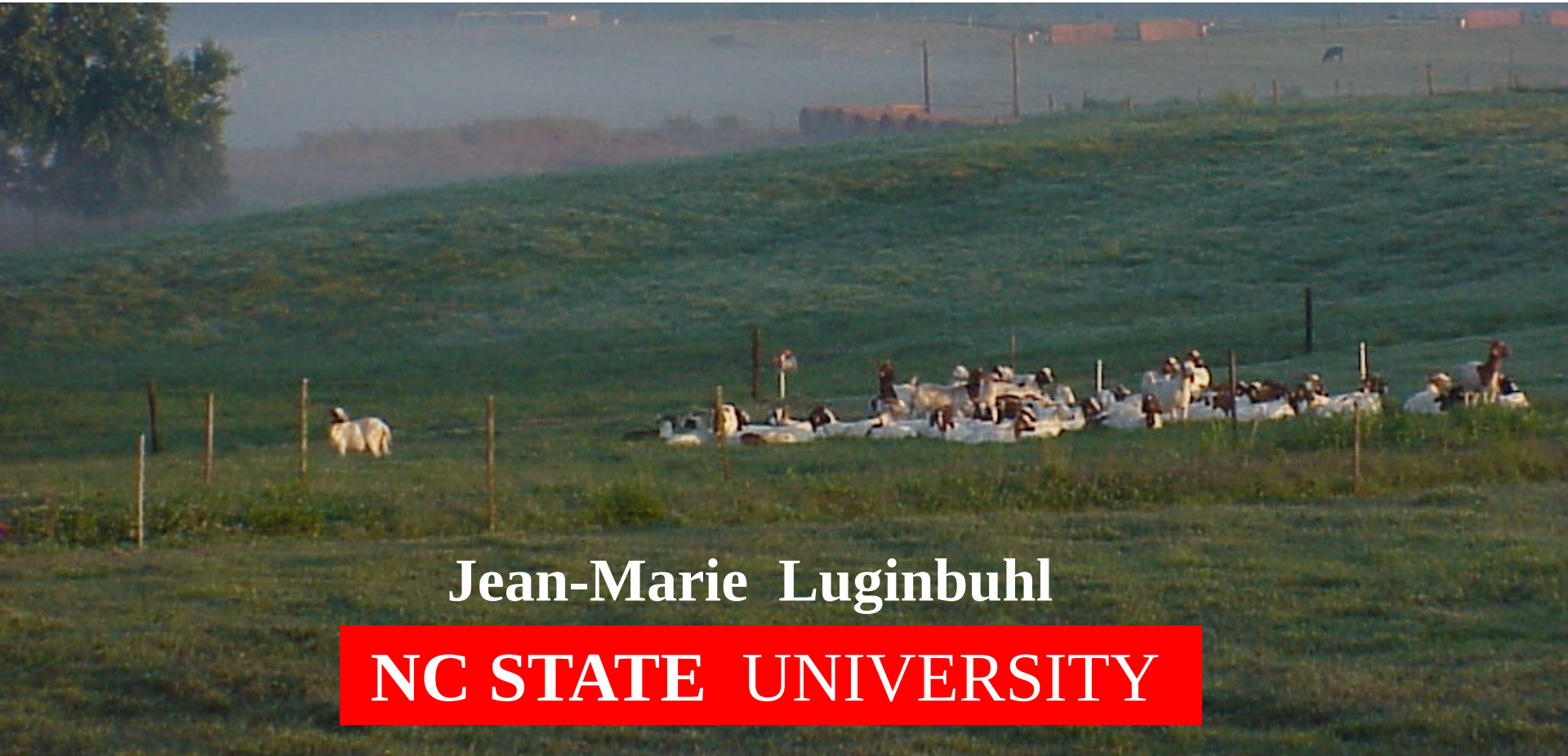
If do not have animals yet, train yourself using family members or friends:
Organize a FAMACHA party!

Integrated GI Parasite Management Program

Goal is not to create parasite-free animals. It is normal for sheep and goats to have parasites.

Goal is to prevent clinical disease and production losses

Part III



Jean-Marie Luginbuhl

NC STATE UNIVERSITY

Three drug families

Drugs kill parasites by starving them or paralyzing them.

1) **Benzimidazoles**

Chemical name ends in '..dazole

Fenbendazole, Albendazole, Oxybendazole

2) **Nicotinics**

Levamisole, Morantel, Pyrantel

3) **Macrolytic lactones**

Avermectins

Ivermectin, Doramectin

Milbemycins

Moxidecin

Benzimidazoles

The "white drenches"

- **Fenbendazole**
  SafeGuard®, Panacur®
- **Albendazole**
  Valbazen®
- **Oxyfendazole**
  Synantic ®

- First class of modern anthelmintics
- Broad spectrum
- Wide margin of safety
- → High level of resistance in industry.
- Kill heads and segments of tapeworms.

Valbazen

Effective against adult liver flukes.
Should not be administered to early pregnant animals

Synantic

Do not use in pregnant animals

Fenbendazole
"Panacur" and "Safeguard"

Different Names, Same Drug

- Approved for goats at
  2.3 mL/100 lb orally
  - 6 day meat WD
  - 0 day milk WD

“Extra-label” Fenbendazole Use in Goats

Goats: 4.6 mL/100 lb orally
- Meat WD: 16 days
- Milk WD: 4 days

Sheep: use at label dose
- 2.3 mL/100 lb
  - 6 day meat WD
  - 0 day milk WD

Albendazole "Valbazen"

- More potent drug but same drug class as fenbendazole
- Approved only for sheep at 3 mL/100 lb orally
  - Meat WD: 7 days

“Extra-label” Albendazole Use in Goats

- 6 mL/100 lb orally (2X sheep dose)
- 8 mL/100 lb orally (2X cattle dose)
  - Meat withdrawal: 9 days
  - Milk withdrawal: 7 days

- Do not use in does in the first trimester of pregnancy

Macrolides

(Macrolytic lactones, ML's)

1) Avermectins

Ivermectin

Ivomec®, Zimecterin®, Eprinex®, Promectin®

Doramectin

Dectomax®

2) Milbemycins

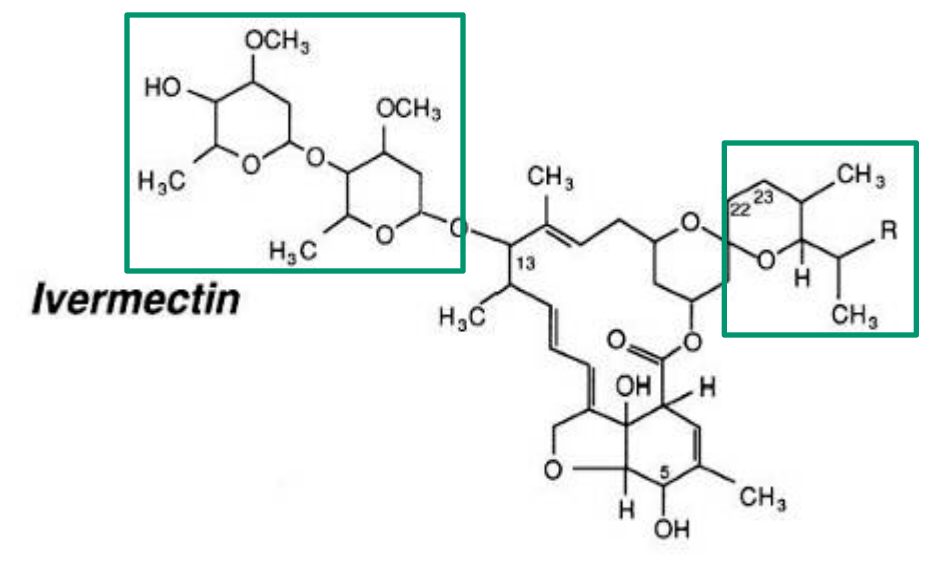
Moxidectin

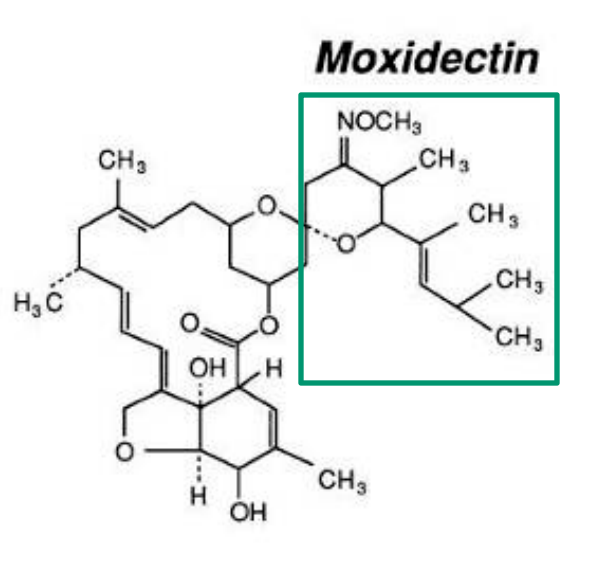
Cydectin®, Quest®

- Newest
- Broad spectrum
  - Including arrested larvae
- Wide margin of safety
- Effective against (biting) external parasites
- Persistent activity

Avermectins / Milbemycins

- These drugs share the same (or very similar) mechanism of action





Ivermectin "Ivomec"

- Labeled only for sheep
- **Ivomec® Sheep Drench**
  - **11.5 mL/100 lb orally**
  - **Meat WD: 11 days**

“Extra-label” Ivermectin Use in Goats

- 23 mL/100 lb orally
  - Meat WD: 14 days
  - Milk WD: 9 days

Moxidectin "Cydectin"

- Labeled only for sheep
- **Cydectin® Oral Sheep Drench**
  - 9 mL/100 lb orally
  - Meat WD: 14 days

“Extra-label” Moxidectin Use in Goats

- **Use sheep oral drench**
  - 18 mL/100 lb orally
    - Meat WD: 23 days
    - Milk WD: not established
      - Do not use in dairy goats

Rec'd for Moxidectin Use in Sheep/Goats

- Must be used carefully and with prevention of
- resistance as a goal
- Minimize use
  - **Suggest to use only in salvage situations, or if testing shows it is the only choice**
- Do not use the pour-on orally as in the past

Nicotinics

- **Levamisole** (clear drench)
  Tramisol ®, Levasole®, Prohibit®
- **Morantel**
  Rumatel®, Positive Pellet, Goat Care-2X, Morantel, Golden Blend
- **Pyrantel**
  Strongid®

Levamisole

Prohibit®, Levasole®, Tramisol®

- Probably the most effective anthelmintic.
- Lowest margin of safety
  - Should be administered orally.
  - Goats – 1.5x sheep dose

- Broad spectrum
- Effective against dormant larvae
- Narrower margin of safety

Levamisole

- Approved for use only in sheep
- More potent drug
- Less worm resistance problems
- Prohibit™ or Tramisol™ Soluble Sheep Drench
  - 4 mL/100 lb orally
  - Meat WD: 3 days

“Extra-label” Use of Levamisole in Goats

- 6 mL/100 lb orally
  - 1.5X sheep dose
- Meat withdrawal
  - 4 days
- Milk withdrawal
  - not established

Levamisole
Problems - Concerns

- Narrow margin of safety
- Weigh animals
  - Especially with goats
- Do not withhold feed
- Do not use in debilitated or dehydrated animals

Rumatel

Morantel tartrate

Strongid

Pyrantel

➢Only effective against adult worms

➢Not much is known about efficacy or resistance

Use Proper Technique

- Ensure proper dose is delivered
- Proper technique when drenching s and goats is very important

Injectable dewormers select for drug resistance and have longer withdrawal periods.

  - drench should be delivered over the back of the tongue
  - critical that full dose lodges in the rumen
    - drench delivered to the mouth may stimulate esophageal groove to close
      - significant drench bypasses the rumen
      - efficacy is reduced

Parasite Dewormers

CLASS OF DRUG	TRADE NAME
Ivermectin	Ivomec
Moxidectin	Cydectin
Morantel	Rumatel, Positive Pellet, Strongid
Levamisole	Levasol, Tramisol
	Prohibit
Fenbendazole	Safeguard, Panacur
Oxifendazole	Synantic
Albendazole	Valbazen

Dewormer Savvy
Give the *Right* Dose

- Goats: 2X sheep dose

- Exception
  - Levamisole
    - 1.5X sheep dose

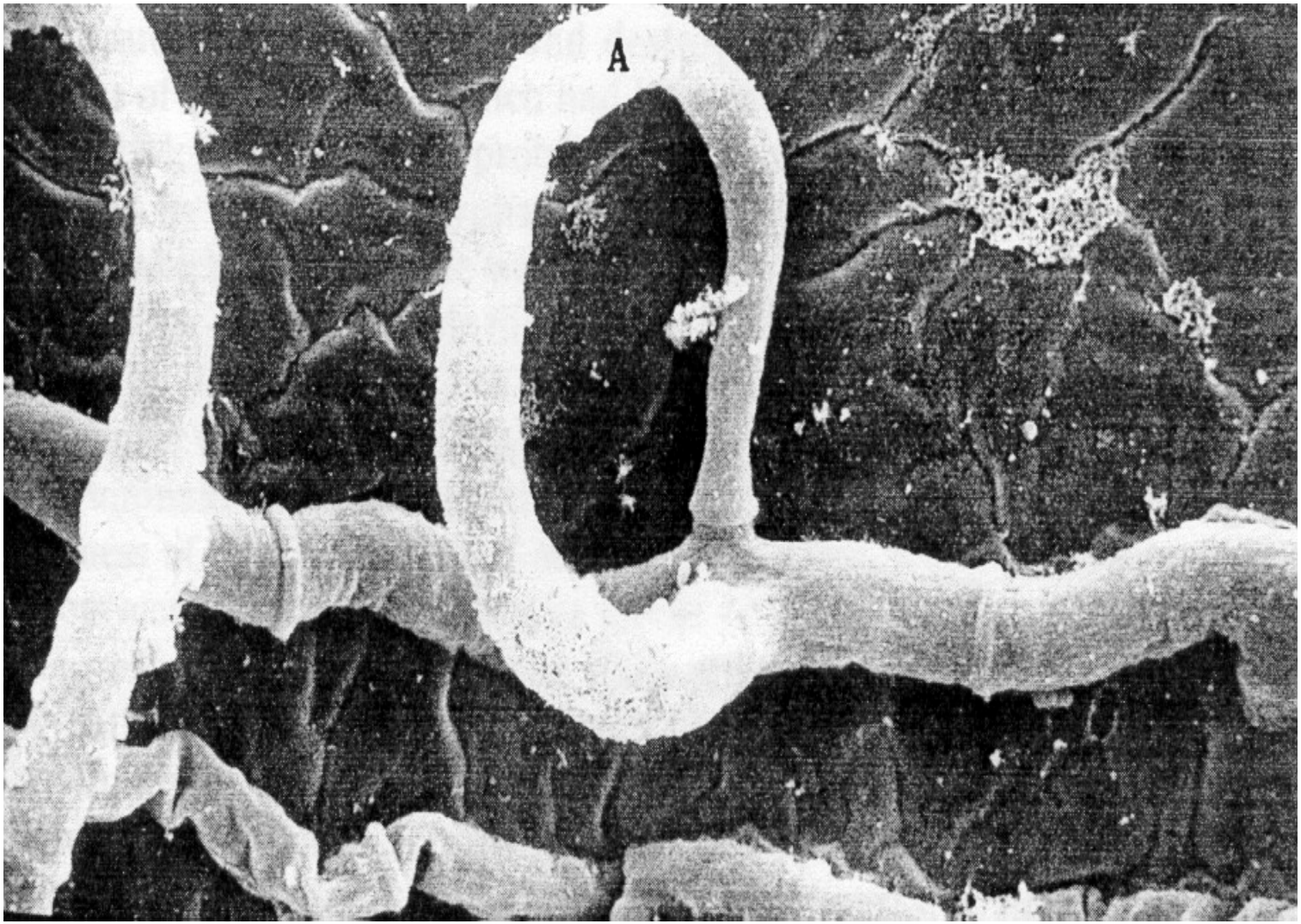
Copper oxide wire particles (COWP)

- Made from Copasure, a copper bolus marketed for copper deficiency in cattle.
- Repackage into doses suitable for sheep and goats.

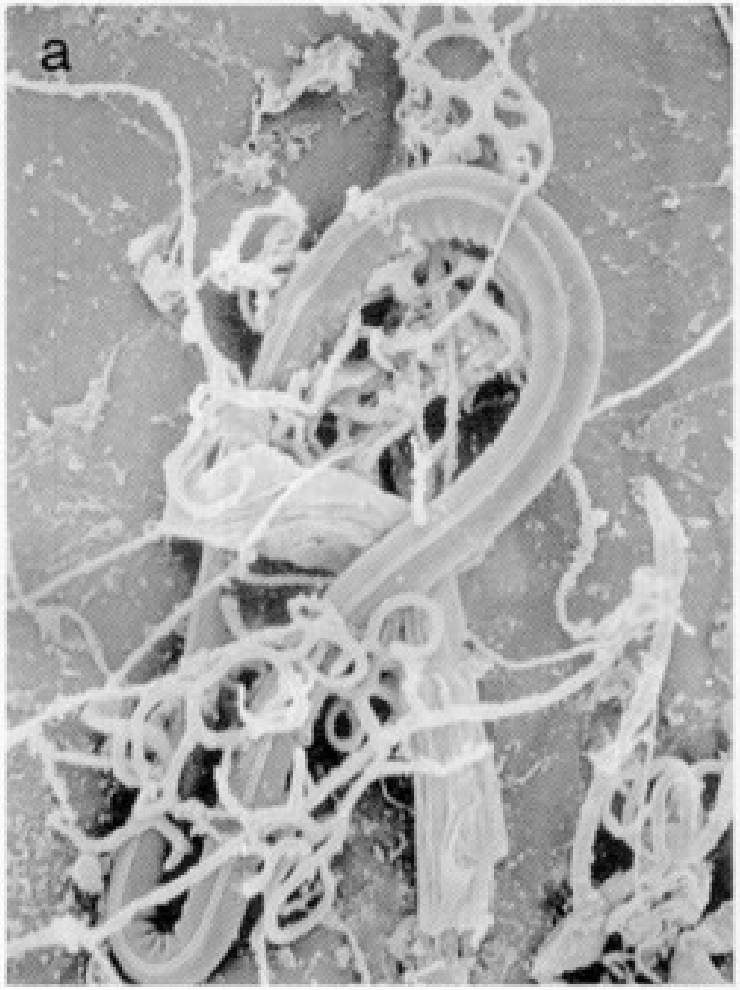
Only effective against
➢*Haemonchus* (the barber pole worm)

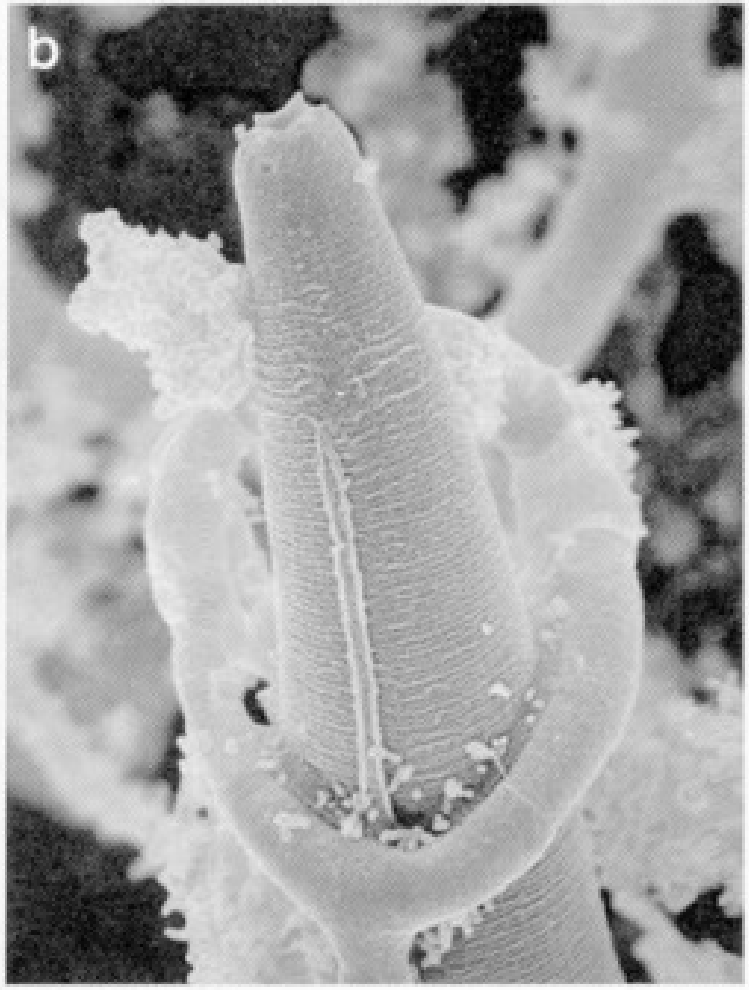
Not effective with NCSU goats in 3 experiments when analyzing FEC, perhaps because our goats have a mixed worm Population (barber pole and black scour worms)

Duddingtonia fragrans, a soil fungus that grows on feces



Duddingtonia fragrans ensnares and kills worm larvae
The dewormer of the future?





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.

Zolvix® (monepantel)

- New drug class
- Amino-acetonitrile derivative (ADD)
- Unique mode of action
- First new anthelmintic class in 25 years
- Kills worms that are resistant to other anthelmintics

- Only registered for use in New Zealand.
- When will it be available in the U.S.?
- Will it be approved for sheep and goats?
- Overuse will cause worms to development resistance to it just like the other drugs.

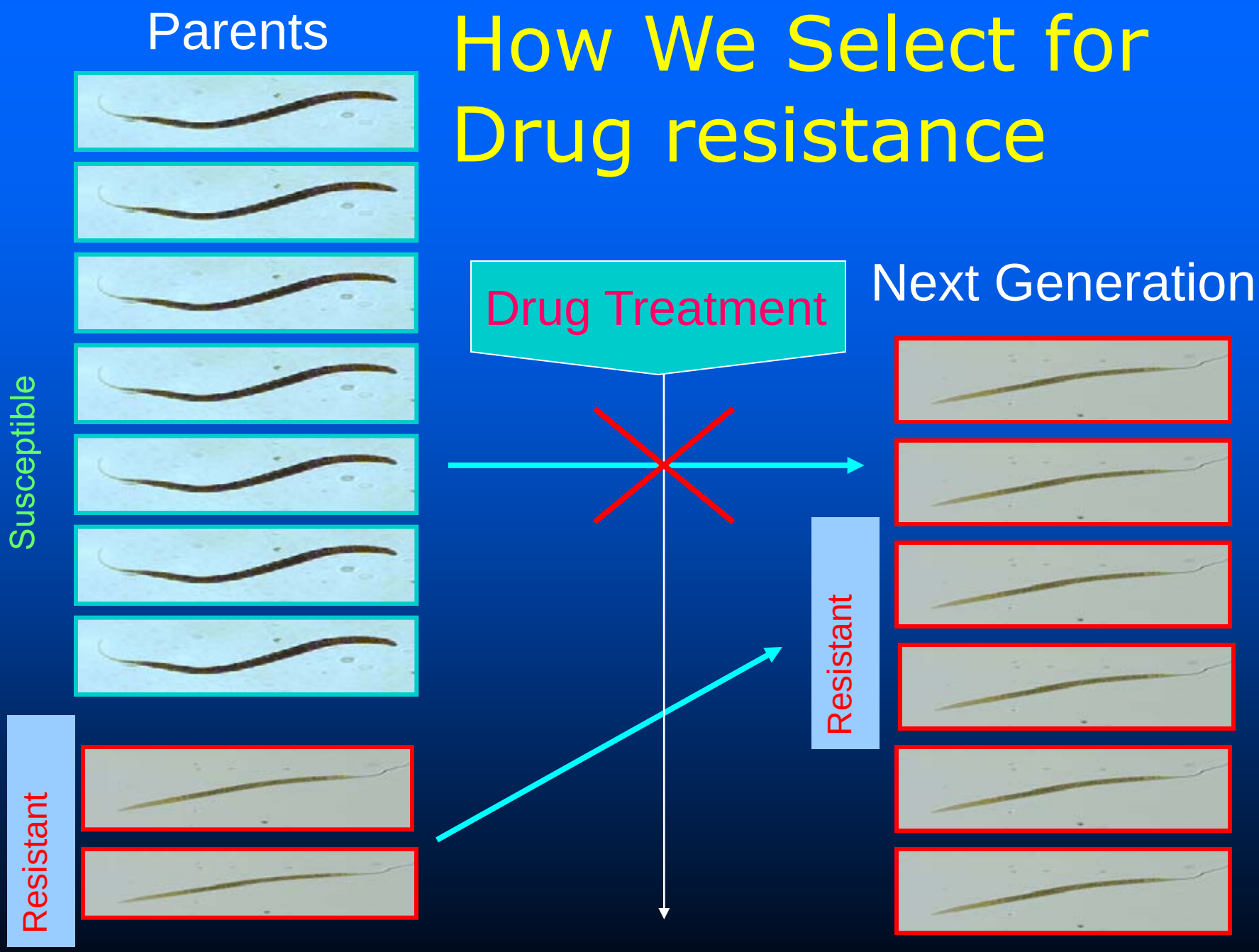
Rotation of Dewormers Is This a Good Idea ???

- Although recommended for many years there are new arguments against using rotation
  - Rotation is NOT a replacement for proper resistance prevention measures
- On many farms, rotation is not possible because of resistance
- If effective, use dewormer until resistance develops, then switch to other class, or rotate dewormers on a yearly basis

Drug Combinations

- Use of combinations of drugs simultaneously have been shown to
  - Decrease rate with which resistance develops
  - Increase the effectiveness of treatment
    - Drugs not useful on their own can achieve reasonable therapeutic results if combined
- BUT – very dangerous if:
  - Do not use selective treatment
    - FAMACHA
  - Do not do efficacy testing to monitor resistance situation (fecal egg counts)

How We Select for Drug resistance



"Refugia"
In refuge from the drug

What is refugia?

- Worms not exposed to drug; therefore still susceptible to treatment.

The goal

- Increase the population of susceptible worms.

How?

- Selective treatment: FAMACHA
- Leave some animals untreated.
- After deworming, do not move animals to a clean pasture.

You do not have to deworm every animal.

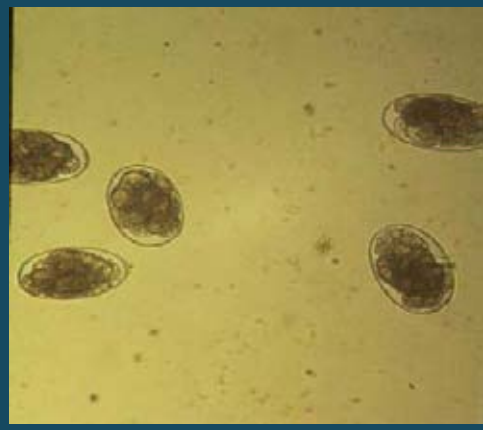
“Smart Drenching”

- Using what we have learned to develop deworming strategies that maximize the effectiveness of treatments while at the same time decreasing the rate at which we create drug resistance

Components of a Smart Drenching Program

- Sound pasture management
- Keep resistant worms off the farm
- Selective treatment -- FAMACHA
- Know the resistance status of the herd/flock
- Utilize host physiology
- Administer the proper dose
  - DO NOT UNDERDOSE: dose for heaviest animal in the group

Know the Resistance Status of the Herd/Flock



- Perform FECRT
  - Conduct fecal egg count before deworming
  - Additional fecal egg count 10-12 days after deworming
  - Control group to confirm resistance/efficacy.
- DrenchRite©
  - (Univ. of GA)
  - Larval development assay (LDA)
- Repeat every 2 years

<u>Drug resistance</u>

< 95 % egg reduction

<u>Severe Resistance</u>

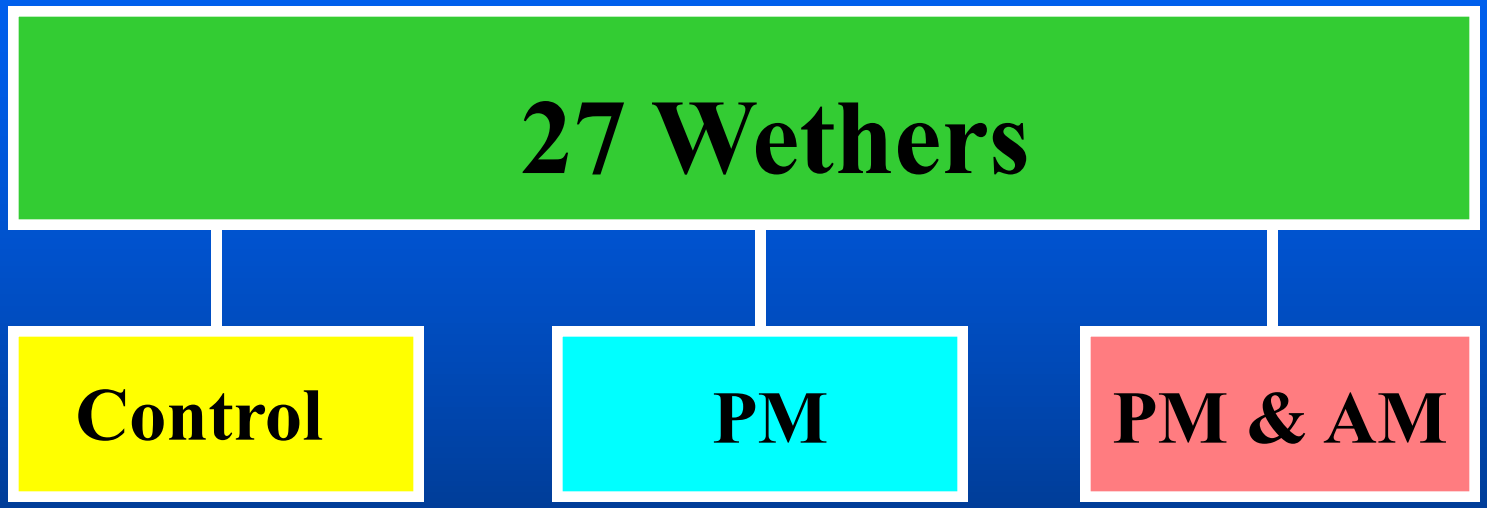
< 60 % egg reduction

** Caused by overuse and misuse of drugs. **

Utilize Host Physiology to Maximize Drug Efficacy

- Restrict feed intake for 24 hours prior to treatment (benzimidazoles and ivermectin)
  - Withholding feed decreases digesta flow rate leading to an increase in drug efficacy
  - Never in late pregnancy
- Repeat dose in 12 hours (benzimidazoles)
- These simple measures can substantially improve efficacy when resistance is present and can help to delay resistance if not yet present

Fenbendazole "Panacur"

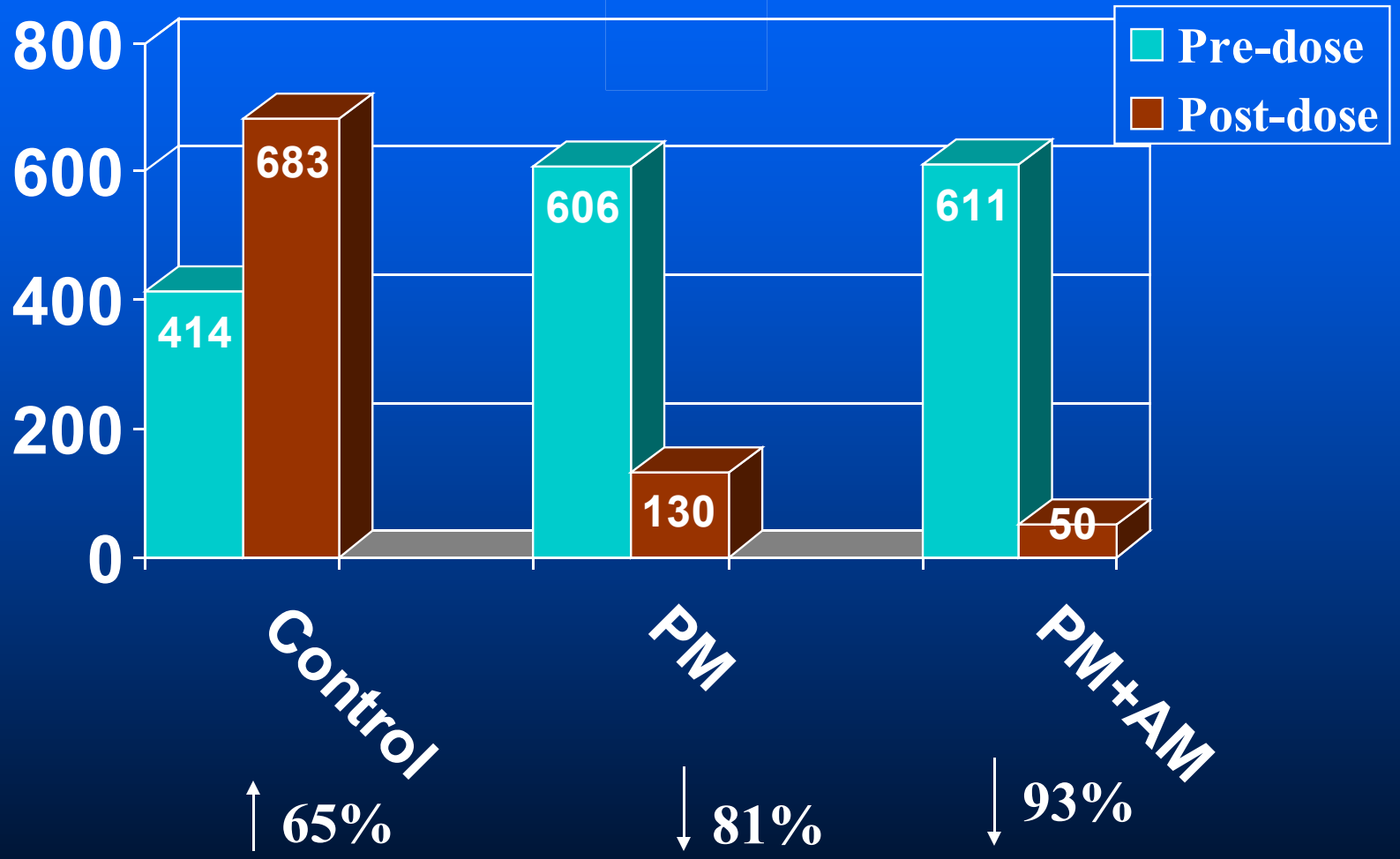


Access to water only for 24 hours

Fecal samples prior to dosing (Pre-dose)

Fecal samples 12 days post-dosing (Post-dose)

Fenbendazole "Panacur"



Genetics and Worms

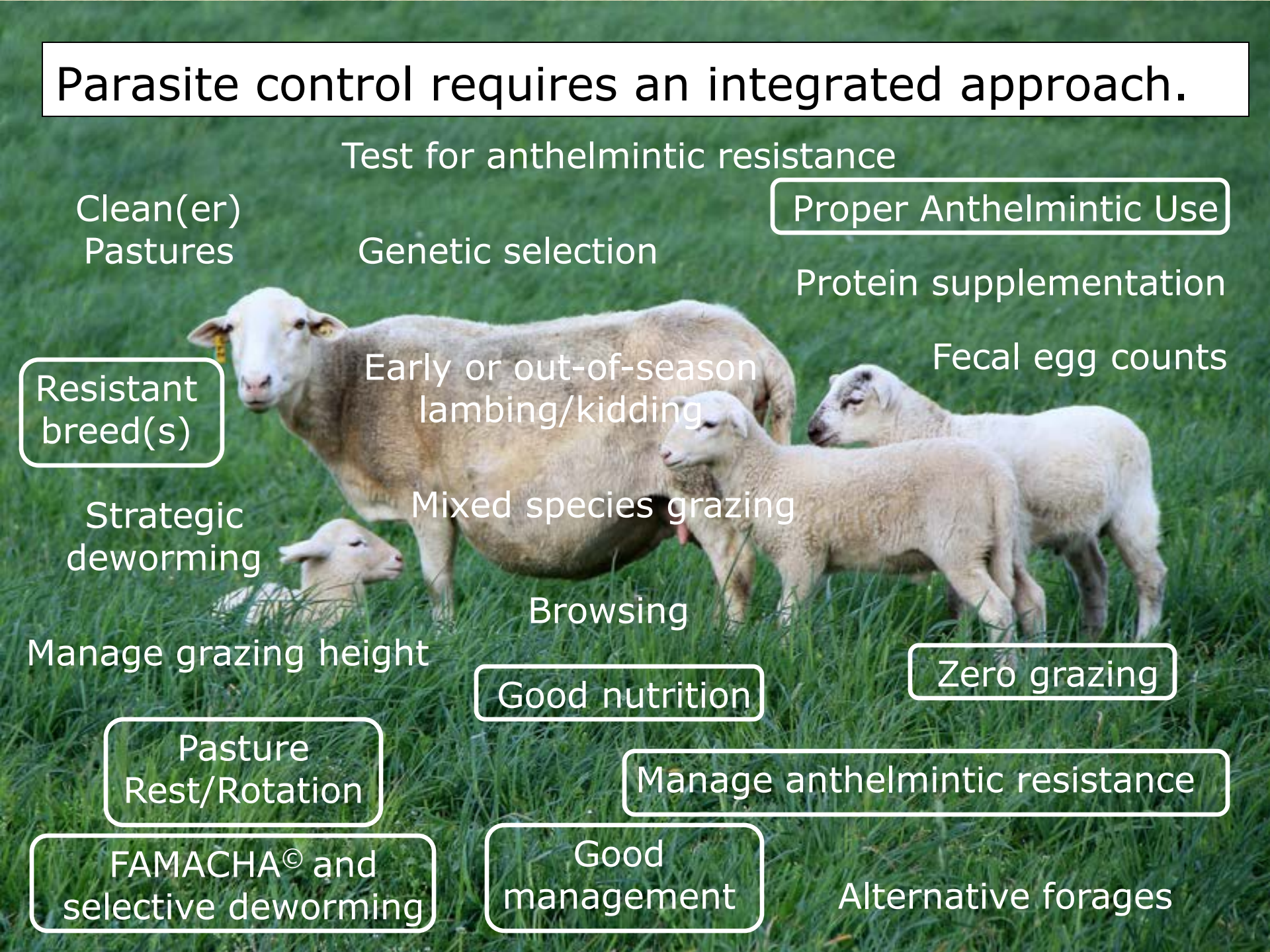
- **Resilience**
  - **The ability to cope with a worm challenge**
- **Resistance**
  - **The ability to limit the establishment of a worm infection**
- **Sire influence**

Parasite traits are moderately heritable: 20-40%

Slowing Down Drug Resistance

- **DO NOT** overuse drugs, especially Levamisole and Moxidectin.
- **DO NOT** introduce resistant-worms to your farm
  - Isolate new animals and deworm them with anthelmintics from three different chemical classes.
- **DO NOT** underdose
  - Weigh animals or dose for heaviest animals in group.
- **DO NOT** rotate dewormers after each treatment
  - Rotate dewormers annually or after effectiveness wanes
  - Rotate among drug families
  - Use specific dewormers for specific situations.
- **DO NOT** treat everybody - FAMACHA
  - Leave some animals untreated

Parasite control requires an integrated approach.



Susan’s Ten commandments for worm control

1

I will not deworm *all* of my livestock on a *regular* schedule.

It's expensive, it's not necessary, and it's what's caused worms to develop resistance to the drugs.

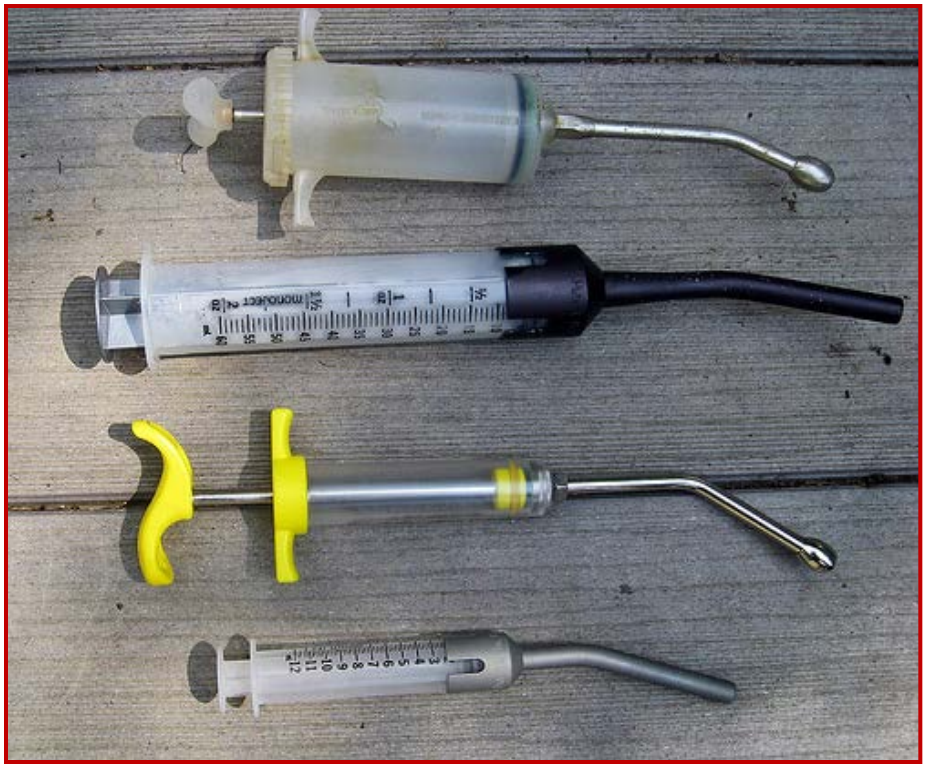
It ‘s estimated that 80 percent of infective worm larvae is found in the first 2 inches of vegetative growth.

2

I will not let my livestock graze pastures that are *shorter* than 3 inches.

3

I will administer all dewormers *orally*.



Injectable dewormers select for drug resistance and have longer withdrawal periods.

4

I will deposit worming medicine into the animal's *esophagus*, not mouth.

Medicine deposited in the mouth may by-pass the rumen and reduce the effectiveness of the drug.

5

I will test for drug resistance.

Otherwise I won't know what works and animals may die. I'll be wasting my money by giving ineffective drugs.

6

I will <u>weigh</u> my livestock so I know *how much* medicine to give them.

If you don't know what your livestock weigh, you may be over- or under-dosing them. Under-dosing leads to drug resistance.

Infective worm larvae and coccidia spores are spread in the feces. Good sanitation helps to prevent disease problems.

7

I will not feed on the ground or in dirty feeders.

Most veterinary experts consider tapeworms to be non-pathogenic. Research has shown no benefit to treatment for tapeworms.

8

Though they look disgusting, I will not let tapeworms bother me.

9
I will observe proper withdrawal periods for anti-parasitic drugs.

It's the law. It's the right thing to do. Extend the withdrawal period when using drugs extra-label.

So far, no natural or herbal dewormers have been proven to be effective.

But, researchers continue to evaluate natural substances for their potential anthelmintic activity.

10

I <u>will not</u> rely on unproven methods or products for controlling worm parasites.

Questions?

jean-marie_luginbuhl@ncsu.edu

Other worms and protozoas

Meningeal worm (deer, brain worm)

Parelaphostrongylus tenuis

Cannot diagnose in a living sheep/goat (necropsy or spinal fluid)

- Parasite of White Tail Deer
- Small ruminants are abnormal hosts.
  - sheep, goats, llama, alpaca, horse
- Parasite has indirect life cycle
  - Deer pass larvae in feces
  - Snails and slugs needed for life cycle
  - Cycle repeats itself when snails and slugs are ingested.
- Once ingested, larva travel from intestinal tract to spinal cord to brain, causing progressively worse symptoms . . .
  - Lameness
  - Gait abnormality
  - Hind quarter weakness
  - Paralysis
  - DEATH
  - Animals maintain appetite

Meningeal worm

Treatment

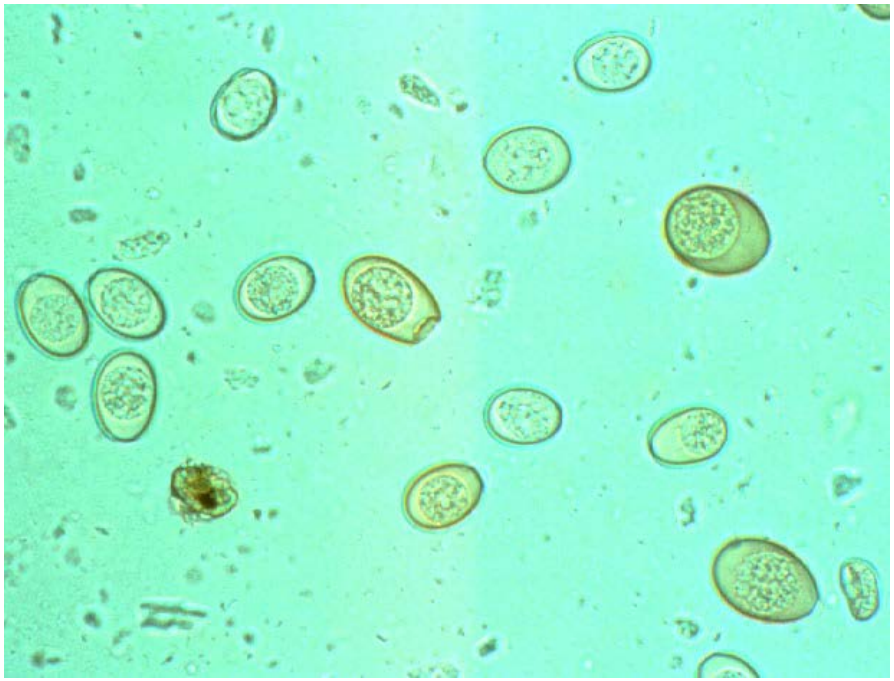
- High doses of anthelmintics
  - Ivermectin
  - Fenbendazole
- Anti-inflammatory drugs
- Some recover on their own.
- Cannot repair damaged tissue.

Prevention

- Restrict access to certain areas of pasture.
  - Fence off wet areas
- Control deer population
- Control snail/slug population
- Monthly deworming
  - Only if problem is severe!

Coccidia

Eimera sp. (species-specific)



- **Single-cell protozoa** that damage lining of small intestines.
  - Causes bloody diarrhea that may be smeared with mucous
  - Damage can be permanent
- Prevent with good sanitation and proper stocking
- Can use feed or water additives to prevent:
  - Lasalocid (Bovatec)[1]
  - Monensin (Rumensin)[2]
  - Decoquinate (Deccox)[1,2]
  - Amprolium (Corid) in water
- Treat with Amprolium or sulfa drugs

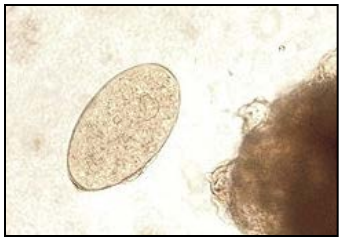
Drugs to treat may be deadly to horses/donkeys

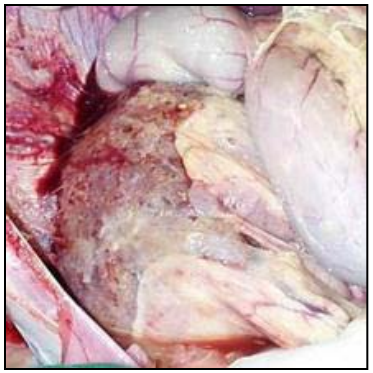
[1]FDA-approved for sheep
[2]FDA-approved for goats

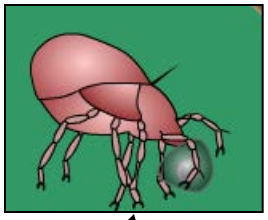
Liver flukes

Fasciola hepatica

- Generally not considered to be a problem in Mid-Atlantic area.
  - Gulf states and Pacific Northwest.
- Requires open water and aquatic snails (wet conditions) to complete life cycle.
- Can kill adult liver flukes with Albendazole (Valbazen®) or Ivomec® Plus).

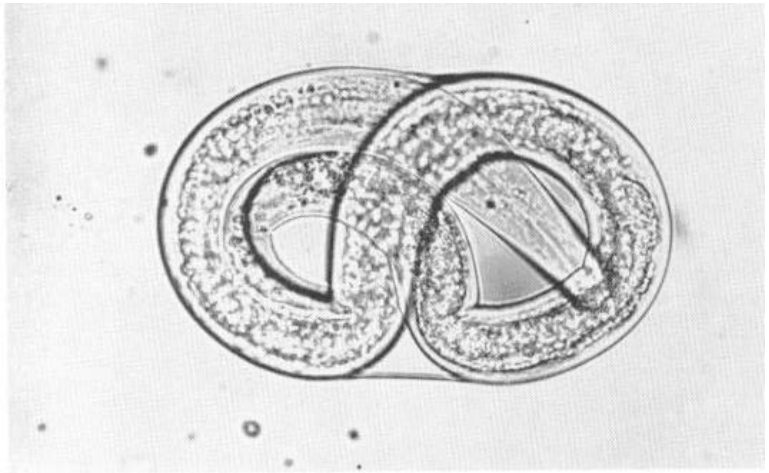






Tapeworms

- Visible in feces
- Has indirect life cycle (requires pasture mites)
- Tend to be non-pathogenic
- Treat with benzimidazoles (Fenbendazole, Albendazole)



Lungworms

- Can have direct or indirect life cycle
- Severe infestations cause respiratory symptoms
- Controlled by same dewormers as for stomach worms.

Questions?