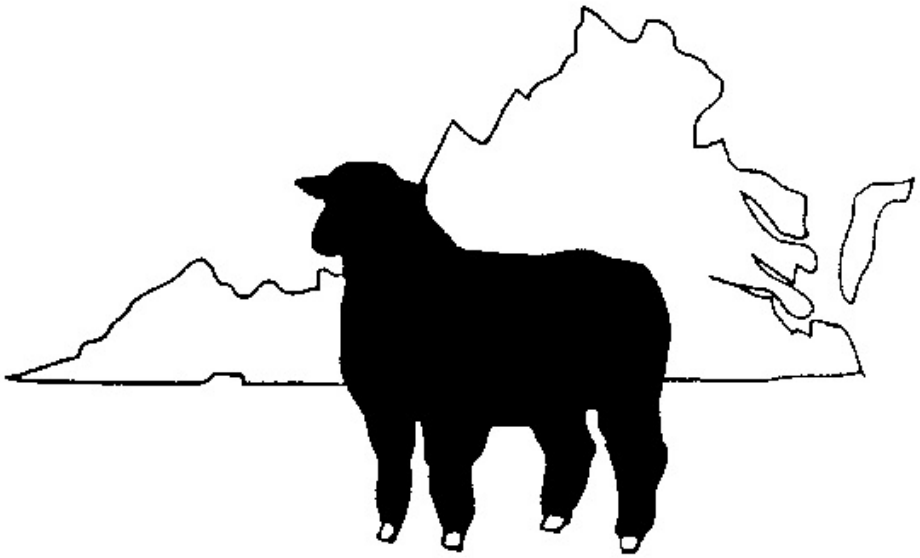
# *Proceedings*

## *2017*

## *VIRGINIA SHEPHERDS' SYMPOSIUM*



***January 13 - 14, 2017***

***ALPHIN-STUART LIVESTOCK ARENA***
***BLACKSBURG, VIRGINIA***

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# FRIDAY, JANUARY 13

**3:00 PM** **Virginia Sheep Industry Board Meeting (open to public)**
*Alphin-Stuart Livestock Arena*

**6:00** **Virginia Sheep Producers Association Board Meeting (open to public)**
*Alphin-Stuart Livestock Arena*

# SATURDAY, JANUARY 14

## ADULT SESSION

**8:30** **Registration & Commercial Exhibits**

**9:30** **Morning Session-**

**"Making the Most of Your Forages"**
*Dr. John Fike, Crop & Soil Environmental Sciences, Virginia Tech*

"**Feeding Strategies for the Ewe Flock"**
*Dr. Dan Morrical, Iowa State*

**"Dealing With Parasites: Where Are We Headed?"**
*Dr. Anne Zajac, VA-MD Regional College of Veterinary Medicine*

**11:45** ***Roy Meek Outstanding Sheep Producer Award Presentation***

**Virginia Sheep Producers Association Annual Business Meeting**

**12:15 pm** **Lamb Lunch**

**1:00** **"Update from ASI"**
*Mr. Bob Leer, ASI Executive Board-Region II Director, Kentucky*

**1:30** **"What is the VFD and What Does It Mean for Sheep Producers?"**
*Dr. John Currin, VA-MD Regional College of Veterinary Medicine*

**"Evaluation of Terminal Sires in Hair Sheep Production Systems"**
*Mr. Andrew Weaver, Animal & Poultry Sciences, Virginia Tech*

**"Economic Impact of Selection for Parasite Resistance and Growth"**
*Mr. Tom Stanley, Virginia Cooperative Extension, Rockbridge Co.*

**"Lambing Season Tips"**
*Producer Panel*

## YOUNG SHEPHERD SYMPOSIUM

*Youth Session will be concurrent with adult session. We will feature two concurrent sessions – beginner and advanced. All activities will be hands-on and interactive. 4H and FFA youth of all experience levels are welcome.*

**9:00 am** **Registration**

**9:30** **Health**
*Parasitology – Advanced Session*
*Basic Health – Beginner Session*

**Genetics**
*Understanding Breed Characteristics – Beginner Session*
*Sheep Sire Selection – Advanced Session*

**11:00** **Marketing/Nutrition**

**12:15 pm** **Lamb Lunch**

**1:00 PM** **Selection/Evaluation**
*"How to See through the Wool"*

**Skill-a-thon Contest**

**3:00** **Adjourn**

# Table of Contents

***2017 VA Shepherds' Symposium***
***Presented By***
***Virginia Sheep Producers Association***

**Page Number**

**Pasture management for sheep production systems**

Pastures form the basis for ruminant production systems in the mid-Atlantic region and successful pasture management is central to productivity and profitability. Successful forage-livestock systems integrate "soil, plant, animal, environmental, and management factors …with the objective of matching the feed requirements of the livestock to the production and quality potential of the forage." The focus of this presentation is on the basics of pasture management in our region, which typically comes down to three things: soil testing, rotational grazing, and stockpiling forages.

**It starts with soils**

Soils are the foundation to any forage-livestock program. Virginia uses a four-tier system for classifying soils into different productivity groups. Pasture systems generally are found on lower quality Class III or Class IV soils. These soils are less productive but still can respond to management. Understanding key concepts about soil fertility is important for management in order to minimize over- or under-application of nutrients and negative impacts both on the environment and on the wallet. Maintaining adequate fertility also is important for keeping (or getting) the forages you want on your farm and for minimizing the ones you don't want. Species such as broomsedge can serve as indicators that either soil phosphorus (P) or ph or both are low; purpletop is associated with low K.

Almost all soil talks bring up Leibig's "Law of the minimum". This essentially states that a soil (and thus plant productivity) will be limited by the most limiting nutrient. E.g., if your soil has plenty of nitrogen (N) and phosphorus (P) but it is low in potassium (K), plant growth will be limited by the limiting level of soil K. So, adding more N and P won't make the soil more productive. Too often producers rely on simple fertility mixes, e.g., 10-10-10 or "triple 19" without really knowing what nutrients are in their soils. The blends aren't bad per se and may be cost effective, but they aren't prescriptive for the needs of different soils. E.g., you may have some soils that hold K, but other part of the farm may be more prone to leaching K. Adjustment fertilizer mixes for small acreages may not be a big concern, but a straight blend might be costly if you are over- or under-fertilizing large acreages.

Soil sampling is essential for really knowing what nutrients your soils need to support forage growth). It may seem a bit ironic, but more productive soils generally will need higher nutrient inputs – at least if they are managed for hay or crops where nutrients routinely are being removed from the system. In that particular case, the degree of nutrient removal also will depend on the forage species because of differences in productivity, nutrient requirements, or both.

Soils can be sampled any time of the year, and a general recommendation is to take the samples every two or three years to keep tabs on their status and to make adjustments to fertility applications as warranted. A couple rules of thumb should be followed when sampling. 1) Get a representative sample. One or two soil plugs pulled from a 20-acre field isn't adequate. Recommendations vary, but five "pokes" per acre with a soil probe is considered a reasonable minimum. On uniform fields, 20 pokes would probably be sufficiently representative. It's also important to distribute the sample locations across the field. 2) Because of the variation across the landscape, sampling should be done by field, by management unit or by landform. E.g., even if they're in the same field, you should sample the upland and lowland part of a pasture separately. If the fencing won't allow you to spread nutrients separately, the soil test information will at least help you determine the greatest need and where to send the

fertilizer truck. Also, avoid sampling nutrient-rich "hot" spots around feed troughs, campsites, or waterers.

Once you have soil test recommendations, follow them as practicable. With a limited budget and rundown soils, it may make better sense to build the nutrients up slowly over time. Getting pH to a reasonable level for the forages you need is probably one of the first best investments in soil fertility because it will help improve availability of nutrients already in the soil system. Adequate pH also is important to support legume growth, which can add N to the system for free.

As noted above, forages can vary substantially in fertility needs – and in management requirements. We have a lot of tall fescue pastures because tall fescue tolerates low soil fertility levels and overgrazing better than other species. Managing for greater productivity and better quality forages will require greater inputs in fertility but perhaps as importantly greater management in general, which is the topic of the next section.

**Pasture management: forage choices and rotational grazing**

Much of the current state of pasture management in extensive (vs. intensive) production systems comes down to a "least input" reflex. That may reflect a number of issues for the producer: lack of knowledge, lack of interest, lack of time, lack of resources, or a lack of return to inputs. To deal with time and resource challenges, some managers default to allowing their livestock make the management decisions. Unfortunately, livestock generally are terrible land managers – but they are great land management tools.

As noted above, forages can reflect the state of soil quality on a farm, but this in turn often reflects the state of forage management. Poor soil fertility can arise from repeated overgrazing. Overgrazing limits the ability of soils to absorb moisture; it also limits plant rooting, meaning plants have difficulty acquiring moisture and nutrients. This limits pasture growth and often results in open, exposed soils which become sites for weeds or undesirable forages. With repeated overgrazing over time, exposed soils are prone to soil and soil nutrient loss through nutrient erosion. Mismanagement in this case puts the system in a downward spiral. Overgrazing due to poor forage production in turn limits forage growth; this encourages weed encroachment and exposes soils; the resulting reduced forage production sets up the system to be overgrazed again.

In cases like this it's time for a new cycle. A rotation, really. Controlling the frequency and intensity of defoliation in pasture systems is the way to manage for both the forages and the productivity you want. First, it allows the manager to determine how severe the defoliation will be. When livestock remove almost all of the leaf area from a plant, the plant must build all the new photosynthetic "machinery" from scratch. If some leaf is left, the recovery process starts quickly, increasing productivity. Managing the defoliation also helps support the types of forages in the pasture. Closer defoliation will encourage more tall fescue, bluegrass and ryegrass than orchardgrass. Of course ryegrass and bluegrass are great forages for sheep, but the knock on these forages is that they will not be productive in hot, dry conditions. Rotational management can allow a producer to graze tighter in spring to encourage desired cool season grasses and then back off or reduce grazing pressure in summer when grass growth slows.

Allowing forages more time to recover has some additional benefits. Keeping a canopy above the ground allows for more root growth belowground. This means plants have better opportunity to search

for and take up soil nutrients and moisture. The canopy also keeps soils cooler, reducing evaporative moisture losses. Cooler soil conditions also help forage growth by keeping the canopy cooler, which is better for cool season plants. The forage canopy also helps capture rainfall and keep nutrients in place.

Along with all these benefits, rotational stocking allows managers flexibility for dealing with difficulties such as long dry spells. Many managers in SW Virginia found themselves without forage this past summer due to a prolonged dry spell. These producers are likely to see low forage growth and more weed pressure in 2017 as a result of management decisions in 2016. At some point, it becomes appropriate to keep animals only in a sacrifice lot and feed hay rather than overgrazing the whole farm and setting all the forages back. By allowing pastures to rest during drought, recovery will be faster following rainfall. As well, the system will be better able to capture rain that comes in short, heavy summer showers if there is grass on the surface to slow and channel the droplets to the soil and roots in the soil to take the moisture up.

As noted above, grazing management can drive pasture composition, and rotational grazing is an important tool for that purpose. We often first think of using rotation to allow plants to recover from defoliation. That is important for the plant and for pasture composition as a whole. An overgrazed pasture which has the forage canopy opened up and exposed soil presents a great opportunity or weed encroachment. On the opposite side of the equation, rotational stocking can be used to address weed issues. Using rotational grazing allows a manager to keep animals on a site longer to force them to clean up less desirable forages and weeds.

Rotational grazing also may some benefit for dealing with intestinal parasites. If pastures can be avoided for 60 to 90 days following a grazing event this can help reduce potential worm burden because of lower survival over time. It may also allow managers to keep grazing events higher off the ground and away from the parasites.

Rotational grazing also may be important as a way to manage *for* certain forages. Species such as alfalfa, birdsfoot trefoil, and lespedeza all will benefit from rest and recovery that may not be possible in a continuously stocked pasture. Grazing trefoil and lespedeza also has been shown to help reduce worm burden due to the anthelmitic effects of their condensed tannins.

**Stockpiling**

Hay feeding is one of the biggest costs for livestock producers, and we can reduce this need through good forage management. Stockpiling is key to this, and stockpiling is dependent on the ability to rotationally graze pastures. Although we often think of stockpiling for fall and winter grazing, there likely is opportunity to use this effectively in summer as well. During times when there is excess growth in late spring and early summer, it may be better to set aside some pastures for end of summer grazing rather than keeping them in the rotation. Having this grass on hand would be useful for dealing with dry periods and also will make it easier to set aside other pastures for fall stockpiling. Of course all of this must fit the objectives. Trying to fatten lambs on this forage would be a challenge, but it should work fine for dry ewes.

Stockpiling in fall is more of an opportunity in pastures that have abundant tall fescue, but even orchardgrass and bluegrass can be stockpiled. However, these softer grasses and legumes will degrade sooner during heavy freeze-thaw conditions, so they will not remain or be as nutritious into the winter.

Using rotation in conjunction with stockpiling can allow a producer to graze fields strategically. E.g., one might hold pastures with more durable fescue for grazing later into the winter. These pastures likely would also be best suited for frost seeding because the sheep would help work the seed into the soil and reduce competition for the seedlings in early spring.

**Schedule**

As you begin the year it may be very helpful to establish a grazing management calendar. Keeping a calendar to refer to is an excellent way to stay on top of management needs and decisions. A few things to consider for the coming year….

Do I need to soil sample? Plan to do this spring or fall, set up a routine time for this, and stick with it. If samples reveal problems, begin working to address through fertility applications and grazing management. If you have particular problem spots now, go ahead and start working on them.

If you need legumes, now into February is an excellent time to begin frost seeding legumes. Don't waste seed on low fertility ground. (That said, if you want to try lespedeza or trefoil, they are more tolerant of poor fertility and will be more successful if there is not strong grass competition.) Graze frost-seeded pastures a little closer in spring to provide more heat to the soil and to reduce competition to seedlings.

Have a drought management strategy for summer. Rotation is a great first line of defense. And, remember when it gets too dry – pull them off and feed hay. It's better to feed hay and not abuse your money maker (the pasture) than to not feed hay and lose your money maker. For folks in warmer areas, you may also want to consider having some warm season grass pastures – which would be another talk!

Late summer and fall is the time to set up the stockpiled forage, as discussed earlier.

Of course, all the management decisions and activities come back to the needs and abilities of the producer. Getting the fundamentals in place may take a bit more time or money up front, but they can save time and improve productivity over the long term.

often In many cases, producers start with a systemSupplemental feeds to meet livestock needs and cover deficits

Do we have a fescue problem?

Strategies:

Feed alfalfa or alt legumes in morning for fescue

French pasture management

Forage Options

Soils available? – thinking systems

Soils map

Soil testing – nutrient return slides from MC

Frost seeding

Buy/Build grazing calendar

Co-grazing

# Supplementing endophyte-infected tall fescue or reed canarygrass with alfalfa or birdsfoot trefoil increases forage intake and digestibility by sheep

Animal Feed Science and Technology

Volume 147, Issues 1–3, 14 November 2008, Pages 116–139

Shrubby vegetation and agro-industrial by-products as alternative feed resources for sheep and goats

# Beneficial and detrimental effects of dietary condensed tannins for sustainable sheep and goat production—Progress and challenges ☆

# MANAGING SHEEP ON PASTURE

Animal performance and enterprise profitability depend, in no small measure, on how well the pasture is managed and utilized. Presented here are nine basic management practices that optimize the productivity of both the animals and the land they graze. How these practices can be applied to meet the forage needs of a 100-ewe flock on 30 acres is then discussed.

## Recommended Pasture Management Practices

- 1.Subdivide large pastures into paddocks for rotational grazing at a high stocking rate. An electric fence can be erected at a reasonable cost and easily moved. Rotational grazing reduces internal parasite infestation of sheep.

- 2.Vary the stocking rate to coincide with pasture productivity. This should result in greater plant vigor, more forage production and less weed problems. Too heavy a stocking rate eventually decreases the pasture stand and forage yield, while too low a rate reduces carrying capacity and results in forage waste.

- 3.Reduce the intake of non-lactating ewes by restricting their grazing time. A pasture's carrying capacity can be increased greatly when non-lactating ewes are restricted to 50 percent of the normal grazing time each week. Increasing the stocking rate and rotating pastures during the non-lactating period also reduces intake.

- 4.Adjust the lambing season to coincide with maximum pasture growth periods in the spring or fall. Cool-season perennial grasses reach their maximum growth in May and June and a second but smaller peak period in the fall. Ewes lambing in March or April make better use of spring pasture growth than ewes that lamb in January or February. These winter lambing ewes must be fed harvested feeds during the period of greatest nutritional needs. Ewes that lamb in September or October make good use of fall pasture growth during lactation. After weaning, which is the period of lowest nutritional needs, these ewes can be maintained on winter pasture, reducing the need for harvested forages.

- 5. Regardless of lambing time, provide additional energy in the form of shelled corn to "flush" at breeding, during the last 4-6 weeks of pregnancy, and in the first 8 weeks of lactation. If low-quality forages are used, protein supplements are also recommended.

- 6. Separate ewes with single lambs from those with twin lambs, and creep feed the twin lambs on pasture. To reduce internal parasite infestation in lambs, separate the ewes and lambs daily. Allow the lambs to graze clean pasture while creep feeding.

- 7. If you raise both cattle and sheep, consider grazing them together. Sheep prefer shorter and more tender grasses, while cattle will consume less tender growth. In addition, cattle may help in reducing predator problems. A ratio of 3-5 sheep for each beef animal will insure that the pasture is well utilized. Ewes nursing lambs may graze first and then be followed by cattle.

- 8. Control weeds and thistles. Although sheep will consume 90 percent of the weeds in a pasture, thistles and some other weeds will be left alone. Non-grazed weeds should be mowed when the animals are rotated to another area or controlled with an approved herbicide.

- 9. Fertilize pastures according to soil test. Optimum pasture production can only be attained with a proper fertilization program.

Manage pasture for parasites

Veterinary Parasitology

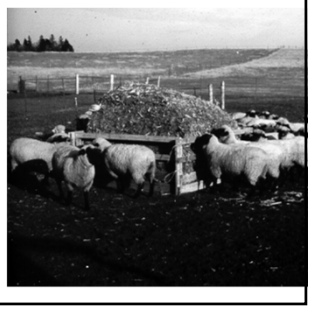
Volume 112, Issues 1–2, 28 February 2003, Pages 147–155


# The effect of birdsfoot trefoil (*Lotus corniculatus*) and chicory (*Cichorium intybus*) on parasite intensities and performance of lambs naturally infected with helminth parasites

- C.L Marley[a, b, c, ,]
- R Cook[c],
- R Keatinge[d],
- J Barrett[b],
- N.H Lampkin[a]

## Feeding Productive Ewes

- Realistic and practical
- Facilities and equipment
- Flock size



## What is the best thing to feed?

- Many would reply high quality alfalfa

Why

## What is 16% grower feed?

- Feed that contains 16% crude protein.
- Is it better than 14% finisher?
- Feed tags list items on an as fed basis

## What is in feeds?

- water (8-60% water)
- minerals (ash 1-4%)
- energy (TDN 40-85%)
  - forages more variable than grains
- protein (5-43%)
- vitamins

## How much will sheep eat?

- Daily intakes
  - ewes 2-5% body weight
    lactating ewes have highest
  - lambs 3-6%
    goes down as lambs get heavier

## Condition scoring

- Evaluating ewes for fatness
- Monitor changes
- 1-5 system
- 11% weight change equals one condition score

## Nutrient Requirements

- Reading those charts

| Stage of Production | Body weight | Daily gain or | Dry Matter Intake | | Energy | | Crude Protein | Cal-cium | Phos-phorous | Vit. | Vit. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | lb | loss | lb | %BW | TDN lb | ME Mcal | lb | grams | grams | A IU | E IU |
| Maintenance | 125 | 0.02 | 2.3 | 1.8% | 1.26 | 2.07 | 0.22 | 2.3 | 2.3 | 2800 | 18 |
| | 150 | 0.02 | 2.6 | 1.7% | 1.45 | 2.38 | 0.25 | 2.6 | 2.4 | 3210 | 19 |
| | 175 | 0.02 | 2.9 | 1.7% | 1.62 | 2.66 | 0.28 | 2.9 | 2.7 | 3610 | 20 |
| | 200 | 0.02 | 3.2 | 1.6% | 1.79 | 2.94 | 0.31 | 3.2 | 3.0 | 3990 | 21 |
| | 225 | 0.02 | 3.5 | 1.6% | 1.96 | 3.21 | 0.33 | 3.5 | 3.2 | 4360 | 22 |

## Nutrient Requirements

- Using those charts
- ex. 175 ewe 1.62 TDN and .28 CP
- Alfalfa 50% TDN 1.62/.5 = 3.2 lbs.
- 3.2 X 16%CP = .51 lbs. of CP

## Stages of Production

- **Maintenance**
  - **weaning until 14 days pre-breeding (138 days)**
- **Flushing/Breeding**
  - **2 weeks pre-breeding till end of breeding (49 days or more)**
- **Early/mid gestation**
  - **Completion of breeding until 4 weeks pre-lambing (80 days or more)**

## Concerns During Early Mid Gestation

- **21 days of severe underfeeding**
- **80 days of moderate underfeeding**
- **Both result in smaller placenta leading to reduced birthweights**

## Mid Gestation Nutrition Goals

- **Maintain condition - mature ewes**
- **Yearlings and two year olds - increase condition**
  - Higher incidence of fetal loss in young ewes.
- **Specific nutrients**
  - **Protein maybe**

    Other species - protein deficiency severely impacts placental size more than energy
- **Crop aftermath grazing - ?? protein**

## Stages of Production

- Late gestation, second most important
  - singles 2 weeks
  - twins 3-4 weeks
  - triplets 4-6 weeks
- Early lactation, *most important*
  - 42 days
- Late lactation
  - 21 days
- Weaning ration
  - 7 days

## Recommendations for LG Feeding

- Alfalfa hay based diets
  - Corn or other economical energy sources
  - Guideline - 1 LB. concentrate per fetus
- Limit roughage intake
  - Mature ewes with 3 fetus or more
  - All ewe lambs
- Low quality roughage as base ration require both protein and energy supplementation
- Low energy diets with poor roughage's may respond to escape protein - MLC, 1983

## Late Gestation

Secretory tissue development occurs.

Larger placenta → more placenta lactogen.

Ewes with multiples have larger placenta weight.

## Consequences of Underfeeding

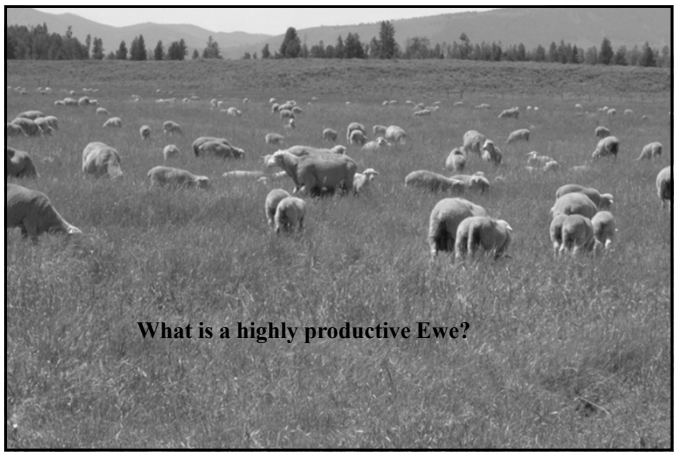
- Weak, small lambs with high mortality
- Reduced colostrum quality and quantity
- Retarded weight gain both pre & post weaning
- Reduced peak milk yield and less total production
- Decreased re-breeding success
- Reduced wool production via fewer secondary follicles

## Consequences of Overfeeding

- Thin wallets
- Fat ewes
  ketosis
- Upper limit on birth weight

## Factors Which Affect Milk Production

Lactation Diet Energy Status
Lactation Diet Protein Status
Late Gestation Nutrition - precaution
Ewe Fatness or Condition
Prolificacy




## High producing ewes

- Twins or better
  - Moderate birth weight
- Raises them all
- 7.5 pounds of milk per day
  twins gaining .75 lb birth to weaning
- Long lived
- Breeds back if desired
- Eats like a horse

## Ewe Lambs

- Lamb at 12-14 months
- Group drop rate of >1.5 w/ 200% ideal
- Produce 4 pounds of milk
  - Lamb gain on twins of .4 lb birth to weaning

## Feeding Management

**Separate by need**

- **Singles vs twins vs triplets**
- **Age: ewe lambs vs mature**
- **Early vs late lambers**

## Late Gestation Rations

**175 pound ewe**

| | 13 lb S | 11.5 lbTw | 9.5 lb Tr |
|---|---|---|---|
| Brome/alfalfa[a] | 4 | 4 | 3 |
| Corn | 1 | 1.5 | 2.5 |

[a] Hay quality good, 13.9 % CP and 56% TDN

Trace mineral salt and Vitamin E

## Late Gestation Rations

**120 pound ewe lamb**

| | 10 lb S | 8.5 lbTw |
|---|---|---|
| Brome/alfalfa[a] | 2 | 1.75 |
| Corn | 1.5 | 2.25 |

[a] Hay quality good, 13.9 % CP and 56% TDN

Trace mineral and Vitamin E

## Lactation rations

**175 pound ewe**

| | Single | | Twins | | Triplets | |
|---|---|---|---|---|---|---|
| **Lamb gain** | **.75** | **1** | **.5** | **.75** | **.4** | **.50** |
| **Brome/alfalfa[a]** | **5.5** | **5.5** | **5.5** | **5.5** | **5.5** | **5.0** |
| **Corn** | **.75** | **1.0** | **1.0** | **2.0** | **2.0** | **2.5** |
| **Soybean meal** | | **.3** | **.3** | **.7** | **.5** | **1.0** |

**[a] Hay quality good, 13.9% CP and 56% TDN**
**Trace mineral and Vitamin E**

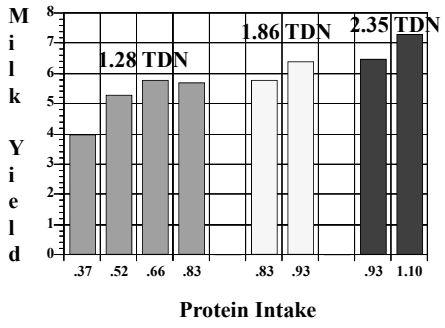
## Lactation rations

**125 lb ewe lamb**

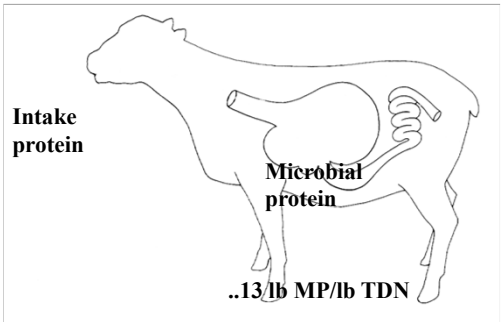
| | Single | Twins |
|---|---|---|
| **Lamb gain** | **.6** | **.4** |
| **Brome/alfalfa[a]** | **3** | **4** |
| **Barley** | **1.5** | **1.5** |
| **Soybean meal** | **.5** | **.5** |

**[a] Hay quality good, 13.9% CP and 56% TDN**
**Trace mineral and Vitamin E**

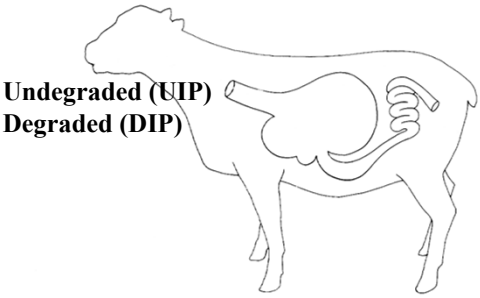
## Energy and Protein vs. Yield



## Protein Sources




## Intake Protein




## Value of Protein Sources for UIP

| | % CP | % UIP | UIP Conc. % |
|---|---|---|---|
| Grass Pasture | 6-20 | 10 | 2 |
| Alfalfa Hay | 16-24 | 15 | 2.7 |
| Barley | 13.5 | 20 | 2.7 |
| SBM 44, Solvent | 44 | 25 | 11 |
| SBM 44, Expeller | 43 | 50 | 21.5 |
| CGM | 60 | 40 | 24 |
| DDGS | 28 | 55 | 15.4 |
| Blood Meal | 85 | 80 | 68 |
| Fish Meal | 60 | 40-80 | 24-48 |

**Milk Yield Results from Additional Protein**

| | Protein Added | |
|---|---|---|
| **Protein Source** | **.18 lbs.** | **.44 lbs.** |
| **Urea** | **.29** | **0** |
| **Nutmeal** | **.88** | **0** |
| **Soybean Meal** | **.88** | **0** |
| **Meat & Bone Meal** | **.88** | **0** |
| **Lineseed Meal** | **1.32** | **0** |
| **Fish Meal** | **1.32** | **.55** |
| **Blood Meal** | **1.32** | **.74** |

**145 lb. ewes rearing twins fed**
**base diet 2.67 TDN 11.6% CP**
Gonzalez et al. 1982

## Vitamin E

**100 IU/day/head extra above feed E**
**14 d pre-lambing through 35 d lactation**

**Mineral source of E is inadequate**
**20 pounds of mineral mixed with**
**4 pounds of E (20K IU/lb)**
**assumes ½ ounce intake per day**

## Iodine

**Lactation Ration = .8 ppm or mg/kg**

**Most mineral mixtures are short**
**needs to be 140 ppm in mineral with .5 ounce intake**
**intake levels**
**Solutions free choice iodized salt**

**Spike mineral source with iodine (EDDI)**

## Summary

- All phases of production are important
- Correctly feeding the flock requires more than one pen
- Adequate MG nutrition for placental development
- LG prepares for lactation and adequate birth weights for high survival
- Lactation takes both protein and energy, wt. loss hurts production

# Critical Nutrition Inputs for Ewe Nutrition

**Dr. Dan Morrical**
**Iowa State University**

Introduction:

Sheep nutrition and feeding is extremely critical to the success or failure of the ewe flock enterprise. As shepherds our task is to provide balanced rations to meet the ewe's nutrient requirements on the least costly basis. Feed costs account for half the cost of producing lamb and wool. Therefore, cost control must always be foremost in the shepherd's mind. Sheep enterprises face a greater challenge in meeting needs of the flock because of the large within flock and between flock variations. This paper reflects the general guidelines for feeding ewes; however, each operation must adapt and modify these guidelines for their specific operation.

Nutrient Requirements:
The amount of nutrients the sheep require is affected by several factors. These include ewe age and weight along with stage of production and level of production. Figure 1 outlines the stages of production, demonstrates how nutrient requirements change through the production cycle. It is important to realize that all ewes in the flock are not at the same stage of production on any given day. This factor is affected by the length of the breeding season and production system (once a year lambing versus accelerated lambing systems).

Critical phases of the production cycle include flushing/breeding as it sets the maximum drop rate for flock. Early/mid gestation is critical in that placental development occurs from day 30-90 of gestation. Placental size or weight effects nutrient transfer between the ewe and fetuses. Underdeveloped placenta results in smaller birth weights regardless of late gestation nutrition. Twenty days of severe underfeeding or 80 days of slight underfeeding will both retard placental growth. The remainder of this paper will deal with late gestation and lactation stages of production since most flocks are grazing during other production phases.

Late Gestation Nutrition:
Determining how much to feed ewes in late gestation is a very difficult practice without fetal scanning. The goal of late gestation nutrition program is to insure adequate nutrient intake for strong vigorous lambs of moderate birth weight. Additionally, ewes must enter lambing season in average to above average body condition to maximize milk production. Adequate birth weight of lambs is critical to a successful lambing season since small lambs have less resistance to cold stress and reduced pre-weaning growth. Excessively big lambs increase the incidence of lambing problems and increases shepherd labor and lamb death loss. Fetal scanning and the separation of ewes into different feeding groups for those carrying singles, versus twins versus triplets or more helps to reduce the real big singles or small twins and triplets. Experienced technicians have accuracy values above 90% on fetal numbers so contracting an experienced scanner is the key to successful implementation of this technology.

The nutrients of greatest concern during late gestation feeding would be energy (TDN), crude protein (CP), calcium, selenium, iodine and vitamin E. The TDN level required is affected by the number of fetuses and cold stress. Winter lambing ewes generally cannot consume enough forage alone to meet their energy requirements, thus requiring the feeding of concentrates (corn).

Fetal growth accelerates rapidly during late gestation. Furthermore, energy required is much higher for the two weeks prelambing versus six weeks prelambing. A means of controlling costs is to step up grain feeding as lambing approaches. Ewes carrying singles require less grain and do not need to receive grain as early as those carrying multiples. Late gestation rations should begin 5-6 weeks prelambing for ewes

carrying triplets. Those with twins can be delayed to 3-4 weeks prelambing whereas those with singles can be held off until two weeks prelambing.

The absolute level of grain to feed is highly dependent upon the nutrient density of the forage being fed. Table 2 demonstrates the huge variation in nutrient density of hays. Nutrient analysis costs $15-$25 per sample and is money well spent. Balancing diets based on average or book values for hay is a risk progressive shepherds should not take especially in highly productive flocks. Furthermore, one can not accurately determine the nutrient density of hays with visual appraisal. Table 1 provides example rations for all phases of production with a wide array of forage sources. To minimize the risk of acidosis from excess grain feeding, ewes receiving over 1.5 pounds of concentrate per day should receive it in split feedings.

Selenium and vitamin E are both critical micro-nutrients for lamb survival and a smooth lambing season. Selenium can be added to the ration of sheep at .3 PPM or .3 mg/kg of feed. The maximum allowable selenium intake from supplemental sources can not exceed .69 mg per head per day. This is a very small amount and extreme care is required in calculating how much to add. More importantly selenium at 2 PPM can be toxic. Selenium status of ewes is dependent upon both the selenium concentration and intake of the mineral, along with the selenium level in the feedstuffs. Flocks with a history of selenium problems in newborn lambs should consider force-feeding selenium via the grain mix. This insures all ewes consume adequate amounts on a more uniform basis. If selenium is force fed, there should not be a free choice selenium source available. Table 3 shows the level of intake required for various selenium concentrations in the mineral or trace mineral salt. Selenium crosses the placenta so newborn lambs selenium status is totally dependent upon the selenium status of their dams in late gestation ration.

Vitamin E, unlike selenium is not toxic. Vitamin E does not cross the placenta so a newborn lamb's only source of E is ewe's milk or injections. The concentration of Vitamin E in ewe's milk or colostrum is directly correlated with the Vitamin E intake of the ewe. Vitamin E levels are extremely variable in feedstuffs because the E denatures with storage and is also denatured in the rumen as grain feeding increases. As a rule of thumb I suggest feeding 100 international units (IU) per ewe per day for each lamb she is carrying or nursing.

We all know iodine is connected with basal metabolic rate. The primary symptom of iodine deficiency is goiter. SDSU and ISU diagnostic labs both report selenium and iodine are the two most common micro mineral deficiencies. The 2007 NRC for Small Ruminants drastically increased the iodine requirements in late gestation for ewes. Iodine requirements are further increased in cold environments. Most commercial mineral supplements for sheep contain inadequate iodine concentrations to meet these higher requirements. A practical solution is to provide iodized salt blocks in combination with the mineral source. If stillbirths and hypothermia is one of your most common cause of lamb losses than iodine deficiency may be an issue in your flock.

Lactation Nutrition:

Lactation is the phase of production with the highest nutrient demand as shown in Figure 1. The amount of nutrients required is dependent upon the number of lambs nursed. Because of the huge differences in requirements, the most important time to split the flock into production groups is during lactation. Ewes peak in milk production around 21 days of lactation and should sustain high milk production levels through 6-8 weeks of lactation.

Nutrient requirements in table 1 are based off of projected milk yield when individual lambs are gaining .75, .65 and .5, respectively for singles, twins, and triplets respectively from birth to weaning. Calculations are based upon a standard of four pounds of ewe milk being required per pound of nursing lamb gain when creep feed is available. Using this standard, one can assume a ewe nursing twins gaining a pound per day

each and with creep feed access would be producing eight pounds of milk per day. This is a very high level of milk production which cannot be sustained without high feeding levels.

Protein and energy are both critical nutrients for milk production. If either nutrient is fed below the requirement, milk yields and subsequently lamb gains will be reduced 10% or more depending upon the magnitude of the short fall. I would suggest that almost all ewes lose weight during lactation, many over 35 pounds. This occurs because energy intake is well below requirements and ewes must mobilize body stores to sustain milk production. Weight loss during lactation is the critical reason that late gestation nutrition must be adequate to insure ewes are in average or better body condition at lambing. Traditionally, fat mobilization during lactation was considered as a means of controlling feed costs. However, excess weight loss is not without its costs. Ewes losing less than .5 condition score during a 60-day lactation will not suffer in terms of milk yield. Since one condition score equates to an 11% change in body weight, a 200 pound ewe could only lose 11 pounds (200 x 5.5%). This value would equate too less than .2 pounds of weight loss per day. It would not be uncommon for many ewes to lose two to three times this amount.

Weight loss during lactation impacts protein requirements. The more weight ewes lose the higher their protein need. This situation is due to the ewe's ability to effectively mobilize body fat but having minimal ability to mobilize body protein for milk synthesis. It is also important to realize that fat conversion to milk is about 60% under protein and energy deficient rations whereas with adequate protein fed, body fat conversion to milk is 80%. To demonstrate this relationship between protein requirements and weight loss, a ewe losing .5 pounds per day requires a lactation ration containing 21% crude protein. However, if the energy intake is increased to prevent weight loss, this ewe would require only 11.5% crude protein in their ration. Generally, energy is cheaper per unit to feed than protein.

Lactation nutrition mistakes:

One of the most common mistakes inexperienced shepherds make is over feeding grain to the ewes in the lambing jug. This situation most frequently occurs when we try to accelerate the milk output in ewes that do not have enough to feed their lambs. This over feeding can create problems with acidosis and lead to less milk production rather than more. Newborn lambs probably do not consume more than 10% of their bodyweight in the first day or two of life, so it is not critical that ewes be pushed while in the jug.

The next mistake that needs to be avoided is over feeding the ewes in the week to ten days before weaning. Many flocks routinely wean ewes while in the peak stage of milk production. It is critical that shepherds modify the pre-weaning diet of ewes to reduce mastitis problems. This is easily accomplished by cutting off the grain feeding for the last 10 days before weaning along with feeding low quality hay. This management input is trying to limit the ewe's protein and energy intake as both nutrients are required for milk production. Feeding straw for the last 2-3 days before weaning further shuts down milk production. After weaning ewes should be maintained on low quality feed for 3-7 days to assist ewes in drying up. Lastly, if ewes are fed by number nursed, it is important to move ewes to the next lower ration if they lose a lamb or lambs.

The nutrition program that ewes require is dynamic and ever changing throughout the production cycle. We as shepherds must make the appropriate adjustments to account for those changes. Ewes have no nutritional wisdom, so it is our jobs as shepherds to do the ration balancing and feeding the appropriate amounts. Iowa State University has a very good excel spreadsheet for balancing rations available at the following webpage. https://store.extension.iastate.edu/Product/BRaNDS-Sheep-Companion-Module-Standard-Edition or https://store.extension.iastate.edu/Product/BRaNDS-Sheep-Companion-Module-Professional-Edition

Table1. Example rations for 175 ewes in various stages of production.

| Feed Ingredient | Early/Mid Gestation | | | | Late Gestation: Singles | | | | Late Gestation: Twins | | | | Late Gestation: Triplets | | | | Lactation: Singles | | | | Lactation: Twins | | | | Lactation: Triplets | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa hay (EB) | 3.3 | | | | 3.5 | | 2.0 | | 3.5 | 2.0 | | | 3.5 | 2.0 | | | 3.7 | | 2.0 | | 5.0 | 3.0 | | | 4.0 | | | |
| Corn silage | | | | 6.0 | | | | 9.0 | | | | 9.0 | | | | 8.0 | | | | 10.0 | | | 13.0 | | | 13.0 | |
| Cornstalks | | | 3.0 | | | | 2.0 | | | | 3.0 | | | 2.0 | | | | | 2.0 | | | 2.0 | | | | | | |
| Grass hay | | 2.5 | | | | 3.0 | | | | 1.5 | | | | | 3.75 | | | 3.0 | | | | | | | | | | |
| Corn | | | | | 1.0 | .75 | | | 1.5 | .75 | 1.5 | .7 | 1.8 | 1.3 | | .9 | .7 | | | | 1.5 | | | | 2.0 | | | |
| SBM | | .3 | | .4 | | .75 | | .8 | | | 1.0 | .7 | | .5 | | .9 | | 1.4 | | .5 | | | 1.0 | | .5 | 1.5 | |
| Corn gluten feed | | | 1.0 | | | | 1.2 | | | | 1.0 | | | | | | | | 1.0 | | | 2.0 | | | | | | |
| Limestone | | | .02 | .01 | | .02 | | .02 | | | .03 | .03 | | | | .03 | | .02 | | .02 | | | .02 | | | .02 | |
| Dical. Phosphate | | | | | | | | | | | | | | | | | .02 | .01 | | .01 | | | .02 | | | .02 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Example rations for 200 ewes in various stages of production.

| Feed Ingredient | Early/Mid Gestation | | | | Late Gestation: Singles | | | | Late Gestation: Twins | | | | Late Gestation: Triplets | | | | Lactation: Singles | | | | Lactation: Twins | | | | Lactation: Triplets | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa hay (EB) | 3.5 | | | | 4.0 | | | | 4.0 | | | | 3.75 | | | | 5.0 | | 3.0 | | 6.0 | | | | 6.0 | | | |
| Corn silage | | | | 7.0 | | | | 12.0 | | | | 12.0 | | | | 10.0 | | | | 12.0 | | | 16.0 | | | 14.0 | |
| Cornstalks | | 4.0 | | | | 4.0 | | | | 4.0 | | | | 3.0 | | | | | 2.0 | | | | | | | | | |
| Grass hay | | | 3.0 | | | | 4.0 | | | | 4.0 | | | | 3.75 | | | 5.0 | | | | 5.0 | | | | | | |
| Corn | | | | | 1.0 | 1.2 | | | 1.5 | 1.5 | | | 1.8 | 2.0 | | 1.0 | .7 | | | | 1.5 | 1.0 | | | 2.0 | | .5 | |
| SBM | | .40 | | .3 | | .6 | | .6 | | .7 | | .8 | .2 | 1.0 | | 1.0 | | 1.0 | 1.0 | | .2 | 1.5 | 1.5 | | .5 | 2.0 | | |
| Corn gluten feed | | | .7 | | | | 1.6 | | | | 2.0 | | | | 2.5 | | | | | | | | | | | | | |
| Limestone | | .01 | | .01 | | .02 | .02 | .02 | | .03 | .03 | .03 | | .04 | .04 | .04 | | .02 | .02 | .02 | | .02 | .02 | | | .02 | | |
| Dical. Phosphate | | | | | | | .01 | | | | | | | | | | | .02 | .02 | .02 | | .02 | .02 | | | .02 | | |

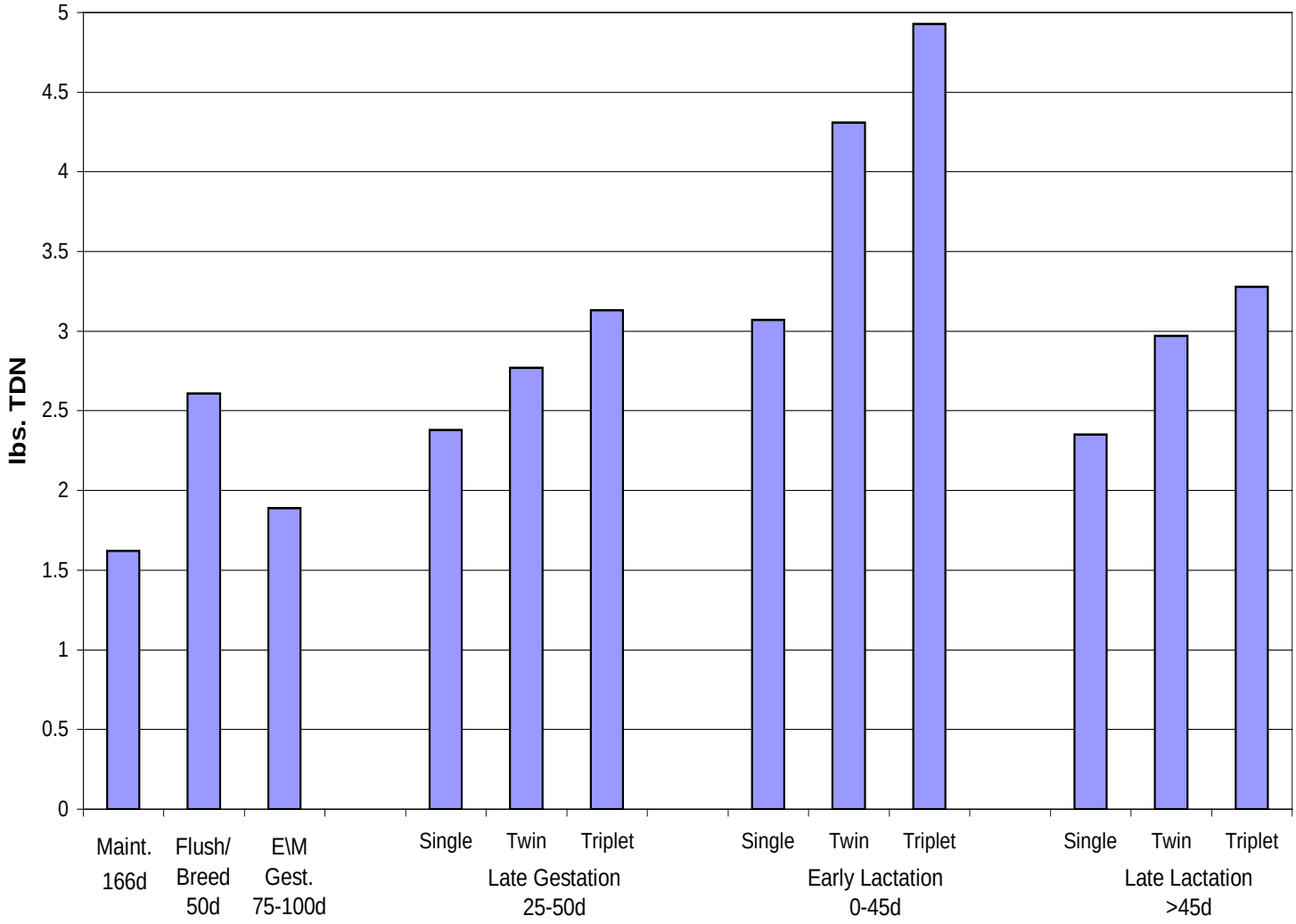



**Figure 1. Total digestible nutrient (TDN) reqiuired by 175 pound ewes through their annual production cycle.**

Table 2. Variation in forage quality from 1994 state wide Iowa forage survey.

| | Crude Protein,% | | | TDN,% | | |
|---|---|---|---|---|---|---|
| Hay type | Average | Low | High | Average | Low | High |
| Grass, 1st cut | 11.6 | 6.1 | 20.7 | 55.7 | 46.6 | 75.2 |
| Grass, 2nd cut | 15.2 | 12.1 | 19.7 | 61.8 | 57.2 | 69.7 |
| Alf/grass, 1st cut | 13.9 | 8.0 | 22.3 | 56.1 | 41.0 | 75.1 |
| Alf/grass, 2st cut | 16.8 | 10.2 | 22.3 | 59.6 | 47.3 | 69.7 |
| Alf/grass, 3st cut | 18.3 | 10.9 | 22.3 | 62.4 | 49.1 | 72.5 |

Nutrient values are based on NIRS technique.

Table 3. Trace mineral salt or mineral intake required for .69 mg selenium intake[a].

| Selenium concentration in Mineral | Intake, oz/head/day |
|---|---|
| 10 PPM or .001 | 2.4 |
| 30 PPM or .003% | .8 |
| 50 PPM or .005% | .5 |
| 70 PPM or .007% | .33 |
| 90 PPM or .009% | .25 |

[a] Maximum allowable by FDA

# IMPROVING PARASITE CONTROL IN SMALL RUMINANTS

Anne Zajac, DVM, PhD, DACVM, Virginia Tech

Virginia-Maryland College of Veterinary Medicine

## Do you know if your drug(s) is/are working?

Time 0 Later Later still Still later

Eventually

## Anthelmintic Resistance

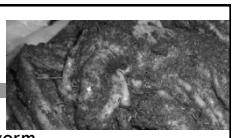
- Assume if a worm population resistant to 1 drug in a group, resistant to all in group
- **By the time you really suspect drug resistance, so many worms are resistant that not using the drug wonresistance here to stay**

| Benzimidazoles | Macrolides A-avermectin M-milbemycin | Nicotinics |
|---|---|---|
| Fenben-dazole **(Safeguard Pancur)** | ivermectin-A **(Ivomec etc.)** | levamisole **(Prohibit)** |
| albendazole **(Valbazen)** | eprinomectin-A (Eprinex) | Pyrantel(Strongid) |
| Oxfendazole (Synanthic) | doramectin-A **(Dectomax)** | morantel **(Rumatel, Goat Care, Positive Pellet)** |
| Oxibenda-zole (Anthelcide) | moxidectin-M **(Cydectin)** | |

## Drug Resistance

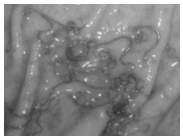
- Even if you do everything right with pasture and drug management you can still have drug resistant parasites


## GI Parasites--Worms



- Most important--barber pole worm, *Haemonchus contortus*
  - Bloodsucking stomach parasite
  - Large numbers can cause anemia and bottle jaw, weakness, death
  - Decreased gains, growth



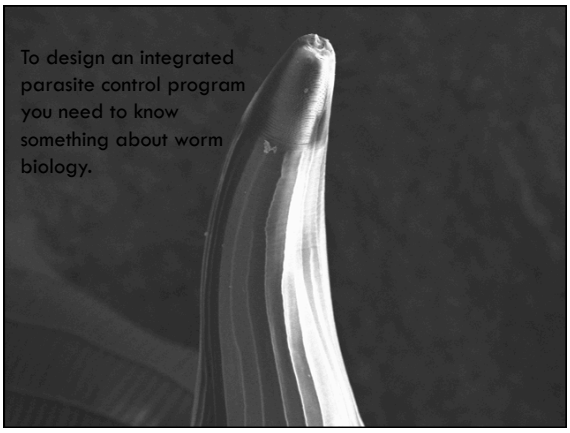


## Parasites

- Barber pole worm doesn't produce diarrhea but other similarparasites may
- Usually not that important by themselves in this area
- Coccidia more likely to cause diarrhea in young animals

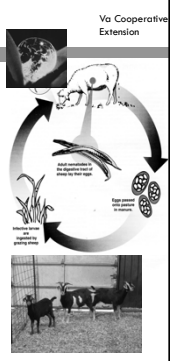

www.nadis.org.uk


www. Sheepandgoat.come



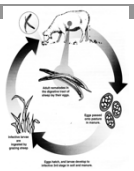

## Life as a Worm

- All *Haemonchus*-type worms have same life cycle
  - Eggs passed in manure
  - Eggs develop, larva hatches
  - Larva develops to infective stage
    - The cooler it is, the longer it takes
  - Larvae move onto forage
    - Sheep, goats infected when grazing
    - Adult lifespan measured in months
- ALL GRAZING ANIMALS HAVE WORMS
  - Generally these worms do not survive well in housing or on dry lots




## Life as a Worm

- How long can the infective larvae last on pasture?
  - Once metabolic reserves used up, they die
  - Hotter it is, the faster they wiggle, the quicker they die
  - In coolerl, moister conditions they live for months



## Life as a Worm

- Can larvae on pasture survive winter weather?
  - Eggs, larvae of some species survive winter weather
  - Barber pole worm doesn't like freezing, mostly die
- But there is another strategy for surviving winter
  - Larvae ingested in the fall become dormant in GI tract (arrested)
  - Wait to become adults till spring
    - While arrested-- No disease, no eggs in manure

## When is Worm Season?

- When do temperature and moisture best support transmission and multiplication of barber pole worm
  - Vermont worm season July-August
  - Virginia worm season June-October
    - Milder winters probably extend worm season
  - Florida worm season almost all year

## Parasite Control in Sustainable Systems

- We have ways of controlling parasites
- Most don't work as dramatically as a fully effective modern dewormers
- So each producer has to decide which elements of control can best be combined for each farm to give good control
- INTEGRATED PARASITE CONTROL PROGRAM

not equal to

**Pasture based**

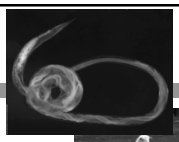
- Babies get the best
- Rotation/sward height
- Stocking rate/time on pasture
- Alternate or mixed grazing
- "Deworming" plants

**Animal based**

- **Targeted treatment**
- **Genetic selection**
- Dewormers
- Copper boluses
- Nutrition

Really not separate lists because change in one affects the other

## Sheep and Goat Response to Worms



- Sheep and goats develop immunity to GI worms
  - Control parasites, doesn't eliminate them
    - Immune animals will have eggs in manure
  - Goats more susceptible than sheep
  - Immunity in place about the time of maturity
    - First lambing ewes and does more susceptible than older animals
  - Dry, non pregnant ewes/does most immune
  - Some animals have better immunity than others regardless of age, breed, sex, etc. based on genetics

## Use Normal Immunity Strategically

- Don't treat animals that don't need treating—Targeted Treatment
  - Slows development of resistance so drugs last longer
- Make conscious effort to improve immunity in flock

## Use Normal Immunity Strategically

- For routine selective deworming, FAMACHA© best for small ruminants in eastern, midwestern US
  - Direct assessment of effects of parasite
    - Match color of ocular membranes to card to evaluate whether treatment is needed
  - Every sheep and goat producer should have a card
  - Saves lives!


## Targeted Selective Treatment

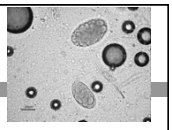
http://web.uri.edu/sheepngoat/parasite-control/

- FAMACHA© training
- Requirement for hands on training
  - Difficult for some producers to get to programs
- Option for on-line training through University of Rhode Island
- Important to Remember
  - Don't wait too long between scorings
  - Get a new card after a year or two


## FAMACHA experience

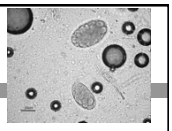
- VA Tech FAMACHA Experience
- 54 ewes and lambs (approx. 90), dewormed in May
  - Mostly hair crosses, some Suffolk
  - Half dewormed monthly
    - 280 individual treatments
  - Half dewormed based on FAMACHA
    - No ewe treatments, 21 lamb treatments

## Use Normal Immunity Strategically



- Benefits of age
  - Earlier lambing season produces older animals at the start of grazing season
  - Adult animals can help clean up larvae on contaminated pasture (sheep especially)
- Don't let parasite susceptible animals pass along those genes
  - Example: a lamb needs 4 dewormings in 2 months, others only 1 or 2

## Use Normal Immunity Strategically



- Make selection for resistance to parasites part of breeding program
  - From within your flock
    - Use fecal egg counts with FAMACHA to assess
    - Enroll in NSIP Lamb Plan and use EBVs
  - From outside your flock
    - Get fecal egg count/EBV information from breeders
    - Ram test with parasite evaluation
- You can make any group of any breed more parasite resistant with selection

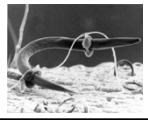

## Fecal Egg Counts

- Don't need to do every animal
- Can do them yourself: http://web.uri.edu/sheepngoat/video/
- VDACS and Virginia Tech--$15.00
  - Seems expensive but not compared to value of animals that are healthier because more parasite resistant

## Use Normal Immunity Strategically

- Breeds with higher levels of resistance to parasites
  - St. Croix
  - Katahdin
  - Gulf Coast/Florida Native
- Have to keep selecting for parasite resistance even in more resistant breeds
- Less research on variation in resistance in goat breeds

## I'll just wait for the new products!

- New drugs
  - Monepantel
    - Thought would be available around 2015
    - Drug company merger—who knows
  - Two other new products in Canada
    - Unlikely to come here
- *Haemonchus* vaccine
  - Not coming to U.S. probably
- Nematophagous fungi
  - Kills larvae in feces
  - Australian company close to having commercial product
  - Expected 2018 for zoo animals, possible use in others?

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# Managing Internal Parasites in Sheep and Goats

By Margo Hale, NCAT Agriculture Specialist
Published 2006
Updated April 2015

IP293

Internal parasite management, especially of *Haemonchus contortus* (barber pole worm, stomach worm), is a primary concern for the majority of sheep and goat producers. These parasites have become more difficult to manage because of developed resistance to nearly all available dewormers. This publication discusses techniques to manage parasites and to prolong the efficacy of dewormers. New management tools that remain under investigation are also discussed. A list of resources follows the narrative.

## Contents



***Owners of these lambs are able to manage internal parasites using sustainable techniques. Photo: Robyn Metzger, NCAT***

USDA This work was supported by the USDA, NIFA Organic Research and Education Initiative (Project No. 2010-51300-21641).

ATTRA *(www.attra.ncat.org)* is a program of the National Center for Appropriate Technology (NCAT). The program is funded through a cooperative agreement with the United States Department of Agriculture's Rural Business-Cooperative Service. Visit the NCAT website (*www.ncat.org*) for more information on our other sustainable agriculture and energy projects.

## Introduction

Many consider the management of internal parasites, primarily *Haemonchus contortus* (barber pole worm), to be the biggest production concern for small ruminants. "There are many important diseases of sheep and goats," notes University of Georgia researcher Ray Kaplan, DVM, PhD, "but none are as ubiquitous or present as direct a threat to the health of goats as internal parasites" (2013). The cost of internal parasite infection includes treatment expense, reduced animal weight gains, and even animal death.

These parasites are difficult to manage because on many farms they have developed resistance to all available commercial dewormers (Howell et al., 2008). Resistance to dewormers is now seen worldwide (Kaplan, 2013). Producers can no longer rely on drugs alone to control internal parasites. Instead, they should employ an integrated approach that relies on sustainable methods to manage internal parasites.

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## Parasite Primer

Internal parasites (worms) exist by feeding off of their host. Some types do this directly, by attaching to the wall of the digestive system and feeding on the host's blood. These types of parasites cause anemia in the host, as well as other symptoms. *Haemonchus contortus* (barber pole worm) is one example of this type. Others live off the nutrients eaten by the host; these cause weight loss but not anemia.

***Most animals in a flock are not visibly affected by parasites and do not need to be treated with dewormers. Photo: Linda Coffey, NCAT***

Mature parasites breed inside the host and "lay eggs," which pass through the host and are shed in the feces. After the eggs pass out of the host, they hatch into larvae. Warm, humid conditions encourage hatching and development. The larvae need moisture to develop and move. They migrate out of the feces and up blades of grass (usually one to two inches). When an animal (sheep or goat) grazes, it may take in parasite larvae along with the grass blade. An animal can also pick up parasite larvae by eating from a feed trough that is contaminated by manure or from bedding in a pen.

Parasite numbers increase over time when conditions are favorable (warm, wet). Internal parasites get out of control and cause damage when their numbers grow beyond what the animal can tolerate. This can happen quickly: barber pole worm, for example, can complete development to the adult stage in two to three weeks, and then begin producing eggs. Mature female barber pole worms can produce up to 10,000 eggs per day (Zajac, 2013). Pastures can quickly become heavily contaminated if animals are not rotated frequently or if animals have a high level of worms.

Infective larvae survive on pasture for a time, and this period is dependent on environmental conditions. Very hot weather will cause them to die faster, and most larvae may be naturally killed off in three months (Zajac, 2013).

Cold weather is not going to "kill the worms," unfortunately, because some internal parasites go into a kind of hibernation inside the animal until conditions are more favorable. This is called "hypobiosis" or "arrested" (terminology used on dewormer labels) and is the survival strategy for barber pole worm in the winter. In late winter and spring, the development will re-start, and this raises numbers of parasites just when lambing is happening (Zajac, 2013). To manage internal parasites properly, it is important to understand the parasite life cycle and factors that encourage multiplication of parasites.

### *Parasitism*

Animals raised in confinement or on pasture-based systems will almost certainly be exposed to internal parasites at some point in their lives. Dry environments, such as arid rangelands, will pose less of a threat for parasite infections. Warm, humid climates are ideal for worms, and therefore animals will have more problems with internal parasites in these climates.

Sheep and goats should be managed so that parasitism is not evident. Sheep and goats will always

### Signs of Parasitism

- Loss of condition
- Rough hair coat
- Scours, diarrhea
- Bottle jaw
- Pale mucous membranes (eyelids, gums), indicating anemia
- Death

*Loss of condition and rough hair coat indicate parasitism. Photo: Courtesy of Jean-Marie Luginbuhl*

*Bottle jaw is a sign of parasitism. Photo: Courtesy of Jean-Marie Luginbuhl*

### Internal Parasite Numbers

- Increase with number of host animals
- Increase during warm, humid weather
- Increase when pastures are grazed too short
- Decrease during hot, dry weather
- Decrease if a non-host animal (cattle or horses) graze the same pasture
- Decrease with pasture rest time, as the larvae naturally die off

host some level of parasite burden. Certain signs of parasitism are seen when the parasite load becomes excessive or when the animal's immunity can no longer overcome the adverse effects of the parasitism. Young animals and those with weakened immune systems due to other diseases are most affected by internal parasitism. One important time when immunity is weakened is at lambing time. This results in a periparturient (around birth) rise, and this weakened immunity coincides with the development of hypobiotic larva, which causes a release of more parasites into the environment (Zajac, 2013). Some breeds or animals within a breed are more resistant to parasites and do not display the periparturient rise (Notter and Burke, no date), which helps with control. A combination of treatment and management is necessary to control parasitism so that it will not cause economic loss to the producer.

While it is ideal to manage animals so there are no visible effects of parasitism, some will nonetheless succumb to the burden of internal parasites. Learn to recognize the signs of internal parasite infections and offer early and effective treatment.

## Resistance to Dewormers

Producers were once instructed to deworm all of their animals every three to six months. Many producers dewormed even more often: as often as every four weeks in humid climates. Now we recognize that this practice is not sustainable because it leads to development of resistance.

Drug resistance is the ability of worms in a population to survive drug treatments that are generally effective against the same species and stage of infection at the same dose rate (Kaplan, 2013). Over-use and misuse of dewormers has led to resistance, and available dewormers are now ineffective in many instances.

Some farms still have dewormers that continue to work, while others have no effective dewormers. Although there are two new classes of dewormers available in some countries, they are not approved in the United States as of this writing, and even if they are eventually approved, "…the positive effect of such valuable resources for the control of parasites might not last long if used following the same application strategies as the three broad spectrum anthelmintic classes…"(Knox et al., 2012). In other words, new dewormers won't last very long unless we change our tactics. In fact, there are already reports of dewormer resistance

**Table 1: Overview of Available Dewormers for Sheep and Goats**

Several types of dewormers are available for use in sheep and goats. Many are not approved for use in sheep and goats, however, so work with a veterinarian to ensure proper "off-label" use. The different classes of dewormers have different modes to kill worms. The level of resistance depends on the class of dewormer and how often the drug was used on a particular farm.

| Drug | Common Names/Brands | Effectiveness |
|---|---|---|
| Benzimidazoles | Albendazole (Valbazen®), Fenbendazole (Safeguard®), Panacur®, Oxfendazole (Synanthic®) | High prevalence of resistance |
| Avermectin/ Milbemycins | Ivermectin (Ivomec®), Eprinomectin (Eprinex®), Moxidectin (Cydectin®), Doramectin (Dectomax®) | Ivermectin—High prevalence of resistance. Often the least effective of all available drugs<br>Moxidectin—Resistance becoming common where used frequently |
| Imidazothiazoles/ Tetrahydropyrimidine | Levamisole (Tramisol®, Prohibit®), Pyrantel (Strongid®), Morantel (Rumatel®) | Low to moderate prevalence of resistance |

*Source: Adapted from Kaplan, 2013 and Williamson, 2013.*

to the new drugs in New Zealand and Australia (Kaplan, 2013).

## Development of Resistance to Dewormers

Internal parasites, especially *H. contortus*, have developed drug resistance (Howell et al., 2008). Drug treatment gets rid of the worms that are susceptible to that particular drug; resistant parasites survive and pass on "resistant" genes. No dewormer is 100% effective, and we know that worms that survive a dose of dewormer are resistant to that dewormer. Therefore, each time you deworm, the proportion of resistant worms increases, and consequently, frequent deworming greatly increases the rate at which resistance develops.

Each time animals are dewormed, the susceptible worms are killed. The resistant ones survive and will reproduce, thus leading to a population of very resistant worms. Meanwhile, underdosing causes larger numbers of the intermediate-strength worms to survive. The weakest, most susceptible worms are killed. But because of the weak dose, more of the stronger worms will be able to survive and reproduce, creating a population of stronger worms in the next generation. Once an animal has been treated (if dosed properly), only resistant worms remain. If the animals are moved to a clean pasture they deposit only resistant worms on the pasture, and there are no susceptible worms to dilute the worm population.

## Refugia

Worms that are not treated are called "refugia." Refugia includes both worms and their consequent eggs in animals that were not treated, as well as eggs and larvae that were on the pasture at the time of deworming and thus not exposed to the dewormer. There is no change in the dewormer-resistance status of these worms. However, in animals that were dewormed, all the worms that survived are obviously resistant to the dewormer. Having some worms in refugia (not treated) ensures that drug-susceptible worms will be maintained in the population (Van Wyk, 2001; Kaplan, no date). A surviving population of untreated (drug-susceptible) worms dilutes the population of resistant worms. Consequently, refugia help ensure that when a dewormer is required, it will be effective because most of the worms will be susceptible to treatment (Kaplan, no date). The concept of refugia has been largely overlooked in the past (Van Wyk, 2001).

When fewer numbers of animals receive treatment, the refugia population remains large. When it comes to slowing the rate with which resistance develops, the more refugia, the better. Sustainable techniques, such as FAMACHA©, reduce the development of drug resistance by increasing refugia.

In contrast, several practices accelerate drug resistance. These include frequent deworming (more

than three times a year), underdosing (often caused by miscalculation of body weight), treating before moving to clean pasture, and treating all animals, regardless of need. These practices lead to resistance because they decrease the number of worms susceptible to dewormers.

Treating all animals regardless of need ignores the importance of refugia and will lead, in time, to a population of worms that cannot be controlled by dewormers. Preserving refugia is one principle of sustainable internal parasite control. Knowing what dewormers work on your farm and how to preserve their efficacy is another. Learn more about using dewormers wisely from "Extending the Efficacy of Anthelmintics" at www.acsrpc.org/#!2013-conference/c1bp4 (Williamson, 2013).

## Assessment of Animals

In order to preserve refugia, it is important to treat only the animals that need it. Producers need to be able to identify the animals that need deworming. One way to assess the parasite load in animals is to take a fecal sample and examine for parasite eggs, using a quantitative method. This is called a "fecal egg count" (FEC), and it is a good method. However, it is time-consuming and requires a microscope. Producers can learn to do this themselves. This training is often a part of internal parasite workshops, and online tutorials are available, including one from Langston University: www2.luresext.edu/goats/library/fec.html. You can also get training in doing fecal egg counts by watching a video or reading the resources found at www.acsrpc.org/#!fecal-egg-counting/c24s2.

Visual examination of animals also provides diagnostic help, and is more immediate. Observing the flock or herd daily enables a producer to notice animals that are separating from the group, lagging behind, showing a lack of energy and vitality, have diarrhea or bottle jaw, and are losing weight. Those animals should be examined and dewormed if needed. Two more systematic methods of visual examination are described below: FAMACHA and the Five Point Check©.

### *FAMACHA*

FAMACHA is a system for assessing the degree of anemia in animals. It works in diagnosing infection with barber pole worm because anemia is the major symptom of the barber pole worm. The FAMACHA system classifies animals into categories (1 to 5) based upon level of anemia (Kaplan, no date). The system was developed in South Africa and has been validated in the United States (Kaplan et al., 2004).

To use the system, you examine the eyelids of sheep and goats (see photo), then treat only the animals that are anemic. This reduces the use of dewormers, slows the development of resistant worms, and saves the producer money. Most importantly, it also allows the producer to select animals that are healthier (Burke and Miller, 2008). Breeding the healthiest animals and culling the weaker individuals makes the flock or herd stronger over time. Note that FAMACHA is only effective for the treatment of *H. contortus* (barber pole worm) because other worms do not cause anemia and so are not detected by this method. Producers must be trained by a veterinarian or other FAMACHA-trained animal health professional in order to use FAMACHA (Kaplan, no date). However, this technique is simple to learn and quick and easy to use. More information on FAMACHA is online at www.acsrpc.org/#!famacha/c9i, including a very helpful video.

Many producers have been trained in this technique, and more than 20,000 FAMACHA cards have been sold in the United States since 2003. In a survey of farmers who were trained in integrated parasite management, including FAMACHA, respondents identified the following benefits (Terrill et al., 2012):

- helped control internal parasitism—94%
- had less parasite problems after training—74%
- saved money in the first year after training, through reduced drug use and fewer animal deaths—88%


***Demonstration of the FAMACHA technique. Photo: Robyn Metzger, NCAT***

### FAMACHA System Saves Money and Reduces Stress

On Maple Gorge Farm, in Prairie Grove, Arkansas, busy schedules prevented the farmers from monitoring parasites. By late summer, the sheep had been grazing for months with no treatment. The farmers noticed a young lamb with bottle jaw and feared they had a huge problem on their hands.

They considered not bringing the animals in for treatment because they were low on dewormer. They knew they wouldn't have enough to treat all of the animals. Then they remembered the FAMACHA system that they had recently been trained in. Using the FAMACHA system, they decided to sort off, identify and treat only the 4s and 5s (anemic animals), and a few 3s that were thin.

To their surprise, only 9 of the 65 sheep actually needed treatment. Identification numbers and FAMACHA scores were recorded. They decided any ewe scoring a 4 or 5 would not be kept in the flock.

This whole process took less than an hour. Treating only the animals in need reduced stress for the animals and farmers, and also saved money. After using the FAMACHA system and seeing how easy it was and the impact it had on their flock, the farmers at Maple Gorge Farm are believers in the system.

Similar results were found in another survey (Whitley et al., 2014), confirming that using integrated parasite management does help producers save money and avoid problems with internal parasitism.

## *Five Point Check*

Five Point Check is a system for identifying animals that need treatment for internal parasites. This system was developed by the same researchers that developed FAMACHA (Bath and Van Wyk, 2009). While FAMACHA is used for identifying only animals that are suffering from *H. contortus* infection, Five Point Check identifies symptoms of other internal parasites, as well. The five points are areas of the animal to observe. It is important to note that each of these symptoms can also be caused by other parasites, or by causes not listed.

## Dewormer Assessment

Once you know who to treat, you need an effective dewormer to use. There are a couple of methods that can be used to determine whether a dewormer is effective against the parasites on your farm. The DrenchRite® Assay is a test performed to detect drug resistance in *Haemonchus contortus* parasites in your herd or flock. A fecal sample is sent to a laboratory for this test. The results will tell you what parasites are present in your herd or flock and what drugs are effective against those parasites (Howell and Storey, 2012). For more information on the DrenchRite Assay, visit the American Consortium for Small Ruminant Parasite Control website at www.acsrpc.org/#!storeyhowell2012/c4qh.

Another tool that can be used to determine dewormer efficacy is a fecal egg count reduction test (FECRT). This test involves collecting fecal samples from animals, treating those animals with a dewormer, and then taking fecal samples from those same animals 10 to 14 days later. By measuring the reduction in fecal egg counts from the first sample to the second, you can determine the effectiveness of your dewormer. For more information on fecal egg counts and conducting a fecal egg count reduction test, consult the American Consortium for Small Ruminant Parasite Control website at www.acsrpc.org/#!fecal-egg-counting/c24s2.

**Table 2. Five Point Check**

| Point | | What to check | Parasite possibility |
|---|---|---|---|
| 1 | Eye | Anemia (FAMACHA score) | Barber pole worm |
| 2 | Back | Body Condition Score | All |
| 3 | Rear | Dag Score | Brown stomach worm |
| 4 | Jaw | Bottle jaw | Barber pole worm |
| 5* | Nose | Nasal discharge | Nasal bots |
| 5* | Coat | Coat condition | Barber pole worm |

*This system was developed for sheep. Goats are not affected by nasal bots, so the coat condition checkpoint is used instead.

Source: Adapted from Susan Schoenian www.sheep101.info/201/parasite.html and www.slideshare.net/schoenian (The Five Point Check).

# Management Techniques for Controlling Parasites

## *Pasture Management*

Producers can use numerous techniques to control parasitism. Pasture management should be a primary tool that producers use to control internal parasites. Sheep and goats ingest infective parasite larvae from pasture, so the rate at which these are ingested can be controlled through pasture management.

Most worm larvae crawl up the plant only one to two inches from the ground. A small percentage will crawl up as much as four inches, but very few get higher than this. Preventing animals from grazing below that point decreases the number of worm larvae ingested. Animals that eat closer to the ground tend to have more problems with internal parasites. It is important to monitor the height of forages in the pasture. Allowing animals to graze pastures too short results in more parasites consumed and in reduced feed intake, therefore harming the animal in two ways. It also inhibits pasture regrowth. So, for the good of the pasture and the animals, do not graze below four inches.

Most larvae migrate no more than 12 inches from a manure pile. Livestock not forced to eat close to their own manure will consume fewer larvae. Providing areas where animals can browse (eat brush, small trees, etc.) and eat higher off of the ground helps to control parasite problems.

Decreasing the stocking rate, either by reducing the number of animals or reducing the amount of time animals spend on a pasture, decreases the number of worms spread on that pasture. The more animals you have on one pasture, the more densely the worms are deposited. Animals on densely stocked pastures are more likely to have parasite problems, unless they are rotated away from the parasites before they can consume larvae. That means within three to four days in ideal conditions (Zajac, 2013). Grazing sheep and goats with cattle, or in a rotation with cattle, can also reduce internal parasite problems. Cattle do not share the same internal parasites as sheep and goats. Cattle consume sheep and goat parasite larvae, which helps "clean" the pasture for the small ruminants. For more information on using pasture management techniques for parasite control, consult ATTRA's publication *Tools for Managing Internal Parasites in Small Ruminants: Pasture Management*.

***Sheep grazing at Maple Gorge Farm in Prairie Grove, Arkansas. Photo: Margo Hale, NCAT***

Certain forages have also been shown to control parasite problems. Tannin-rich forages, such as sericea lespedeza, help reduce internal parasite egg counts (Min and Hart, 2003; Shaik et al., 2004). Other plants, including plantain, chicory, and wormwood, also have an anthelmintic effect, although wormwood also produces toxic compounds. Providing tannin-rich forages and diverse pastures can help animals battle internal parasites. ATTRA's publication *Tools for Managing Internal Parasites in Small Ruminants: Sericia Lespedeza* provides a more detailed discussion of this topic.

***At left: Eating higher off the ground reduces the number of parasite larvae consumed. Photo: Margo Hale, NCAT***

***High levels of tannins in forages such as sericea lespedea reduce worm burdens. Photo: Courtesy of Jean-Marie Luginbuhl***

*Sheep breeds such as Gulf Coast Native show resistance to parasites. Photo: Linda Coffey, NCAT*

## Selecting Resistant Animals

There are several breeds of sheep and goats that show resistance to parasites. There is something in their genetic makeup that causes them to host a smaller parasite load. Sheep breeds such as Gulf Coast Native, St. Croix, Katahdin, and Barbados Blackbelly show an increased resistance to parasite loads. Spanish, Myotonic, and Kiko goat breeds have also shown a tolerance to parasites. Resistance will vary among individuals within breeds as well. Some animals, regardless of breed, will be more resistant to parasites than others. Research shows that 20% to 30% of the animals carry 70% to 80% of the worms in a flock or herd (Kaplan, no date). Having parasite-resistant animals will decrease the need for dewormers.

Within any breed, certain animals are more tolerant of parasite loads than others. These resilient animals can host a large parasite burden, yet show few signs of parasitism. Producers should cull animals that are always "wormy," and select for animals that have a natural resistance or tolerance to a slight parasite burden. The FAMACHA system will help you identify those resistant or more tolerant animals. The ATTRA publication *Tools for Managing Internal Parasites in Small Ruminants: Animal Selection* provides information on selecting animals for parasite resistance and building a stronger herd or flock.

## Nutrition

Research shows that animals are more tolerant of internal parasites, and perhaps more resistant, when their immune systems are supported with good nutrition (Knox et al., 2012; Turner et al., 2012; Coop and Kyriazakis, 2001). Better health and better production are likely when animals are provided adequate energy, protein, minerals, and water. More information on this topic is included in the ATTRA publication *Tools for Managing Internal Parasites in Sheep and Goats: Pasture Management.*

# Treatment

## Copper Wire Particles

Research has been performed on the use of copper wire particles to control internal parasites. Studies show that copper wire particle boluses administered to lambs decrease parasite loads (Burke et al., 2004). However, higher doses may increase the risk for copper toxicity in sheep. Copper wire particle treatments are effective against barber pole worm but not other genera of worms and

### Smart Drenching

Smart Drenching refers to the ways producers can use dewormers (drenches) more selectively and effectively. —*Source: Southern Consortium for Small Ruminant Parasite Control, SCSRPC*

Used in conjunction with FAMACHA, Smart Drenching helps slow the development of parasite resistance. The components of Smart Drenching are:

1. Find out which dewormers work by performing a fecal egg count reduction test or a DrenchRite larval developmental assay.
2. Weigh each animal prior to deworming. Double the cattle/sheep dose when deworming goats for all dewormers, except Levamisole, which should be dosed at 1.5 times the cattle/sheep dose in goats.
3. Deliver the dewormer over the tongue in the back of the throat with a drench tip or drench gun.
4. Withhold feed 12 to 24 hours prior to drenching with benzimidazoles, ivermectin, doramectrin, and Moxidectin, if possible.
5. Benzimidazole efficacy is greatly enhanced by repeating the drench 12 hours after the first dose. Albendazole should not be used during early pregnancy (during buck/ram exposure and up to 30 days after their removal).
6. Simultaneously use two classes of dewormers if resistance is suspected.
7. Drench only the animals that need treatment. (SCSRPC, no date.)

only against the mature parasite (Bang et al., 1990; Chartier et al., 2000; Burke et al., 2005; Burke et al., 2007b). The copper particles will increase concentrations of copper in the blood, so it is important to use low doses (0.5- to 1-gram doses for lambs or kids less than one year of age; 1- to 2-gram doses for ewes or does older than one year of age) (Burke and Miller, 2006; Burke et al., 2007a). Refer to the ATTRA publication *Tools for Managing Parasites in Small Ruminants: Copper Oxide Wire Particles* for more information on how to use copper wire particles to treat internal parasites.

### *Nematode-trapping Fungus*

Another parasite-management tool currently being researched is the use of nematode-trapping fungus. This fungus traps parasite larva in the feces, interrupting the parasite's life cycle. Research has shown that the fungus is "effective in significantly reducing development of L3 and appears to be an effective tool for biocontrol of parasitic nematodes in goats" (Terrill et al., 2004). The use of these fungi is still being researched. The fungi is not yet available in the United States but may become available in the near future. You can read more about it at www.acsrpc.org/#!fungus/cp9i.

### *Alternative Treatments*

There are many other alternative treatments that sheep and goat producers have used to manage internal parasite infections. Some of these alternatives have been researched, while others are used based on anecdotal information. The researchers of the American Consortium for Small Ruminant Parasite Control (ACSRPC) have investigated many alternative treatments. You can find information about many of these on the ACSRPC website, at www.acsrpc.org/#!alternatives/cyv8. Garlic, papaya, and the herbal dewormers tested by Burke et al. did not control internal parasites (2009a and 2009b). Escobar (2013) reviewed other alternatives in www.acsrpc.org/#!2013-conference/c1bp4.

## Conclusion

Control of internal parasites in sheep and goats can be a daunting task. Previous control methods are no longer viable, so other techniques must be used—techniques such as increased pasture management, Smart Drenching, FAMACHA, the Five Point Check, and selecting parasite-resistant animals can help to manage internal parasites. Attention to nutrition and to pasture management will also help control levels of infection. These techniques reduce dependence on dewormers and lead to a more sustainable parasite-management program. Combining many of these techniques in a program will be much more effective than only relying on any one. ATTRA publications on this subject can help in assessing and improving the health of sheep and goats.

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# Further Resources

## *ATTRA Resources*

The following publications are available from ATTRA. Copies can be requested by calling 800-346-9140 or at our website: www.attra.ncat.org.

- Meat Goats: Sustainable Production
- Dairy Goats: Sustainable Production
- Tips for Marketing Sheep and Goat Products: Live Animals
- Tips for Marketing Sheep and Goat Products: Meat
- Tips for Marketing Sheep and Goat Products: Dairy

- Tips for Marketing Sheep and Goat Products: Fiber
- Tips for Marketing Sheep and Goat Products: Vegetation Management Services
- Dairy Sheep
- Predator Control for Sustainable and Organic Livestock Production

## *Other Resources*

American Consortium for Small Ruminant Parasite Control (ACSRPC)
www.acsrpc.org

*Packed with a wealth of up-to-date information for producers, this site also holds the Proceedings of the 10th Anniversary Conference of the American Consortium for Small Ruminant Parasite Control. Find the papers at www.acsrpc.org/#!2013-conference/c1bp4.*

Association of Small Ruminant Practitioners
1910 Lyda Avenue
Bowling Green, KY 42104-5809
270-793-0781
http://aasrp.org

*This site includes a listing of members and an opportunity to subscribe to Wool and Wattle and to the listserv. Find a veterinarian, or refer your veterinarian to this page for more support in working with sheep and goats.*

Maryland Small Ruminant Page
www.sheepandgoat.com

*This is an enormous collection of articles, presentations, and archived webinars on any topic you can think of related to sheep and goats.*

Langston University, Oklahoma

- E. (Kika) de la Garza Institute for Goat Research www.luresext.edu/goats/index.htm
- Information about Internal & External Parasites of Goats, www.luresext.edu/goats/training/parasites.html

*Explore this site for Goat Field Day Proceedings, online tutorials for fecal egg counting, information about nutrition and a Web-based training course.*

**Managing Internal Parasites in Sheep and Goats**

By Margo Hale, NCAT Agriculture Specialist

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# Tools for Managing Internal Parasites in Small Ruminants: Animal Selection

By Linda Coffey, NCAT Agriculture Specialist

IP400

## Contents



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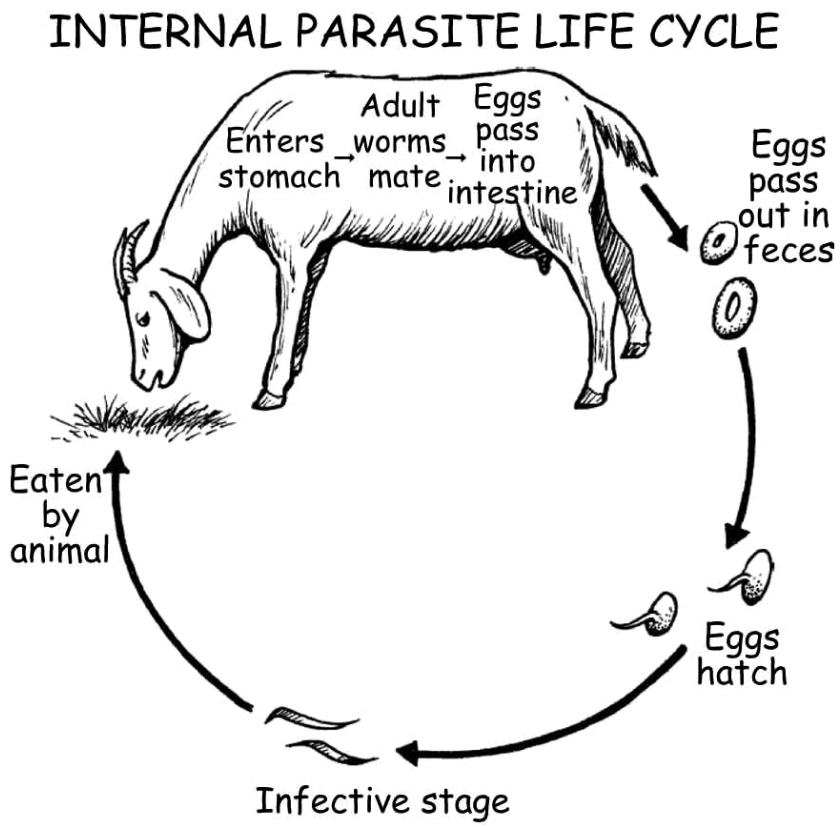
For long-term animal health, improving sheep and goat resistance or resilience to internal parasites is a very important strategy. Animal breeding can build a stronger, more resistant herd or flock if producers will identify and select the best animals for long-term health. This publication discusses methods and rationale for selecting sheep and goats with improved resistance or resilience to internal parasites. It also briefly describes other management tools helpful to producers and to the small ruminants raised in humid areas.

*Animals can be selected for their resistance to parasites, resulting in a stronger flock. Photo: Linda Coffey, NCAT*

## Introduction

Internal parasites are a major health problem for sheep and goats raised in humid areas, especially where land is limited. For years, anthelmintics have mitigated the effects of these parasites and enabled farmers and ranchers to maintain the productivity and health of their livestock. However, internal parasites have developed resistance to anthelmintics (dewormers). Today's sheep or goat producer must use all available tools to help manage internal parasites.

Mature parasites breed inside the host and "lay eggs," which pass through the host and are shed in the feces. After the eggs pass out of the host, they hatch into larvae. Warm, humid conditions encourage hatching of the eggs and development into infective larvae. The larvae need moisture, such as dew or rain, to break open the fecal pellet and move. They migrate out of the feces and travel up blades of grass. When an animal (sheep or goat) grazes, it may take in parasite larvae along with the grass blade. Parasite numbers increase over time when conditions are favorable




*Source: ATTRA's "An Illustrated Guide to Sheep and Goat Production"*
*Artist: Robert Armstrong*

(warm, wet). The larvae mature inside the host, and the cycle continues.

Adult internal parasites affect their host in various ways. They can damage the lining of the stomach or intestines, which can lead to weight loss and anemia, along with related symptoms such as weakness, bottle jaw, and anorexia (loss of appetite). *Haemonchus contortus* (barberpole worms) disrupt and damage the stomach lining and feed on blood, which can result in anemia. Other worms and coccidia cause intestinal lining damage, which can result in reduced absorption of nutrients and lead to scours (diarrhea) and weight loss or poor weight gain.

This publication is concerned with breeding resistance to gastrointestinal nematodes (roundworms). Coccidia are mentioned in passing, as they are important internal parasites in lambs and kids, and producers should be alert to the possibility of coccidia and get a good diagnosis so that effective treatments can be used. To learn more about coccidiosis and the prevention and treatment of this disease, see http://old.cvm.msu.edu/extension/Rook/ROOKpdf/coccidia.PDF.

**Related ATTRA Publications**
www.attra.ncat.org

Managing Internal Parasites in Sheep and Goats

Tools for Managing Internal Parasites in Small Ruminants: Copper Wire Particles

Tools for Managing Internal Parasites in Small Ruminants: Sericea Lespedeza

When adult parasite numbers inside the host animal reach a level that causes obvious illness, producers have historically relied on anthelmintics (dewormers) to kill the parasites and allow the animal to heal and recover. However, as the animal grazes, it may be continually ingesting more parasite larvae, giving a new "crop" of parasites a home inside the animal. The presence of parasite larvae in the environment is often referred to as a "challenge," and animals that can perform well in spite of the challenge are either resilient (tolerant) or resistant to internal parasites. Selecting animals that are resistant will lower the challenge on the

***Bottle jaw. Photo: J.M. Luginbuhl, NCSU***

***This goat is suffering from internal parasites. Note the posture, extreme thinness, poor hair coat and lack of vigor. Photo: J.M. Luginbuhl, NCSU***

***This goat appears healthy and in good condition. Photo: Linda Coffey, NCAT***

farm over time. Selecting animals that are resilient may not impact the number of parasite larvae in the environment, but will result in better animal survival and production in the face of a challenge.

**Is there a problem?**

Signs of internal parasite infection commonly include some or all of the following. Note that some signs may be caused by other conditions as well.

- Poor growth or reduced milk production
- Loss in body condition (animal becomes thinner in spite of good nutrition)
- Rough hair coat or poor fleece
- Scouring (diarrhea: wet feces rather than pelleted; not seen with all parasites)
- Reduced vigor (animals appear lethargic and lag behind the flock or herd)
- Reduced appetite
- Anemia (seen in pale mucous membranes; caused by bloodsucking parasites, such as *Haemonchus contortus*)
- Bottle jaw
- Sudden death after a stress (e.g., an animal is chased on a hot, humid day)

Because internal parasites are so adaptable, difficult to control, and damaging to animal health, it is important that producers use every available tool to protect their livestock and keep internal parasite populations in check.

**What can you do?**

Strategies or tools that can be employed to fight internal parasite infection include:

- Good nutrition to support the immune system
- Selective deworming based on FAMACHA© or other criteria
- Pasture management
- Alternative control methods (e.g., botanicals, copper oxide wire particles)
- Selecting resistant animals
- For more about these strategies, see the ATTRA publication *Managing Internal Parasites in Sheep and Goats.*

The remainder of this publication explores various aspects of selecting animals for internal parasite resistance.

## Animal Selection

**Resistance to internal parasites** means that an animal exposed to internal parasites suppresses establishment of parasites inside the body, or suppresses fecundity (egg-laying) of the worms if they do establish. Shedding of parasite eggs will be minimal in a resistant animal, so a resistant animal will benefit the whole flock by reducing contamination of the farm.

Research has shown that internal parasites are not evenly distributed in a herd or flock. Often 80% of the internal parasites will be in 20% of the animals. This is referred to as the "80/20 rule." If you can identify those animals harboring the most parasites and remove them from your herd, you can lower pasture contamination significantly. Also, because resistance is heritable, breeding those animals that are more resistant will result in a stronger herd over time. For example, one study found that Merino sheep that were selected for resistance had fecal egg counts (FEC) reduced by 69%. Also, the FEC in untreated selected sheep were lower than the FEC in strategically drenched unselected sheep; in other words, the effect of breeding was greater than the effect of strategic treatment (Eady et al., 2003). In an Australian study, Merino ewes selected for increased resistance to *H. contortus* had significantly lower egg counts at all times before and during the peri-parturient period, compared to ewes selected for susceptibility (Woolaston, 1992). Heritability in goats is thought to be lower and resistance is expressed later (at older ages), but selecting for resistance is still feasible and will result in lower pasture contamination over time (Vagenas et al., 2002).

***Research has shown that internal parasites are not evenly distributed in a herd or flock.***

*Rams and bucks have a large impact on the parasite status of the farm. These Gulf Coast rams have never needed deworming. Photo: Linda Coffey, NCAT*

*Just as coat color is heritable, so is resistance to internal parasite infection. Photo: Linda Coffey, NCAT*

Resistance is measured by taking fecal samples and doing quantitative fecal egg counts on animals that have not been dewormed in at least six weeks (preferably all animals treated or untreated similarly). Animals shedding fewer eggs are then identified and retained for breeding, while animals shedding the most eggs would be identified and then culled. Rams and bucks provide half of the genetic material for the lamb and kid crop, so choosing a more resistant sire would have a large impact on the parasite resistance and contamination level on the farm in years to come.

The problem with selecting for resistance is that sometimes production traits are negatively correlated with resistance (Bisset, 1996; Hoste and Chartier, 1993). Because stress impacts the immune system and makes an animal more susceptible to internal parasites, producers might observe that a doe that produces the most milk (causing a nutritional or metabolic stress) also has the most trouble with parasites. Also, lambs being raised as twins usually have a higher fecal egg count than those raised as singles (Wolf et al., 2008). Producers will have to balance the factors of observed internal parasite resistance and production traits and consider the whole farm system (Torres-Acosta and Hoste, 2008).

## Breeds

Because of the variability mentioned earlier and the heritability, it is possible to make progress within a breed by focusing on resistance to internal parasites as a selection trait. Katahdin breeders are working on this now. See an interesting presentation about a SARE project at http://mysare.sare.org/2008conference/speakers/Bielek.ppt.

Additionally, there are some breeds that have been naturally selected for resistance to internal parasites. These breeds usually were developed in situations and climates that favored internal parasites. The animals were then selected by "survival of the fittest," and they will be significantly more resistant on average than other breeds that were not raised under those conditions. A note of caution is in order: these resistant breeds will still have variability within their ranks, and each animal will need to be evaluated on its merits. On a pasture-based buck test in Oklahoma in 2008, the best buck and the worst buck for internal parasite resistance were the same breed (see www.kerrcenter.com/publications/goat_report_08.pdf).

It is possible to have parasite problems even though the breed is known to be resistant, and that resistance can be lost when the animals are no longer subjected to the same selection pressure that was present when the breed was being developed. When a producer stops paying attention to internal parasite resistance and selects animals with no regard to that trait, weaker animals may be retained for breeding.

Still, it is useful to know which breeds have shown parasite resistance. Incorporating one of those breeds may have almost immediate impact on internal parasite problems and will have long-term benefits. Again, the farm goals and production traits of importance must be kept in mind. Also, when using a resistant breed for crossbreeding, there will be a lot of variability in the F1 and F2 generation. (Crossing two breeds results in the F1 generation; crossing the F1 ewes with F1

*This lamb is the F1 generation from Gulf Coast and Suffolk parents. Photo: Linda Coffey, NCAT*


*Gulf Coast Native sheep are resistant to internal parasites. Photo: Linda Coffey, NCAT*

*St. Croix and Katahdin sheep. Photo: Joan Burke, ARS*

rams yields the F2 generation.) See, for example, the work of J. E. Miller, who experimented with Suffolk (susceptible) and Gulf Coast Native (resistant) sheep (Miller et al., 2006). During that experiment, he found in one infection period FEC in the F2 sheep ranging from 167-149,933 eggs per gram. An article that includes a table listing resistant breeds of sheep is available at www.aces.edu/pubs/docs/U/UNP-0006.

In general, breeds with some tropical influence are thought to be more resistant to internal parasites. For example, Hampshire ewes were shown to be less resistant than St. Croix, Katahdin, and Dorper ewes (Burke and Miller, 2002). Also, Dorper lambs were less resistant than Katahdin lambs, which were less resistant than St. Croix lambs (Burke and Miller, 2004). Katahdin was more resistant than Dorper and Dorset breeds (Vanimisetti et al., 2004). Gulf Coast Native, Florida Native, St. Croix, and Barbados Blackbelly are sheep that were selected in tropical areas, and they have been shown to be more resistant than Rambouillet; Hampshire; Finn-Dorset x Rambouillet; Suffolk; and Dorset x Rambouillet (summarized in Amarante and Amarante, 2003).

Some animals are not resistant to parasites but are able to produce well and remain healthy in spite of internal parasite exposure. These animals are termed "resilient" or "tolerant." There are obvious advantages to resilient animals because they may require fewer treatments and can continue being productive under challenge. The disadvantage is that resilient animals may be spreading a lot of internal parasite eggs in their manure, thereby contaminating the farm and causing health problems for other (non-resilient and non-resistant) animals.

It can be difficult to see the difference between resistance and resilience, unless you do fecal egg counts to get a sense of the worm population within the animal and the overall challenge on the herd. A resistant animal, like a resilient one, should appear healthy and vigorous. If *H. contortus* (a bloodsucker) is the main problem, then both resilient and resistant animals will not be anemic, while susceptible animals with sufficient challenge will show illness, including pale membranes.

Also, on farms where there is not much challenge (not many parasite larvae present in the environment), all animals can appear resistant or resilient. The first years of having small ruminants on a farm often are trouble-free (concerning internal parasite infection), lulling the producer into a false sense of security. Unfortunately, when there is sufficient challenge to identify the resistant or resilient animals, there will be susceptible animals suffering from illness and needing deworming treatment.

The good news is that selecting animals for resistance to internal parasites seems to be sustainable. After selecting sheep lines for 10 years for high or low FEC when exposed to *H. contortus*, researchers challenged the sheep with both *H. contortus* and *Trichostrongylus colubriformis*. The parasites did not adapt to the resistant animals, as they can to drugs (Kemper et al., 2009). Also, as shown in this research and in others, selecting animals for resistance to one species of parasite also helps confer resistance to another (Gruner et al., 2004; Hoste and Chartier, 1998; Sreter et al., 1994; Gauly and Erhardt, 2001; Green et al., 1999; Wolf et al., 2008).

## Measuring Resistance or Resilience

Measuring fecal egg counts is the most accurate way to identify animals with internal parasite resistance within a herd or flock. Resistant animals' immune systems will not allow larvae to establish and develop into mature egg-laying adults, or will suppress the egg-laying ability of the adults that do establish. Therefore, resistant animals will not be shedding as many eggs in their feces as similarly exposed non-resistant animals.

However, there are many factors that affect fecal egg counts besides the susceptibility of the animal. These include the level of exposure (challenge), stage of production of the animals (young or lactating animals may shed more eggs), and the type of forage being grazed (consuming high-tannin forage such as sericea lespedeza causes fecal egg counts to drop dramatically). Supplementation or otherwise providing better nutrition has been shown to lower FEC (Kahn et al., 2003; Eady et al., 2003) and reduce anemia (Burke et al., 2004). Also, the parasites themselves account for some variation. Some parasites (such as *Haemonchus contortus*) are very prolific and will produce a lot of eggs. Other species may not; for those, a lower egg count may still mean a serious internal parasite infection. Also, internal parasites don't lay eggs continuously and so eggs are not evenly distributed in feces. If you sample an animal twice, you will find some variation in fecal egg count even on the same day. And the number of adult worms inside the animal may not be well correlated with the fecal egg count (Saddiqi et al., 2010); immature adults and older worms produce less and males produce none.

*Katahdin ewe and lambs. Photo: Margo Hale, NCAT*

With all this in mind, it is clear that fecal egg counts are not a perfect tool. However, the information gained is very useful and doing fecal egg counts is the best way to assess challenge on the flock or herd and to find those animals that are harboring fewer internal parasites (Gray, 1998). Breeding decisions can be based on one or two samples if fecal egg counts are done during a time of high challenge, such as at weaning or early post-weaning for lambs, and during lactation for ewes. During those times, the animals that are resistant will stand out, and this is the time when heritability is higher (Gauly and Erhardt, 2001). Doing more than one sample improves the assessment of heritability, but this must be balanced against the cost.

Many producers do their own fecal egg counts. The process is fairly simple, and it can be expensive to have a veterinarian process samples. Also, not all veterinarians report quantitative results. There are workshops where the procedure is taught, and there are also instructions available online. See the Further Resources section to find links to tutorials.

The National Sheep Improvement Center (NSIP, http://nsip.org) calculates estimated breeding values (EBV) for sheep producers and breed associations. The EBV is based on progeny performance and evaluates the genetic merit of an animal for a particular trait. The Katahdin breed is currently the only U.S. breed that has EBVs for parasite resistance, using fecal egg counts from lambs at weaning and early post-weaning. Australian breeds have been calculating EBVs for parasite resistance for much longer.

To improve a herd or flock, producers will want to consider internal parasite resistance or resilience in conjunction with other goals, such as growth, reproduction, milk production, and overall health. Also, using data such as fecal egg counts requires consideration of all the factors that influence fecal egg counts. It would not be fair to compare the fecal egg count of a dry four-year-old ewe to that of a twin four-month-old lamb or that of a yearling ewe raising twins. A single lamb that has had access to excellent pasture and creep feed will have an edge over one that has been a nursing triplet on average pasture. Be sure to compare "apples to apples" when using the fecal egg count data to select animals for breeding.

*This yearling dairy doe is nursing twins and may have a higher fecal egg count than an older or dry doe. Photo: Linda Coffey, NCAT*

**Factors Affecting Fecal Egg Counts**

- Level of larval challenge affected by:
  - — Pasture management
  - — Weather
  - — Stocking rate (animal density)
- Species composition (types of worms)
- Worm burden
- Immune response of animal (affecting worm establishment and adult fecundity) affected by:
  - — Genetics
  - — Age
  - — Production stage
  - — Stress (including nutritional)
- Dietary factors
  - — Quality of pasture, especially protein levels
  - — Pasture species composition
  - — Pasture height and presence of browse or forbs
  - — Pasture management
  - — Overall quality and quantity of diet
- Selective grazing habits
- Variability of egg distribution within the fecal sample
- Diurnal patterns of egg laying
- Food transit times
- Fecal throughput and consistency
- Laboratory technique
  - — Collecting sample
  - — Preparing sample
  - — Counting eggs

Given all of these factors, the accuracy of fecal egg counts is improved if you take more than one sample—and you need to compare numbers within sampling time (don't compare across seasons or years) and within groups of animals (don't compare across ages or production stages). There is some indication that you can save effort and expense and still get a good indication of genetic merit of a sire by doing a pooled sample within a group of half-siblings.

Focusing on selecting resistant sires may be the most cost-effective and helpful approach for flock improvement (Douch et al., 1996). Sire evaluation accuracy increases with the number of offspring evaluated and the number of farms where the sire is used, as this decreases the variability caused by dam and by management. In a study conducted with Katahdin lambs where fecal egg counts were measured at 8 and 22 weeks, there were "large and significant" sire effects at both times, and these sires maintained their ranking across years, flocks, and measurement times. This emphasizes the importance of selecting good rams to improve the health of your flock (Notter et al., 2007).

Fecal egg counts provide more detailed information to guide producers in selecting animals that are not shedding as many internal parasite eggs. However, it is labor-intensive and can be costly. There is an alternative method for finding resistant or resilient animals, if *Haemonchus contortus* (barberpole worm, a blood-sucking parasite) is the primary parasite. The FAMACHA© system was developed in South Africa as a means of assessing anemia, a symptom of infection of barberpole worm. To use this method, a trained producer simply examines the inner surface of the lower eyelid and compares the color of the membranes to the five shades of pink on the FAMACHA© card. A score of 1 (bright pink) indicates no anemia, while a score of 5 (white) means severe anemia and severe infection. Producers can chart the scores of the flock or herd and record the scores on each animal every two weeks during the parasite season, and deworm only those animals that are anemic (scores of 4 and 5, or 3 if other indications, such as poor body condition, are present). In areas where barberpole worm is the main parasite, FAMACHA© can serve as a quick and inexpensive way to select animals with fewer parasite problems. However, some animals can have a good FAMACHA© score (brighter pink, a 1 or 2) and yet be shedding some eggs in their feces. These animals are resilient rather than resistant.

***Focusing on selecting resistant sires may be the most cost-effective and helpful approach for flock improvement.***


***The FAMACHA© system can help identify resistant or resilient animals. Photo: Margo Hale, NCAT***

**What do you learn from a FAMACHA© score?**

If a given animal has a FAMACHA© score of 1, you can say that the animal is not anemic. But you don't know why unless you look at more data; it could be that the animal has not been challenged by *Haemonchus contortus.* Or it could be that the animal has been challenged, but is resilient. Finally, it might be that the animal has been challenged but is resistant.

To decide which is true, you have to look at the rest of the flock: are any of them anemic, or are all scoring well with FAMACHA©? If all are doing well (not anemic), then probably the challenge is not high enough yet to cause illness. Keep watching. And remember that many internal parasites do not cause anemia; be alert for other signs of illness, including loss of weight, animals that are lagging behind, or scours.

If some are anemic (indicating that *Haemonchus* is causing a problem) while others are doing well, then you have identified some animals that handle the challenge of *Haemonchus*. Are they resilient or resistant? A fecal egg count can help sort that out; high counts on an animal that is not anemic may indicate resilience. Very low counts point to a resistant animal. Repeated observations are necessary for more accurate decisions.

The point is that a single FAMACHA© score does not really tell what is happening on a farm or even in a particular animal. Noting the condition of the whole flock or herd—and doing this over the course of the whole season—and using fecal egg counts to gain further information can help a producer understand the state of the internal parasites that reside on the farm. Charting the FAMACHA© scores and observing the trend is a great help in managing the health of the flock or herd, and checking animals on a regular schedule will eventually give confidence in the ability of a particular animal to remain healthy. But one good FAMACHA© score is not a reason for complacency. Use the system as it is intended for a quick, inexpensive way to diagnose animals needing treatment and, more importantly, to select the most resistant or resilient animals for breeding.

Still, research has shown a good correlation with FAMACHA© score, packed cell volume (PCV, a measure of anemia), and fecal egg counts where *H. contortus* is the main parasite in the population (Bisset et al., 2001; Kaplan et al., 2004; Burke and Miller, 2008). For more on the use of the FAMACHA© system, see www.acsrpc.org.

Another way to assess the health of animals (and in doing so, be able to identify more parasite-resistant animals) is called the Five Point Check© (see Table 1, next page). This system has been taught in South Africa and is a reminder to look at the whole animal when deciding whether or not internal parasites are a problem (Bath and van Wyk, 2009). This approach helps detect the presence of internal parasites in addition to *Haemonchus contortus.* Many producers already do a version of this.

Of course, body condition score may be low for other reasons, including poor nutrition, heavy milking, diseases such as Johne's, or poor teeth. Nasal discharge can also occur for other reasons, and nose bots are not a problem in all regions. One additional point to make concerning "dag score"—fecal soiling, due to scouring— is that there is evidence that some animals with resistance to internal parasites have more diarrhea (scouring). It is thought that their immune response includes diarrhea as a way to shed internal parasites. Therefore, some animals that have been treated with dewormers because of this symptom are actually resistant to internal parasites (Wolf et al., 2008). Scouring also can be a result of lush pasture, or it can indicate coccidiosis. It is important to examine all the evidence when assessing animal health.

Another important piece of evidence is animal vigor. An animal that is lethargic or lagging behind the flock is likely to have some health issue, and internal parasites are often the culprit. It is a good idea to examine those animals closely and treat as needed.

## *How to Use This Information in Selecting Animals in Your Herd or Flock*

- What resources do you have, and how much time and money can you spend?
  - — *Minimal* - always record anthelmintic treatments and cull those individuals

**Table 1: Five Point Check**

| Point | What to Check | | Which Parasites |
|---|---|---|---|
| 1 | Eye | Paling of ocular membranes<br>FAMACHA© score | Barber pole worm<br>Liver fluke |
| 2 | Back | Body condition score | All |
| 3 | Rear | Dag score<br>Fecal soiling<br>Evidence of scouring | Brown stomach worm<br>Hair worm<br>Threadworm<br>Nodule worm |
| 4 | Jaw | Sub-mandibular edema<br>"bottle jaw" | Barber pole worm<br>Liver fluke |
| 5 | Nose | Nasal discharge | Nasal bots |

*Source: www.sheep101.info/201/parasite.html*

needing more than three treatments a year; don't select ram lambs or buck kids from dams or sires that require frequent treatment or from farms that do not keep records

— *Medium* - as above, but also do FAMACHA© if *Haemonchus contortus* is a problem in your area, and keep those records. Record weights of lambs and kids. Use an index to factor in age of dam, type of birth, and days of age; retain those animals that can thrive in your system and perform well with less intervention

— *More resources* and/or more motivation to improve quickly—as above, but also take fecal samples and have quantitative counts, and record those. If *H. contortus* is present, use FAMACHA© to monitor internal parasite infection and take fecal samples during a time when animals are challenged. Taking another sample a month later can add confidence for breeding decisions. Again, remember to consider age of the animal and production stage and number of nursing progeny, or this favors single births and dams nursing singles or not lactating.

As your flock or herd improves, you can select with greater pressure; cull any animal needing two treatments a year, or one, for example. As contamination decreases on the farm, your animals should have less and less trouble with parasites and have better production.

## Encouragement

It may seem that selecting for resistance to internal parasites involves a lot of extra work. Researchers admit that it will take a lot of time to make significant progress so that a flock will be relatively free of clinical disease even under challenge. Internal parasites have many advantages in this game, including the ability to wait for the right time to become active again and infect animals or to actively breed and lay eggs so that eggs will be deposited during a favorable time of the year. Parasites are prolific and can cause enormous problems to the host in a relatively short period of time.

***Keeping records and selecting animals with the ability to fight off parasites is the best long-term strategy for managing internal parasites. Photo: Linda Coffey, NCAT***

But research has shown that significant progress can be made and that health and production of the sheep and goats will improve as a result. Strategies for identifying sires with superior resistance do exist and can make a great difference in a flock or herd when they are employed. Selecting for resistance while keeping production traits also in mind can save a producer a lot of money and heartache as the animals themselves help fight internal parasites and remain healthier. Pasture contamination is reduced when resistant animals are present.

Ten years from now, sheep and goats could be much more resistant if producers will put time and effort into identifying and selecting the sires that are more resistant. Next year, your own flock could be more resistant than it is now. Each breeder who puts effort into selecting for this trait will benefit the business. Organic producers will benefit from having resistant stock, but so will non-organic producers because anthelmintics are not always effective and parasites have developed resistance to many of the existing drugs.

As mentioned earlier, some breeders are taking advantage of the National Sheep Improvement Program (NSIP) services to establish estimated breeding values (EBVs) for parasite resistance. This has been done in Australia with great results. The NSIP is now teaming up with Australian geneticists to strengthen the capacity of U.S. and Australian breeders to make improvements. See http://nsip.org for more information. Producers who support breeders who are using EBVs for internal parasite resistance will be voting with their dollars for a more sustainable system. It takes a concerted effort among breeders within a particular breed to develop resistant genetics.

## Summary

Selecting animals with the ability to fight off internal parasites (and other diseases) is the best long-term strategy for managing internal parasite problems. There are a variety of methods accessible to the producer to help with this aspect of animal selection. Animal selection is a vital tool in improving sheep and goat herds.

Still, animal selection is not the only tool a producer will need. To have a profitable and productive enterprise, a producer will want to use all the tools, especially pasture management, because none of the other tools will be effective without good pasture management. Using as many of the tools as possible and paying attention (and spending time and money) on identifying and selecting those animals that can resist internal parasites and/or be resilient to the effects of internal parasites will pay dividends for years to come. Animal selection is a vital component of a holistic parasite management strategy.

# Internal Parasite Management Assessment

YES NO

❑ ❑ 1. Are parasites kept at a level that does not affect animal performance?

How do you know? _____ _____

_____

How do you monitor the parasite load in your animals? _____

_____

2. What practices do you use to reduce parasite problems and avoid the use of anthelmintics?

❑ ❑ Cull animals that get dewormed the most
❑ ❑ Use cleaner pastures (rest pastures, cut for hay, graze cattle)
❑ ❑ Graze diverse pastures
❑ ❑ Reduce stocking rate
❑ ❑ Avoid grazing pastures shorter than 3 inches
❑ ❑ Use browse and/or forages with high condensed tannin content
❑ ❑ Graze cattle or horses with goats or sheep
❑ ❑ Separate classes of susceptible animals
❑ ❑ Raise breeds and individuals with resistance to parasites
❑ ❑ Select rams or bucks with parasite resistance

3. What parasite control program do you use to reduce the use of anthelmintics and manage parasite loads? (www.scsrpc.org for information about these techniques.)

❑ ❑ Visual observation to detect animals with parasite problems
❑ ❑ Use FAMACHA© (see www.acsrpc.org)
❑ ❑ Check fecal egg counts prior to and following treatment to monitor loads and check effectiveness of anthelmintics
❑ ❑ Change class of anthelmintic once resistance is noticed
❑ ❑ Strategic deworming just before kidding or lambing
❑ ❑ Deworm all new animals (and check fecal egg counts seven to 10 days later to be sure there are no eggs in the feces)
❑ ❑ Use Smart Drenching (see www.acsrpc.org)
❑ ❑ Deworm only those animals that need it
❑ ❑ Cull animals that need frequent deworming (more than three treatments per season for adults; less, as your flock or herd gets stronger)

Other: list here_____

_____

_____

***Source: ATTRA's Small Ruminant Sustainability Checksheet***

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## Further Resources

**Sustainable Agriculture Research and Education (SARE)**
www.sare.org

*The SARE website holds many research reports of interest to sheep and goat producers. To access these reports, go to the homepage, click on "project reports" and then search "internal parasite" to bring up a list of reports that can be informative on this subject. There is a PowerPoint presentation on the subject of selecting animals for internal parasite resistance that is very informative and interesting. The presentation illustrates many important concepts of selecting animals for internal parasite resistance. Go to: mysare.sare.org/2008Conference/speakers/Bielek.ppt and also see the report on that Farmer/Rancher SARE project, FNC05-583.*

**The American Consortium for Small Ruminant Parasite Control (ACSRPC)**
www.scsrpc.org or www.acsrpc.org

*ACSRPC was formerly known as the Southern Consortium for Small Ruminant Parasite Control (SCSRPC) and provides up-to-date scientific research and recommendations for producers. There is a six-part series of articles written for producers and previously published in the Goat World. Part 1 is at www.scsrpc.org/SCSRPC/Publications/part1.htm. Part 6 includes instructions for doing fecal egg counts, and a good discussion. There are other articles listed on the site, including information about FAMACHA©and Smart Drenching.*

*A summary of SARE-funded work done by the SCSRPC is collected in this article: www.sare.org/Learning-Center/Fact-Sheets/National-SARE-Fact-Sheets/Sustainable-Control-of-Internal-Parasites-in-Small-Ruminant-Production*

**Langston University**
www.luresext.edu

*Langston University's website includes two tutorials for doing fecal egg counts (located at www.luresext.edu/goats/library/fec0.html and www.luresext.edu/goats/library/fec.html). The information is slightly different in these presentations. Also see the chapter in the web-based training manual at www.luresext.edu/goats/training/parasites.html#diag for more complete information about internal and external parasite control.*

**Maryland Small Ruminant Page**
www.sheepandgoat.com

*Susan Schoenian is an educator with the University of Maryland Cooperative Extension Service. She has generously shared information with the world through this website. She also has posted some excellent presentations at Slideshare, including some about integrated parasite management. These presentations are very helpful and will add to understanding of the problem and solutions. Access them from the main website.*

# SHEEP Dewormer Chart

ACSRPC
(www.acsrpc.org)

***Important --Please read notes below before using this chart***

| 1 ml = 1cc | Valbazen (albendazole) ORALLY | SafeGuard (fenbendazole) ORALLY | Ivomec Sheep Drench (ivermectin) ORALLY | Prohibit (levamisole) ORALLY | Cydectin Sheep Drench (moxidectin) ORALLY |
|---|---|---|---|---|---|
| Weight Pounds (lbs) | 7.5 mg/kg 0.75 ml/ 25 lb | 5 mg/kg 0.6 ml/ 25 lb | 0.2 mg/kg 2.9 ml/ 25 lb | 8 mg/kg 2 ml/ 25 lb | 0.2 mg/kg 2.3 ml/25 lb |
| 20 | 0.6 | 0.5 | 2.3 | 1.5 | 1.8 |
| 25 | 0.75 | 0.6 | 2.9 | 1.8 | 2.3 |
| 30 | 0.9 | 0.7 | 3.4 | 2.2 | 2.7 |
| 35 | 1.1 | 0.8 | 4.0 | 2.6 | 3.2 |
| 40 | 1.2 | 0.9 | 4.5 | 2.9 | 3.6 |
| 45 | 1.4 | 1.0 | 5.1 | 3.3 | 4.1 |
| 50 | 1.5 | 1.1 | 5.7 | 3.7 | 4.5 |
| 55 | 1.7 | 1.3 | 6.2 | 4.0 | 5.0 |
| 60 | 1.8 | 1.4 | 6.8 | 4.4 | 5.4 |
| 65 | 2.0 | 1.5 | 7.4 | 4.7 | 5.9 |
| 70 | 2.1 | 1.6 | 8.0 | 5.1 | 6.3 |
| 75 | 2.3 | 1.7 | 8.5 | 5.5 | 6.8 |
| 80 | 2.4 | 1.8 | 9.1 | 5.8 | 7.2 |
| 85 | 2.6 | 1.9 | 9.7 | 6.2 | 7.7 |
| 90 | 2.7 | 2.0 | 10.2 | 6.6 | 8.1 |
| 95 | 2.9 | 2.1 | 10.8 | 6.9 | 8.6 |
| 100 | 3.0 | 2.2 | 11.4 | 7.3 | 9.1 |
| 105 | 3.2 | 2.3 | 1.02 | 7.7 | 9.5 |
| 110 | 3.3 | 2.5 | 12.5 | 8.0 | 10 |
| 115 | 3.5 | 2.6 | 13.1 | 8.4 | 10.5 |
| 120 | 3.6 | 2.7 | 13.7 | 8.8 | 10.9 |
| 125 | 3.8 | 2.8 | 14.2 | 9.1 | 11.4 |
| 130 | 3.9 | 2.9 | 14.8 | 9.5 | 11.8 |
| 140 | 4.2 | 3.0 | 15.4 | 10.2 | 12.7 |
| 150 | 4.5 | 3.1 | 16.0 | 11.0 | 13.6 |

**Valbazen** Suspension (11.36 % or 113.6 mg/ml): 7.5 mg/kg orally; approved in sheep with meat withdrawal time of 7 days. Do NOT use in pregnant ewes in the first trimester of pregnancy.

**Safe-Guard/ Panacur** Suspension (10% or 100 mg/ml): Note that SafeGard is not approved for use in sheep. Sheep dose is 5 mg/kg orally; meat withdrawal time of 6 days.

**Ivomec Drench for Sheep** (0.08% or 0.8 mg/ml): 0.2 mg/kg orally; approved in sheep with meat withdrawal time of 11 days. Protect from light.

**Prohibit Soluble Drench Powder (Sheep)**: (Note that this drug is also sold as Levasol and Tramsiol) 8 mg/kg ORAL dose. Approved for use in sheep with meat withdrawal of 3 days. Solution prepared by dissolving a 52 gram packet in 1 quart (943 ml) of water. This yields a solution with 49.6 mg/ml. Always make sure to follow directions on packet when preparing.
If dosing lambs, it is safer to dilute further (1 packet in 2 quarts of water), and then administer twice the amount listed on the chart. The larger volume administered will provide a wider margin for safety if there are small errors in dosing.

**Cydectin Sheep drench** (1 mg/ml): 0.2 mg/kg orally; approved in sheep with meat withdrawal time of 14 days.

ACSRPC
(www.acsrpc.org)

## NOTE for Guideline for Dewormer (Anthelmintic) Dosages in Sheep

This chart was developed by Ray M. Kaplan, DVM, PhD and Lisa Williamson, DVM, MS (University of Georgia). It is provided as a possible guideline for anthelmintic (deworming) dosages for sheep. Producers should always consult their veterinarian for advice on their specific management situation for determining which dewormer(s) are best to use in their flock, and the proper dosages for their flock. Meat withdrawal times should always be strictly adhered to.

Note that drug resistance in parasites of sheep is extremely common. The effectiveness of a particular dewormer should always be tested before being used by performing either a Fecal Egg Count Reduction Test (FECRT) or DrenchRite larval development assay (contact Dr. Kaplan's laboratory [706-542-0742] for more information about the DrenchRite test).

Updated September 2014

ACSRPC
(www.acsrpc.org)

# Dewormer Chart for Goats

***Important --Please read notes below before using this chart***

| 1 ml = 1cc | Valbazen (albendazole) ORALLY | SafeGuard (fenbendazole) ORALLY | Ivomec Sheep Drench (ivermectin) ORALLY | Prohibit (levamisole) ORALLY | Cydectin Sheep Drench (moxidectin) ORALLY | Rumatel (morantel) Feed Pre-mix ORALLY |
|---|---|---|---|---|---|---|
| **Weight Pounds (lbs)** | **20 mg/kg 2 ml/ 25 lb** | **10 mg/kg 1.1 ml/ 25 lb** | **0.4 mg/kg 6 ml/ 25 lb** | **12 mg/kg 2.7 ml/ 25 lb** | **0.4 mg/kg 4.5 ml/25 lb** | **10 mg/kg 45 gm/100 lb BW (Durvet)** |
| 20 | 1.6 | 0.9 | 4.8 | 2.2 | 3.6 | |
| 25 | 2.0 | 1.1 | 6.0 | 2.7 | 4.5 | 11 grams |
| 30 | 2.4 | 1.4 | 7.2 | 3.3 | 5.4 | |
| 35 | 2.8 | 1.6 | 8.4 | 3.8 | 6.5 | |
| 40 | 3.2 | 1.8 | 9.6 | 4.4 | 7.3 | |
| 45 | 3.6 | 2.1 | 10.8 | 4.9 | 8.2 | |
| 50 | 4.0 | 2.3 | 12.0 | 5.5 | 9.0 | 23 grams |
| 55 | 4.4 | 2.5 | 13.2 | 6.0 | 10 | |
| 60 | 4.8 | 2.7 | 14.4 | 6.6 | 11 | |
| 65 | 5.2 | 3.0 | 15.6 | 7.1 | 12 | |
| 70 | 5.6 | 3.2 | 16.8 | 7.7 | 12.7 | |
| 75 | 6.0 | 3.4 | 18.0 | 8.2 | 13.6 | 34 grams |
| 80 | 6.4 | 3.6 | 19.2 | 8.8 | 14.6 | |
| 85 | 6.8 | 3.9 | 20.4 | 9.3 | 15.4 | |
| 90 | 7.2 | 4.1 | 21.6 | 9.9 | 16.4 | |
| 95 | 7.6 | 4.3 | 22.8 | 10.4 | 17.3 | |
| 100 | 8.0 | 4.6 | 24.0 | 11.0 | 18 | 45 grams |
| 105 | 8.4 | 4.8 | 25.2 | 11.5 | 19 | |
| 110 | 8.8 | 5.0 | 26.4 | 12.1 | 20 | |
| 115 | 9.2 | 5.2 | 27.6 | 12.6 | 21 | |
| 120 | 9.6 | 5.5 | 28.8 | 13.2 | 22 | |
| 125 | 10.0 | 5.7 | 30.0 | 13.7 | 22.7 | 56 grams |
| 130 | 10.4 | 5.9 | 31.2 | 14.3 | 23.6 | |
| 140 | 11.2 | 6.4 | 33.6 | 15.4 | 25.4 | |
| 150 | 12.0 | 6.8 | 36.0 | 16.5 | 27.3 | 68 grams |

**Valbazen** Suspension (11.36 % or 113.6 mg/ml): 20 mg/kg orally; withdrawal time is 9 days for meat and 7 days for milk Do NOT use in pregnant does in the first trimester of pregnancy

**Safe-Guard/ Panacur** Suspension (10% or 100 mg/ml): the label dose in goats is 5 mg/kg, but a 10 mg/kg dosage is recommended. At 10 mg/kg, withdrawal time is 16 days meat and 4 days for milk. Add 1 day for each additional day the drug is used (e.g. if administered 2 days in a row then withhold milk for 5 days after 2nd dose).

**Ivomec Sheep Drench** (0.08% or 0.8 mg/ml): 0.4 mg/kg orally; meat withdrawal time is 14 days and milk withdrawal is 9 days.

**Prohibit Soluble Drench Powder (Sheep)**: (Note that this drug is also sold as Levasol and Tramsiol) 12 mg/kg oral dose with meat withdrawal of 4 days and milk withdrawal of 3 days. Solution prepared by dissolving a 52 gram packet in 1 quart (943 ml) of water. This yields a solution with 49.6 mg/ml. If dosing kids, it is safer to dilute further (1 packet in 2 quarts of water), and then administer twice the amount listed on the chart. The larger volume administered will then provide a wider margin for safety if there are small errors in dosing.

**Cydectin Sheep drench** (1 mg/ml): use orally at 0.4 mg/kg orally; for a single dose the meat withdrawal time is 17 days and milk withdrawal is 8 days. Note that these withdrawal times are only applicable for the sheep oral drench at the dose given here. Higher doses will require a longer withdrawal time.

**Morantel tartrate** (Rumatel) recommended label dose for goats is 10 mg/kg, orally. There is 0 (zero) withdrawal time for milk in lactating cattle and dairy goats. Meat withdrawal time for goats is 30 days. Because of the large differences in morantel concentration among the various products, it is important to carefully read the label and make sure you are dosing correctly. The dosage on the chart above is for Durvet Rumatel. {With Durvet Rumatel, feed 0.1 lb (45 grams) per 100 lbs. BW; and with Manna Pro feed 1.0 lb per 100 lb. BW}. There is also a highly concentrated form called Rumatel 88, but this is meant for mixing into large volumes of feed (feed 0.1 lb (45 gram) per 2000 lb BW). Note that the 10 mg/kg dose used for the chart is the label dose; administering 1.5 – 2X this dose may improve efficacy. If an elevated dose is used then withdrawal times would need to be extended.

**NOTE on Guideline for Anthelmintic Dosages in Goats**

The attached chart was developed by Ray M. Kaplan, DVM, PhD, DACVM, DEVPC (University of Georgia) with subsequent contributions by Patty Scharko DVM, MPH (Clemson University). It is provided as a possible guideline for anthelmintic (deworming) dosages for goats. Producers should always consult their veterinarian for advice on their specific management situation, for determining which of the dewormers remain effective on the farm, and for determining the most appropriate dosages for their herd. Meat and milk withdrawal times listed in this document are based on the most current information available from FARAD as of it's writing. Be aware that these recommended withdrawal times may change over time as new pharmacologic information is obtained.

With the exception of fenbendazole administered at the 5 mg/kg dose, these drugs are **not** approved by the Food and Drug Administration (FDA) for use in goats, and when used in goats are considered extra label use. Fenbendazole at the recommended dose rate of 10 mg/kg is also considered extra-label usage. The FDA regards extra-label use of drugs as an exclusive privilege of the veterinary profession and is only permitted when a bona fide veterinarian-client-patient relationship exists and an appropriate medical diagnosis has been made. The following chart is intended to serve as a guideline for improving accuracy when dosing goats with an anthelmintic, but these drugs should be used in goats only when appropriate veterinary advice has been received. Cattle pour-on dewormers should NEVER be used in goats to treat internal parasites.

Drug resistance to multiple drugs and sometimes to all available drugs in parasites of goats is extremely common. The effectiveness of a dewormer should always be tested before being used by performing a Fecal Egg Count Reduction Test (FECRT) or DrenchRite larval development assay (contact Sue Howell in Dr. Kaplan's laboratory [706-542-0742; or drenchrt@uga.edu] for more information about the DrenchRite test, current cost = $450).

To improve the effectiveness of deworming treatments, multiple dewormers may be administered at the same time sequentially. It is important not to mix the different drugs together as they are not chemically compatible. They should be given separately, but can all be given at the same time, one right after the other. It is always recommended to treat goats selectively given their individual need for treatment based on FAMACHA score, fecal egg count, body condition score, and other health measurements as a guide. This recommendation is even more important when using drugs in combination. If all animals in the herd are treated, resistance to the dewormers will develop rapidly, and if using a combination there will be nothing left to use when this happens.

**ADDITIONAL NOTE ON CYDECTIN:** For a short period, it was recommended to administer Cydectin (moxidectin) by injection. However, new information suggests that the oral route is preferred. If the cattle injectable is used, FARAD recommends a 120-130 day meat withdrawal time. NOTE that the cattle pour-on formulation should NOT be administered to goats orally – this is not permissible under extra-label use law. ALWAYS use the sheep oral drench. Check http://www.acsrpc.org/ website for more information on drug choice and drug resistance.

Updated September 2014

**ACSRPC**
**(www.acsrpc.org)**

## Table 1: Commonly used anthelmintics in sheep and goats.

| Drug | Class | Approved Sheep | Approved Goats | Dosage (mg/kg) | How Supplied | Prevalence of Resistance* | Meat WDT | Milk WDT For Goats | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Ivermectin | AM | Yes | No | Sheep 0.2<br>Goats 0.4 | Sheep oral drench | high | Sheep 11 days<br>Goats 14 days** | 9 days** | Cattle injectable formulation not recommended |
| Doramectin | AM | No | No | Sheep 0.2<br>Goats 0.4 | Injectable | high | ND | NE | Not recommended because long residual activity promotes resistance |
| Moxidectin | AM | Yes | No | Sheep 0.2<br>Goats 0.4 | Sheep oral drench | low to moderate | Sheep 14 days<br>Goats 17 days** | 8 days** | Kills Ivermectin-resistant *Haemonchus*. Minimize use to preserve efficacy |
| Levamisole | I/T | Yes | No | Sheep 8.0<br>Goats 12.0 | Soluble drench powder | low to moderate | Sheep 3 days<br>Goats 4 days** | 3 days | Toxic side effects = salivation, restlessness, muscle fasciculations. Recommend weighing goats before treatment. |
| Morantel | I/T | No | Yes | Goats 10 | Feed premix | moderate | Goats 30 days | 0 days | Approved for use in lactating goats. Surveys for prevalence of resistance have not been performed. |
| Fenbendazole | BZ | No[a] | Yes | Sheep 5.0<br>Goats 5.0[b] | Paste<br>Suspension<br>Feed block<br>Mineral Pellets | high | Goats 6 days[c] (for suspension only) | 0 days[c] (for suspension only) | [a]Approved in Big-horned sheep.<br>[b] Label dose is 5.0 mg/kg but 10 mg/kg is recommended for goats.<br>[c]Listed WDT are for the 5 mg/kg dose. At 10 mg/kg, WDT should be extended to 16 days for meat and 4 days for milk** |
| Albendazole | BZ | Yes | No | Sheep 7.5<br>Goats 20 | Paste<br>Suspension | high | Sheep 7 days<br>Goats 9 days** | 7 days** | Don't use within 30 days of conception. Effective against Moniezia tapeworms. |

AM = Avermectin/Milbemycin (Macrocyclic Lactone)
BZ = Benzimidazole
I/T = Imidazothiazole/Tetrahydropyrimidine
WDT = Withdrawal time
NE = Milk WDT has not been established in goats; product should not be used in lactating dairy goats
ND = Meat withdrawal time has not been established. To be safe it is suggested to double cattle WDT
*****In the southern United States. Prevalence of resistance has not been established elsewhere.
******Based on FARAD recommendations

**Table is modified from one published in 5th edition of *Current Veterinary Therapy: Food Animal Practice* "Anthelmintic Therapy in an Era of Resistance," by Ray M. Kaplan, DVM, PhD, DipEVPC. It has been updated to reflect changes as of September 2014.**
*****This table is intended for veterinary use only. Others should consult with their veterinarian before using any drug in an extra-label manner*****

# Why and How To Do FAMACHA© Scoring

Use of the FAMACHA© system allows small ruminant producers to make deworming decisions based on an estimate of the the level of anemia in sheep and goats associated with barber pole worm (*Haemonchus contortus)* infection.

Figure 1. Barber pole worm (*Haemonchus contortus*)

The barber pole worm (Figure 1) is the most economically important parasite affecting sheep and goat production on pasture and the most common cause of anemia during the grazing season in most of the U.S. It has a small "tooth" that lacerates the animal's stomach (abomasum) wall, and it feeds on the blood that is released. This can result in anemia, (reduction below normal in the number of red cells in the blood) and in severe cases, death.

The FAMACHA© card, developed in South Africa, was introduced to the U.S. by the American Consortium for Small Ruminant Parasite Control (***www.acsrpc.org***). It is a tool that matches the color of the eye mucous membranes of small ruminants with a laminated color chart showing 5 color categories that correspond to different levels of anemia. Category 1 represents "not anemic" with category 5 representing "severely anemic."

The FAMACHA© system uses the scores determined with the card to identify and selectively deworm sheep and goats with anemia. Selective deworming minimizes drug use and slows the development of drug resistant GIN parasites. It can also aid in selective breeding decisions by identifying those animals that are most susceptible to barber pole worm infection.

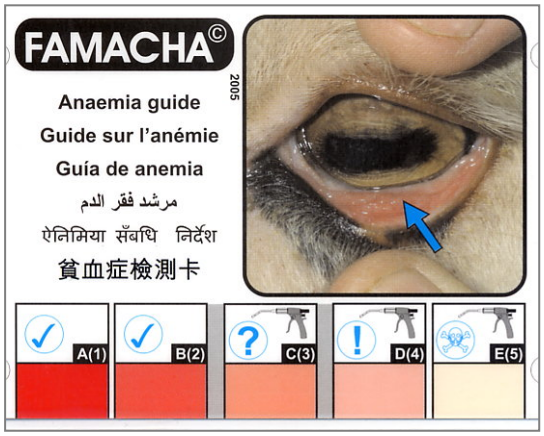


Figure 2. FAMACHA© card. *www.acsrpc.org*

## Precautions

- FAMACHA© is only applicable where the barber pole worm (*H. contortus)* is the main GIN parasite causing clinical disease.
- Redness of the ocular membranes can be caused by eye disease, environmental irritants, and systemic disease. Though they are uncommon, these conditions can mask anemia.
- Other causes of anemia exist, but they are uncommon compared to barber pole worm infection during the grazing season.
- An elevated FAMACHA© score is not the only reason to deworm an animal. GIN can play a role in other signs of disease including:
    - Diarrhea
    - Bottle jaw
    - Poor body condition
    - Dull hair coat or abnormal fleece
    - Exercise or heat intolerance

**General guidelines for using the FAMACHA© card**

- Always check eyes outside in direct, natural light. If options are limited due to handling needs, an area of the barn where natural light enters directly in the morning or afternoon (such as a door or window) is acceptable. When scoring, there does not need to be bright sunshine, but it should be performed in full daylight.
- Always use the card when scoring your animals and do not try to score from memory of the colors.

**How to examine your animals with the FAMACHA© card:**

- Proper FAMACHA© scoring technique includes exposing the lower eye mucous membranes and matching them to the equivalent color on the FAMACHA© card (Figure 3). **COVER, PUSH, PULL, POP** is a 4-step process describing the proper technique.

Figure 3. FAMACHA© scoring a goat. The lower eye mucous membranes are exposed and compared to the colors on the FAMACHA© card to estimate the level of anemia. Use the COVER, PUSH, PULL, POP! method described above.

1. **COVER** the eye by rolling the upper eyelid down over the eyeball.
2. **PUSH** down on the eyeball. An easy way to tell if you are using enough pressure is that you should see that the eyelashes of the upper eyelid are curling up over your thumb.
3. **PULL** down the lower eyelid.
4. **POP!** The mucous membranes will pop into view. Make sure that you do not score the inner surface of the lower eyelid, but rather <u>score the bed of mucous membranes</u>.

- Match the color of the pinkest portion of the mucous membranes to the FAMACHA© card.
- Make sure that you do not shade the eye with your body.
- Be quick – make your decision and move on. The longer the mucous membranes are exposed, the redder they get. Go with your first impression.
- Repeat the process and score the other eye because it may be different. Use the higher score and err on the side of caution.
- There are no half numbers!

**Interpreting the FAMACHA© results**

Animals in FAMACHA© category 4 & 5:

- *Always* deworm sheep & goats in categories 4 & 5.

Animals in FAMACHA© category 1 & 2:

- Don't deworm 1's & 2's unless there is other evidence of parasitic disease such as the presence of diarrhea, poor body condition, dull hair coat or abnormal fleece.

Animals in FAMACHA© category 3:

- Consider deworming if:
  - >10% of flock/herd scores a 4 or 5.
  - Lambs and kids (usually recommended).
  - Pregnant or lactating ewes/does (usually recommended).
  - Animals in poor body condition.
  - Concerned about an animal's general health and well being, for example, if an animal is in poor body condition, or suffering from another disease.
  - Always err on the side of caution.

**How often do I monitor?**

If <10% of herd/flock scores in categories 4 or 5:

- Every 2 weeks during the grazing season. Susceptible animals can go downhill rapidly when worm numbers are high (warm, moist conditions / summer months).

- During spring and fall, when temperatures are cooler and the barber pole worm may be less active, this interval could be extended to 3-4 weeks.

- During winter the interval can be extended, but remember that ewes/does may develop problems with the barber pole worm when lambing/kidding coincides with arrested parasites resuming development, and they should be checked more often.


If >10% of flock/herd scores in categories 4 or 5:

- Recheck weekly
- Treat all 3's
- Change pastures (if possible)

Anemic animals recover most quickly if they are removed from heavily infected pasture. If animals are dewormed and turned back out on the same pasture that first led to disease, they may take an extended period to return to a score of 1 or 2 since they will continue to be re-infected by the larva on pasture. It is okay to re-treat those animals based on FAMACHA© score.

**Maintaining the FAMACHA© card**

- Store in dark place when not in use because the card will fade with time.
- Replace card after 12 to 24 months of use (varies depending upon use and storage conditions).
- Keep a spare card in a location protected from light (compare with the card in use).
- Training is required to gain the initial card. Contact your veterinarian, your local Cooperative Extension small ruminant specialist or the American Consortium for Small Ruminant Parasite Control (***www.acsrpc.org***) for more information including available workshops. As part of a Northeast SARE grant, the University of Rhode Island is offering an online training program for FAMACHA© certification. Visit our website for more information and detailed instructions, **http://web.uri.edu/sheepngoat/famacha/**. Replacement cards can be obtained through the University of Georgia (***famacha@uga.edu***), your veterinarian or your FAMACHA© trainer.

**Recordkeeping**

Keep records of FAMACHA© scores and other parasite monitoring performed on your animals each year. FAMACHA© cards come with a recordkeeping template, or view our project recordkeeping sheets available on our website.

For more information, including our demonstration video on FAMACHA© scoring and our online training program for FAMACHA© certification, visit our website: ***http://web.uri.edu/sheepngoat*****.** The video can also be viewed directly from the URI YouTube channel page (**UniversityOfRI**): ***https://www.youtube.com/watch?v=I5rcuvVG56Q*****.**

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# Compliance Policy Guide

# Sec. 615.115 Extralabel Use of Medicated Feeds for Minor Species

# Guidance for FDA Staff

*Additional copies are available from:*
*Food and Feed Policy Staff*
*Office of Policy and Risk Management*
*Office of Regulatory Affairs*
*Food and Drug Administration*
*12420 Parklawn Drive*
*Rockville, MD 20857*
*http://www.fda.gov/ora/compliance_ref/cpg/default.htm*

Submit comments on this compliance policy guide (CPG) at any time. Submit electronic comments to http://www.regulations.gov. Submit written comments to the Division of Dockets Management (HFA-305), Food and Drug Administration, 5630 Fishers Lane, Rm. 1061, Rockville, MD 20852. All comments should be identified with the Docket No. FDA-1999-D-1875.

**U.S. Department of Health and Human Services**
**Food and Drug Administration**
**Office of Regulatory Affairs**
**and**
**Center for Veterinary Medicine**

**December 2016**

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# Compliance Policy Guide

# Sec. 615.115 Extralabel Use of Medicated Feeds for Minor Species

# Guidance for FDA Staff

*This guidance represents the current thinking of the Food and Drug Administration (FDA or Agency) on this topic. It does not establish any rights for any person and is not binding on FDA or the public. You can use an alternative approach if it satisfies the requirements of the applicable statutes and regulations. To discuss an alternative approach, contact the FDA office responsible for this guidance as listed on the title page.*

## I. Introduction

This revised Compliance Policy Guide (CPG) is an update to the Compliance Policy Guide published in April 2001. The revised CPG represents the Agency's current thinking on extralabel use of new animal drugs approved for use in or on animal feed (medicated feeds) (as defined in 21 CFR Sec. 558.3(b)(8)) for minor species (as defined in 21 CFR 516.3(b). Minor species are defined by exclusion as animals other than cattle, horses, swine, chickens, turkeys, dogs and cats. The CPG is intended to provide guidance to the field concerning the Agency's exercise of enforcement discretion with regard to the extralabel use of over-the-counter (OTC) and veterinary feed directive (VFD) medicated feeds in minor species. It does not confer any rights for or on any person and does not operate to bind FDA or the public.

In general, FDA's guidance documents do not establish legally enforceable responsibilities. Instead, they describe the agency's current thinking on various topics and should be viewed only as recommendations, unless specific regulatory or statutory requirements are cited. The use of the word *should* in agency guidances means that something is suggested or recommended, but not required.

## II. Background

Prior to 1994, the Federal Food, Drug, and Cosmetic Act (the FD&C Act) did not permit the extralabel use of animal drugs, but the Agency exercised enforcement discretion regarding extralabel use of animal drugs provided certain criteria were met. These criteria were published in Compliance Policy Guide 7125.06 and were largely incorporated into the Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA). AMDUCA amended the FD&C Act to permit extralabel uses under certain conditions. The regulations promulgated pursuant to AMDUCA are codified at 21 CFR part 530.

AMDUCA does not permit extralabel use of medicated feeds. However, there are some minor species that cannot be practically medicated in any way other than through the use of medicated feeds. Furthermore, minor species such as fish and game birds have very few drugs approved for

their use. In such situations, a veterinarian may determine that extralabel use of medicated feed is needed to prevent suffering and death in these minor species.

Before the implementation of AMDUCA, the Agency occasionally exercised enforcement discretion for the extralabel use of medicated feeds in minor species based on a medical need as long as the medicated feeds were formulated and labeled in accordance with their approved application. This enforcement discretion continued after AMDUCA because the law does not permit extralabel use of medicated feeds. The Agency is providing this guidance to our field personnel on how to address such extralabel use.

On January 1, 2017, a number of drugs used in feeds convert from OTC marketing status to VFD marketing status as a result of the recommendations provided in Guidance for Industry #213: New Animal Drugs and New Animal Drug Combination Products Administered in or on Medicated Feed or Drinking Water of Food-Producing Animals: Recommendations for Drug Sponsors for Voluntarily Aligning Product Use Conditions with GFI #209. This revised CPG provides additional guidance to our field personnel on how to address the extralabel use of OTC and VFD drugs in medicated feed for minor species.

## III. Policy

### *A. Summary Statement*

"Extralabel use" means actual use or intended use of a drug in an animal in a manner that is not in accordance with the approved labeling. This includes, but is not limited to, use in species not listed in the labeling, use for indications (disease or other conditions) not listed in the labeling, use at dosage levels, frequencies, or routes of administration other than those stated in the labeling, and deviation from the labeled withdrawal time based on these different uses. (21 CFR § 530.3(a)).

AMDUCA amended section 512 of the FD&C Act to permit extralabel uses of drugs under certain conditions except in animal feed. 21 U.S.C. 360b(a)(4)(A). The extralabel use of a new animal drug in animal feed in a manner other than permitted by section 512 of the FD&C Act and FDA's implementing regulations results in the new animal drug being unsafe under section 512(a)(1) of the FD&C Act and adulterated under section 501(a)(5) of the FD&C Act. Because the FD&C Act does not permit extralabel use of drugs in animal feed, such use causes the medicated feed to be unsafe under section 512(a)(2) of the FD&C Act and adulterated within the meaning of section 501(a)(6) of the FD&C Act. The Agency may consider regulatory action when it finds such use or intended use.

However, when there are no approved treatment options available and the health of animals is threatened, and suffering or death would result from failure to treat the affected animals, extralabel use of medicated feed may be considered for treatment of minor species. Because of the need to have therapeutic options available for treatment of minor species, and to help ensure animal safety and human food safety, FDA is issuing this revised CPG to provide guidance to FDA staff with respect to factors to consider when determining whether to take enforcement action against a veterinarian, animal producer, feed manufacturer, and/or feed distributor for the

extralabel use of OTC and VFD medicated feeds in minor species. In general, the Agency will not recommend or initiate enforcement action against the veterinarian, animal producer, feed mill, or other distributor when extralabel use is consistent with this document.

### *B. General Considerations*

In the course of an inspection or other activity to investigate compliance, field personnel must look at the following to determine whether to recommend or initiate regulatory action against a veterinarian, animal producer, feed mill, or other distributor for the extralabel use of OTC and VFD medicated feeds in minor species. *All* of the following conditions must be present in order to consider enforcement discretion:

1. The medicated feed is used in an extralabel manner only with the express prior written recommendation (see section C. Veterinarian Considerations) and oversight of a licensed veterinarian within the context of a valid veterinarian-client-patient relationship as defined in 21 CFR 530.3(i), which says "A valid veterinarian-client-patient relationship is one in which:

    - a veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;

    - there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and

    - the practicing veterinarian is readily available for follow up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept."

2. The medicated feed is used in an extralabel manner only for treatment of minor species as defined in the Code of Federal Regulations (21 CFR 516.3(b)). As previously stated, extralabel use under this revised CPG is limited to:

    - use in minor species not listed in the labeling,

    - use for indications (diseases or other conditions) not listed in the labeling, and

    - extension of the labeled withdrawal time (see section C. Veterinarian Considerations/General).

3. The Type A medicated article is approved for use in or on animal feed and such feed is manufactured and labeled according to the approved labeling as described in 21 CFR part 558;

4. Extralabel use of medicated feed in a food-producing minor species is limited to use in a minor species similar to the species for which the medicated feed is approved. Extralabel use of medicated feed for:

    - aquaculture is limited to medicated feeds approved for use in aquatic species;
    - avian species is limited to medicated feeds approved for use in avian species; and
    - mammalian species is limited to medicated feeds approved for use in mammalian species.

5. Extralabel use of medicated feed is limited to a farmed or confined minor species. Use for the treatment of unconfined wildlife is not appropriate and thus is outside the scope of this CPG;

6. Extralabel use is limited to therapeutic treatment when the health of an animal is threatened and suffering or death may result from failure to treat. It is unacceptable under any circumstances to use a medicated feed in an extralabel manner for improving rate of weight gain, feed efficiency, or other production purposes.

7. The person, including veterinarians, animal producers, feed mill distributors, or other distributors, as applicable, has not promoted or advertised the medicated feed for an extralabel use. Such promotional activity is not appropriate because extralabel use of medicated feed is not legally permissible under the FD&C Act.

This CPG does not apply to the extralabel use of a new animal drug used in animal feed if the new animal drug in question is not approved by FDA for use in or on animal feed. Further, this CPG does not apply to medicated feeds which contain a drug or drug class that is specifically excluded by FDA from extralabel use. At this time, these specific exclusions include all drugs or drug classes prohibited for extralabel use in animals (21 CFR 530.41). Please note that all of the drugs on the prohibited list are dosage form drugs, and none of the drugs or drug classes on the prohibited list has an approved application for use in medicated feed. FDA intends that all such drugs or drug classes be excluded from this CPG even if, at some point in the future, any become approved for use in medicated feed. Examples of such prohibited drugs or drug classes are fluoroquinolones, glycopeptides, and cephalosporin antimicrobials. FDA will update this CPG if it becomes necessary to exclude the extralabel use in minor species of additional drugs approved for use in medicated feed.

### *C. Veterinarian Considerations*

#### *General*

In the course of an inspection or other activity to investigate compliance, in order to consider enforcement discretion in cases where a veterinarian is recommending or authorizing the extralabel use of an approved new animal drug in or on animal feed for use in a minor species, field personnel must also determine that, along with meeting all of the applicable conditions listed above in section *B. General Considerations*, the veterinarian has done all of the following:

1. Made a careful diagnosis and evaluation of the therapeutic indication for which the drug is to be used;

2. Made a determination within the context of a valid veterinarian-client-patient relationship that there is no approved new animal drug that (i) is labeled for such use, and (ii) contains the same active ingredient in the dosage form and concentration necessary for treatment; or, in cases where there is an approved new animal drug, the approved drug is clinically ineffective (see #7) for the use for which the medicated feed is intended;

3. Ascertained that there is no therapeutic dosage form that can be practically used under legal extralabel use;

4. Instituted procedures to ensure that the identity of treated animals is carefully maintained;

5. Established a withdrawal period that is substantially extended beyond that of the approved use (supported by appropriate scientific information) prior to marketing of milk, meat, eggs, or other edible products derived from the treated minor species, if applicable;

6. Taken appropriate measures to ensure that assigned timeframes for withdrawal are met and no unsafe drug residues occur in any food-producing animal subjected to extralabel treatment; and

7. Has reported any adverse reactions to FDA within 10 days of occurrence by visiting FDA's webpage entitled "How to Report Animal Drug Side Effects and Product Problems" at: http://www.fda.gov/AnimalVeterinary/SafetyHealth/ReportaProblem/ucm055305.htm. The veterinarian also should have reported treatments that were not clinically effective.

***Over-The-Counter (OTC) Medicated Feed***

In cases where a veterinarian is recommending the extralabel use of an OTC medicated feed for a minor species, in order to consider enforcement discretion field personnel must determine that, along with meeting all of the applicable conditions listed above in sections *B. General Considerations* and *C. Veterinarian Considerations/General*, the veterinarian has done all of the following:

1. Made a written recommendation that includes the medical rationale (e.g., diagnosis, drug selection, dose and duration, and the required withdrawal period), dated within 6 months prior to use;

2. Provided the client with a copy of the written recommendation; and

3. Kept copies of the written recommendation and makes them available to the FDA upon request.

***Veterinary Feed Directive (VFD) Medicated Feed***

In cases where a veterinarian is authorizing the extralabel use of a VFD medicated feed for a minor species, in order to consider enforcement discretion field personnel must determine that,

along with meeting all of the applicable conditions listed above in sections *B. General Considerations* and *C. Veterinarian Considerations/General* and satisfying the applicable requirements in the regulations relating to VFD drugs under 21 CFR 558.6, the veterinarian has done all of the following:

1. Completed a separate written recommendation to the client for the extralabel use that includes the medical rationale (e.g., diagnosis, drug selection, dose and duration, and the withdrawal period (see above at section *C. Veterinarian Considerations/General*), dated within 6 months prior to use;

    a. Provided the client with a copy of the written recommendation; and

    b. Kept copies of the written recommendation for 2 years and makes them available to the FDA upon request.

2. Completed the VFD consistent with the approved labeling for the indication. In the "Special Instructions" the veterinarian should note:

    a. "This VFD is being issued in accordance with CPG 615.115";

    b. The actual species for which the medicated feed is intended (unless that species is already reflected on the VFD because the VFD drug is approved for use in that minor species, but is being used for a different indication); and

    c. The withdrawal time associated with the extralabel use if different than the labeled withdrawal time as already reflected on the VFD (see section *C. Veterinarian Considerations/General*).

### *D. Animal Producer (Client) Considerations*

#### *General*

In the course of an inspection or other activity to investigate compliance, in order to consider enforcement discretion with respect to an animal producer using medicated feed in an extralabel manner for a minor species, field personnel must determine that, along with meeting all of the applicable conditions listed above in section *B. General Considerations*, the animal producer has done all of the following:

1. Kept complete and accurate records of medicated feeds received, including labels, invoices, and dates fed. These records are kept for at least 2 years from the date of delivery of the medicated feed;

2. Instituted procedures to ensure that the identity of treated animals is carefully maintained;

3. Taken appropriate measures to ensure that assigned timeframes for withdrawal are met and no unsafe drug residues occur in edible products derived from an animal receiving extralabel treatment;

4. Used the medicated feed in accordance with Federal, State, and local environmental and occupational laws and regulations. This is especially important for aquaculture uses;

5. Met the requirements of the Federal Clean Water Act as implemented under the National Pollutant Discharge Elimination System (NPDES), as well as any requirements applicable to ground-water pollution. The producer should contact the offices responsible for issuing NPDES permits, and other similar permits, to be certain there are no objections to the use and release of the drug; and

6. Followed user safety provisions as set forth in approved product labeling to protect individuals who may be exposed to the drug.

***Over-The-Counter (OTC) Medicated Feed***

In cases where a veterinarian is authorizing the extralabel use of an OTC medicated feed for a minor species, in order to consider enforcement discretion, field personnel must determine that the animal producer has kept a copy of the veterinarian's written recommendation for the extralabel use of the medicated feed, the copy is being kept by the animal producer for at least 2 years after feeding the medicated feed, and during that time making it available to FDA upon request.

***Veterinary Feed Directive (VFD) Medicated Feed***

In cases where a veterinarian is authorizing the extralabel use of a VFD medicated feed for a minor species, in order to consider enforcement discretion, field personnel must determine that the animal producer has complied with the applicable VFD regulations in 21 CFR 558.6, including keeping a copy of the VFD for 2 years and during that time making such records available to FDA upon request.

### *E. Medicated Feed Manufacturer or Distributor Considerations*

In the course of an inspection or other activity to investigate compliance, in order to consider enforcement discretion with respect to an individual or firm who manufactures and/or distributes medicated feed for extralabel use in minor species, field personnel must determine that the medicated feed manufacturer and/or distributor has done all of the following:

1. Formulated the medicated feed as approved[1];

[1] The non-medicated ingredients (nutrients) may be customized to be appropriate for the diet of the minor species as long as the customization is not in conflict with the medicated feed approval. The manufacturer/distributor is expected to engage with the client (animal producer) and/or nutritionist to formulate a medicated feed with appropriate nutrient content for the minor species that is consistent with the terms of the approval.

2. Labeled the medicated feed to reflect the approved bluebird label (http://www.fda.gov/AnimalVeterinary/Products/AnimalFoodFeeds/MedicatedFeed/BlueBirdLabels/default.htm);

3. Maintained the manufacturing record (including capturing any nutrient modifications) for 1 year as required by 21 CFR part 225. (Note that any records that would also be required under 21 CFR part 507 relating to the manufacturing, processing, packing, or holding of animal food must be kept for at least 2 years); and

4. If applicable, met the requirements for the manufacture/distribution of a veterinary feed directive (VFD) medicated feed in 21 CFR 558.6, including maintaining the VFD for 2 years and during that time making such records available to FDA upon request.

## IV. Regulatory Action Guidance

Districts should consult with CVM, Division of Compliance, prior to taking enforcement action against a veterinarian, animal producer, feed mill distributor, or other distributor for the extralabel use of OTC and VFD medicated feeds in minor species.

Priority for enforcement action for extralabel use will generally be given to:

1. Veterinarians who authorize such use of the medicated feed in a manner that is inconsistent with sections III. *B. General Considerations* and *C. Veterinarian Considerations*;

2. Animal producers who use the medicated feed in a manner that is inconsistent with sections III. *B. General Considerations* and *D. Animal Producer (Client) Considerations*; and

3. Individuals or firms that manufacture or distribute the medicated feed in a manner that is inconsistent with sections III. *B. General Considerations* and *E. Medicated Feed Manufacturer or Distributor Considerations*.

In cases where the circumstances described in sections *III.B.* through *III.E.* of this CPG do not exist, the following regulatory actions may be taken:

A Warning Letter is ordinarily the first choice of action. The following language should be used to cite the violation:

> The animal drug **** is adulterated within the meaning of Section 501(a)(5) of the Federal Food, Drug, and Cosmetic Act [the FD&C Act] as its use or intended use does not conform to its approved application in accordance with Section 512(a)(1) of the FD&C Act.
>
> The animal feed **** is adulterated within the meaning of Section 501(a)(6) of the FD&C Act as its use or intended use does not conform to its approved application in accordance with Section 512(a)(2)(A) of the FD&C Act.

If a veterinarian did not recommend or authorize the use of the medicated feed for extralabel purposes, the Warning Letter should be issued to the animal producer with a copy sent to the veterinarian, if applicable. If a veterinarian recommended the use of the medicated feed for extralabel use other than as described in section *III.C.*, the Warning Letter should be issued to the veterinarian with a copy sent to the animal producer.

If an individual or firm manufactures and/or distributes medicated feed other than as described in section *III.E.*, the Warning Letter should be issued to the manufacturer or distributor, with a copy to the animal producer and veterinarian, if applicable.

The medicated feed manufacturer or distributor also may be considered for enforcement action if there is sufficient evidence to show that it knew that the medicated feed was intended for extralabel use in other than a minor species.

If there is a tissue residue violation, the District should establish the responsible individuals. This would ordinarily be the animal producer and/or veterinarian. However, in rare situations such as an incorrect formulation or use of a new animal drug that is not approved for use in medicated feed, the medicated feed manufacturer and/or distributor may be considered responsible for the violation. The District should follow Compliance Program Guidance Manual 7371.006 and should cite the tissue residue food adulteration violation under Section 402(a)(2)(C)(ii) of the FD&C Act.

Should field personnel have any questions about the application of this guide, they may call CVM's Division of Compliance at (240) 402-7001 or email at CVMcompliance@fda.hhs.gov.

## V. Specimen Charges

### *Domestic Seizure*

> The animal drug **** is adulterated within the meaning of Section 501(a)(5) as its use or intended use does not conform to its approved application in accordance with Section 512(a)(1) of the FD&C Act.
>
> The animal feed **** is adulterated within the meaning of Section 501(a)(6) as its use or intended use does not conform to its approved application in accordance with Section 512(a)(2)(A).

*Material between asterisks is new or revised.*

Issued: 04/18/2001

Revised: 12/05/2016

# Evaluation of terminal sire breeds in hair sheep production systems

**A.R. Weaver, D.L. Wright, M.A. McCann, D.R. Notter, A.M. Zajac, S.A. Bowdridge, S.P. Greiner**

**Goal:**
Develop crossbreeding systems which will improve lamb performance and market acceptability, without sacrificing the fitness traits of parasite resistance and forage adaptability.

**Methods:**
Breeding Program/Animal Management
The existing flock of 100 Katahdin ewes at the Southwest AREC was utilized. The ewe flock was randomly assigned to three breeding groups of ~30 ewes each. One-third of the flock was mated to Katahdin, Texel or Suffolk rams. Katahdin rams which are owned by the SWAREC were used to generate the purebred hair lambs (controls) and use of these existing genetics will maintain genetic ties to previous work at the station. Suffolk rams originated from the Virginia Tech Sheep Center on campus. Texel rams were purchased from industry sources. Ewes were mated in the fall to lamb in March. Ewes were randomly assigned to a pasture group or dry lot group after lambing. The lambs maintained in the dry lot went to West Virginia University after weaning and were fed in an expanded metal floor facility free of parasites.

Measurement of Lamb Performance
At both locations, data was collected on number of lambs born, birth weight, lambing difficulty, and lamb survival for comparison between sire breeds. Lambs remained on the ewe until weaning, and therefore were exposed to internal parasites through natural infection. Lamb growth was measured at weaning (60 d age).

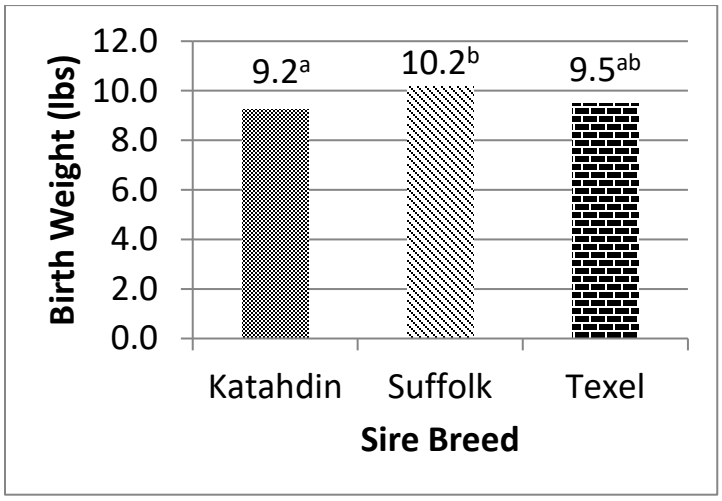
Post-weaning lambs were moved to clean pastures (not grazed by sheep during current grazing season). Lambs received supplemental feed (75% TDN, 13% CP) at a rate of 2.0% of body weight daily. Body weights and parasitism assessment (FEC/PCV/FAMANCHA) were conducted at 14 d intervals. Lambs were dewormed as necessary. Lambs will be grown post-weaning to a target body weight of 110 lbs.

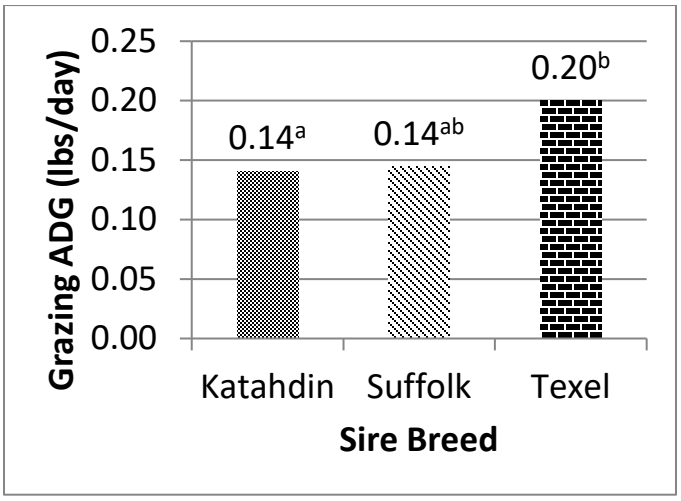
At WVU, lambs were given a primary challenge of *H. contortus* parasite larvae, and FEC response measured for 5 weeks. After deworming and a short rest period, these same lambs were administered a second *H. contortus* challenge and response measured for an additional 5 weeks. Body weight and FEC measurements were recorded throughout the period.

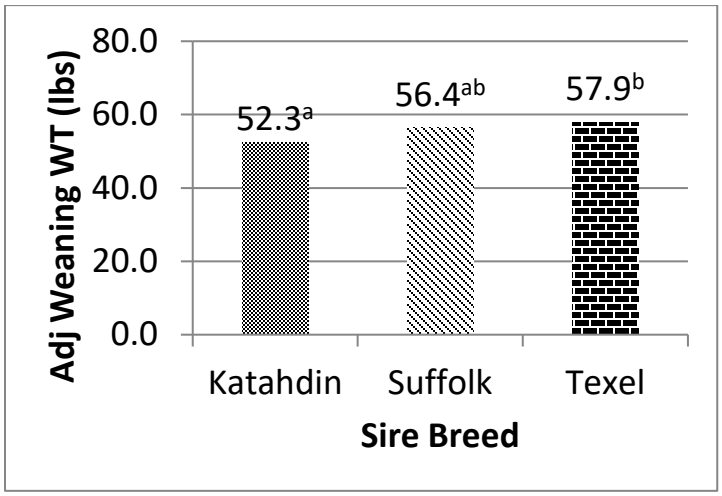
Upon reaching a final market weight a subsample of six lambs per breed group will be harvested at the Virginia Tech Meat Center for determination of carcass merit.

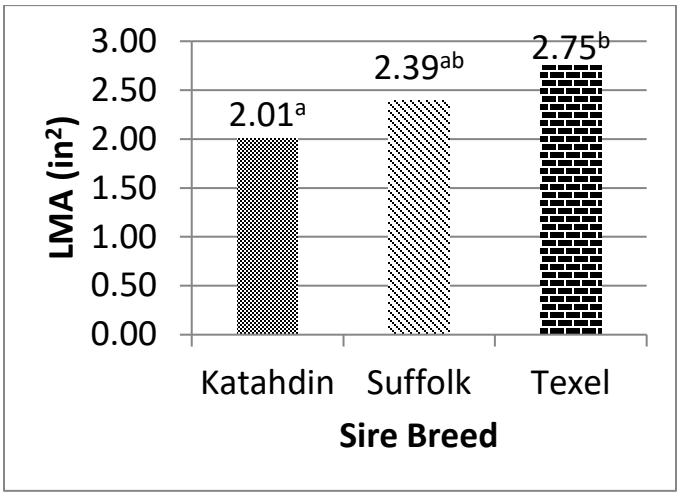
Collaboration with WVU on this project provides a unique opportunity to quantify differences in parasite tolerance among the sire breeds using both controlled and natural-infection research protocols which may subsequently be compared to better understand the biology of parasite resistance.

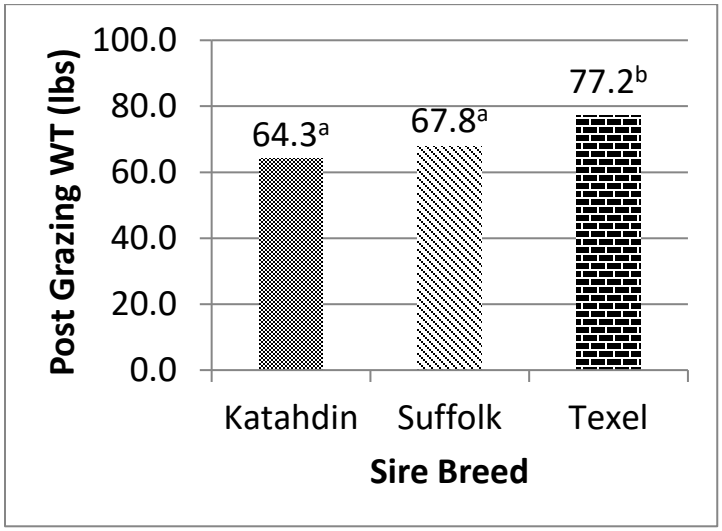
# 2015 Summary

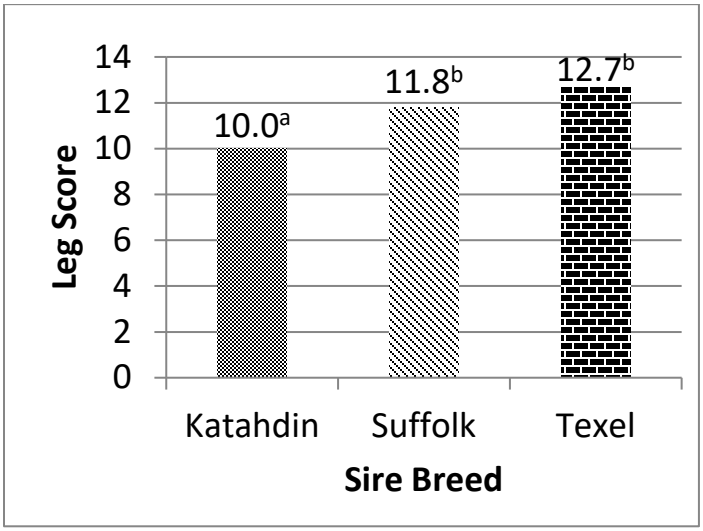


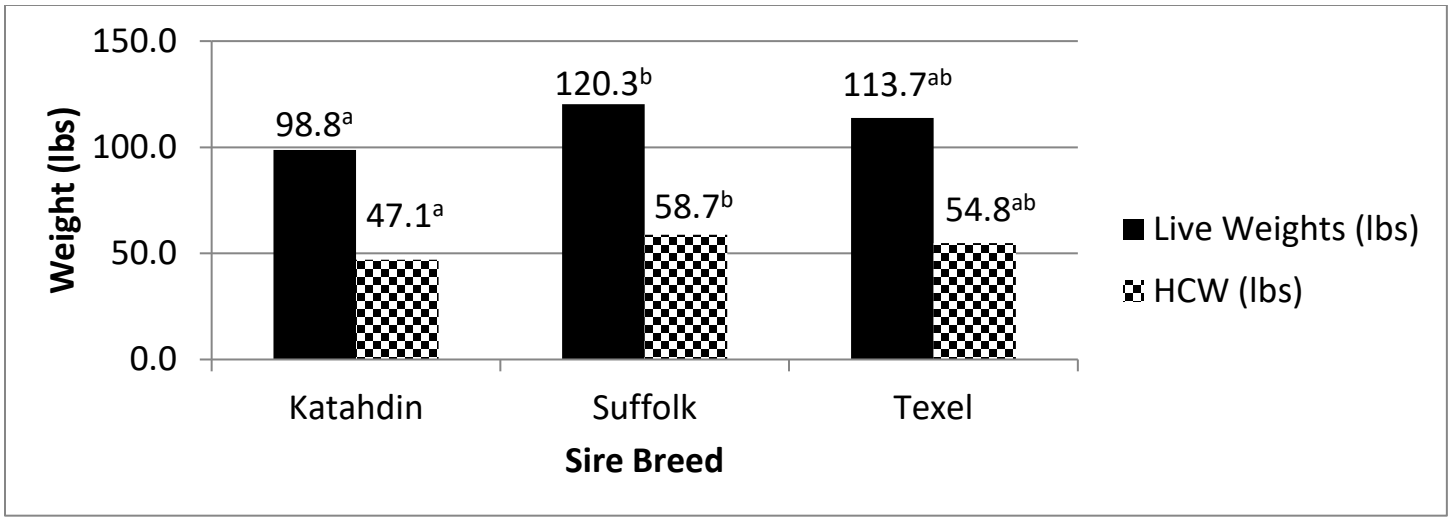



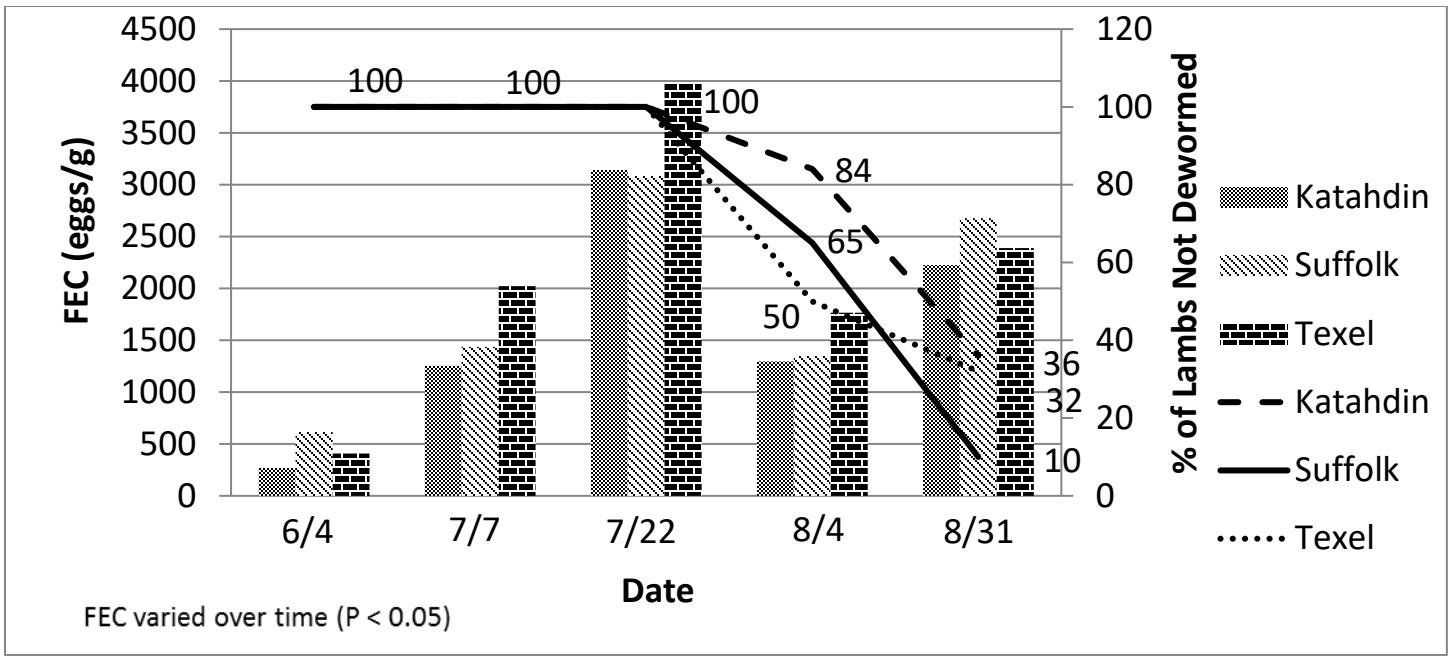



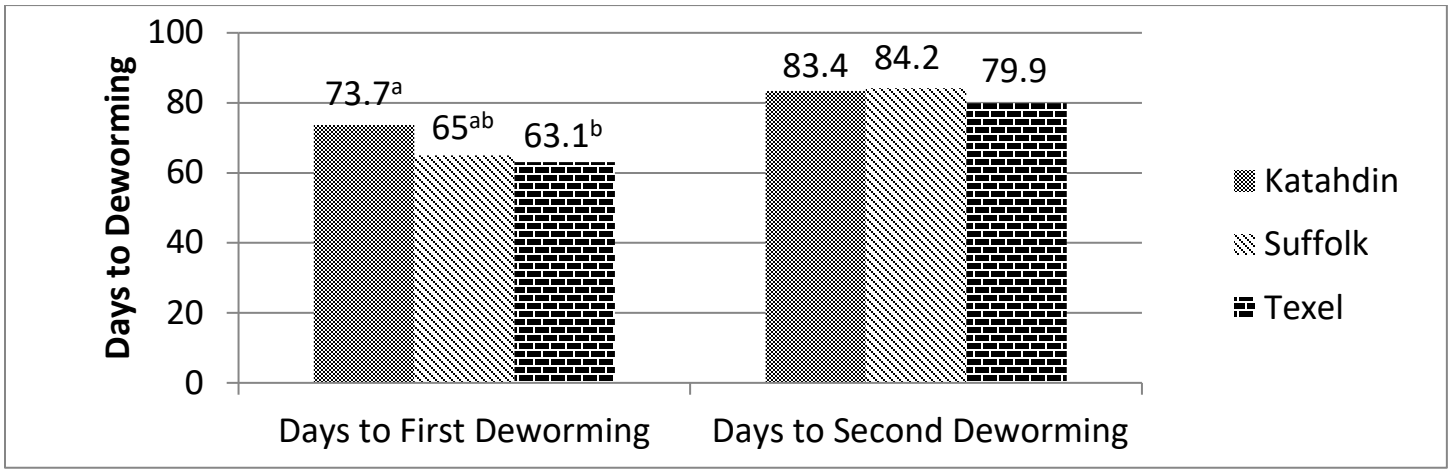




*Points denoted by different letters are significant to P < 0.05



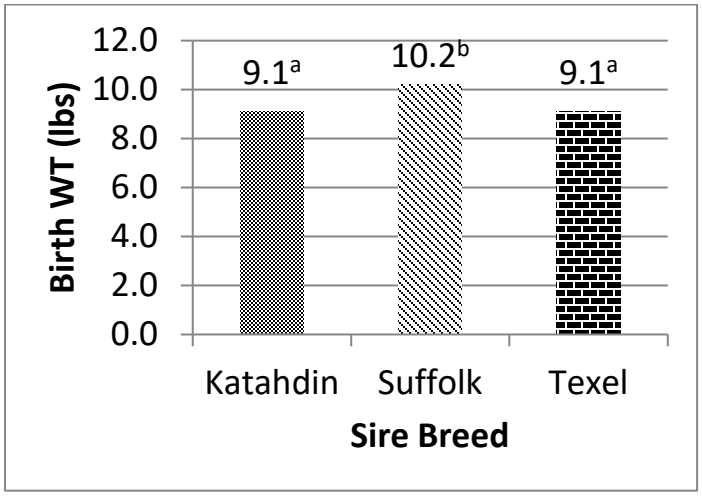



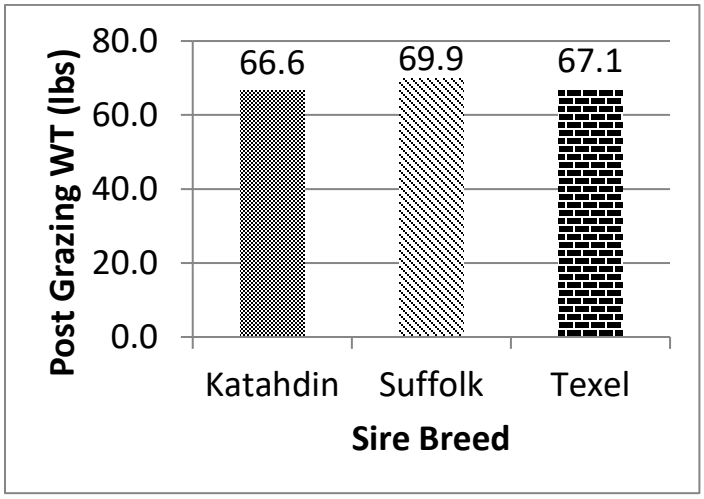

FEC varied over time ($P < 0.05$)

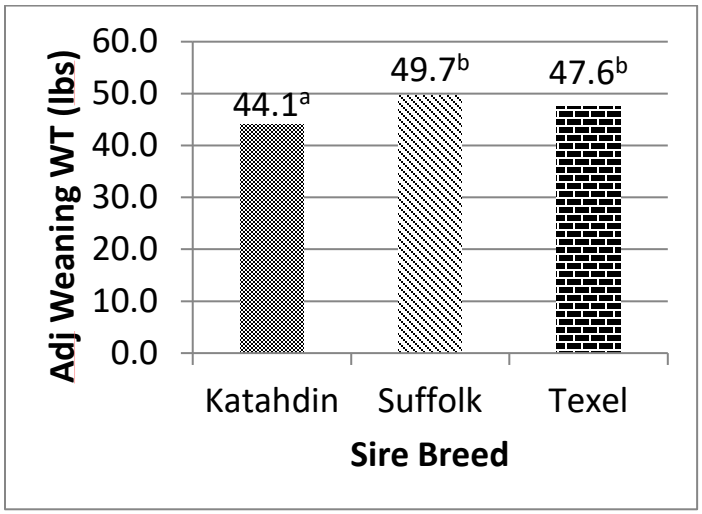


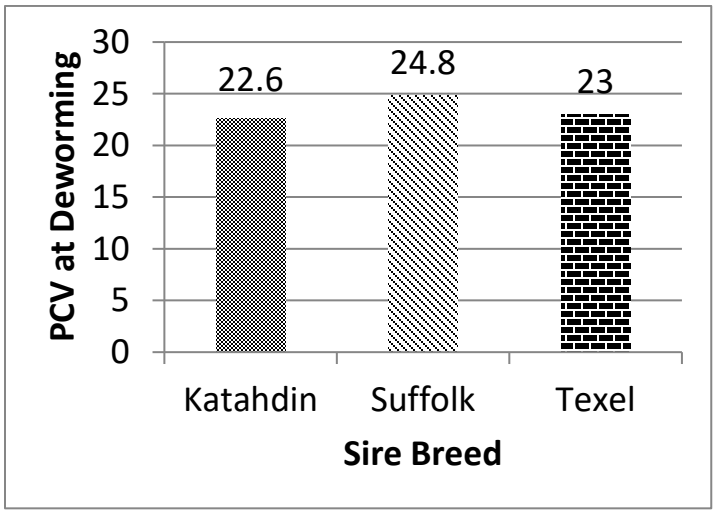

*Points denoted by different letters are significant to $P < 0.05$

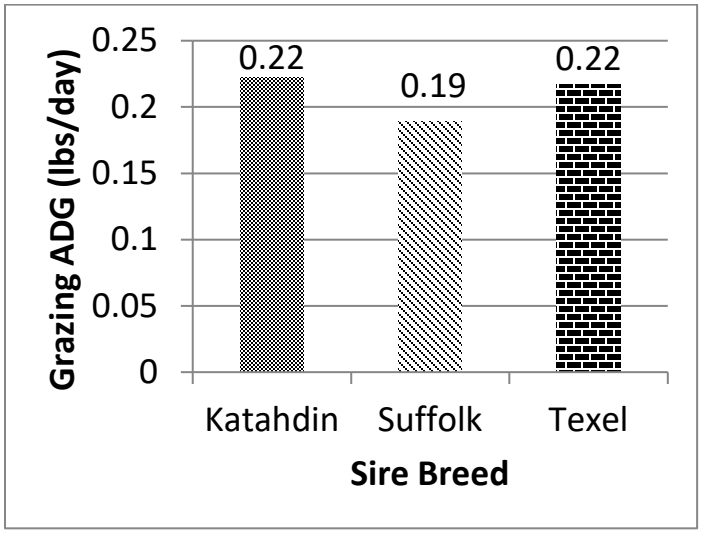
# 2016 Summary

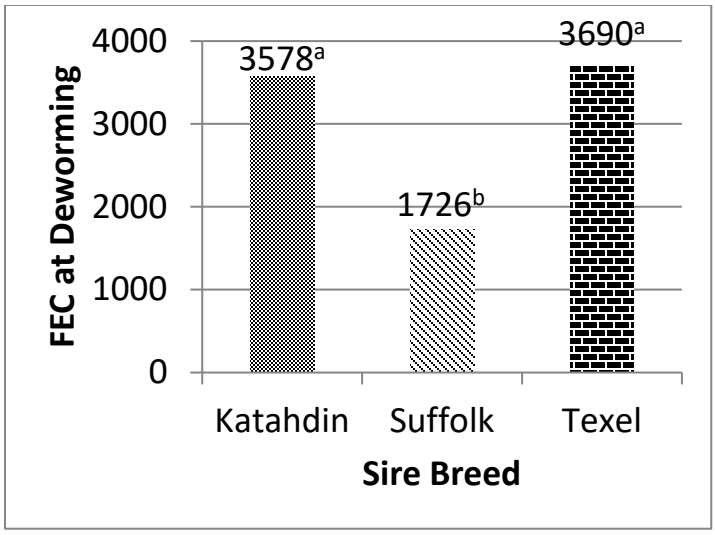
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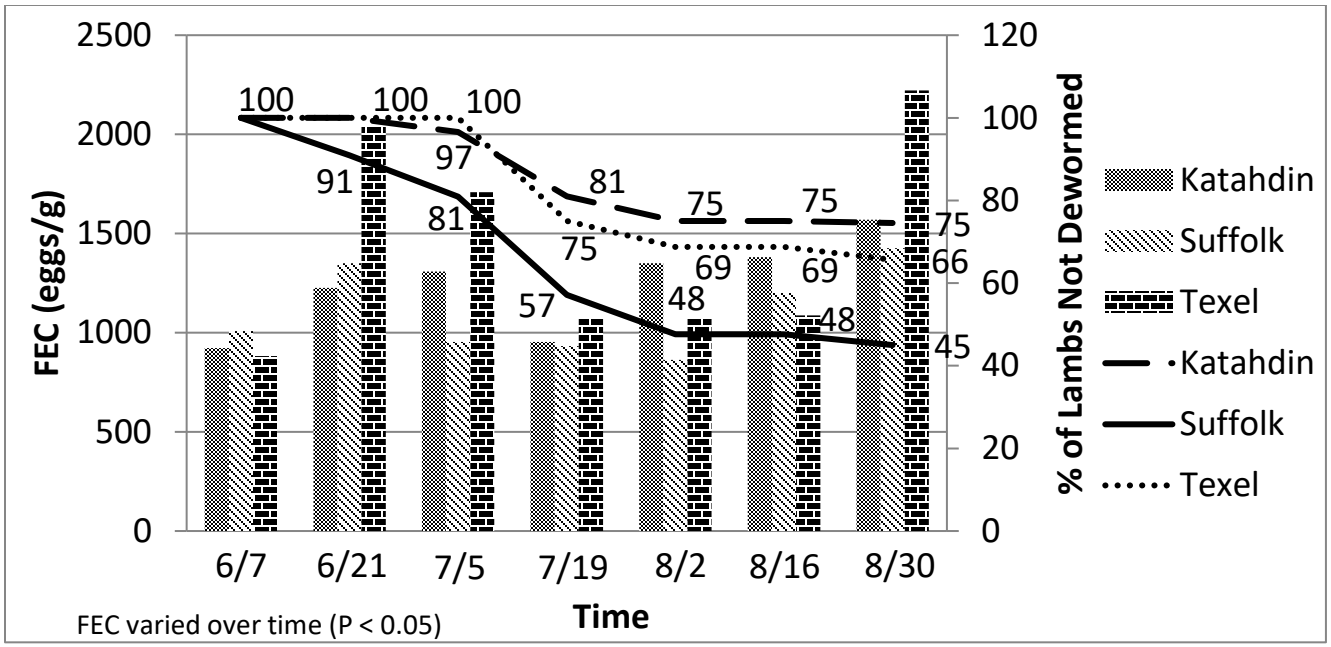
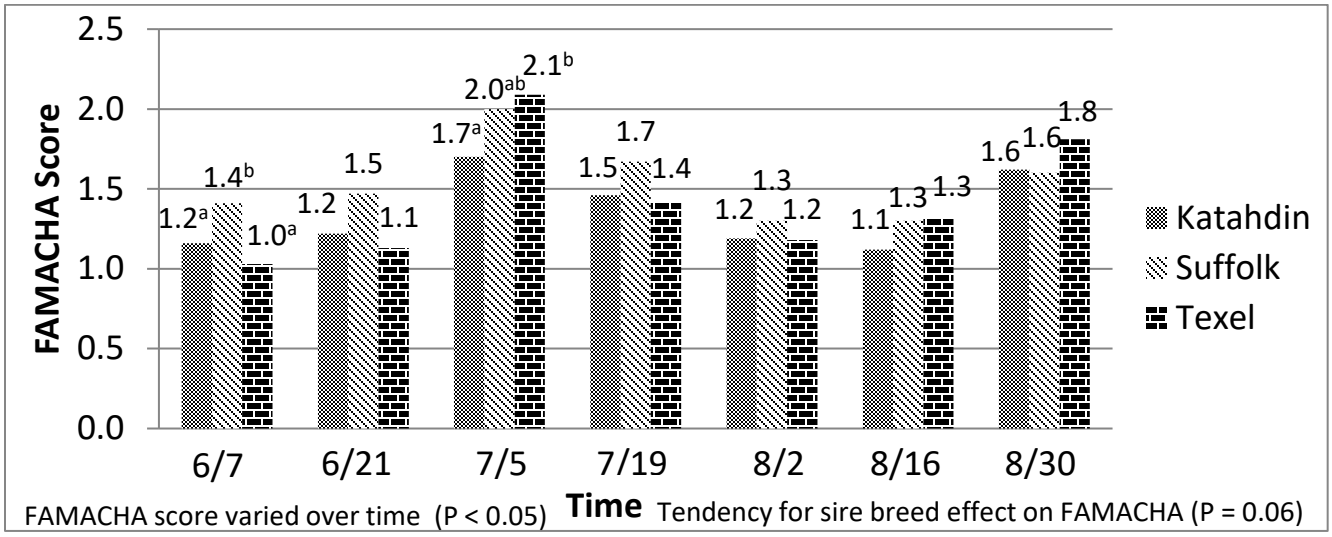
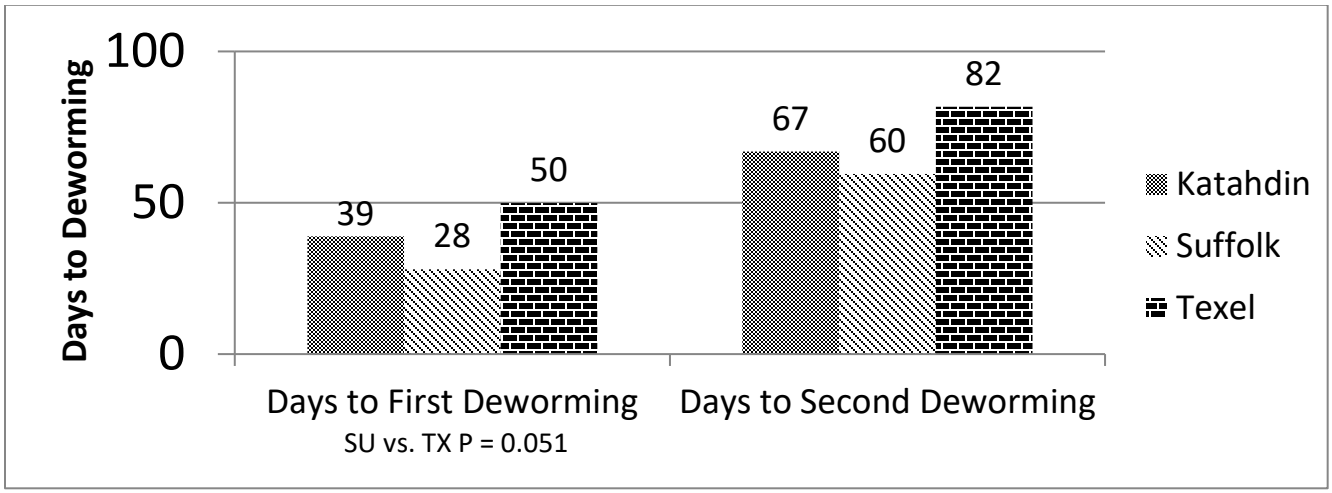



FEC varied over time ($P < 0.05$)




FAMACHA score varied over time ($P < 0.05$) Tendency for sire breed effect on FAMACHA ($P = 0.06$)

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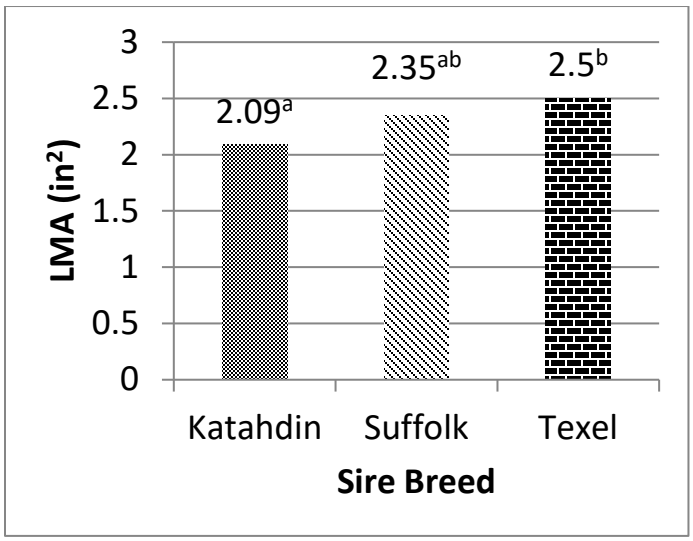


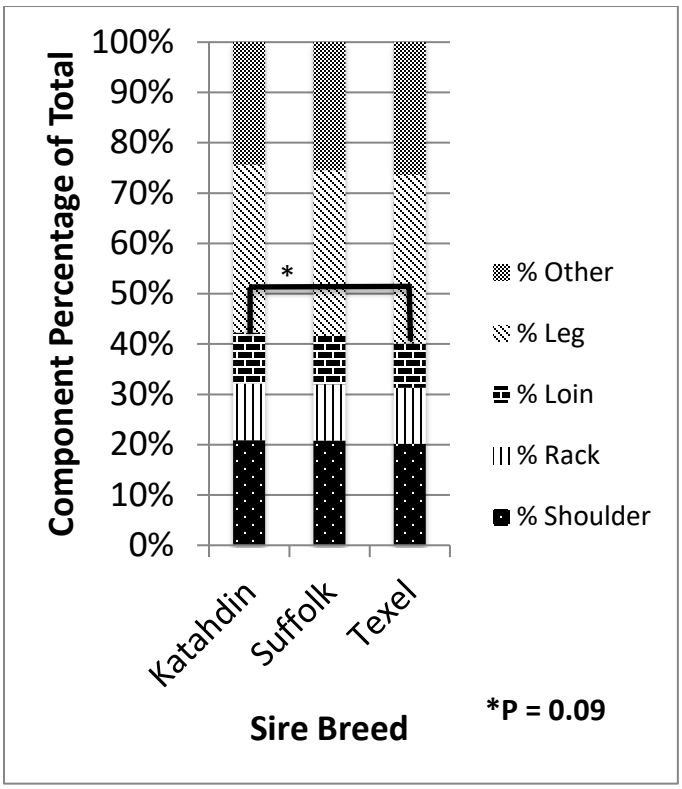


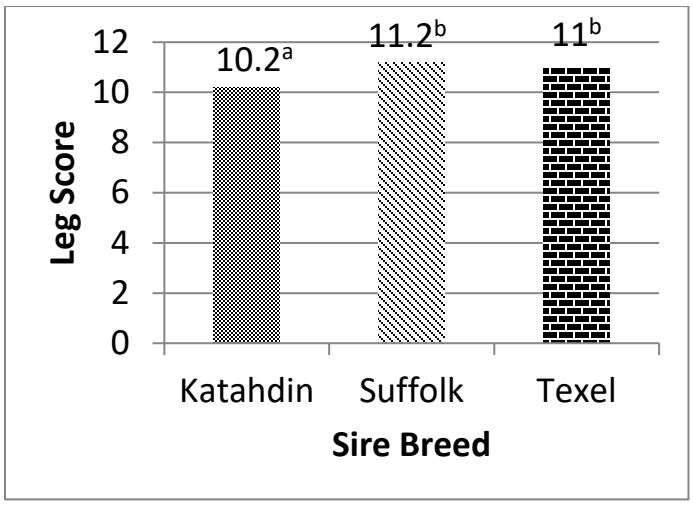


*Points denoted by different letters are significant to P < 0.05

# Summary

Pre-weaning

Similar ewe genetics resulted in no sire breed effects for number of lambs born or number of lambs weaned per ewe. While the Suffolk-sired lambs were the heaviest at birth, there were no observed differences in lambing difficulty. In both years, the Katahdin-sired lambs were the lightest at weaning. There were no differences for average daily gain (ADG) prior to weaning.

Post weaning growth

In year one, the Texel-sired lambs were the heaviest at the end of the summer grazing season (Aug. 31) while also having the greatest ADG during this time period. In year two, there was a tendency for a sire breed effect on weight over the grazing season. While the Suffolk-sired lambs were the heaviest over the entire time period, there were no sire breed differences in weight at the conclusion of the grazing season. There were also no sire breed effects for ADG.

Parasite Resistance

Fecal egg count (FEC), packed cell volume (PCV), and FAMACHA scored varied over the summer grazing season with no sire breed effects. However, a greater percentage of Suffolk-sired lambs in both years required deworming at some point. In year one, the Katahdin-sired lambs took the greatest number of days before requiring deworming. In year two, there was a tendency for the Texel-sired lambs to take a greater number of days before deworming than the Suffolk-sired lambs. In addition, the Suffolk-sired lambs had the lowest FEC at deworming.

Carcass Merit

The Suffolk-sired lambs were the heaviest at harvest in both years while also having the greatest hot carcass weights (HCW). There were no differences in dressing percentage. The Texel-sired lambs had the greatest loin muscle area (LMA) in both years as well as leg scores in year one. The Katahdin-sired lambs had the greatest internal fat in year one with no differences in year two. There were also no sire breed differences for USDA Yield or Quality Grades. There was a tendency for the Katahdin-sired lambs to have a greater percentage loin than the Texel-sired lambs; however, there were no further sire breed differences in component percentages. There were no differences in carcass value between the sire breeds resulting from composition.

Conclusions

The Texel breed as terminal sires in hair sheep production systems has shown potential for increasing growth and enhancing carcass merit while maintaining parasite tolerance similar to the Katahdin. The Texel-sired lambs had the greatest grazing growth in year one while having the greatest LMA and greater leg scores than the Katahdin-sired lambs in both years. Deworming rates were similar for Katahdin- and Texel-sired lambs in both years.

## Returns on Ram Selection: a theoretical 10-year budget scenario to estimate financial return on selection for measureable economically important traits.

By Tom Stanley, Extension Agent, Farm Business Management

The attached budgets and tables attempt to illustrate the financial impact a focused sire-selection program can have on flock performance and financial returns. The author has attempted to describe a spring lambing sheep flock that is experiencing significant parasite pressure and has a genetic base with moderate to low growth rates. The analysis attempts to quantify the financial impacts that consistent application of selection standards over time. The analysis illustrates annual net income being improved by 14% when selecting for growth alone, 23% when selecting for lower fecal egg count alone, and 38% when sires are used that improve both growth and lower fecal egg count. Table 5 calculates the value each ram brings to the particular selection program.

The flock's financial performance in the first year of the selection program is illustrated in the complete enterprise budget that follows. The author has set flock size at 100 ewes since this makes the costs and returns a little easier to inspect at a glance since when looking at total costs for the flock- cost per ewe can be determined simply by moving the decimal two places. The budget assumes a ratio of 25 ewes to one ram. In the case of flocks smaller than 25 ewes or there are fewer ewes per ram the estimated returns to the shepherd for each ram selected will be lower.

These budget projections attempt to quantify the financial benefit that can be captured when heritable traits of economic importance can be quantitatively measured and sire selection based on these traits is consistently applied over time. Recent interest in sires rated for their fecal egg count and the success in improving parasite resistance through sire selection in Australia and New Zealand prompts us to explore the possible financial benefit from purchasing rams identified as having lower fecal egg counts.

There are limitations to this type of analysis. The heritability of the selected trait(s) and the number of traits that are simultaneously selected for impacts the rate of progress. The plethora of other management and environmental factors that impact costs and returns alter what a shepherd will actually experience. However, it is the type of analysis presented here that allows us to hold these other factors constant and hopefully isolate and observe the benefits that can be realized through sire selection. In this scenario, the flock in year one is composed of ewes with typical fecal egg counts and moderate to low growth rates, therefore there is 'room to improve'. Flocks that have already achieved high rates of growth or have high levels of parasite resistance are less likely to realize as much gain as is illustrated here.

Points to Remember:

**1) This is a 'theoretical exercise' intended to illustrate the progress a shepherd can make with a flock that has potential to improve in both growth and parasite resistance.**

**2) The progress in flock performance described in these budget scenarios is accomplished exclusively through ram selection. It is assumed that the rams that have superior performance for growth and/or lower FEC are accurately identified. Much more rapid progress could be achieved if a shepherd also purchases replacement ewes that are superior in the performance areas described (growth and/or lower fecal egg count).**

**3) Genetic progress on a flock basis is a process of years and requires focus and planning. The more traits we attempt to improve, the slower the progress.**

**4) Aggressive selection for one trait often results in compromising on other traits.**

Virginia Cooperative Extension

**Shepherd's Symposium, January 2017** PUBLICATION 446-047

# COMPLETE ENTERPRISE BUDGET, YEAR 1 OF SIRE SELECTION SCENARIO

**100 EWES $8,837.48 =Net Income**

**170% LAMB CROP** | **4 RAMS** | **100% OF LAMBS FINISHED WITH PURCHASED FEED**

**20% LAMB Death Loss** | **20% CULLS** | **40 WEANING WEIGHT (LBS)**

**1.36 = Lambs Raised per Ewe** | **0.50 ADG** | **7.0 TO 1 POST WEANING FEED CONVERSION**

| ITEM | HEAD | | CWT | UNIT | PRICE | | QUANTITY | TOTAL | Your Farm |
|---|---|---|---|---|---|---|---|---|---|
| **1. GROSS RECEIPTS** | | 20% Percent of Lambs Unthrify | | | | $/hd | | | |
| Good Lambs | 94 | @ | 1.10 | Cwt | $200.00 | 220.00 | 102.96 | $20,592.00 | |
| Unthrifty Lambs | 23 | @ | 0.65 | Cwt | $230.00 | 149.50 | 15.21 | $3,498.30 | |
| Cull Ewes | 16 | @ | 1.50 | Cwt | $90.00 | | 24.00 | $2,160.00 | |
| Cull Ram | 1 | @ | 2.00 | Cwt | $80.00 | | 2.00 | $160.00 | |
| Wool | | | 6.50 | Lbs/Head | $0.80 | | 669.50 | $535.60 | |
| **2. TOTAL GROSS RECEIPTS** | | | | | | **$269.46** | **Per Ewe** | **$26,945.90** | |
| **3. VARIABLE COSTS** | | | | | | | | | |
| | | | Est. Acres= | 52.55 | | | | | |
| | Feed Loss | T/Ac | | | | | | | |
| Alfalfa Hay | 5.0% | | | Ton | $135.00 | | 5.50 | $742.49 | |
| 1st cutting grass hay | 20.0% | | | Ton | $50.00 | | 0.00 | $0.00 | |
| 2nd cutting grass hay | 5.0% | 1.50 | 10.22 | Ton | $180.00 | | 15.33 | $2,759.40 | |
| Stkpld Fescue DM | 15.0% | 3.00 | 8.91 | Ton | $20.00 | | 26.72 | $534.46 | |
| Pelleted Supplement | 2.0% | | | Ton | $275.00 | | 13.73 | $3,774.69 | |
| Corn | 2.0% | | | Ton | $175.00 | | 12.03 | $2,104.69 | |
| | | Lbs per | | | | | | | |
| Flush Ewes | 0.5 | Ewe | 21 | days | $400.00 | per Ton | 0.53 | $210.00 | |
| Perinneal Alf/Grass DM | 15.0% | 4.00 | 11.19 | Ton | $20.00 | | 44.75 | $895.02 | |
| Summer Annual DM | 15.0% | 3.50 | 1.23 | Ton | $20.00 | | 4.31 | $86.25 | |
| Winter Annual DM | 15.0% | 2.00 | 0.00 | Ton | $20.00 | | 0.00 | $0.00 | |
| Grinding & Mixing | | Cwt | | Cwt | $0.00 | | 0.00 | $0.00 | |
| Salt & Mineral | | Lbs per Ewe | | Cwt | $20.00 | | 19.58 | $391.64 | |
| Vet & Medicine | | $/Head | | Head | $7.57 | | 100 | $756.78 | |
| Shearing & Wool Handling | | | | Head | $6.00 | | 104 | $624.00 | |
| Supplies | | | | Head | $5.00 | | 100 | $500.00 | |
| Electric Netting | | | | Rolls | $125.00 | | 4 | $500.00 | |
| Replacement Ram | | | | Head | $600.00 | | 1 | $600.00 | |
| Synchronize ewes | | | | Head | $0.00 | | 100 | $0.00 | |
| Stockpiled Pasture | 0.00 | Acres per Ewe | | Acre | $51.00 | | 0 | $0.00 | |
| Pasture | 0.35 | Acres per Ewe | | Acre | $12.00 | | 35 | $420.00 | |
| Haul Cull Sheep | | | | Head | $2.00 | | 17 | $34.00 | |
| Market Cull Sheep | 12 | $/Head | | Head | $7.09 | | 17 | $204.00 | |
| Haul Sheep | | | | Head | $3.00 | | 93.6 | $280.80 | |
| Market Sheep | 12 | $/Head | | Head | $9.60 | | 93.6 | $1,123.20 | |
| Virginia Check-off | | | | Head | $0.50 | | 134 | $67.00 | |
| Building & Fence Repairs | | | | Head | $12.00 | | 100 | $1,200.00 | |
| Utilities | | | | Head | $0.90 | | 100 | $90.00 | |
| Bedding | 8 | Lbs per Ewe | | Ton | $80.00 | | 0.4 | $32.00 | |
| Machinery (Non-Crop) | | | | Head | $1.78 | | 100 | $178.00 | |
| Land Rental | | | | Acre/Year | $0.00 | | 35 | $0.00 | |
| Labor | | Hours per Week | | Hours | $0.00 | | 0 | $0.00 | |
| Operating Interest | 12 | Months | | Dollars | 0.00% | | $ 16,466 | **$0.00** | |
| **4. TOTAL VARIABLE COSTS** | | | | | | **$181.08** | **Per Ewe** | **$18,108.42** | |
| **5. ANNUAL DEBT PAYMENTS** | | | | | | | | **$0.00** | |
| **6. PROJECTED NET RETURN TO EQUITY, MANAGEMENT, & FAMILY LABOR** | | | | | | **$88.37** | **Per Ewe** | **$8,837.48** | |

| **Table 1.** | | | **Projected Returns When Level of Performance Remains Constant** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | |
| % of Lamb Death Loss | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| % of Lamb Crop Unthrifty but marketed | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| Weaning Weight | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | |
| Days on Feed | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | |
| Total Cost / Ewe | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | |
| Return / Ewe | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over 10 years:** | | | | **$625.86** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |
| | | | | | | | | | | | |
| **Scenario Assumptions:** | | | | | | **Essential Performance Benchmarks:** | | | | | |
| Spring Lambing Flock with high parasite load. | | | | | | Lambing Percentage | | | | | |
| 100 ewes, 4 rams, one ram purchased annually | | | | | | Ewe Cull Rate | | | | | |
| Management Uses FAMACHA for deworming decisions | | | | | | Lamb Death Loss | | | | | |
| Healthy Lambs weigh 110 lbs at market, and bring $2.00 / lb | | | | | | % Unthrifty Lambs (survive to be marketed but are poor quality) | | | | | |
| Unthrifty Lambs weigh 65 lbs at market and bring $2.30 / lb | | | | | | Weaning Weight | | | | | |
| No labor, land rent, or interest charges in this budget | | | | | | Total Number of Times Drench Administered | | | | | |
| Interest Rate for Net Present Value Calculations: | | | 3.00% | | | Avg Daily Gain by Lambs on Feed | | | | | |

**Table 2. Projected Returns When Ram Selection Focuses On Growth**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 0% |
| % Unthrifty Lambs | 20 | 20 | 20 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | -10% |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 0% |
| Weaning Weight | 40 | 40 | 45 | 45 | 47 | 47 | 50 | 52 | 55 | 55 | 38% |
| Days on Feed | 140 | 133 | 118 | 118 | 110 | 105 | 92 | 89 | 81 | 79 | -44% |
| Avg Daily Gain | 0.500 | 0.525 | 0.550 | 0.550 | 0.575 | 0.600 | 0.650 | 0.650 | 0.675 | 0.700 | 40% |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 0% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | 0% |
| Total Cost / Ewe | $ 181.08 | $ 178.97 | $ 174.90 | $ 173.28 | $ 184.39 | $ 182.03 | $ 176.96 | $ 175.15 | $ 172.45 | $ 170.38 | -6% |
| Return / Ewe | $ 88.37 | $ 90.49 | $ 94.56 | $ 97.82 | $ 86.71 | $ 89.08 | $ 94.15 | $ 95.95 | $ 98.66 | $ 100.72 | 14% |

**Net Present Value of Income Stream per Ewe over the first ten years of intense selection: $796.82**

*Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb

**Table 3. Projected Returns When Ram Selection Focuses On Lower Fecal Egg Count.**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 18 | 18 | 16 | 14 | 13 | 12 | 10 | 10 | -50% |
| % Unthrifty Lambs | 20 | 20 | 18 | 18 | 16 | 15 | 13 | 11 | 9 | 7 | -65% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 16 | 13 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 39 | 39 | 38 | 37 | 37 | 37 | 37 | 36 | -10% |
| Days on Feed | 140 | 140 | 149 | 158 | 169 | 172 | 183 | 183 | 183 | 185 | 32% |
| Avg Daily Gain | 0.500 | 0.500 | 0.475 | 0.450 | 0.425 | 0.425 | 0.400 | 0.400 | 0.400 | 0.400 | -20% |
| Annual Drenches* | 797 | 797 | 618 | 598 | 412 | 396 | 378 | 220 | 219 | 198 | -75% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 93.37 | $ 86.70 | $ 67.40 | $ 61.52 | $ 55.05 | $ 34.55 | $ 34.83 | $ 30.78 | -74% |
| Total Cost / Ewe | $ 181.08 | $ 181.08 | $ 183.71 | $ 183.67 | $ 202.99 | $ 206.68 | $ 208.00 | $ 209.32 | $ 212.25 | $ 213.57 | 18% |
| Return / Ewe | $ 88.37 | $ 88.37 | $ 93.62 | $ 93.66 | $ 85.12 | $ 92.17 | $ 98.43 | $ 100.37 | $ 107.89 | $ 108.53 | 23% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | **$811.31** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | |

| **Table 4.** | | **Projected Returns When Ram Selection Focuses On Both Growth And Lower Fecal Egg Count.** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 19 | 18 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Unthrifty Lambs | 20 | 19 | 18 | 17 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 17 | 16 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 42 | 42 | 43 | 45 | 45 | 47 | 48 | 49 | 23% |
| Days on Feed | 140 | 140 | 136 | 130 | 122 | 118 | 118 | 110 | 103 | 102 | -27% |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.525 | 0.550 | 0.550 | 0.550 | 0.575 | 0.600 | 0.600 | 20% |
| Annual Drenches | 797 | 797 | 802 | 806 | 566 | 565 | 567 | 569 | 567 | 570 | -28% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.91 | $ 120.47 | $ 88.96 | $ 87.88 | $ 87.22 | $ 86.56 | $ 87.04 | $ 87.46 | -27% |
| Total Cost / Ewe | $ 181.08 | $ 181.26 | $ 180.61 | $ 181.79 | $ 196.46 | $ 191.73 | $ 192.87 | $ 191.99 | $ 194.59 | $ 192.20 | 6% |
| Return / Ewe | $ 88.37 | $ 89.02 | $ 92.57 | $ 96.38 | $ 88.68 | $ 94.15 | $ 96.71 | $ 103.41 | $ 114.14 | $ 121.73 | 38% |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$833.74** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |

| **Table 5.** | | | |
|---|---|---|---|
| System/Description | Net Present Value of Income Stream per ewe over 10-year period of sire selection | Net Present Value of income stream per ewe, multiplied by 25 ewes and spread across 2.5 rams* | Dollars delivered to the shepherd by each ram above what will be realized from a 'grade ram' that does not improve the flock in either growth or fecal egg count.** |
| Flock Maintains Level Performance | $625.86 | $6,258.60 | $0.00 |
| Rams are selected for Growth only | $796.82 | $7,968.20 | $1,709.60 |
| Rams are selected for Low FEC only | $811.31 | $8,113.10 | $1,854.50 |
| Rams are selected for both Low FEC and Growth | $833.74 | $8,337.40 | $2,078.80 |
| | | *2.5 rams = 10 year period with a new ram introduced every 4 years | **based on 25 ewes per ram, new ram every 4 years |

# Returns on Ram Selection: a theoretical 10-year budget scenario to estimate financial return on selection for measureable economically important traits.

By Tom Stanley, Extension Agent, Farm Business Management

The attached budgets and tables attempt to illustrate the financial impact a focused sire-selection program can have on flock performance and financial returns. The author has attempted to describe a spring lambing sheep flock that is experiencing significant parasite pressure and has a genetic base with moderate to low growth rates. The analysis attempts to quantify the financial impacts that consistent application of selection standards over time. The analysis illustrates annual net income being improved by 14% when selecting for growth alone, 23% when selecting for lower fecal egg count alone, and 38% when sires are used that improve both growth and lower fecal egg count. Table 5 calculates the improved profit each ram brings to the particular selection program. The values in Table 5 capture some but not all of the 'multiplier effects' that a ram will have where the flock is generating its own replacement females.

The flock's complete costs and returns in the first year of the selection program is illustrated in the itemized enterprise budget that follows. The author has set flock size at 100 ewes since this makes the costs and returns a little easier to inspect at a glance since when looking at total costs for the flock- cost per ewe can be determined simply by moving the decimal two places. The budget assumes a ratio of 25 ewes to one ram. In cases where there are fewer than 25 ewes per ram the estimated returns to the shepherd for each ram selected will be lower.

These budget projections attempt to quantify the financial benefit that can be captured when heritable traits of economic importance can be quantitatively measured and sire selection based on these traits is consistently applied over time. Recent interest in sires rated for their fecal egg count (FEC) and the success in improving parasite resistance through sire selection based on FEC in Australia and New Zealand prompts us to explore the possible financial benefit from purchasing rams identified as having lower fecal egg counts.

There are limitations to this type of analysis. The heritability of the selected trait(s) and the number of traits that are simultaneously selected for impacts the rate of progress. The plethora of other management and environmental factors that impact costs and returns alter what a shepherd will actually experience. However, it is the type of analysis presented here that allows us to hold these other factors constant and hopefully isolate and observe the benefits that can be realized through sire selection. In this scenario, the flock in year one is composed of ewes with typical fecal egg counts and moderate to low growth rates, therefore there is 'room to improve'. Flocks that have already achieved high rates of growth or have high levels of parasite resistance are less likely to realize as much gain as is illustrated here.

Points to Remember:

**1) This is a 'theoretical exercise' intended to illustrate the progress a shepherd can make with a flock that has potential to improve in both growth and parasite resistance.**

**2) The progress in flock performance described in these budget scenarios is accomplished exclusively through ram selection. It is assumed that the rams that have superior performance for growth and/or lower FEC are accurately identified. Much more rapid progress could be achieved if a shepherd also purchases replacement ewes that are superior in the performance areas of growth and/or lower fecal egg count.**

**3) Genetic progress on a flock basis is a process of years and requires focus and planning. The more traits we attempt to improve, the slower the progress.**

**4) Aggressive selection for one trait often results in compromising on other traits.**

Virginia
Cooperative
Extension

Shepherd's Symposium, January 2017

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# COMPLETE ENTERPRISE BUDGET, YEAR 1 OF SIRE SELECTION SCENARIO

| | | | |
|---|---|---|---|
| | 100 EWES | $8,837.48 =Net Income | |
| 170% LAMB CROP | 4 RAMS | 100% OF LAMBS FINISHED WITH PURCHASED FEED | |
| 20% LAMB Death Loss | 28% CULLS | 40 WEANING WEIGHT (LBS) | |
| 1.36 = Lambs Raised per Ewe | 0.50 ADG | 7.0 TO 1 POST WEANING FEED CONVERSION | |

| ITEM | HEAD | | CWT | UNIT | PRICE | | QUANTITY | TOTAL | Your Farm |
|---|---|---|---|---|---|---|---|---|---|
| **1. GROSS RECEIPTS** | 20% Percent of Lambs Unthrify | | | | $/hd | | | | |
| Good Lambs | 94 @ | | 1.10 | Cwt | $200.00 | 220.00 | 102.96 | $20,592.00 | |
| Unthrifty Lambs | 23 @ | | 0.65 | Cwt | $230.00 | 149.50 | 15.21 | $3,498.30 | |
| Cull Ewes | 16 @ | | 1.50 | Cwt | $90.00 | | 24.00 | $2,160.00 | |
| Cull Ram | 1 @ | | 2.00 | Cwt | $80.00 | | 2.00 | $160.00 | |
| Wool | | | 6.50 | Lbs/Head | $0.80 | | 669.50 | $535.60 | |
| **2. TOTAL GROSS RECEIPTS** | | | | | | **$269.46** | Per Ewe | **$26,945.90** | |
| **3. VARIABLE COSTS** | | | | | | | | | |
| | | | Est. Acres= | 52.55 | | | | | |
| | Feed Loss | T/Ac | | | | | | | |
| Alfalfa Hay | 5.0% | | | Ton | $135.00 | | 5.50 | $742.49 | |
| 1st cutting grass hay | 20.0% | | | Ton | $50.00 | | 0.00 | $0.00 | |
| 2nd cutting grass hay | 5.0% | 1.50 | 10.22 | Ton | $120.00 | | 15.33 | $2,759.40 | |
| Stkpld Fescue DM | 15.0% | 3.00 | 8.91 | Ton | $20.00 | | 26.72 | $534.46 | |
| Pelleted Supplement | 2.0% | | | Ton | $275.00 | | 13.73 | $3,774.69 | |
| Corn | 2.0% | | | Ton | $175.00 | | 12.03 | $2,104.69 | |
| | | Lbs per | | | | | | | |
| Flush Ewes | 0.5 | Ewe | 21 | days | $400.00 | per Ton | 0.53 | $210.00 | |
| Perinneal Alf/Grass DM | 15.0% | 4.00 | 11.19 | Ton | $20.00 | | 44.75 | $895.02 | |
| Summer Annual DM | 15.0% | 3.50 | 1.23 | Ton | $20.00 | | 4.31 | $86.25 | |
| Winter Annual DM | 15.0% | 2.00 | 0.00 | Ton | $20.00 | | 0.00 | $0.00 | |
| Grinding & Mixing | | Cwt | | Cwt | $0.00 | | 0.00 | $0.00 | |
| Salt & Mineral | | Lbs per Ewe | | Cwt | $20.00 | | 19.58 | $391.64 | |
| Vet & Medicine | | $/Head | | Head | $7.57 | | 100 | $756.78 | |
| Shearing & Wool Handling | | | | Head | $6.00 | | 104 | $624.00 | |
| Supplies | | | | Head | $5.00 | | 100 | $500.00 | |
| Electric Netting | | | | Rolls | $125.00 | | 4 | $500.00 | |
| Replacement Ram | | | | Head | $600.00 | | 1 | $600.00 | |
| Synchronize ewes | | | | Head | $0.00 | | 100 | $0.00 | |
| Stockpiled Pasture | 0.00 | Acres per Ewe | | Acre | $51.00 | | 0 | $0.00 | |
| Pasture | 0.35 | Acres per Ewe | | Acre | $12.00 | | 35 | $420.00 | |
| Haul Cull Sheep | | | | Head | $2.00 | | 17 | $34.00 | |
| Market Cull Sheep | 12 | $/Head | | Head | $7.09 | | 17 | $204.00 | |
| Haul Sheep | | | | Head | $3.00 | | 93.6 | $280.80 | |
| Market Sheep | 12 | $/Head | | Head | $9.60 | | 93.6 | $1,123.20 | |
| Virginia Check-off | | | | Head | $0.50 | | 134 | $67.00 | |
| Building & Fence Repairs | | | | Head | $12.00 | | 100 | $1,200.00 | |
| Utilities | | | | Head | $0.90 | | 100 | $90.00 | |
| Bedding | 8 | Lbs per Ewe | | Ton | $80.00 | | 0.4 | $32.00 | |
| Machinery (Non-Crop) | | | | Head | $1.78 | | 100 | $178.00 | |
| Land Rental | | | | Acre/Year | $0.00 | | 35 | $0.00 | |
| Labor | | Hours per Week | | Hours | $0.00 | | 0 | $0.00 | |
| Operating Interest | 12 | Months | | Dollars | 0.00% | | $ 16,466 | **$0.00** | |
| **4. TOTAL VARIABLE COSTS** | | | | | | **$181.08** | Per Ewe | **$18,108.42** | |
| **5. ANNUAL DEBT PAYMENTS** | | | | | | | | **$0.00** | |
| **6. PROJECTED NET RETURN TO EQUITY, MANAGEMENT, & FAMILY LABOR** | | | | | | **$88.37** | Per Ewe | **$8,837.48** | |

| Table 1. | | | Projected Returns When Level of Performance Remains Constant | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 |
| % of Lamb Death Loss | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| % of Lamb Crop Unthrifty but marketed | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Weaning Weight | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Days on Feed | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 |
| Total Cost / Ewe | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 |
| Return / Ewe | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 |

**Net Present Value of Income Stream per Ewe over 10 years:** **$753.81**

*Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb

| **Scenario Assumptions:** | | **Essential Performance Benchmarks That Change:** |
|---|---|---|
| Spring Lambing Flock with high parasite load. | | Ewe Cull Rate |
| 100 ewes, 4 rams, one ram purchased annually | | Lamb Death Loss |
| Management Uses FAMACHA for deworming decisions | | % Unthrifty Lambs (survive to be marketed but are poor quality) |
| Healthy Lambs weigh 110 lbs at market, and bring $2.00 / lb | | Weaning Weight |
| Unthrifty Lambs weigh 65 lbs at market and bring $2.30 / lb | | Total Number of Times Drench Administered |
| No labor, land rent, or interest charges in this budget | | Avg Daily Gain by Lambs on Feed |
| Interest Rate for Net Present Value Calculations: | 3.00% | Feed Efficiency (Growth Sire Only, not printed in tables) |

| Table 2. | | Projected Returns When Ram Selection Focuses On Growth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 0% |
| % Unthrifty Lambs | 20 | 20 | 20 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | -10% |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 0% |
| Weaning Weight | 40 | 40 | 45 | 45 | 47 | 47 | 50 | 52 | 55 | 55 | 38% |
| Days on Feed | 140 | 133 | 118 | 118 | 110 | 105 | 92 | 89 | 81 | 79 | -44% |
| Avg Daily Gain | 0.500 | 0.525 | 0.550 | 0.550 | 0.575 | 0.600 | 0.650 | 0.650 | 0.675 | 0.700 | 40% |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 0% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | 0% |
| Total Cost / Ewe | $ 181.08 | $ 178.97 | $ 174.90 | $ 173.28 | $ 184.39 | $ 182.03 | $ 176.96 | $ 175.15 | $ 172.45 | $ 170.38 | -6% |
| Return / Ewe | $ 88.37 | $ 90.49 | $ 94.56 | $ 97.82 | $ 86.71 | $ 89.08 | $ 94.15 | $ 95.95 | $ 98.66 | $ 100.72 | 14% |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$796.82** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |

| Table 3. | Projected Returns When Ram Selection Focuses On Lower Fecal Egg Count. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 18 | 18 | 16 | 14 | 13 | 12 | 10 | 10 | -50% |
| % Unthrifty Lambs | 20 | 20 | 18 | 18 | 16 | 15 | 13 | 11 | 9 | 7 | -65% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 16 | 13 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 39 | 39 | 38 | 37 | 37 | 37 | 37 | 36 | -10% |
| Days on Feed | 140 | 140 | 149 | 158 | 169 | 172 | 183 | 183 | 183 | 185 | 32% |
| Avg Daily Gain | 0.500 | 0.500 | 0.475 | 0.450 | 0.425 | 0.425 | 0.400 | 0.400 | 0.400 | 0.400 | -20% |
| Annual Drenches* | 797 | 797 | 618 | 598 | 412 | 396 | 378 | 220 | 219 | 198 | -75% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 93.37 | $ 86.70 | $ 67.40 | $ 61.52 | $ 55.05 | $ 34.55 | $ 34.83 | $ 30.78 | -74% |
| Total Cost / Ewe | $ 181.08 | $ 181.08 | $ 183.71 | $ 183.67 | $ 202.99 | $ 206.68 | $ 208.00 | $ 209.32 | $ 212.25 | $ 213.57 | 18% |
| Return / Ewe | $ 88.37 | $ 88.37 | $ 93.62 | $ 93.66 | $ 85.12 | $ 92.17 | $ 98.43 | $ 100.37 | $ 107.89 | $ 108.53 | 23% |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$811.31** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |

| Table 4. | | Projected Returns When Ram Selection Focuses On Both Growth And Lower Fecal Egg Count. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 19 | 18 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Unthrifty Lambs | 20 | 19 | 18 | 17 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 17 | 16 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 42 | 42 | 43 | 45 | 45 | 47 | 48 | 49 | 23% |
| Days on Feed | 140 | 140 | 136 | 130 | 122 | 118 | 118 | 110 | 103 | 102 | -27% |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.525 | 0.550 | 0.550 | 0.550 | 0.575 | 0.600 | 0.600 | 20% |
| Annual Drenches | 797 | 797 | 802 | 806 | 566 | 565 | 567 | 569 | 567 | 570 | -28% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.91 | $ 120.47 | $ 88.96 | $ 87.88 | $ 87.22 | $ 86.56 | $ 87.04 | $ 87.46 | -27% |
| Total Cost / Ewe | $ 181.08 | $ 181.26 | $ 180.61 | $ 181.79 | $ 196.46 | $ 191.73 | $ 192.87 | $ 191.99 | $ 194.59 | $ 192.20 | 6% |
| Return / Ewe | $ 88.37 | $ 89.02 | $ 92.57 | $ 96.38 | $ 88.68 | $ 94.15 | $ 96.71 | $ 103.41 | $ 114.14 | $ 121.73 | 38% |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$833.74** | | | | | | | |

*Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb

| Table 5. | | | |
|---|---|---|---|
| System/Description | Net Present Value of Income Stream per ewe over 10-year period of sire selection | Net Present Value of income stream per ewe, multiplied by 25 ewes and spread across 2.5 rams* | Dollars delivered to the shepherd by each ram above what will be realized from a ram that does not improve the flock in either growth or fecal egg count.** |
| Flock Maintains Level Performance | $753.81 | $7,538.10 | $0.00 |
| Rams are selected for Growth only | $796.82 | $7,968.20 | $430.10 |
| Rams are selected for Low FEC only | $811.31 | $8,113.10 | $575.00 |
| Rams are selected for both Low FEC and Growth | $833.74 | $8,337.40 | $799.30 |

*2.5 rams = 10 year period with a new ram introduced every 4 years

**based on 25 ewes per ram, new ram every 4 years

## Returns on Ram Selection: a theoretical 10-year budget scenario to estimate financial return on selection for measureable economically important traits.

By Tom Stanley, Extension Agent, Farm Business Management

The attached budgets and tables attempt to illustrate the financial impact a focused sire-selection program can have on flock performance and financial returns. The author has attempted to describe a spring lambing sheep flock that is experiencing significant parasite pressure and has a genetic base with moderate to low growth rates. The analysis attempts to quantify the financial impacts that consistent application of selection standards over time. The analysis illustrates annual net income being improved by 14% when selecting for growth alone, 23% when selecting for lower fecal egg count alone, and 38% when sires are used that improve both growth and lower fecal egg count. Table 5 calculates the value each ram brings to the particular selection program.

The flock's financial performance in the first year of the selection program is illustrated in the complete enterprise budget that follows. The author has set flock size at 100 ewes since this makes the costs and returns a little easier to inspect at a glance since when looking at total costs for the flock- cost per ewe can be determined simply by moving the decimal two places. The budget assumes a ratio of 25 ewes to one ram. In the case of flocks smaller than 25 ewes or there are fewer ewes per ram the estimated returns to the shepherd for each ram selected will be lower.

These budget projections attempt to quantify the financial benefit that can be captured when heritable traits of economic importance can be quantitatively measured and sire selection based on these traits is consistently applied over time. Recent interest in sires rated for their fecal egg count and the success in improving parasite resistance through sire selection in Australia and New Zealand prompts us to explore the possible financial benefit from purchasing rams identified as having lower fecal egg counts.

There are limitations to this type of analysis. The heritability of the selected trait(s) and the number of traits that are simultaneously selected for impacts the rate of progress. The plethora of other management and environmental factors that impact costs and returns alter what a shepherd will actually experience. However, it is the type of analysis presented here that allows us to hold these other factors constant and hopefully isolate and observe the benefits that can be realized through sire selection. In this scenario, the flock in year one is composed of ewes with typical fecal egg counts and moderate to low growth rates, therefore there is 'room to improve'. Flocks that have already achieved high rates of growth or have high levels of parasite resistance are less likely to realize as much gain as is illustrated here.

Points to Remember:

**1) This is a 'theoretical exercise' intended to illustrate the progress a shepherd can make with a flock that has potential to improve in both growth and parasite resistance.**

**2) The progress in flock performance described in these budget scenarios is accomplished exclusively through ram selection. It is assumed that the rams that have superior performance for growth and/or lower FEC are accurately identified. Much more rapid progress could be achieved if a shepherd also purchases replacement ewes that are superior in the performance areas described (growth and/or lower fecal egg count).**

**3) Genetic progress on a flock basis is a process of years and requires focus and planning. The more traits we attempt to improve, the slower the progress.**

**4) Aggressive selection for one trait often results in compromising on other traits.**

Virginia Cooperative Extension

**Shepherd's Symposium, January 2017** PUBLICATION 446-047

# COMPLETE ENTERPRISE BUDGET, YEAR 1 OF SIRE SELECTION SCENARIO

**100 EWES $8,837.48 =Net Income**

**170% LAMB CROP** | **4 RAMS** | **100% OF LAMBS FINISHED WITH PURCHASED FEED**

**20% LAMB Death Loss** | **20% CULLS** | **40 WEANING WEIGHT (LBS)**

**1.36 = Lambs Raised per Ewe** | **0.50 ADG** | **7.0 TO 1 POST WEANING FEED CONVERSION**

| ITEM | HEAD | | CWT | UNIT | PRICE | | QUANTITY | TOTAL | Your Farm |
|---|---|---|---|---|---|---|---|---|---|
| **1. GROSS RECEIPTS** | | 20% Percent of Lambs Unthrify | | | | $/hd | | | |
| Good Lambs | 94 | @ | 1.10 | Cwt | $200.00 | 220.00 | 102.96 | $20,592.00 | |
| Unthrifty Lambs | 23 | @ | 0.65 | Cwt | $230.00 | 149.50 | 15.21 | $3,498.30 | |
| Cull Ewes | 16 | @ | 1.50 | Cwt | $90.00 | | 24.00 | $2,160.00 | |
| Cull Ram | 1 | @ | 2.00 | Cwt | $80.00 | | 2.00 | $160.00 | |
| Wool | | | 6.50 | Lbs/Head | $0.80 | | 669.50 | $535.60 | |
| **2. TOTAL GROSS RECEIPTS** | | | | | | **$269.46** | **Per Ewe** | **$26,945.90** | |
| **3. VARIABLE COSTS** | | | | | | | | | |
| | | | Est. Acres= | 52.55 | | | | | |
| | Feed Loss | T/Ac | | | | | | | |
| Alfalfa Hay | 5.0% | | | Ton | $135.00 | | 5.50 | $742.49 | |
| 1st cutting grass hay | 20.0% | | | Ton | $50.00 | | 0.00 | $0.00 | |
| 2nd cutting grass hay | 5.0% | 1.50 | 10.22 | Ton | $180.00 | | 15.33 | $2,759.40 | |
| Stkpld Fescue DM | 15.0% | 3.00 | 8.91 | Ton | $20.00 | | 26.72 | $534.46 | |
| Pelleted Supplement | 2.0% | | | Ton | $275.00 | | 13.73 | $3,774.69 | |
| Corn | 2.0% | | | Ton | $175.00 | | 12.03 | $2,104.69 | |
| | | Lbs per | | | | | | | |
| Flush Ewes | 0.5 | Ewe | 21 | days | $400.00 | per Ton | 0.53 | $210.00 | |
| Perinneal Alf/Grass DM | 15.0% | 4.00 | 11.19 | Ton | $20.00 | | 44.75 | $895.02 | |
| Summer Annual DM | 15.0% | 3.50 | 1.23 | Ton | $20.00 | | 4.31 | $86.25 | |
| Winter Annual DM | 15.0% | 2.00 | 0.00 | Ton | $20.00 | | 0.00 | $0.00 | |
| Grinding & Mixing | | Cwt | | Cwt | $0.00 | | 0.00 | $0.00 | |
| Salt & Mineral | | Lbs per Ewe | | Cwt | $20.00 | | 19.58 | $391.64 | |
| Vet & Medicine | | $/Head | | Head | $7.57 | | 100 | $756.78 | |
| Shearing & Wool Handling | | | | Head | $6.00 | | 104 | $624.00 | |
| Supplies | | | | Head | $5.00 | | 100 | $500.00 | |
| Electric Netting | | | | Rolls | $125.00 | | 4 | $500.00 | |
| Replacement Ram | | | | Head | $600.00 | | 1 | $600.00 | |
| Synchronize ewes | | | | Head | $0.00 | | 100 | $0.00 | |
| Stockpiled Pasture | 0.00 | Acres per Ewe | | Acre | $51.00 | | 0 | $0.00 | |
| Pasture | 0.35 | Acres per Ewe | | Acre | $12.00 | | 35 | $420.00 | |
| Haul Cull Sheep | | | | Head | $2.00 | | 17 | $34.00 | |
| Market Cull Sheep | 12 | $/Head | | Head | $7.09 | | 17 | $204.00 | |
| Haul Sheep | | | | Head | $3.00 | | 93.6 | $280.80 | |
| Market Sheep | 12 | $/Head | | Head | $9.60 | | 93.6 | $1,123.20 | |
| Virginia Check-off | | | | Head | $0.50 | | 134 | $67.00 | |
| Building & Fence Repairs | | | | Head | $12.00 | | 100 | $1,200.00 | |
| Utilities | | | | Head | $0.90 | | 100 | $90.00 | |
| Bedding | 8 | Lbs per Ewe | | Ton | $80.00 | | 0.4 | $32.00 | |
| Machinery (Non-Crop) | | | | Head | $1.78 | | 100 | $178.00 | |
| Land Rental | | | | Acre/Year | $0.00 | | 35 | $0.00 | |
| Labor | | Hours per Week | | Hours | $0.00 | | 0 | $0.00 | |
| Operating Interest | 12 | Months | | Dollars | 0.00% | | $ 16,466 | **$0.00** | |
| **4. TOTAL VARIABLE COSTS** | | | | | | **$181.08** | **Per Ewe** | **$18,108.42** | |
| **5. ANNUAL DEBT PAYMENTS** | | | | | | | | **$0.00** | |
| **6. PROJECTED NET RETURN TO EQUITY, MANAGEMENT, & FAMILY LABOR** | | | | | | **$88.37** | **Per Ewe** | **$8,837.48** | |

| **Table 1.** | | | **Projected Returns When Level of Performance Remains Constant** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | |
| % of Lamb Death Loss | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| % of Lamb Crop Unthrifty but marketed | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| Weaning Weight | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | |
| Days on Feed | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | |
| Total Cost / Ewe | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | $ 197.14 | |
| Return / Ewe | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | $ 73.37 | |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over 10 years:** | | | | **$625.86** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |
| | | | | | | | | | | | |
| **Scenario Assumptions:** | | | | | | **Essential Performance Benchmarks:** | | | | | |
| Spring Lambing Flock with high parasite load. | | | | | | Lambing Percentage | | | | | |
| 100 ewes, 4 rams, one ram purchased annually | | | | | | Ewe Cull Rate | | | | | |
| Management Uses FAMACHA for deworming decisions | | | | | | Lamb Death Loss | | | | | |
| Healthy Lambs weigh 110 lbs at market, and bring $2.00 / lb | | | | | | % Unthrifty Lambs (survive to be marketed but are poor quality) | | | | | |
| Unthrifty Lambs weigh 65 lbs at market and bring $2.30 / lb | | | | | | Weaning Weight | | | | | |
| No labor, land rent, or interest charges in this budget | | | | | | Total Number of Times Drench Administered | | | | | |
| Interest Rate for Net Present Value Calculations: | | | 3.00% | | | Avg Daily Gain by Lambs on Feed | | | | | |

**Table 2. Projected Returns When Ram Selection Focuses On Growth**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 0% |
| % Unthrifty Lambs | 20 | 20 | 20 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | -10% |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 0% |
| Weaning Weight | 40 | 40 | 45 | 45 | 47 | 47 | 50 | 52 | 55 | 55 | 38% |
| Days on Feed | 140 | 133 | 118 | 118 | 110 | 105 | 92 | 89 | 81 | 79 | -44% |
| Avg Daily Gain | 0.500 | 0.525 | 0.550 | 0.550 | 0.575 | 0.600 | 0.650 | 0.650 | 0.675 | 0.700 | 40% |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 0% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | 0% |
| Total Cost / Ewe | $ 181.08 | $ 178.97 | $ 174.90 | $ 173.28 | $ 184.39 | $ 182.03 | $ 176.96 | $ 175.15 | $ 172.45 | $ 170.38 | -6% |
| Return / Ewe | $ 88.37 | $ 90.49 | $ 94.56 | $ 97.82 | $ 86.71 | $ 89.08 | $ 94.15 | $ 95.95 | $ 98.66 | $ 100.72 | 14% |

**Net Present Value of Income Stream per Ewe over the first ten years of intense selection: $796.82**

*Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb

**Table 3. Projected Returns When Ram Selection Focuses On Lower Fecal Egg Count.**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 18 | 18 | 16 | 14 | 13 | 12 | 10 | 10 | -50% |
| % Unthrifty Lambs | 20 | 20 | 18 | 18 | 16 | 15 | 13 | 11 | 9 | 7 | -65% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 16 | 13 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 39 | 39 | 38 | 37 | 37 | 37 | 37 | 36 | -10% |
| Days on Feed | 140 | 140 | 149 | 158 | 169 | 172 | 183 | 183 | 183 | 185 | 32% |
| Avg Daily Gain | 0.500 | 0.500 | 0.475 | 0.450 | 0.425 | 0.425 | 0.400 | 0.400 | 0.400 | 0.400 | -20% |
| Annual Drenches* | 797 | 797 | 618 | 598 | 412 | 396 | 378 | 220 | 219 | 198 | -75% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 93.37 | $ 86.70 | $ 67.40 | $ 61.52 | $ 55.05 | $ 34.55 | $ 34.83 | $ 30.78 | -74% |
| Total Cost / Ewe | $ 181.08 | $ 181.08 | $ 183.71 | $ 183.67 | $ 202.99 | $ 206.68 | $ 208.00 | $ 209.32 | $ 212.25 | $ 213.57 | 18% |
| Return / Ewe | $ 88.37 | $ 88.37 | $ 93.62 | $ 93.66 | $ 85.12 | $ 92.17 | $ 98.43 | $ 100.37 | $ 107.89 | $ 108.53 | 23% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | **$811.31** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | |

| **Table 4.** | | **Projected Returns When Ram Selection Focuses On Both Growth And Lower Fecal Egg Count.** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 19 | 18 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Unthrifty Lambs | 20 | 19 | 18 | 17 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 17 | 16 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 42 | 42 | 43 | 45 | 45 | 47 | 48 | 49 | 23% |
| Days on Feed | 140 | 140 | 136 | 130 | 122 | 118 | 118 | 110 | 103 | 102 | -27% |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.525 | 0.550 | 0.550 | 0.550 | 0.575 | 0.600 | 0.600 | 20% |
| Annual Drenches | 797 | 797 | 802 | 806 | 566 | 565 | 567 | 569 | 567 | 570 | -28% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.91 | $ 120.47 | $ 88.96 | $ 87.88 | $ 87.22 | $ 86.56 | $ 87.04 | $ 87.46 | -27% |
| Total Cost / Ewe | $ 181.08 | $ 181.26 | $ 180.61 | $ 181.79 | $ 196.46 | $ 191.73 | $ 192.87 | $ 191.99 | $ 194.59 | $ 192.20 | 6% |
| Return / Ewe | $ 88.37 | $ 89.02 | $ 92.57 | $ 96.38 | $ 88.68 | $ 94.15 | $ 96.71 | $ 103.41 | $ 114.14 | $ 121.73 | 38% |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$833.74** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |

| **Table 5.** | | | |
|---|---|---|---|
| System/Description | Net Present Value of Income Stream per ewe over 10-year period of sire selection | Net Present Value of income stream per ewe, multiplied by 25 ewes and spread across 2.5 rams* | Dollars delivered to the shepherd by each ram above what will be realized from a 'grade ram' that does not improve the flock in either growth or fecal egg count.** |
| Flock Maintains Level Performance | $625.86 | $6,258.60 | $0.00 |
| Rams are selected for Growth only | $796.82 | $7,968.20 | $1,709.60 |
| Rams are selected for Low FEC only | $811.31 | $8,113.10 | $1,854.50 |
| Rams are selected for both Low FEC and Growth | $833.74 | $8,337.40 | $2,078.80 |
| | | *2.5 rams = 10 year period with a new ram introduced every 4 years | **based on 25 ewes per ram, new ram every 4 years |

# Returns on Ram Selection: a theoretical 10-year budget scenario to estimate financial return on selection for measureable economically important traits.

By Tom Stanley, Extension Agent, Farm Business Management

The attached budgets and tables attempt to illustrate the financial impact a focused sire-selection program can have on flock performance and financial returns. The author has attempted to describe a spring lambing sheep flock that is experiencing significant parasite pressure and has a genetic base with moderate to low growth rates. The analysis attempts to quantify the financial impacts that consistent application of selection standards over time. The analysis illustrates annual net income being improved by 14% when selecting for growth alone, 23% when selecting for lower fecal egg count alone, and 38% when sires are used that improve both growth and lower fecal egg count. Table 5 calculates the improved profit each ram brings to the particular selection program. The values in Table 5 capture some but not all of the 'multiplier effects' that a ram will have where the flock is generating its own replacement females.

The flock's complete costs and returns in the first year of the selection program is illustrated in the itemized enterprise budget that follows. The author has set flock size at 100 ewes since this makes the costs and returns a little easier to inspect at a glance since when looking at total costs for the flock- cost per ewe can be determined simply by moving the decimal two places. The budget assumes a ratio of 25 ewes to one ram. In cases where there are fewer than 25 ewes per ram the estimated returns to the shepherd for each ram selected will be lower.

These budget projections attempt to quantify the financial benefit that can be captured when heritable traits of economic importance can be quantitatively measured and sire selection based on these traits is consistently applied over time. Recent interest in sires rated for their fecal egg count (FEC) and the success in improving parasite resistance through sire selection based on FEC in Australia and New Zealand prompts us to explore the possible financial benefit from purchasing rams identified as having lower fecal egg counts.

There are limitations to this type of analysis. The heritability of the selected trait(s) and the number of traits that are simultaneously selected for impacts the rate of progress. The plethora of other management and environmental factors that impact costs and returns alter what a shepherd will actually experience. However, it is the type of analysis presented here that allows us to hold these other factors constant and hopefully isolate and observe the benefits that can be realized through sire selection. In this scenario, the flock in year one is composed of ewes with typical fecal egg counts and moderate to low growth rates, therefore there is 'room to improve'. Flocks that have already achieved high rates of growth or have high levels of parasite resistance are less likely to realize as much gain as is illustrated here.

Points to Remember:

**1) This is a 'theoretical exercise' intended to illustrate the progress a shepherd can make with a flock that has potential to improve in both growth and parasite resistance.**

**2) The progress in flock performance described in these budget scenarios is accomplished exclusively through ram selection. It is assumed that the rams that have superior performance for growth and/or lower FEC are accurately identified. Much more rapid progress could be achieved if a shepherd also purchases replacement ewes that are superior in the performance areas of growth and/or lower fecal egg count.**

**3) Genetic progress on a flock basis is a process of years and requires focus and planning. The more traits we attempt to improve, the slower the progress.**

**4) Aggressive selection for one trait often results in compromising on other traits.**

Virginia
Cooperative
Extension

Shepherd's Symposium, January 2017

PUBLICATION 446-047

# COMPLETE ENTERPRISE BUDGET, YEAR 1 OF SIRE SELECTION SCENARIO

| | | | |
|---|---|---|---|
| | 100 EWES | $8,837.48 =Net Income | |
| 170% LAMB CROP | 4 RAMS | 100% OF LAMBS FINISHED WITH PURCHASED FEED | |
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| 1.36 = Lambs Raised per Ewe | 0.50 ADG | 7.0 TO 1 POST WEANING FEED CONVERSION | |

| ITEM | HEAD | | CWT | UNIT | PRICE | | QUANTITY | TOTAL | Your Farm |
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| Cull Ram | 1 @ | | 2.00 | Cwt | $80.00 | | 2.00 | $160.00 | |
| Wool | | | 6.50 | Lbs/Head | $0.80 | | 669.50 | $535.60 | |
| **2. TOTAL GROSS RECEIPTS** | | | | | | **$269.46** | Per Ewe | **$26,945.90** | |
| **3. VARIABLE COSTS** | | | | | | | | | |
| | | | Est. Acres= | 52.55 | | | | | |
| | Feed Loss | T/Ac | | | | | | | |
| Alfalfa Hay | 5.0% | | | Ton | $135.00 | | 5.50 | $742.49 | |
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| Stkpld Fescue DM | 15.0% | 3.00 | 8.91 | Ton | $20.00 | | 26.72 | $534.46 | |
| Pelleted Supplement | 2.0% | | | Ton | $275.00 | | 13.73 | $3,774.69 | |
| Corn | 2.0% | | | Ton | $175.00 | | 12.03 | $2,104.69 | |
| | | Lbs per | | | | | | | |
| Flush Ewes | 0.5 | Ewe | 21 | days | $400.00 | per Ton | 0.53 | $210.00 | |
| Perinneal Alf/Grass DM | 15.0% | 4.00 | 11.19 | Ton | $20.00 | | 44.75 | $895.02 | |
| Summer Annual DM | 15.0% | 3.50 | 1.23 | Ton | $20.00 | | 4.31 | $86.25 | |
| Winter Annual DM | 15.0% | 2.00 | 0.00 | Ton | $20.00 | | 0.00 | $0.00 | |
| Grinding & Mixing | | Cwt | | Cwt | $0.00 | | 0.00 | $0.00 | |
| Salt & Mineral | | Lbs per Ewe | | Cwt | $20.00 | | 19.58 | $391.64 | |
| Vet & Medicine | | $/Head | | Head | $7.57 | | 100 | $756.78 | |
| Shearing & Wool Handling | | | | Head | $6.00 | | 104 | $624.00 | |
| Supplies | | | | Head | $5.00 | | 100 | $500.00 | |
| Electric Netting | | | | Rolls | $125.00 | | 4 | $500.00 | |
| Replacement Ram | | | | Head | $600.00 | | 1 | $600.00 | |
| Synchronize ewes | | | | Head | $0.00 | | 100 | $0.00 | |
| Stockpiled Pasture | 0.00 | Acres per Ewe | | Acre | $51.00 | | 0 | $0.00 | |
| Pasture | 0.35 | Acres per Ewe | | Acre | $12.00 | | 35 | $420.00 | |
| Haul Cull Sheep | | | | Head | $2.00 | | 17 | $34.00 | |
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| Haul Sheep | | | | Head | $3.00 | | 93.6 | $280.80 | |
| Market Sheep | 12 | $/Head | | Head | $9.60 | | 93.6 | $1,123.20 | |
| Virginia Check-off | | | | Head | $0.50 | | 134 | $67.00 | |
| Building & Fence Repairs | | | | Head | $12.00 | | 100 | $1,200.00 | |
| Utilities | | | | Head | $0.90 | | 100 | $90.00 | |
| Bedding | 8 | Lbs per Ewe | | Ton | $80.00 | | 0.4 | $32.00 | |
| Machinery (Non-Crop) | | | | Head | $1.78 | | 100 | $178.00 | |
| Land Rental | | | | Acre/Year | $0.00 | | 35 | $0.00 | |
| Labor | | Hours per Week | | Hours | $0.00 | | 0 | $0.00 | |
| Operating Interest | 12 | Months | | Dollars | 0.00% | | $ 16,466 | **$0.00** | |
| **4. TOTAL VARIABLE COSTS** | | | | | | **$181.08** | Per Ewe | **$18,108.42** | |
| **5. ANNUAL DEBT PAYMENTS** | | | | | | | | **$0.00** | |
| **6. PROJECTED NET RETURN TO EQUITY, MANAGEMENT, & FAMILY LABOR** | | | | | | **$88.37** | Per Ewe | **$8,837.48** | |

| Table 1. | | | Projected Returns When Level of Performance Remains Constant | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 |
| % of Lamb Death Loss | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| % of Lamb Crop Unthrifty but marketed | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Weaning Weight | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Days on Feed | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 | 0.500 |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 |
| Total Cost / Ewe | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 | $ 181.08 |
| Return / Ewe | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 | $ 88.37 |

**Net Present Value of Income Stream per Ewe over 10 years:** **$753.81**

*Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb

| **Scenario Assumptions:** | | **Essential Performance Benchmarks That Change:** |
|---|---|---|
| Spring Lambing Flock with high parasite load. | | Ewe Cull Rate |
| 100 ewes, 4 rams, one ram purchased annually | | Lamb Death Loss |
| Management Uses FAMACHA for deworming decisions | | % Unthrifty Lambs (survive to be marketed but are poor quality) |
| Healthy Lambs weigh 110 lbs at market, and bring $2.00 / lb | | Weaning Weight |
| Unthrifty Lambs weigh 65 lbs at market and bring $2.30 / lb | | Total Number of Times Drench Administered |
| No labor, land rent, or interest charges in this budget | | Avg Daily Gain by Lambs on Feed |
| Interest Rate for Net Present Value Calculations: | 3.00% | Feed Efficiency (Growth Sire Only, not printed in tables) |

| Table 2. | | Projected Returns When Ram Selection Focuses On Growth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 0% |
| % Unthrifty Lambs | 20 | 20 | 20 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | -10% |
| % Culling Rate | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 0% |
| Weaning Weight | 40 | 40 | 45 | 45 | 47 | 47 | 50 | 52 | 55 | 55 | 38% |
| Days on Feed | 140 | 133 | 118 | 118 | 110 | 105 | 92 | 89 | 81 | 79 | -44% |
| Avg Daily Gain | 0.500 | 0.525 | 0.550 | 0.550 | 0.575 | 0.600 | 0.650 | 0.650 | 0.675 | 0.700 | 40% |
| Annual Drenches* | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 797 | 0% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.35 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | $ 119.28 | 0% |
| Total Cost / Ewe | $ 181.08 | $ 178.97 | $ 174.90 | $ 173.28 | $ 184.39 | $ 182.03 | $ 176.96 | $ 175.15 | $ 172.45 | $ 170.38 | -6% |
| Return / Ewe | $ 88.37 | $ 90.49 | $ 94.56 | $ 97.82 | $ 86.71 | $ 89.08 | $ 94.15 | $ 95.95 | $ 98.66 | $ 100.72 | 14% |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$796.82** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |

| Table 3. | Projected Returns When Ram Selection Focuses On Lower Fecal Egg Count. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 18 | 18 | 16 | 14 | 13 | 12 | 10 | 10 | -50% |
| % Unthrifty Lambs | 20 | 20 | 18 | 18 | 16 | 15 | 13 | 11 | 9 | 7 | -65% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 16 | 13 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 39 | 39 | 38 | 37 | 37 | 37 | 37 | 36 | -10% |
| Days on Feed | 140 | 140 | 149 | 158 | 169 | 172 | 183 | 183 | 183 | 185 | 32% |
| Avg Daily Gain | 0.500 | 0.500 | 0.475 | 0.450 | 0.425 | 0.425 | 0.400 | 0.400 | 0.400 | 0.400 | -20% |
| Annual Drenches* | 797 | 797 | 618 | 598 | 412 | 396 | 378 | 220 | 219 | 198 | -75% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 93.37 | $ 86.70 | $ 67.40 | $ 61.52 | $ 55.05 | $ 34.55 | $ 34.83 | $ 30.78 | -74% |
| Total Cost / Ewe | $ 181.08 | $ 181.08 | $ 183.71 | $ 183.67 | $ 202.99 | $ 206.68 | $ 208.00 | $ 209.32 | $ 212.25 | $ 213.57 | 18% |
| Return / Ewe | $ 88.37 | $ 88.37 | $ 93.62 | $ 93.66 | $ 85.12 | $ 92.17 | $ 98.43 | $ 100.37 | $ 107.89 | $ 108.53 | 23% |
| | | | | | | | | | | | |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$811.31** | | | | | | | |
| *Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb | | | | | | | | | | | |

| Table 4. | | Projected Returns When Ram Selection Focuses On Both Growth And Lower Fecal Egg Count. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | % Change Yr10 vs Yr 1 |
| % Lamb Crop | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 0% |
| % Death Loss | 20 | 20 | 19 | 18 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Unthrifty Lambs | 20 | 19 | 18 | 17 | 17 | 17 | 16 | 15 | 12 | 11 | -45% |
| % Culling Rate | 20 | 20 | 20 | 20 | 18 | 17 | 16 | 15 | 15 | 15 | -25% |
| Weaning Weight | 40 | 40 | 42 | 42 | 43 | 45 | 45 | 47 | 48 | 49 | 23% |
| Days on Feed | 140 | 140 | 136 | 130 | 122 | 118 | 118 | 110 | 103 | 102 | -27% |
| Avg Daily Gain | 0.500 | 0.500 | 0.500 | 0.525 | 0.550 | 0.550 | 0.550 | 0.575 | 0.600 | 0.600 | 20% |
| Annual Drenches | 797 | 797 | 802 | 806 | 566 | 565 | 567 | 569 | 567 | 570 | -28% |
| Annual Drench Cost | $ 119.35 | $ 119.35 | $ 119.91 | $ 120.47 | $ 88.96 | $ 87.88 | $ 87.22 | $ 86.56 | $ 87.04 | $ 87.46 | -27% |
| Total Cost / Ewe | $ 181.08 | $ 181.26 | $ 180.61 | $ 181.79 | $ 196.46 | $ 191.73 | $ 192.87 | $ 191.99 | $ 194.59 | $ 192.20 | 6% |
| Return / Ewe | $ 88.37 | $ 89.02 | $ 92.57 | $ 96.38 | $ 88.68 | $ 94.15 | $ 96.71 | $ 103.41 | $ 114.14 | $ 121.73 | 38% |
| **Net Present Value of Income Stream per Ewe over the first ten years of intense selection:** | | | | **$833.74** | | | | | | | |

*Annual Drenches = Total number of times a de-worming drench is administered to either a sheep or a lamb

| Table 5. | | | |
|---|---|---|---|
| System/Description | Net Present Value of Income Stream per ewe over 10-year period of sire selection | Net Present Value of income stream per ewe, multiplied by 25 ewes and spread across 2.5 rams* | Dollars delivered to the shepherd by each ram above what will be realized from a ram that does not improve the flock in either growth or fecal egg count.** |
| Flock Maintains Level Performance | $753.81 | $7,538.10 | $0.00 |
| Rams are selected for Growth only | $796.82 | $7,968.20 | $430.10 |
| Rams are selected for Low FEC only | $811.31 | $8,113.10 | $575.00 |
| Rams are selected for both Low FEC and Growth | $833.74 | $8,337.40 | $799.30 |

*2.5 rams = 10 year period with a new ram introduced every 4 years

**based on 25 ewes per ram, new ram every 4 years

# Lambing Management Tips

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Lambing season is a very enjoyable time of year for many shepherds. Investment of time and sound management practices pay dividends for producers during lambing time. The profitability of a sheep operation is largely dependent upon maximizing the number of lambs marketed per ewe exposed, while minimizing costs of production. Since most lamb deaths occur at or shortly after birth, lambing time is critical. The three primary causes of death of lambs around lambing time are difficulty during the birthing process, starvation, and hypothermia. Management practices at lambing time are essential for the economic viability of the sheep operation.

Dystocia (lambing problems) has been shown to be a significant cause of lamb mortality. Losses due to stillbirths and dystocia can be reduced by frequent visits to the lambing barn and timely assistance of ewes. Pregnant ewes should be checked every 3-4 hours. Many shepherds do their last check at 11 p.m. or midnight and then again at 5 or 6 a.m. Ewes that will lamb between these times usually show signs at the late night observation. Ewes close to lambing will be restless and may try to claim other newborn lambs. Ewes in labor will normally separate themselves, and frequently choose a corner or area along a wall or feedbunk to nest and deliver. The lambing area should be dry and well bedded, and sources of cold drafts that will chill newborn lambs should be eliminated. It is not necessary to have a heated lambing barn- a dry, draft-free area is more important. The lambing process can vary considerably between ewes. Ewes in labor should be left undisturbed. However, once the ewe begins forceful straining and the water bags are passed, delivery should normally take place within 45-60 minutes. Once the front legs are visible, lambs should be born within 30-45 minutes. After the first lamb is born, subsequent lambs are normally delivered within 30 minutes. Prolonged delivery beyond these times may indicate lambing difficulty, and the ewe should be examined and assisted if necessary. Prior to assisting the ewe, the examiner should wash the ewe's vulva with mild soap and water. Likewise, the shepherd should thoroughly wash their hands and arms and wear an OB sleeve when assisting or examining a ewe. When assistance is required to deliver one lamb, the uterus should be examined for additional lambs. For lambs that are pulled, a piece of straw may be gently inserted into the nostril as an irritant to help stimulate breathing.

When possible, ewes should be allowed to give birth where they initially bed down. Moving ewes to individual pens when they start lambing may prolong the birthing process and cause other complications. Additionally, allowing ewes to complete the lambing process before moving them to jugs will keep the jugs drier and help prevent injury to lambs in multiple birth situations. Lambing jugs should measure at least 5 ft. x 5 ft., with a maximum slat spacing of 3 in. Large breeds and multiple births may require larger jugs. The environment of the jug is critical to newborn lamb health and survival. The jugs should be kept well bedded, dry, and free of drafts. For facilities with cement floors, a base of lime or sawdust/shavings is recommended under straw. Cement floors can be cold and damp, and

therefore a source of chilling and pneumonia in newborn lambs. When feasible, lambing jugs should be cleaned between ewes.

The first 24-48 hours after birth are a critical time for the ewe and her lambs. During this time, bonding occurs between the ewe and her lambs. The jugs also assist the shepherd in keeping a close eye on the ewe and lambs during this time. Upon moving the ewe into the jug, the lambs' navels should be immersed in a 7% iodine solution. Iodine helps prevent infection and promotes drying of the navel.

Colostrum is the milk produced by the ewe up to 18 hours after birth. It has important nutritional value for the newborn lamb. Colostrum also contains essential antibodies that provide protection against certain diseases for the newborn lamb, and provides energy to keep the lamb warm. Newborn lambs are susceptible to hypothermia due to their large body surface area in relation to body weight, and relatively low energy reserves.

Lambs should receive adequate intakes of colostrum within 30-60 minutes after birth. To help insure this, the ewe's teats should be stripped to remove the wax plugs that frequently obstruct the teat. In some cases, lambs that appear to be nursing may not be getting milk due to these plugs. Stripping the teats will also confirm the ewe has milk. Lambs should be monitored closely to make sure they nurse. Lambs that have nursed will have a full stomach upon palpation. Crutching ewes prior to lambing will enhance the lamb's ability to access the udder, particularly with long-fleeced ewes. Lambs that have not nursed should be assisted. Most lambs have a strong suckling reflex shortly after birth, and will nurse when presented a teat. It may be necessary to close the lamb's mouth on the teat and/or squirt milk in the lamb's mouth to initiate suckling. An effort should be made to help the lamb nurse the ewe before other methods are used to get colostrum into the lamb.

In some cases, the lamb is unable to nurse the ewe even with assistance. These lambs may be small, weak, chilled, rejected by the ewe, or injured. In these cases, stomach tube feeding is necessary to get colostrum into the lamb. Lamb stomach tubes that attach to syringes are available commercially, and should be on hand for all shepherds. For lambs that require tubing, start with 2-4 oz. the first feeding (30 cc equals ~1 oz.). Many times, this first feeding will energize weak or chilled lambs, and they will respond and be able to nurse on their own thereafter. If not, the lamb may require an additional tube feed an hour or two later. As a guideline, a 10 pounds lamb needs approximately 16 oz. of colostrum the first 24 hourse of life.

Virginia is largely a Selenium deficient state. Deficiency of Selenium and/or Vitamin E causes white muscle disease in lambs. For prevention of this disease and all-around flock health and performance, the ewe flock should be provided a high-selenium complete mineral mix specifically formulated for sheep during gestation (fed free-choice). Additionally, lambs should receive supplemental Vitamin E and Selenium in the first few days after birth.

## *Outstanding Sheep Producer Award Recipients*

2015 – Larry and Lisa Weeks, Augusta County
2014 – Jeff Lawson, Augusta County
2013 – Laura Begoon, Rockingham County
2012 – Sonny and Ashley Balsley, Augusta County
2011 – Leo Tammi, Augusta County
2010 – Bobbi Hefner, Highland County
2009 – Mac Swortzel, Augusta County
2008 – David Shiflett, Augusta County
2007 – Doug Riley, Augusta County
2006 – Mike Carpenter, VDACS
2005 – Jim Wolford, Wythe County
2004 – Martha Mewbourne, Scott County
2004 – David Redwine, Scott County
2003 – Martha Polkey, Loudoun County
2002 – Carlton Truxell, Augusta County
2001 – Corey Childs, Clarke County
2000 – John Sponaugle, Rockingham County
1999 – Bill Stephenson, Page County
1998 – Gary Hornbaker, Clarke County
1997 – Bruce Shiley, Clarke County
1996 - Weldon Dean, Rockingham County
1995 - Bill Wade, Augusta County
1994 - John Henry Smith, Russell County
1993 - Robin Freeman, Chesapeake
1992 - Courtland Spotts, Pulaski County
1991 - Ted Bennett, Halifax County
1990 - Clinton Bell, Tazewell County
1989 - Rex Wightman, Shenandoah County
1988 - Tim Sutphin, Pulaski County
1987 - Zan Stuart, Russell County
1986 - J. W. Riley, Augusta County
1985 - John Bauserman, Fauquier County
1984 - Roy Meek, Pulaski County
1983 - Jonathan May, Rockingham County