Integrated Parasite Management (IPM) in Small Ruminants

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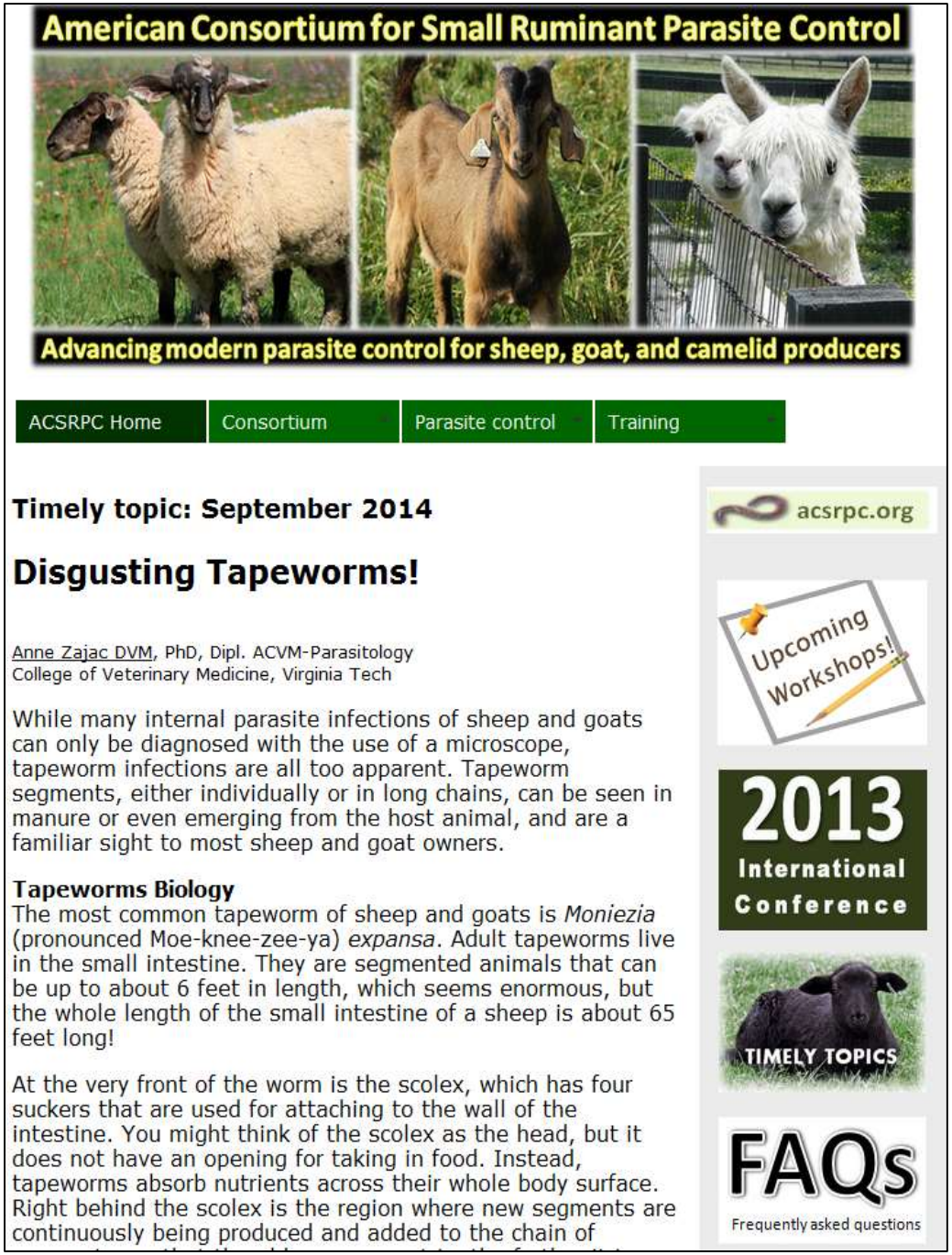
Western Maryland Pasture-Based Meat Goat Performance Test (since 2006)

The primary goal of the test is to identify bucks that are resistant and resilient to parasites.

The Baalands, Clear Spring, Maryand

Purebred and crossbred Katahdin sheep

I recently purchased my first ram with an EBV for parasite resistance (fecal egg counts).



American Consortium for Small Ruminant Parasite Control (ACSPRC)

www.acsrpc.org
www.wormx.info

Today's topics

- Anthelmintics
- Parasites
- Integrated parasite management (IPM)
  - Targeted selective treatment (TST)
    1. FAMACHA©
    2. Five Point Check©
- Fecal egg counting

Top-performing buck
2014 buck test

Anthelmintic (dewormer) resistance

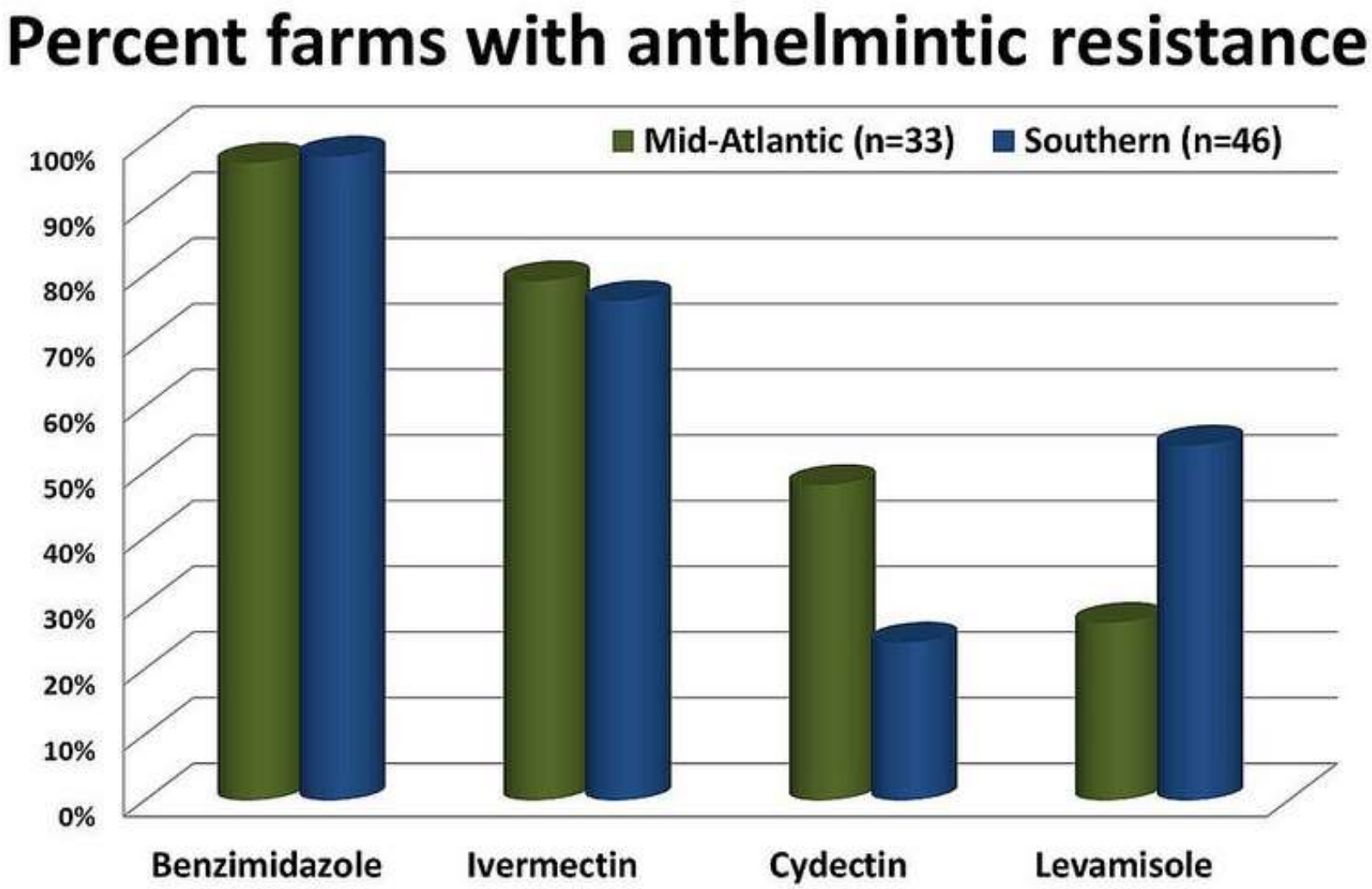
- Resistance is **inevitable**; no treatment will kill 100 percent of worms.
- Worms have developed resistance to **all** dewormers and **all** dewormer classes.
- Resistance **varies** by geographic region and individual farm and is the result of past deworming practices.

Anthelmintic = Dewormer

Anthelmintic (dewormer) resistance

- Resistant worms pass their resistant genes onto their offspring; resistance is **permanent**!
- You cannot prevent resistance, but you can affect the **rate** by which it develops.
- On most farms, resistance is probably still at a level where there is **still** time to slow it down and enable the continued use of some anthelmintics.

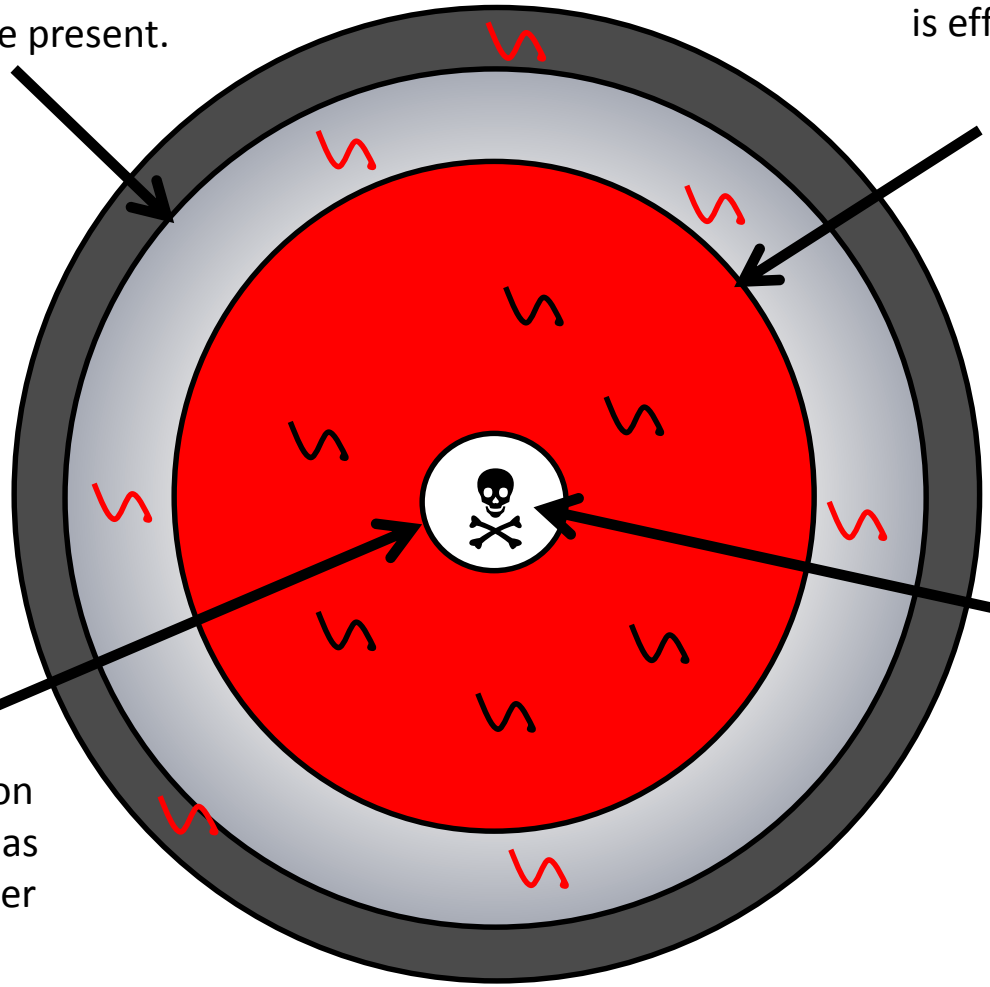
Anthelmintic resistance quantified



Understanding anthelmintic resistance

95-100% effective. Small number of resistant worms may be present.

80-95% effective. Treatment is effective, but resistance is increasing.



Anthelmintic failure. Animals die.

Less than 80%. Production losses become apparent as effectiveness of dewormer moves closer to zero.

Adapted from Wormer Resistance "The need for change" Meat Promotion Wales

You can slow drug resistance by increasing refugia.

- Decrease frequency of anthelmintic treatments.
- Do not treat everyone; leave some animals untreated.
- Do not move treated animals to a clean pasture.
- Do not deworm when there is a low level of pasture contamination or infection in animals.

- Re-introduce susceptible worms (?).

Refugia are worms that have not been exposed to drug(s): "in refuge".

You shouldn't make it easier for worms to develop resistance to the drugs.

- By exposing them to sub-therapeutic levels of drug(s) via:
  1) Underdosing
  2) Using injectable dewormers
  3) Using pour-on dewormers
  4) Depositing drug into mouth instead of esophagus.
  5) Using persistent activity dewormers

Do not introduce resistant worms to your farm

- Quarantine drenching: to prevent the introduction of resistant worms to your farm, deworm all newly acquired animals with anthelmintics from 2-3 anthelmintic classes.

- In Western Maryland Pasture-Based Meat Goat Performance Test, sequential deworming with albendazole, moxidectin, and levamisole usually reduces fecal egg counts by more than 95 percent.

For sale
Buck - $1,000
Resistant worms - free

Anthelmintics 101

There are only 3 families of drugs.

1. Fenbendazole
   Safeguard®
   Panacur®
2. Albendazole
   Valbazen®
3. Oxybendazole
   Synanthic®

BENZIMIDAZOLES

1

1. Avermectins
   a) Ivermectin
      Ivomec®
      Primectin®
      Privermectin®
   b) Eprinomectin
      Eprinex®
   c) Doramectin
      Dectomax®
2. Milbimycins
   a) Moxidectin
      Cydectin®
      Quest®

MACROCYLIC LACTONES

2

1. Imidazothiaoles
   a) Levamisole
      Prohibit®
2. Tetrahydropyrimidines
   a) Morantel
      Rumatel®
      Positive Goat Pellet
      Goat dewormer
   b) Pyrantel
      Strongid®

NICOTINIC AGONISTS

3

FDA-approved anthelmintics for sheep

	(1) Benzimidazoles	(2) Macrocylic lactones		(3) Nicotinics
		Avermectins	Milbimycins	
Adult worms	✓	✓	✓	✓
Immature worms (L4)	✓	✓	✓	✓
Hypobiotic larvae	✓	✓	✓	?
Lung worms	✓	✓	✓	✓ +
Tape worms	✓			
Adult liver flukes	✓			
Coccidia				
External parasites		✓	✓	
Persistent activity			✓	
Safety	Restricted use during early pregnancy	++++	++++	++
Resistance	++++	+++	++	+
FDA-approved	**Valbazen®**	**Ivomec®**	**Cydectin®**	**Levamisole®**
Labeled dosage	3 ml/100 lbs.	3 ml/26 lbs.	1 ml/11 lbs.	2 ml/50 lbs.
Meat withdrawal	7 days	11 days	7 days	3 days

FDA-approved anthelmintics for goats

	(1) Benzimidazoles		(3) Nicotinics
	SafeGuard®	**Valbazen®**	**Rumatel®**
Adult worms	✓	✓	✓
Immature worms (L4)	✓	✓	
Hypobiotic larvae	✓	✓	
Lung worms	✓	✓	
Tape worms	not labeled		
Adult liver flukes		✓	
Coccidia			
External parasites			
Safety	**++++**	**Restricted use during early pregnancy**	**+++**
Resistance	**++++**	**na**	**?**
Labeled dosage per 100 lbs.	2.3 ml	4 ml	0.44 g
Meat withdrawal	6 days	7 days	30 days
Milk withdrawal	NA	NA	0 days

Extra-label anthelmintics for goats

	(1) Benzimidazoles		(2) Macrocylic lactones		(3) Nicotinics
	SafeGuard®	Valbazen®	Ivomec®	Cydectin®	Prohibit®
Adult worms	✓	✓	✓	✓	✓
Immature worms (L4)	✓	✓	✓	✓	✓
Hypobiotic larvae	✓	✓	✓	✓	?
Lung worms	✓	✓	✓	✓	✓ +
Tape worms	✓	✓			
Adult liver flukes		✓			
Coccidia					
External parasites			✓	✓	
Persistent activity				?	
Safety	++++	Restricted use during early pregnancy	++++	++++	++
Resistance	++++	++++	+++	++	+
Dosage per 25 lbs.	1.1 ml	2 ml	6 ml	4.5 ml	2.7 ml
Meat withdrawal	16 days	9 days	14 days	17 days	4 days
Milk withdrawal	4 days	7 days	9 days	8 days	3 days

Zolvix® (monepantel): a new anthelmintic

- New drug class: amino-acetonitrile derivative
- Unique mode of action
- First new anthelmintic in 25 years
- Kills worms that are resistant to other drugs
- Resistance already reported in Australia.
- Not yet available in US (soon).
- Will be available by prescription (Rx) only.

“Alternative” (non-chemical) dewormers

- Many natural compounds are professed to have “anthelmintic-like” properties; the list is overwhelming!
- However, there is no consistency as to if and how alternative dewormers have been evaluated or reported in the scientific literature.
- Studies are lacking, inconsistent, and/or not repeatable.
- Some natural anthelmintics are potentially toxic to the animal.


COWP bolus

2014 Western Maryland Pasture-Based Meat Goat Performance Test
Anthelmintic effect of copper oxide wire particles (COWPs)

- Mid-way through the test, at day 42, which was the end of the "parasite challenge phase" of test, test bucks (n=77) were given a gel cap containing ~0.5 g of copper oxide wire particles (COWPs).

- On day 42, nine (9/77) bucks required deworming and were also dewormed with a commercial dewormer (levamisole or moxidectin).

- Twenty-nine (29) bucks from our pen vs. pasture study served as controls: they did not receive any treatment.

2014 Western Maryland Pasture-Based Meat Goat Performance Test
Anthelmintic effect of copper oxide wire particles (COWPs)

Treatment		# goats	July 17 Avg. FEC	July 31 Avg. FEC	Avg. FECR
Dewormer	Effective	8	8735	103	98.6
	Ineffective	1	500	275	45.0
COWP	Effective	53	2768	388	81.7
	Ineffective	8	723	2000	< 0
No treatment (Control)	Pasture	15	2164	2371	< 0
	Pen	12	1216	758	37.7

My perspective and recommendation on alternative "dewormers"

- Alternative dewormers are <u>not likely</u> to replace commercial anthelmintics.

- Alternative dewormers may <u>complement</u> commercial dewormers by:

  + Disrupting the free-living stage of the parasite (e.g. inhibit egg hatching or larvae development)
  + Improving natural immunity of animal
  + Improving overall management of the herd

  = **Reducing the number of animals that require treatment with a commercial dewormer.**

- It's okay to use alternative dewormers, even unproven ones, so long as you continue to <u>regularly monitor</u> animals for signs of parasitism and deworm those showing clinical signs with an effective drug.

Determining anthelmintic resistance

- It is recommended that you test for anthelmintic resistance every 2-3 years.
- FAMACHA© and the Five Point Check© don't work if you don't have an effective treatment(s) for clinically-parasitized animals.
- Clinically-parasitized animals will almost always die without an effective anthelmintic treatment (deworming).
- There are two ways to test for anthelmintic resistance.
    1) Fecal egg count reduction test (FECRT)
    2) DrenchRite® Assay

1) Fecal egg count reduction test (FECRT)

- Determines the effectiveness of an individual treatment.
- In Mid-Atlantic region, best time to do is early to mid-summer when *Haemonchus* (barber pole worm) is most active.
- Collect fecal samples ($\geq$ 250 epg) from treated animals (ideally, n $\geq$ 15) for each anthelmintic (or combination) you want to test.
- Favor animals with higher FAMACHA© and dag scores.
- If possible, include a group (n $\geq$ 15) of untreated animals as a <u>control</u> group.

Fecal egg count reduction test (FECRT)

- Compare pre- and post-treatment fecal egg counts
  a) 8-10 days for benzimidazoles (SafeGuard®, Valbazen®)
  b) 14-17 days for macrocylic lactones (Ivomec®, Cydectin®)
  c) 5-7 days for levamisole (Prohibit®)
  d) 10-14 days for all dewormers

http://www.uaex.edu/Other_Areas/publications/PDF/FSA-9608.pdf

Fecal egg count reduction test

2012 Western Maryland Pasture-Based Meat Goat Performance Test

[Pre-test Tx: albendazole + moxidectin + levamisole]

TEST ID	2-Jun FEC-0	14-Jun FEC-1	14-Jun FECRT
01	4100	150	96.3%
02	6033	0	100.0%
03	1200	0	100.0%
04	3900	0	100.0%
05	2500	ns	na
06	3000	175	94.2%
07	533	0	100.0%
08	4775	467	90.2%
09	700	0	100.0%
10	850	0	100.0%
11	ns	0	na
12	1033	0	100.0%
13	4300	25	99.4%
14	6833	0	100.0%
15	11000	33	99.7%
16	13267	0	100.0%
17	3160	0	100.0%
18	4360	0	100.0%
20	80	25	68.8%
21	2200	0	100.0%
73	15150	0	100.0%
24	1325	0	100.0%
25	1067	25	97.7%

TEST ID	2-Jun FEC-0	14-Jun FEC-1	14-Jun FECRT
26	1600	0	100.0%
27	1257	0	100.0%
28	40	0	100.0%
29	ns	0	na
30	800	0	100.0%
32	1600	0	100.0%
52	1625	0	100.0%
33	80	0	100.0%
34	0	0	na
35	0	0	na
36	857	0	100.0%
37	467	0	100.0%
38	2300	0	100.0%
39	3350	75	97.8%
40	1275	86	93.3%
42	25	0	100.0%
43	40	0	100.0%
44	500	67	86.6%
45	375	0	100.0%
51	280	0	100.0%
46	1875	120	93.6%
47	450	50	88.9%
48	1257	ns	na
49	ns	0	na

TEST ID	2-Jun FEC-0	14-Jun FEC-1	14-Jun FECRT
AVERAGE	2532	29	97.7%
MEDIAN	1266	0	100.0%
STDEV	3373	76	5.77%

Fecal egg count reduction test

Sheep farm (Katahdins) in West Virginia (2013)

Control

FEC1	FEC2	FECR
800	425	47%
475	2000	-321%
2300	2625	-14%
1850	3750	-103%
1475	2200	-49%
2375	3125	-32%
7025	7475	-6%

Cydectin

FEC1	FEC2	FECR
6075	1075	82%
3000	1025	66%
2425	1275	47%
2625	750	71%

Ivermectin

FEC1	FEC2	FECR
2175	100	95%
275	325	-18%
1500	4675	-212%
1400	375	73%
775	25	97%
3000	1275	58%
7350	3850	48%
10500	1075	90%

Levamisole

FEC1	FEC2	FECR
850	225	74%
1175	1750	-49%
2375	100	96%
10925	450	96%
2775	125	95%
5325	50	99%
3600	475	87%
12300	100	99%

Valbazen

FEC1	FEC2	FECR
575	7425	-1191%
425	200	53%
3725	725	81%
575	250	57%
3400	900	74%
2275	875	62%
8925	525	94%
6285	1250	80%
7150	3799	47%

2) DrenchRite® Assay

- Determines drug resistance for all anthelmintic classes simultaneously from a pooled fecal sample.

  → Resistance to Cydectin® is predicted based on the results for ivermectin.

- Also determines which parasites your animals have.

- Collect a pooled fecal sample from at least 10 animals with ≥350-500 epg.

- Follow instructions for collecting, handling, and shipping sample to Dr. Ray Kaplan's lab at the University of Georgia.

http://www.wormx.info/Resources/Topics/DrenchRiteAssay.html

DrenchRite Report Form

Ray M. Kaplan, DVM, PhD
Dept. of Infectious Disease
College of Veterinary Medicine
University of Georgia
Athens, GA 30602
Phone # (706) 542-0742
E-mail: jscb@uga.edu, bstorey@uga.edu

Accession No.: 9-13-184
Date Collected: 9/4/2013
Date Received: 9/5/2013
Date Reported: 9/27/2013
Lot #: PK 05121 SHowell

Test Results

Pooled fecal egg count: 2050 epg

Predominant worm species present: 98% Haemonchus, 2% Other (on plate)

	BZ	LEV	IVM	MOX DD*
Critical Well / Delineating Dose*	10.5	3	6.5	10
Resistance Status**	R	S	R	S

**R= Resistant SR= Suspected Resistant S= Susceptible

Benzimidazole (BZ) = Panacur, Safeguard, Valbazen
Levamisole (LEV) = Tramisole, Levasole
Ivermectin (IVM) = Ivomec, Eprinex, Dectomax
Moxidectin (MOX) = Cydectin

Interpretation

Resistant: A significant proportion of the worm population is resistant to this dewormer. Depending upon level of resistance, actual efficacy may vary from 0% to as high as 95%. If low-level resistance is present, the drug may still be highly effective, but if used frequently, resistance is expected to worsen rapidly. If a selective treatment approach (FAMACHA©) is adopted while level of resistance is still low, then this drug may remain useful for an extended period of time. If high level resistance is reported, then this drug should not be used for treatment.

Susceptible: This drug is effective in killing the worms infecting the animals at this time. Re-testing with DrenchRite is suggested every 2 years.

Suspected Resistant: Results are inconclusive (borderline for resistance) -- resistant worms may be present. An on-farm test of drug efficacy by fecal egg count reduction test is recommended for this drug.

NOTES: Cydectin (moxidectin) is not tested in the DrenchRite test, but we can estimate whether resistance to Cydectin is present based on the results for ivermectin.

COMMENTS: Coproculture results - 96% Haemonchus, 3% Trichostrongylus/Teladorsagia mix, 1% Oesophagostumum*

* there were several strongyloides present on both FEC and on the coproculture.

A comparison of tests

FECRT

- Takes 7-14 days to get results, longer if someone else does FECs.
- Cost for 75 samples
  (15 samples x 4 drugs + control group)
  75 x Labor = ?
  75 x $5 = $375
  75 x $10 = $750
- Need more animals
- Get percent resistance/efficacy.
- Results can vary by animal.

DrenchRite® Assay

- Labor-intensive lab test
- Only one lab in US does DrenchRite® Test (UGA)
- Takes 3-4 weeks to get results
- Cost $450 per sample

Small ruminants are affected by many internal parasites, but only a few are generally important.

Multi-cellular (helminths)

1. Nematodes
   Roundworms
2. Cestodes
   Tapeworms
3. Trematodes
   Flukes

Single-cell (protozoa)

Roundworms - nematodes - *strongyle*

Primary

1. *Haemonchus contortus*
   Barber pole worm

2. *Teladorsagia circumcinta (Ostertagia)*
   brown stomach

3. *Trichostrongylus* spp.
   black scour
   stomach hair

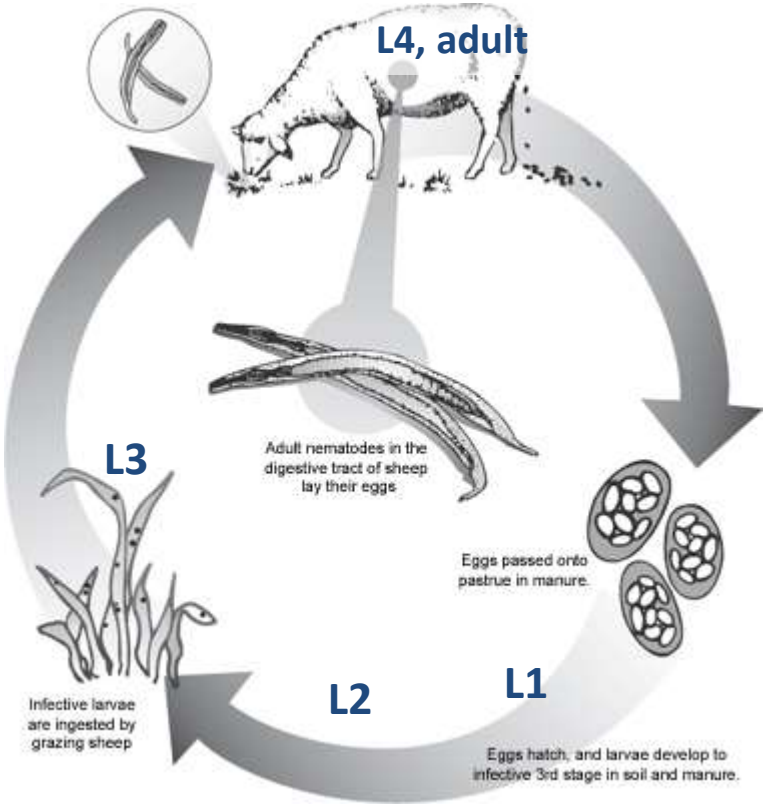
Secondary

- *Cooperia*
  small intestinal
- *Nematodirus*
  thread or thin necked intestinal
- *Oesaphagostomum*
  nodule worm
- *Bunostomum*
  Hookworm
- *Trichuris ovis*
  Whipworm
- Strongyloides
- Lungworms

- *Parelaphostrongylus tenuis*
  Meningeal worm
  Deer worm, brain worm

Haemonchus – Trichostrongylus – Teladorsagia

- Short, direct life cycles (3-4 weeks) that are weather-dependent.
- Can overwinter on pasture.
- Ability to go into hypobiotic (arrested) state (in host) when environmental conditions are not conducive to their development
- Vary in their egg laying ability.
- Eggs look same under microscope.



Haemonchus contortus
Barber pole worm

- Primary parasite in warm, moist climates.
- One of the most pathogenic parasites
- Prolific egg layer
- Blood sucker
- Causes anemia and bottle jaw.
- Death can be sudden.
- Other symptoms: weight loss, loss of body condition, poor stamina, anorexia -- but not usually diarrhea.

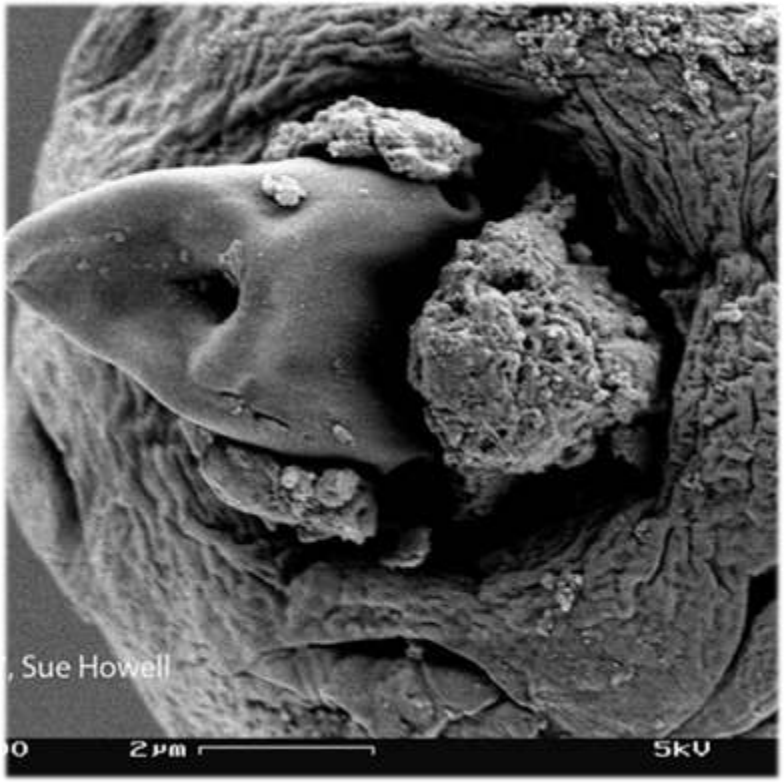


Image from University of Georgia

Other strongyles
Teladorsagia and *Trichostrongylus*

- Usually of secondary importance.
- Usually part of mixed infections with barber pole worm.
- Cause production loss, weight loss, dagginess (scours) - only occasional death.

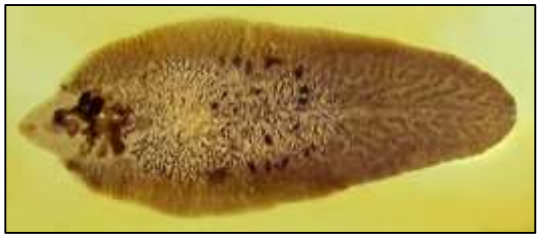
Lungworms

- Direct or indirect life cycle
- Larvae visible in feces.
- Severe infestations can cause respiratory symptoms: coughing, fluid on lungs, pneumonia.
- Difficult to diagnose in live animal; usually diagnosed at necropsy
- Drugs which control GI parasites will also control lungworms.

Liver flukes

Fasciola hepatica

- Regional problem: mostly Pacific Northwest and Gulf States.
- Require open water and aquatic snails as intermediate host.
- Similar symptoms as barber pole worm.
- Treat adult liver flukes with albendazole (Valbazen®) or Ivomec® Plus (clorsulon).



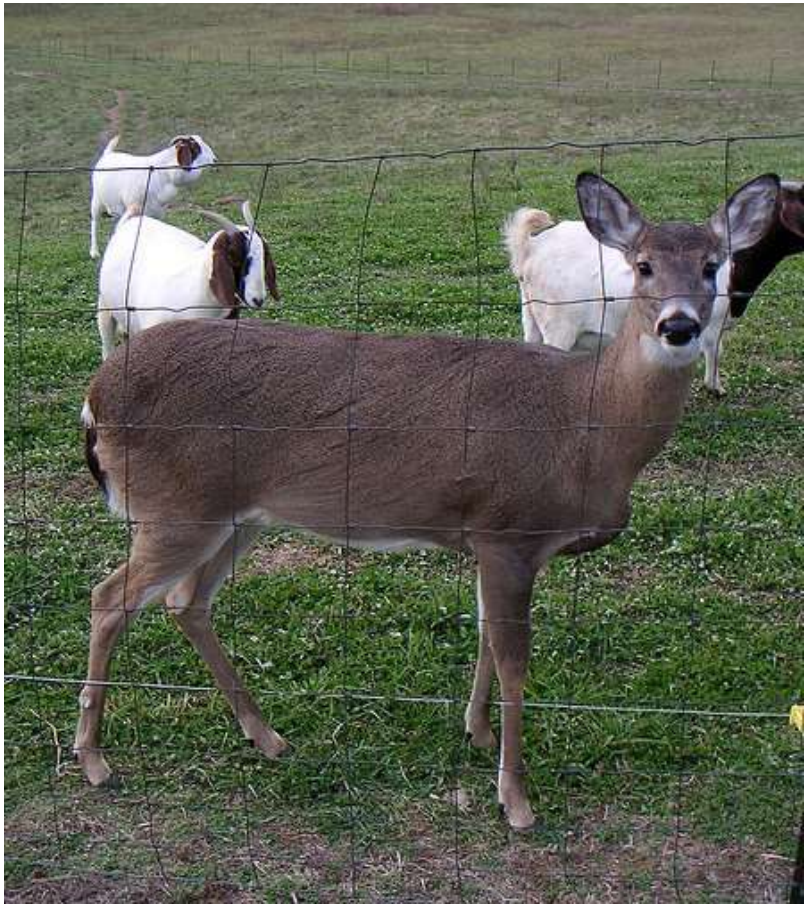
Tapeworms *(Moniezia expansa)*

- Only worm that is visible in feces.
- Indirect life cycle; pasture mite is intermediate host.
- Usually non-pathogenic; usually no benefit to treatment.
- Heavy infestations may cause intestinal blockage (rare) or affect gut motility (occasional).
- Treat with SafeGuard® (2x dose), Valbazen®, or praziquantel (Quest Plus®, Equimax®, or Zimecterin Gold®).
- Sheep and goats are intermediate host for tapeworms that infect dogs.

http://www.wormx.info/Resources/Topics/Zajac-Tapeworms.html

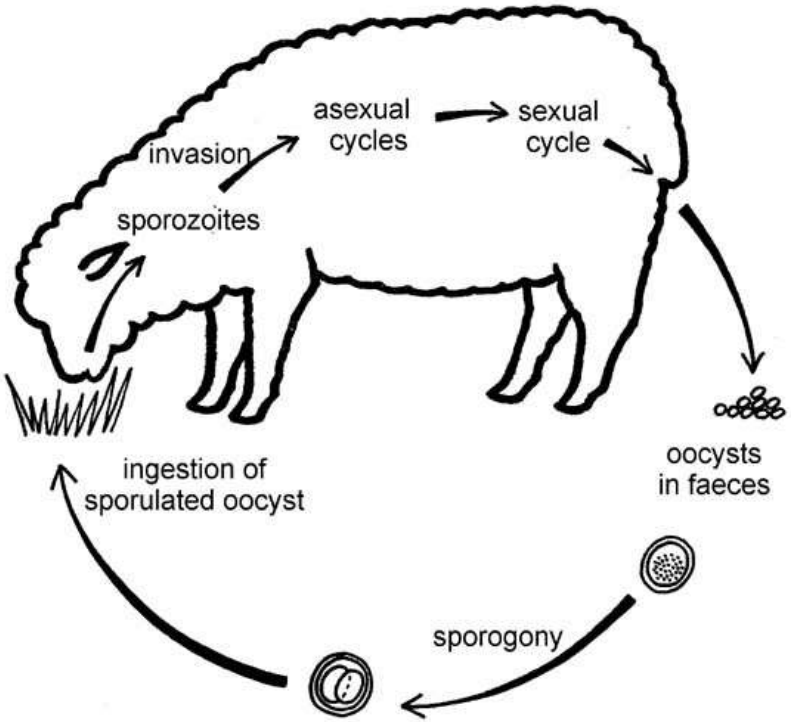
Meningeal worm *(Parelaphostrongylus tenuis)*

- Parasite of white tail deer.
- Sheep, goats, and camelids become abnormal hosts.
- Indirect life cycle: snail or slug is intermediate host.
- Causes neurological symptoms.
- No definitive diagnosis in live animal.
- Treatment protocols involve high doses of anthelmintics and anti-inflammatory drugs.
- Fenbendazole (SafeGuard®) and ivermectin (Ivomec®) are drugs of choice for meningeal worm.
- Cornell University working on vaccine.



Coccidia (*Eimeria* spp.)

- Single-cell protozoa
- Species-specific
- Not all pathogenic
- More complicated life cycle than worms.
- Damages lining of small intestines; damage can be permanent.
- Causes diarrhea (not always) and ill thrift.



http://old.cvm.msu.edu/extension/Rook/ROOKpdf/coccidia.PDF

Coccidia (*Eimeria* spp.)

- Prevent with good management and sanitation.
- Prevent with coccidiostats in water, mineral, feed, and/or milk.
  - Lasalocid (Bovatec®)
  - Monensin (Rumensin®) ☠
  - Decoquinate (Deccox®)
  - Amprolium (Corid)
- Treat with Corid (Rx) or sulfa antibiotics (Rx).
- Sericea lespedeza pellets may provide “natural” control of coccidiosis.

http://www.wormx.info/Resources/Topics/SL-SS.html

Integrated parasite management (IPM)

Using chemical and non-chemical means to control parasites

Non-chemical

- Host immunity
- Kidding and weaning management
- Nutritional management
- Pasture and grazing management
- Genetic selection

Chemical

- Proper use of anthelmintics, including Targeted Selected Treatment (TST)
  - FAMACHA©
  - Five Point Check©

Host immunity
Goats vary in their susceptibility to parasites

Most susceptible

- Kids, kids, kids
  - Weanlings
  - Early weaned kids
  - Spring born kids
  - Late-born kids
  - Artificially reared kids
- Periparturient does
  - High producing does
  - Yearling does
- Geriatric animals

Less susceptible

- Bucks
- Dry does
- Pets

Kidding and weaning management

- You can time kidding to minimize parasite problems.
- Optimal time to kid will vary by climate and other factors.
- In Mid-Atlantic region, producers who kid in winter and fall report less parasite problems.
- Weaning age will affect susceptibility to parasites.
- There are pros and cons to different weaning ages.

Nutritional management

- Goats in better body condition and on a higher plane of nutrition are better able to tolerate the effects of parasitism.
- Sheep studies have shown that protein supplementation (above NRC requirements) in late pregnancy can reduce fecal egg counts in periparturient ewes.
- In the Mid-Atlantic region, pastures are usually deficient in energy.

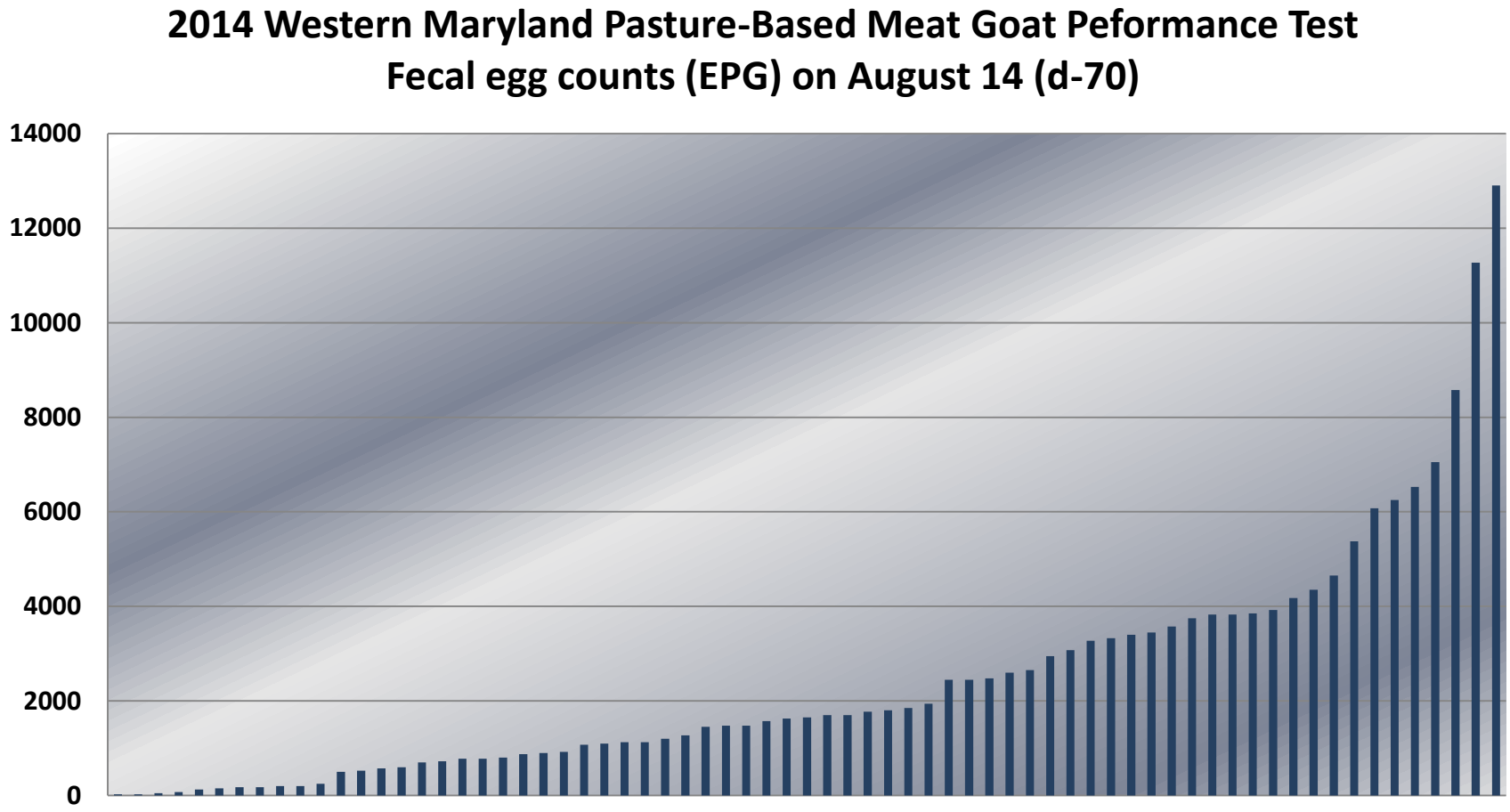
Pasture and grazing management

- Safe pastures
- Low risk pastures
- Evasive grazing
- Strip grazing
- Rotational grazing
- Multi-species grazing
- Composting manure before spreading
- Alternative forages
  - Tanniferous forages
  - Annuals
  - Legumes, forbs, herbs
- Minimum grazing height
- Delayed grazing
- Night penning
- Zero grazing

Genetic selection

- In meat goats, there are some documented breed differences for parasite resistance.
- There is as much genetic variation within a breed as between breeds.
- The 80:20 rule: 20-30 percent of the herd is responsible for 70-80 percent of the pasture contamination (cull them).

FECs are not evenly dispersed in a flock or herd of animals.



Genetic selection: two traits

RESISTANCE

- Ability of the host to reduce number of parasites that establish, reproduce, or survive.
- Quantified by fecal egg counts (# eggs per gram of feces), which are an indirect measure of the worm burden in the animal.

RESILIENCE

- Ability of host to tolerate parasitic infection: maintain health, thrive, grow, reproduce.
- Quantified by observation or measurement of clinical signs: packed cell volume (PCV), weight gain/loss, body condition, dag score.
- FAMACHA© scores estimate PCV.

Genetic selection

- There are significant (though variable) correlations between FEC and PCV and FEC and FAMACHA© scores.
- Estimates for the heritability of FECs in goats are also quite variable; there are no estimates for the US goat population.
- Lincoln University (Missouri) has embarked on a long term selection study on parasite resistance in meat goats (research herd is ¾ Kiko x ¼ Boer).

Targeted Selective Treatment (TST)

What is it?

- Only treating animals that require treatment <u>or</u> only treating animals that would benefit from treatment.

What does it do?

1. Slows drug resistance
   - Reduces # of treatments
   - Increases refugia
2. Identifies susceptible animals.

Decision-making tools for TST

- TST requires **practical** decision-making tools that farmers/ producers can use.
- The **first** tool developed was the FAMACHA© system.
- The Five Point Check© is an **extension** of the FAMACHA© system.

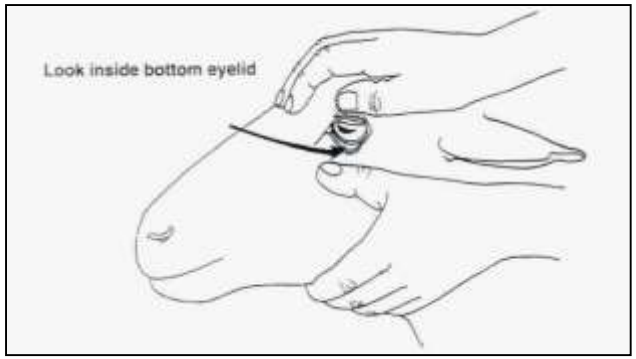
FAMACHA© System

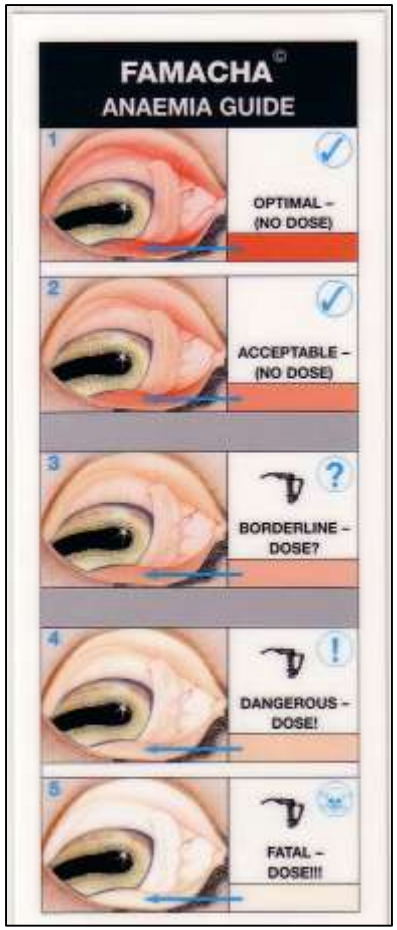
- System developed for small sheep producers in South Africa in response to growing anthelmintic resistance.
  - Validated in US
  - Validated for goats

- A system to assess barber pole worm infection in sheep and goats and to determine the need for deworming individual animals.

- Named for its originator: Dr. Francois "Faffa" Malan **Fa**ffa **Ma**lan **Ch**art

FAMACHA© System





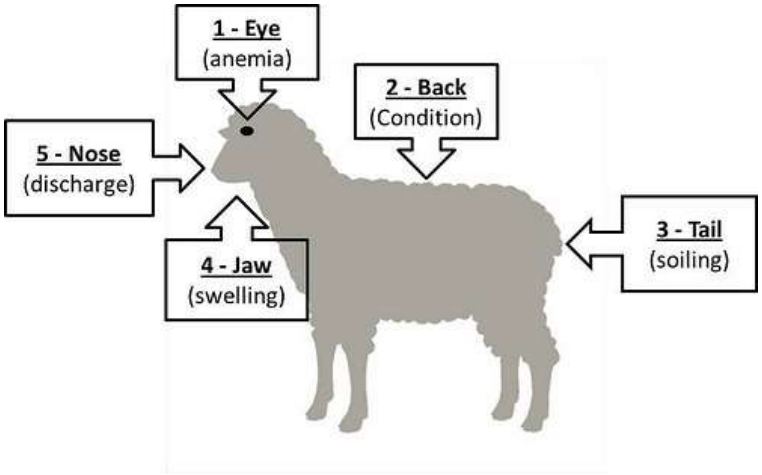
Clinical Category	Eye Lid Color	Packed Cell Volume/PCV	Treatment recommendation
1	Red	$\geq$ 28	No
2	Red-Pink	23-27	No
3	Pink	18-22	?
4	Pink-White	13-17	Yes
5	White	$\leq$ 12	Yes

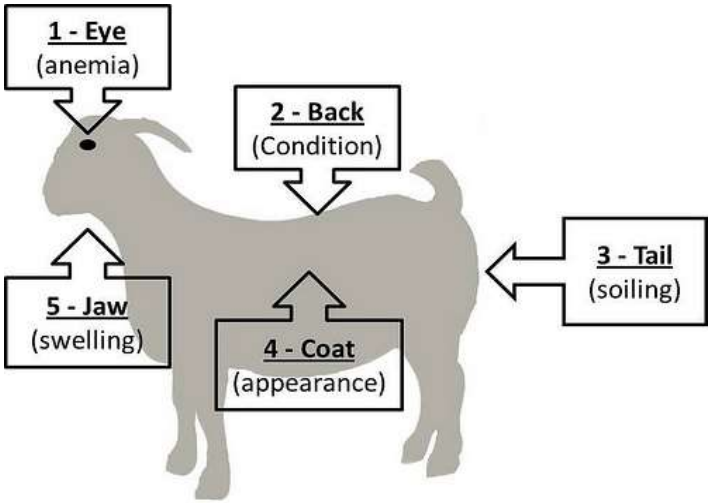
Tips for using FAMACHA©

- Check at appropriate intervals; varies by season, animals, and risk.
- No half scores, use paler score
- Be consistent
- Learn your animals
- Don’t ignore other symptoms and factors.
- Test for anthelmintic resistance.
- Replace card, as necessary.

Five Point Check© 5.✓©

- Addresses limitations of FAMACHA©, which is only effective for blood feeding parasites, such as Haemonchus.
- Extension of TST to determine need for deworming for all internal parasites that affect sheep and goats.
- Especially useful when deciding whether or not to deworm FAMACHA© score 3's.
- Involves 5 check points on the animal: eye, back, tail, jaw, and nose.
- Developed for sheep.
  - For goats, can replace nose checkpoint with coat condition.





Check Point	Observation	Possibilities
1. EYE	Anemia 1-5 (FAMACHA© card)	**Barber pole worm (*Haemonchus*)** Liver fluke Hook worms Other worms and causes
2. BACK	Body condition score 1-5 (BCS card)	**Brown stomach worm (*Teladorsagia*)** **Bankrupt worm (*Trichostrongylus*)** Nodular worm Other worms and causes
3. TAIL	Fecal soiling (1-5) Dag score card	**Brown stomach worm (*Teladorsagia*)** **Bankrupt worm (*Trichostrongylus*)** **Coccidia (*Eimeria*)** Nodular worm (Oesophagostomum) Other worms and causes
4. JAW	Soft swelling “Bottle jaw” 1-5	**Barber pole worm (*Haemonchus*)** **Coccidia (*Eimeria*)** Liver fluke Hook worms Other worms and causes
5. NOSE	Discharge 1-5	**Nasal botfly** Lungworms Pneumonia Other causes
5. COAT	Coat condition 1-3	**Barber pole worm (*Haemonchus*)** **Brown stomach worm (*Teladorsagia*)** **Bankrupt worm (*Trichostrongylus*)** **Coccidia (*Eimeria*)** External parasites Other causes

#2 - Back - Body condition score (BCS)

- Many worms can cause a loss of body condition.
- Poor or declining body condition can also be a sign of age, poor nutrition, or other diseases.
- Animals also vary in their ability to carry and hold body condition.



Body condition scoring (BCS)

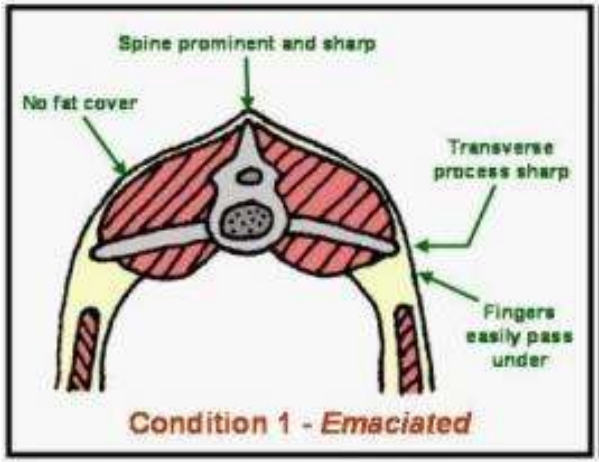
- Is used to determine how fat or thin an animal is.
- Cannot be determined by simply looking at an animal.
- Is accomplished by feeling for the amount of fat and muscle over the back, ribs, and loin.
- Is one of the most useful management practices.
- Should be done on a regular basis.

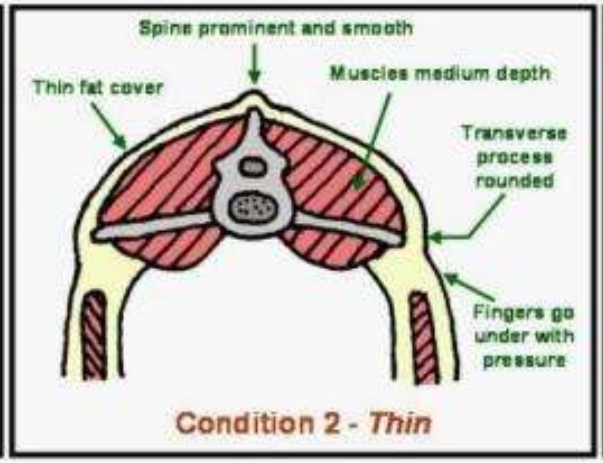
Body Condition Scoring

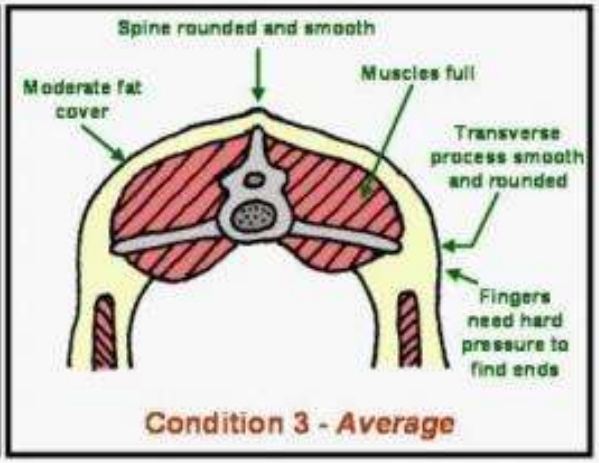
Score		Spineous process	Rib cage	Loin eye
1	**Very thin**	Easy to see and feel, sharp	Easy to feel and can feel under	No fat covering
2	**Thin**	Easy to feel, but smooth	Smooth, slightly rounded, need to use slight pressure to feel	Smooth, even fat cover
3	**Good condition**	Smooth and rounded	Smooth, even feel	Smooth, even fat cover
4	**Fat**	Can feel with firm pressure, no points can be felt	Individual ribs cannot be felt, but can still feel indent between ribs	Thick fat
5	**Obese**	Smooth, no individual vertebra can be felt	Individual ribs cannot be felt. No separation of ribs felt.	Thick fat covering, may be lumpy and "jiggly"

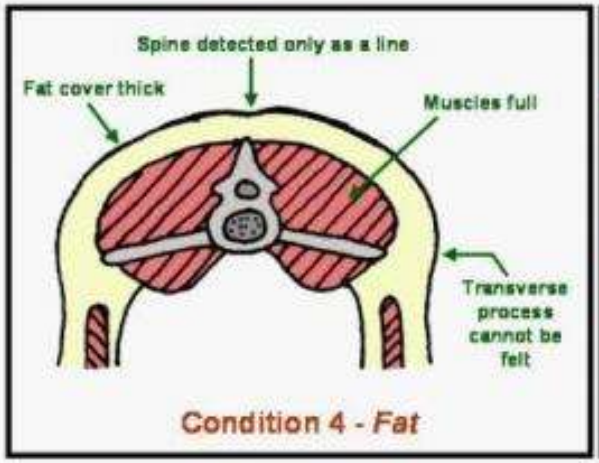
Source: www.smallstock.info

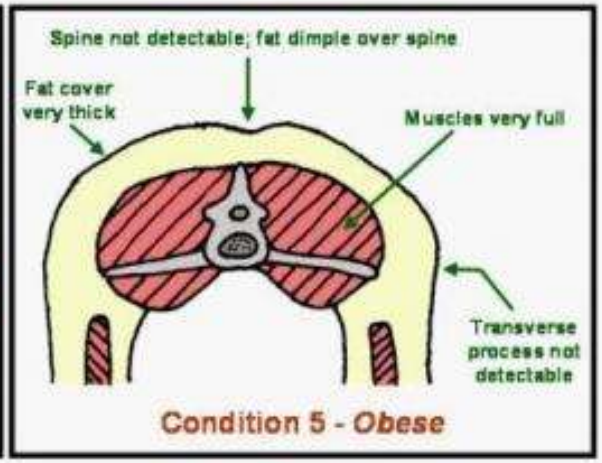
Body Condition Scores – Sheep/Goats







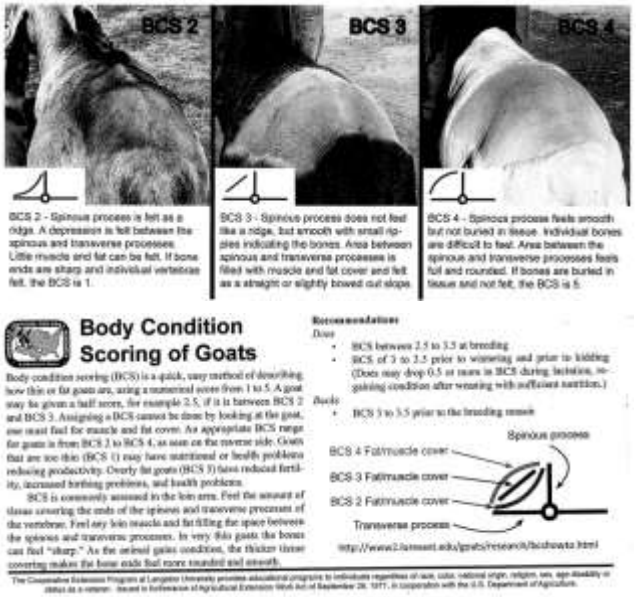




Adapted from "Body Condition Scoring of Sheep" by J.M. Thompson and H. Meyer (Oregon State University)

UK UNIVERSITY OF KENTUCKY
College of Agriculture
Department of Animal Sciences

Langston University resources on body condition scoring



Card
(similar to FAMACHA© card)

Factsheet

YouTube video

#3 - Tail - dag score

- The hindquarters of the animal are assessed to determine dag score or degree of fecal soiling.
- Many worms can cause scours (diarrhea).
- Stress and diet are other causes of diarrhea.

What are dags?

- Dried feces left dangling on the wool on a sheep’s rear end.

Dag scoring

Score	Description	Action
0	No fecal soiling at all. No indication for treatment/action.	None
1	Very slight soiling on edge of tail/on each side	None
2	Slight soiling on edge of tail/on each side	Usually none
3	Moderate soiling, dag formation	Consider treatment/action
4	Severe soiling, severe dag formation	Treatment recommended
5	Very severe, watering diarrhea extending to hocks.	Treatment essential

Source: University of Pretoria

SIL Dag Score chart

Use this chart for scoring sheep for dags. Note that zero is for "no dags" while 5 is for most daggy. You can use fewer scores but SIL does not recommend using less than a four point scale (zero plus 3 grades of dagginess).

SIL Dag Score Scale

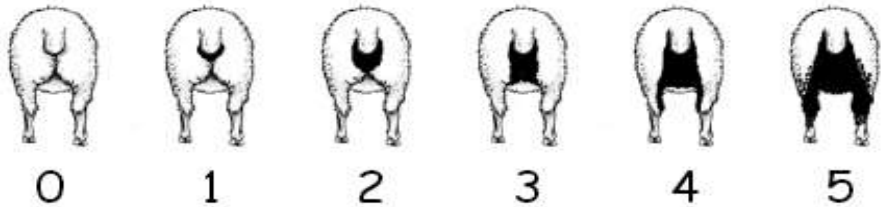
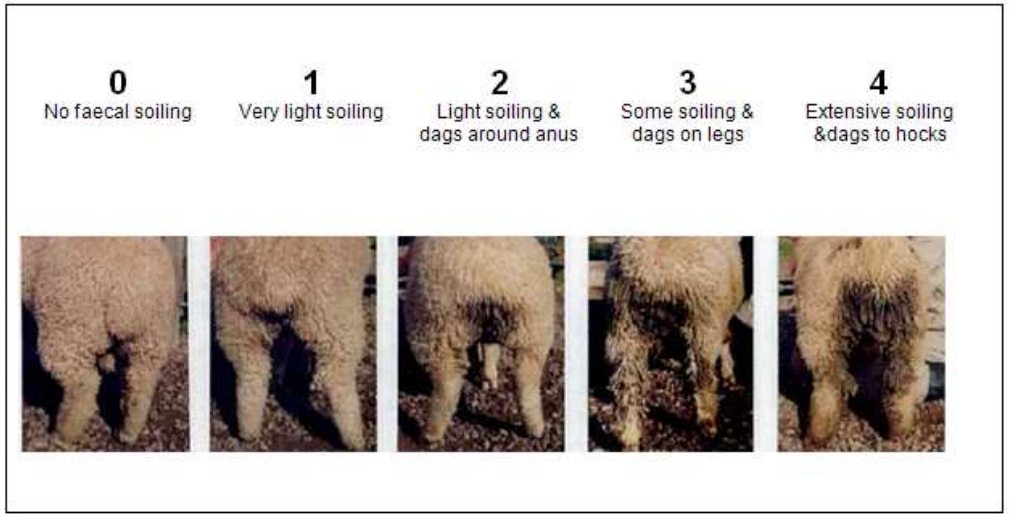
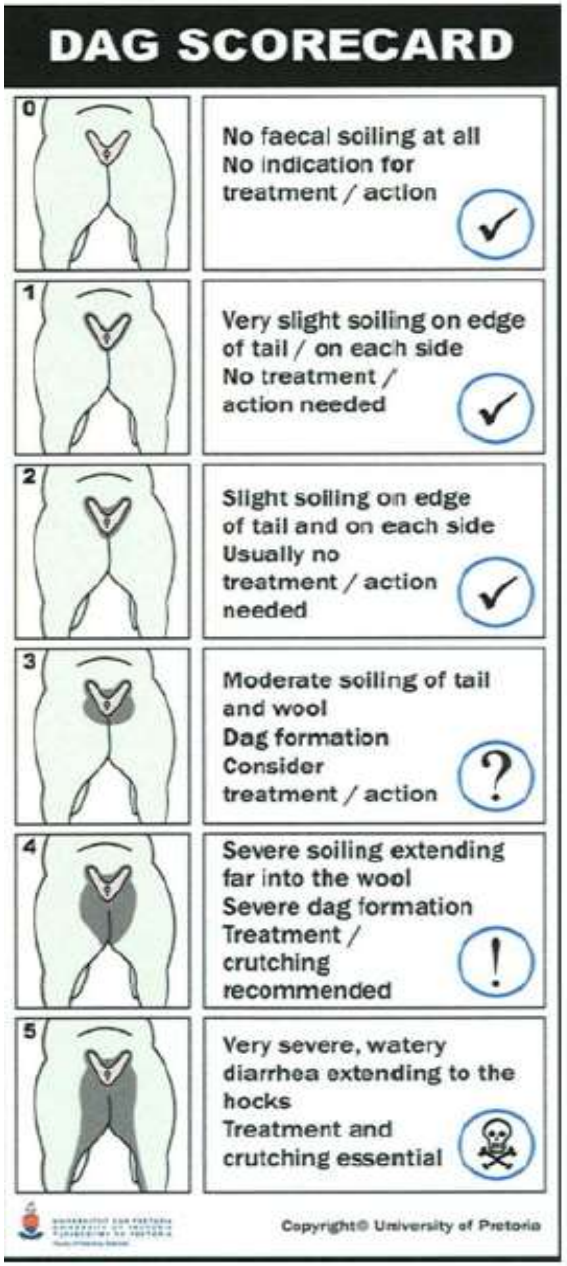


Figure 2.2 Dag Score Reference Guide





#4 - Bottle jaw

(submandibular subcutaneous edema)

- An accumulation of fluid (swelling) under the lower jaw of a sheep, goat, or calf.
- Usually a result of anemia (blood loss).
- Occurs primarily due to the infestation of barber pole worms (*Haemonchus contortus*) or other blood-feeding parasites.

#5 - Coat condition

- The condition of a goat's hair coat can be indicative of its overall health and thriftiness.
- At the Western Maryland Research & Education Center, we use a scoring system of 1-3, where 2 is average coat quality.

Other factors to consider

…especially when deciding whether to deworm FAMACHA 3's

- Fecal consistency
- Weight gain
- Fecal egg count
- Scores of other animals
- Risk of reinfection
- Frequency of FAMACHA© scoring and Five Point Check©

What do to when deworming is not enough or only marginally effective.

- Dose with another class of anthelmintic.
- Give supportive therapy
  - Vitamin B complex
  - Iron or Red cell
  - Nutri-drench
  - Probiotics
  - Proteinaceous feeds
- Remove parasitized animal from pasture (source of reinfection).

Fecal Egg counts (FECs)

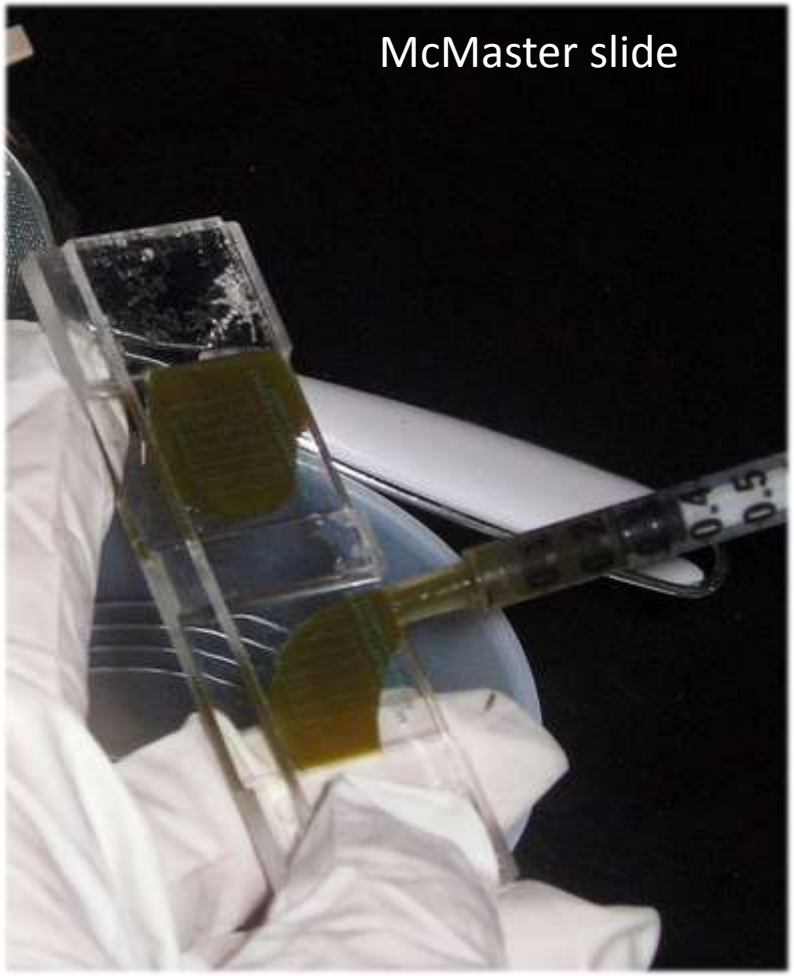
- A quantitative measurement that is expressed as eggs per gram of feces (EPG, epg).

  vs. “positive” or “negative” or +,++, +++ from a simple fecal flotation (which is not very useful!)

- Uses a measured amount of feces and flotation solution.

- An approximation of the worm load an animal is carrying.

- A “snapshot” in time.



FEC data from the Western Maryland Pasture-Based Meat Goat Performance Test

Test ID	FEC d-28	FAMACHA©
303	1650	3
304	1000	3
305	275	3
310	2040	2
334	125	3
335	3000	4
337	1300	3
338	3167	3
355	4650	2
356	6725	2
357	6000	3
358	4900	4
339	120	4
340	4240	3
351	14680	3
352	2125	5
353	33	4
359	867	3
360	200	2
361	1240	3
362	2225	2
363	525	2
367	200	2

Year	Genetic correlation (-1 to 1) between FECs and FAMACHA© scores	
2007	0.29	Intermediate
2008	0.42	Intermediate
2009	0.18	Weak
2010	0.23	Weak
2011	0.14	Weak
Avg. 5 years	0.25	Weak to intermediate

Limitations of fecal egg counts

- Not a highly accurate test, especially at low numbers.
- Parasites vary in their egg producing capacity.
- Immature worms (L4s) suck blood, but do not lay eggs.
- Inhibited larvae do not lay eggs.
- There is a day-to-day variability in counts, even in stable worm populations.
- Eggs are not always evenly distributed in manure.
- Loose stools (diarrhea) may underestimate egg counts.
- Some eggs look the same and cannot be differentiated at the egg stage (e.g. *Haemonchus* vs. *Trichostrongylus*)
- Not all parasites (or strains) are pathogenic.
- There are different procedures for doing fecal egg counts.
- Possibility of human error.

Three main uses of fecal egg counts

1) Determine anthelmintic (drug) resistance.

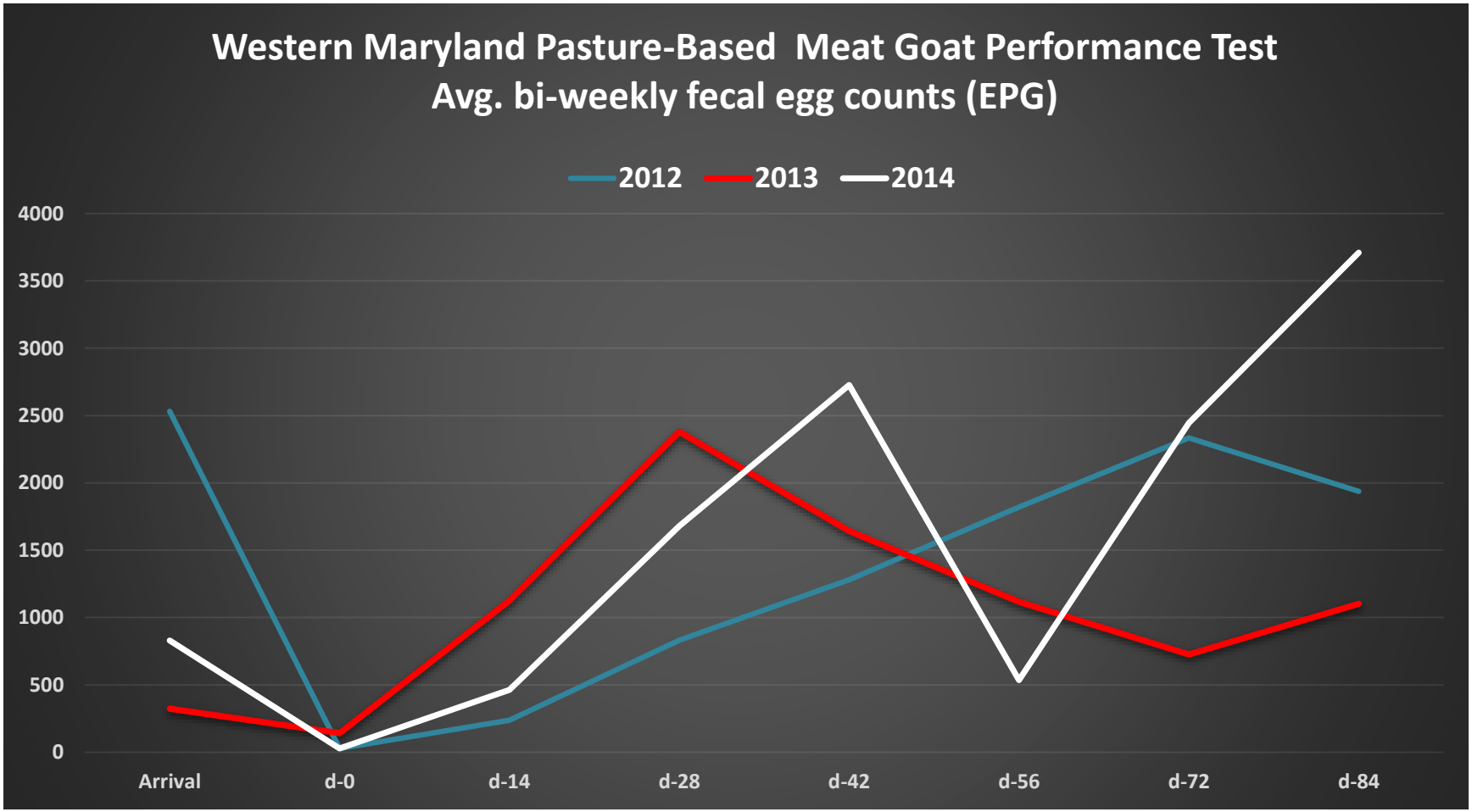
2) Monitor pasture contamination.

3) Select animals for their genetic ability to resist worms.

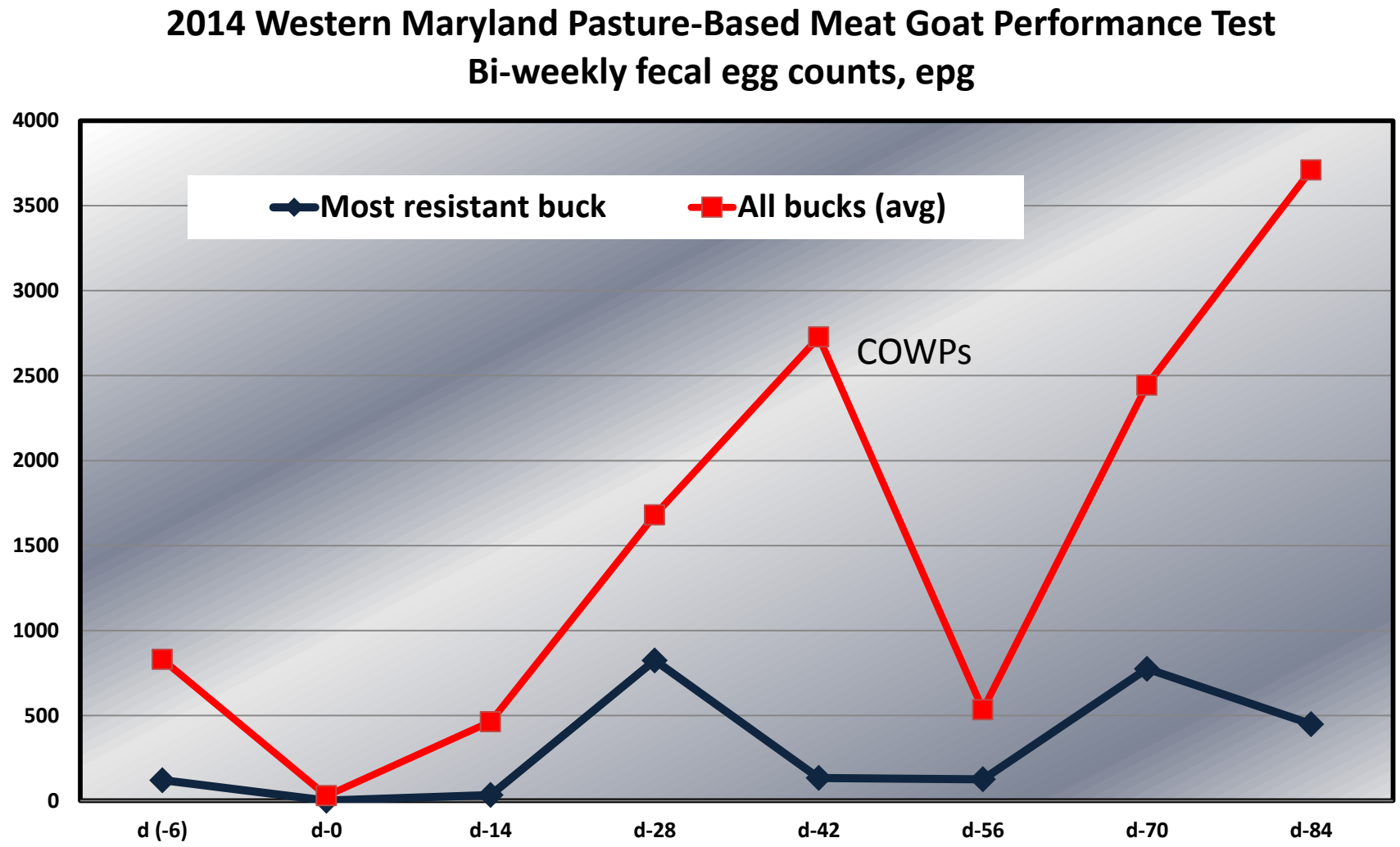
4) Not a reliable way to diagnose parasitic disease in an individual animal.

What do fecal worm egg counts tell us? http://ohioline.osu.edu/vme-fact/pdf/0027.pdf

Use fecal egg counts to monitor pasture contamination



Use fecal egg counts to selection animals (especially) males that are more resistant to internal parasites.



Hands-on fecal egg counting

What you need

- Microscope (10 x 10 = 100x)
- McMaster slide
- Flotation solution
- Gram scale (optional)
- Cups or vials
- Craft stick or tongue depressors
- Cheese cloth or tea strainer
- Pipettes or syringes

Modified McMaster Procedure

1) Weigh out 4 g of feces
2) Add 26 ml of flotation solution
3) Crush and mix feces using stick
4) Drain solution through cheese cloth or tea strainer into a clean cup
5) After stirring solution, draw up solution from top of mixture
6) Fill both sides of slide chamber.
7) Allow slide to sit for 5-10 minutes
8) Place slide on microscope
9) Focus on grid
10) Count strongyle-type eggs inside of and under grid lines
11) Record number of eggs for each grid.
12) Multiply their sum by 25 to get EPG

Note: If using 2 g of feces, add 28 ml of flotation solution and multiple number of eggs in both chambers by 50.

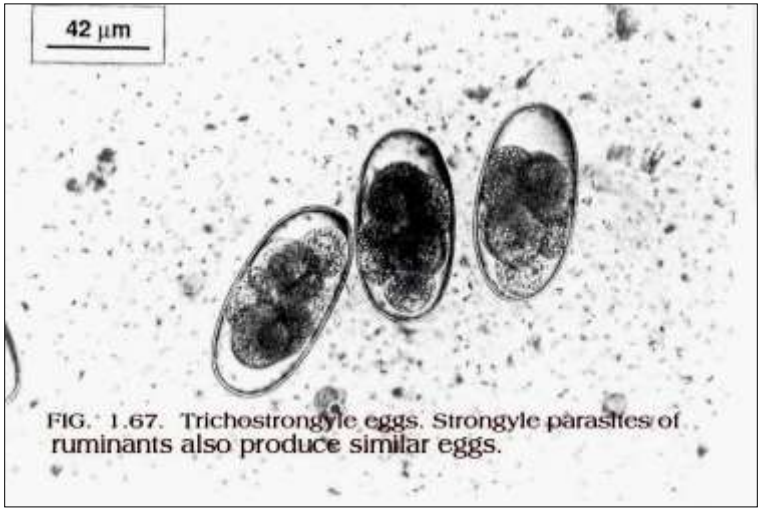
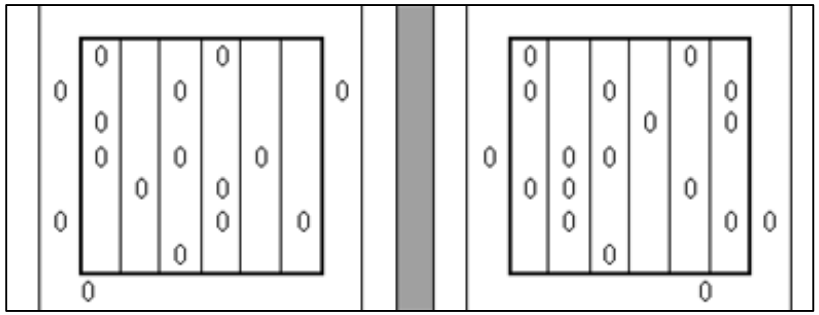


FIG. 1.67. Trichostrongyle eggs. Strongyle parasites of ruminants also produce similar eggs.



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Guide to Internal Parasites of Ruminants

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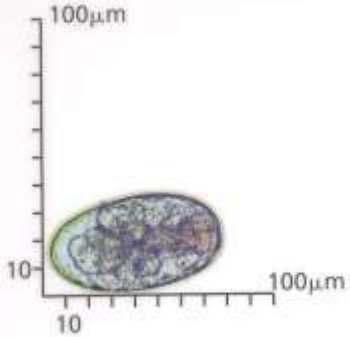

Ostertagia
(brown stomach worm)

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)

G.H Bliss and W.G. Kvasnicka; the compendium, April 1987

Thank you for your attention. Questions?

UNIVERSITY OF MARYLAND EXTENSION
SMALL RUMINANT PROGRAM

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