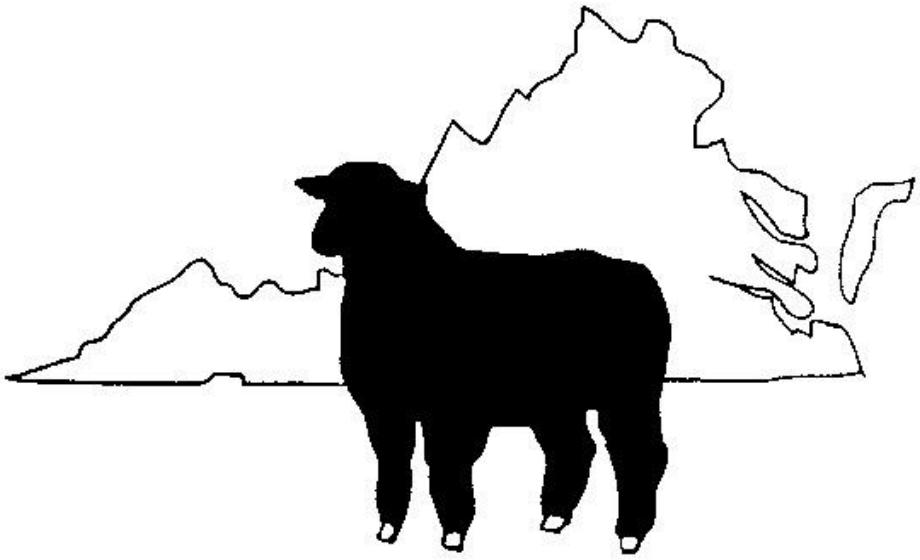
Proceedings

2019

VIRGINIA SHEPHERDS' SYMPOSIUM



January 4 - 5, 2019

ALPHIN-STUART LIVESTOCK ARENA
BLACKSBURG, VIRGINIA

Table of Contents

2019 VA Shepherds' Symposium
Presented By
Virginia Sheep Producers Association

Page Number

Sponsors

Augusta Cooperative Farm Bureau, Inc. – Shawna Bratton/Allison Bagley
1205B Richmond Road
Staunton, VA 24401
540-885-1265, Ext. 231
ABagley@augustacoop.com

Cargill – Jessica Lohman
6606 W. Broad Street
Richmond, VA 23230
540-336-1980
Jessica_Lohman@cargill.com

Farm Credit of the Virginias – Jenna Roeder
PO Box 1900
Romney, WV 26757
304-822-4173
jroeder@fcvirginias.com

Virginia Farm Bureau Federation – Tony Banks
PO Box 27552
Richmond, VA 23261
804-290-1150
tony.bank@vafb.org

Virginia Sheep Industry Board
c/o Matthew Sponaugle
261 Mt. Clinton Pike
Harrisonburg, VA 22802
540-383-7983
matthew.sponaugle@vdacs.virginia.gov

Virginia Sheep Producers Association
Dept of Animal & Poultry Sciences
Virginia Tech
Blacksburg, VA 24061
540-231-9159
sgreiner@vt.edu

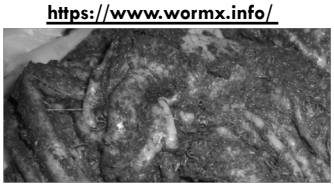
PARASITE CONTROL STRATEGIES: WHERE DO WE GO FROM HERE?

Anne Zajac, DVM, PhD (azajac@vt.edu)
Member, American Consortium for Small Ruminant Parasite Control

Virginia-Maryland College of Veterinary Medicine

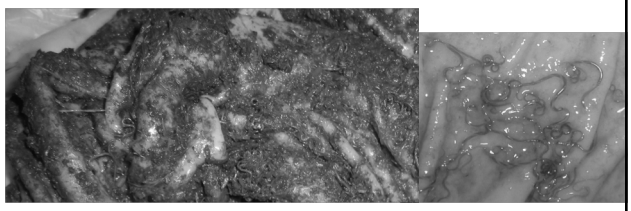
What Are The Parasites?

- Gastrointestinal nematode worms (GIN) biggest disease problem in the eastern US in small ruminants
- Coccidia come second
- Meningeal worm (deer worm) a distant third in most cases
- **MOST UP TO DATE INFORMATION: https://www.wormx.info/**



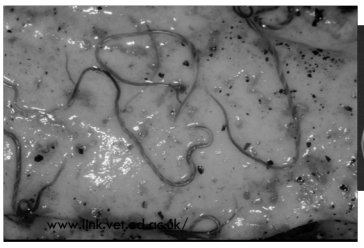
Stomach and Intestinal Worms

- Most important--barber pole worm, *Haemonchus contortus*
  - Abomasal (stomach) parasite
  - Exploits many environments, management practices



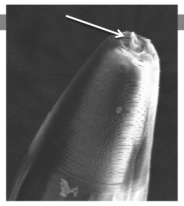
Haemonchus contortus--Barber Pole Worm (wireworm)

- Worms about an inch long
- White reproductive tract wraps around red intestine—looks like barber pole



Stomach and Intestinal Worms

- *Haemonchus contortus*
  - Blood sucking parasite
    - Large numbers can cause anemia (pale mucous membranes), weakness and bottle jaw
    - Decreased gains, growth
    - No diarrhea



Parasites

- Barber pole worm doesn't produce diarrhea but other related worms might
  - Usually not as important by themselves, can cause problems in some specific circumstances when management and/or environment allow build-up

www.nadis.org.uk

www. Sheepandgoat.com

Why Are GIN So Bad?

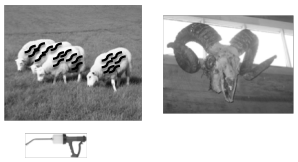
- Drug resistance a fact of life
- Only 3 different types of drugs used for GIN
  - Worms resistant to one member of a group resistant to all

Benzimidazoles	Macrocyclic lactones	Nicotinics
fenbendazole **(Safeguard Panacur)**	Ivermectin **(Ivomec etc.)**	levamisole **(Prohibit)**
albendazole **(Valbazen)**	moxidectin (**Cydectin**)	morantel **(Rumatel, Goat Care, Positive Pellet)**
Others oxfendazole (Synanthic)	Others eprinomectin (Eprinex)	Others Pyrantel (Strongid, Banmith-horses, pigs)
oxibendazole (Anthelcide-horses)	Doramectin (Dectomax)	

Unless you test for resistance you can't be sure your drugs are working

New drug with time →

Drug looks like it's working but losses occurring



By the time you realize resistance is present, most worms are resistant and not using the drug for awhile doesn't make it effective again

My sheep
- Closed flock for at least 20 years
- Virtually no anthelmintic use

Barber pole Drenchrite results :
- Benzimidazoles: Suspected resistance
- Levamisole: Resistance
- Ivermectin: Suspected resistance

Integrated Parasite Management Practices

Pasture based

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

Animal based

- Targeted treatment
- **Genetic selection**
- Nutrition
- **Dewormer combinations**
- **Copper boluses**

Really not separate lists because change in one affects the other

Dewormer Use

www.sheep101.info

- Use the correct dose—see dewormer charts
  - Sheep and goats metabolize drugs differently
  - Effective dose in goats is two times the sheep dose except:
    - Levamisole (1.5 times)
    - Goat dose listed on the Safeguard® label too low
- Observe withdrawal times

Dewormers Use--Combinations

- May see recommendations for increasing dose or multiple treatments to improve drug efficacy—when resistance first becoming a problem these often worked
- Now you can't be confident about effect without testing
- Probably better to go with combination treatment
  - Treat at the same time with 2 or 3 drugs from different drug groups
  - Additive effect of treatments

Combination treatments

- Full dose of 2 or 3 drugs from different groups
- Do not mix drugs—administer separately, one right after the other in separate syringes
- Observe longest withdrawal of products used
- Combination products are routine in other countries, but not approved and marketed here
- Use in a targeted selective treatment program—
- See attached file

Targeted Selective Treatment

- Deworm only the animals that need it
- In most circumstances the majority of animals may not need deworming because of low parasite challenge or effective immunity
- Benefits
  - Use less dewormer
  - **Slows rate of development of resistance to dewormers**

Targeted Selective Treatment

- For routine selective deworming, FAMACHA© best for small ruminants in most of US
  - Direct assessment of effects of parasite
  - Every sheep and goat producer should have a card!
    - Also useful in selection decisions
- Don't forget supportive care for the white eyes!
  - Take off infected pasture
  - Good food
  - Reduce risk of reinfection

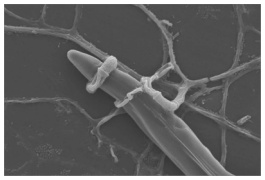
Targeted Selective Treatment

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

- FAMACHA© training
- Requirement for hands on training
  - Difficult for some producers
- Tell your friends--option for on-line training
  - University of Rhode Island

At Last—Something New!

- Reducing the number of larvae on pasture
- New product expected to become available this year (really!)
- *Duddingtonia flagrans*—fungus that feeds on nematodes
- *https://www.wormx.info/single-post/2018/02/06/Video-Duddingtonia-flagrans*



Duddingtonia flagrans

- Fungus found throughout the world
- Fungal spores fed to animals, pass through into manure
- Environmental conditions cause spores to "hatch", fungus forms net that traps and consumes nematode parasite larvae
  - Not coccidia or other parasites
- Known for many years that can reduce numbers of parasites on pasture
- Commercializing fungus was the slow step

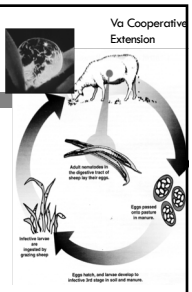
Duddingtonia flagrans

- Australian company has created commercial products starting shipment to US this spring
- Approved in almost all states (including VA)
- BioWorma® will be sold for mixing with feed—not to individual producers, through veterinarians
- Livamol® with BioWorma® can be sold to individual producers

Duddingtonia flagrans

- Is this the replacement for dewormers that don't work?
- NO—by itself it isn't the answer but we hope it will be a really useful part of integrated parasite control
- Downsides
  - Doesn't get rid of all the parasites
  - Some years may be more effective than others
    - Good year for parasites vs bad year for example
  - Will be probably be pretty pricey
- Challenge is to establish how to use it most effectively and economically
- Do do that must know something about parasite biology

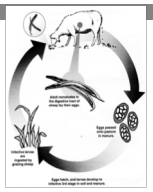
Life as a Worm



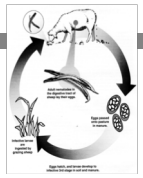
- All *Haemonchus* family have same life cycle
  - Eggs passed in manure
  - Eggs develop, larva hatches
  - Larva develops to infective stage
    - Takes about 5-7 days minimum
    - The cooler it is, the longer it takes
  - Larvae move onto forage
    - Sheep, goats infected when grazing
    - Adults start egg laying in about 3 weeks
- ALL GRAZING ANIMALS HAVE WORMS
  - Generally these worms do not survive well in housing

Other useful information--

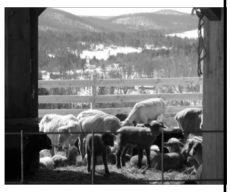
- How long can the infective larvae last on pasture?
  - Once metabolic reserves used up, they die
  - Hotter it is, the faster they wiggle, the quicker they die
  - In cool, moist conditions they live for months



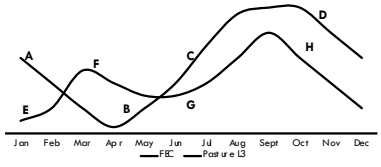
Can larvae in the environment survive winter weather?



- Eggs and larvae of some species survive winter weather better than others
  - Barber pole worm does not like freezing weather, most eggs and larvae die
- But there is another strategy for surviving winter
  - Larvae ingested in the fall enter stomach wall and become dormant (hypobiosis)
  - Wait to become adults till spring
    - While hypobiotic,-- No disease, no eggs in manure



GIN Fecal Egg Counts (FEC) and Pasture L3
Patterns important, not numbers



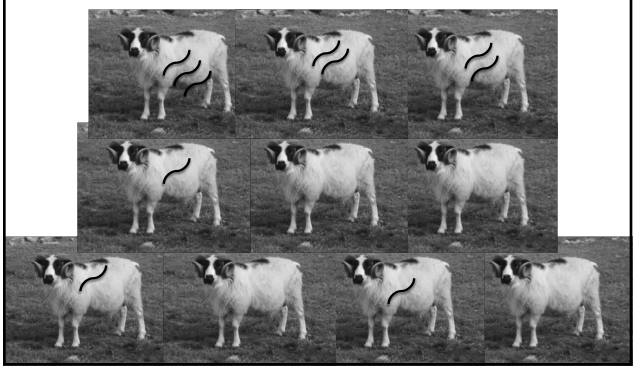
A-residual larvae from fall, too cold for much development
B-residual larvae mostly gone, but new larvae developing from spring bump in FEC. Egg to L3 goes faster with warmer temps
C-rapid increase in pasture larvae as young animals become infected from spring
D-new eggs on pasture develop more slowly as temperatures cool, L3 begin to fall

E fecal egg counts low—larvae arrested, little new infection
F resumption of development of arrested larvae produces "spring rise" in FEC
G FEC dips because not enough larvae yet to replace worms as they age and die, then rise as new wave of L3 increases infections
H decline as more incoming larvae become arrested and eggs don't develop quickly or at all as temperatures cool

So When Is the Best Time to Use Fungus

- Research will be done in next few years to establish best practices for use in different regions
- For now, try to be strategic

Inherent variation in susceptibility to parasite selection means that some animals will always have fewer parasites (all other things being equal). This resistance to infection can be selected for.

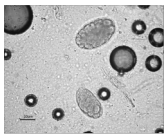


How Can You Select for Resistance?

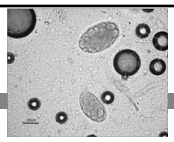
- By Breed
  - Hair sheep
  - Goats?
- Increase resistance by crossbreeding
- Can also select within breed

Selecting Resistant Animals

- FAMACHA©
  - Allows culling of animals needing more deworming
  - Hard to separate resistance and resilience in deciding which animals to keep
- Fecal egg counts
  - Number of eggs in feces directly related to number of barber pole worms
  - Most common measure or resistance
- Combining FAMACHA and fecal egg counts would provide even more information
- Genetic markers? Not yet



Selection for Immunity



- Include selection for resistance
  - Use FECs and FAMACHA
  - Know about resistance in animals you are buying
    - Ask breeders for information
    - Ram test with parasite evaluation
  - Use Estimated Breeding Values in selection decisions—NSIP
- Everyone should be considering resistance to parasites in making decisions about breeding and replacements

Copper Oxide Wire Particles

- Like a moderately effective dewormer
  - Copper oxide wire particles have specific effect on *Haemonchus*
  - Other forms of copper not effective
- Can buy 2g boluses as copper supplement for goats
- Dose for *Haemonchus* control lower—may need to repackage
- Don't use too often, be mindful of copper toxicity in sheep
- One study indicated efficacy of a dewormer can be boosted when used with bolus
- READ more before using, talk to vet
- See attachment

Do not administer to Lambs or Kids of unknown copper status or those supplemented with other sources of copper. Veterinary advice should be sought before treating breeds such as North Ronaldsay, Texels or Lleyns known to be copper sensitive.

Timely Topics

January 2017

Combination Dewormers: The Time is Now

Dr. Ray Kaplan, Professor of Parasitology
University of Georgia, College of Veterinary Medicine

American Consortium for Small Ruminant Parasite Control

Resistance to dewormers is a fact of life, and the situation has worsened greatly in recent years. Surveys indicate that most farms have worms resistant to at least two of the three major groups of dewormers. Many have resistance to all three groups, and some farms now have resistance to all available dewormers. But, having worms in your animals that are resistant to dewormers does not mean that all the worms are resistant. For instance, when all the commonly used dewormers were first introduced, their efficacy was >99%. Once efficacy falls below 95%, it indicates that drug resistance is present. At 95% the drug is still very useful, but once drug resistance is present, it usually worsens over time as more and more doses of that drug are given.

Image by S. Schoenian

As the effectiveness of the dewormer decreases, it provides less and less benefit, and once it falls to <50%, it is no longer useful as a sole treatment. Given this situation, what is the best approach for using dewormers? Contrary to popular belief, rotating between dewormers will not prevent resistance from worsening, and is no longer recommended. Rather, dewormers should be used together at the same time in combination.

There now is very strong evidence that using combination treatment is the best method for using dewormers and should be instituted on all farms immediately.

How and why do combination treatments work?

Research done in New Zealand has convincingly shown that the best approach is to use several different dewormers all at one time as a combination treatment. In fact, in Australia and New Zealand, there currently are few dewormer products sold as single drugs; most products contain 3, 4, or 5 different groups of dewormers (note: other counties have some dewormers that are not available in the US).

There are 2 major benefits to using drugs in combination:

1) You get an additive effect with each drug used, thus the efficacy of the treatment increases with each additional drug given (see Table 1 below); and
2) By achieving a higher efficacy, there are fewer resistant worms that survive the treatment, thus there is a greater dilution of resistant worms by the susceptible portion of the population (see Table 2).

Furthermore, as seen in Table 2, the sooner you start using a combination, the better off you will be, since you see the greatest difference in the percent of resistant survivors when efficacy of dewormers is high. The more dewormers that are used in combination, the greater the efficacy of treatment will be. However, if all the dewormers individually have poor efficacy, the combination will not reach high efficacy. As seen in Table 1, once efficacy falls to 50%, even a combination of 3 dewormers will still fail to reach a 90% efficacy.

As an illustration of why combinations help reduce the development of resistance, but rotation of dewormers does not, let us look at some numbers. If two drugs each with 90% efficacy are used in rotation, then each time animals are treated 10% of the worms survive (the resistant ones). In contrast, if these same two drugs are used in combination at the same time, then the efficacy increases to 99%. This calculation involves a simple additive function; the first drug kills 90%, and the second drug kills 90% of the remaining 10% [90% + (90% x 10%) = 99%]. Thus the efficacy achieved is now 10X greater and this then yields 10X fewer resistant survivors.

Because fewer resistant worms survive at each treatment, there is a greater dilution of the resistant worms among the majority of worms in refugia that are still susceptible. This then will greatly slow the development of drug resistance in the overall worm population. In contrast, if using a rotation of drugs, you would get 10X as many resistant worms surviving each time you treat. Additionally, given the high rates of drug resistance that are known to exist, it is likely that one or more of the dewormers will have poor efficacy, thus you risk rotating from an effective (or relatively effective) dewormer to an ineffective dewormer. By using dewormers as a combination, you eliminate the risk of rotating to a poorly effective drug, and get an additive benefit that maximizes the effectiveness of each treatment given.

Research shows that combinations are the best approach

But – it gets even better. Dr. Dave Leathwick (AgResearch, New Zealand) published a paper in 2015 in the Journal International Journal for Parasitology: Drugs and Drug Resistance, where seven farms previously diagnosed with resistance to at least two groups of dewormers were enrolled in a study where each farm implemented a tailored program of "best practice parasite management." The aim was to ascertain whether the programs, which included the almost exclusive use of combination dewormers, were able to prevent resistance from developing further. Strategies implemented on each farm varied, but had consistent underlying principles to avoid over-use of dewormers, manage refugia (and to ensure that only effective anthelmintics were used, by administering them only as a combination).

After five years, they demonstrated an overall improvement in the efficacy of the dewormers (when tested individually), indicating that the use of dewormers in combination, when applied with other best practices designed to reduce use of dewormers and maintain refugia, caused a reversion back toward susceptibility. So, there now is very strong evidence that using combination treatment is the best method for using dewormers and should be instituted on all farms immediately.

Precautions and issues to consider

Finally, before using this approach there are a few precautions to be aware of.

1) In New Zealand and Australia, products are sold that contain a combination of dewormers, so only one product needs to be administered. In contrast, in the USA, no dewormers are yet sold in this formulation, so the dewormers need to be bought and administered separately. This increases the cost as compared to the products available in these other countries. Additionally, the different groups of dewormers are not chemically compatible, thus they cannot be mixed together in the same syringe. Rather, they need to be administered separately, but can be given one immediately after the other.

1) All dewormers should be administered at the full recommended dose whether administered singly or in combination.

2) When using dewormers in combination, meat and milk withdrawal times will be equal to the dewormer used with the longest withdrawal time period

3) If using dewormers in combination, it is critical to maintain refugia; thus, one should be using a selective treatment approach based on FAMACHA© (see FAMACHA© section of the ACSRPC website for more information on this method and for further explanations of refugia). The presence of refugia is essential to realize the full benefits from combinations. In fact, if refugia are not maintained then you will not get the necessary dilution of the resistant survivors, and this will then lead to having multiple-resistant worms that can no longer be controlled with the combination treatment.

4) If the efficacy of your dewormers are >80%, it is possible you may not notice any difference in the clinical response of treatments when applied singly vs. in combination. However, the impact on the further development of resistance could be quite large (see Table 2).

5) Any safety precautions that exist for a single dewormer will also exist when used in a combination; however, there are no known additional risks with using more than one dewormer at the same time.

Table 1: Impact of using dewormers in combination on the efficacy of treatments. The increases in efficacy are due to a simple additive effect as per the equation below: Where D1 = efficacy of dewormer 1, D2 = efficacy of dewormer 2, D3 = efficacy of dewormer 3, C2 = efficacy of D1+D2, and C3 = efficacy of D1+D2+D3
C2% = D1% + (100-D1%)*D2%
C3% = C2% + (100-C2%)*D3%

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

Table 2: Impact of combinations on percent of resistant worms that survive. Table shows the % of worms killed by a single dewormer vs a combination treatment with two dewormers both with the same efficacy, ranging from 80% to 99%. The last column shows the magnitude of the difference between % of worms killed and % surviving when one or two dewormers in combination are used. Note that the higher the efficacy of the drugs, the smaller the difference in efficacy when used in combination, but the greater the difference in the % of resistant survivors.

Efficacy of Dewormer		Single Dewormer	2 Dewormers in Combination	Fold Difference
99	% Killed	99	99.99	1.01x
	% Surviving	1	0.01	**100x**
98	% Killed	98	99.96	1.02x
	% Surviving	2	0.04	**50x**
95	% Killed	95	99.75	1.05x
	% Surviving	5	0.25	**20x**
90	% Killed	90	99	1.1x
	% Surviving	10	1	**10x**
80	% Killed	80	96	1.2x
	% Surviving	20	4	**5x**

Timely Topics were written by members of the American Consortium for Small Ruminant Parasite Control. They are for educational and informational purposes only. They are not meant as a substitute for professional advice from a veterinarian or other animal science professionals. Some treatments described in the articles may require extra label drug use, which requires a valid veterinarian-client-patient relationship.

COPPER OXIDE WIRE PARTICLES

February 2018

INTRODUCTION

Internal parasites pose a difficult challenge for many sheep and goat producers. Parasites are numerous and adaptable. Some traditional control methods may fail due to parasites having developed resistance to anthelmintics (dewormers). Organic producers usually face even greater difficulties because they are more limited in their control options.

A multi-pronged approach to managing internal parasites is now recommended. This approach includes attention to nutrition, good pasture management, animal selection, and good sanitation. But even with these important measures, some animals will still need treatment.

One treatment that may be effective is copper oxide wire particles (COWP). These tiny metal particles are a slow release form of copper that can be administered in a gel cap. The following provides information about incorporating COWP into a parasite management plan.

GETTING STARTED

- Research indicates that COWP (alone) are only effective against the adult barber pole worm, *Haemonchus contortus*.
- A good way to screen for *H. contortus* levels is to use the FAMACHA© method of assessing anemia.
- As with dewormers, COWP should only be administered to animals that need treatment, as determined by the FAMACHA© system and/or Five Point Check©.
- Some organic certifiers may allow the use of COWP for management of the barber pole worm.

Gel cap containing COWP

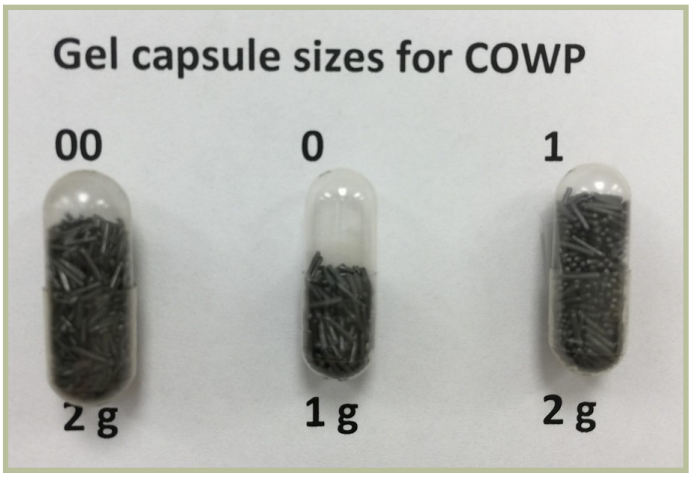
Image by: Susan Schoenian

HOW TO USE

- Find a source of COWP. They are sold as copper supplements for cattle (12.5 and 25 g boluses) and goats (2 and 4 g boluses; g = gram) that are consuming copper-deficient diets.
- Repackage COWP, as necessary, to achieve the desired dose.
- Purchasing cattle boluses and repackaging them into small gelatin capsules will save money. You can weigh the wire particles or fill the capsule to the appropriate level by "eye-balling" it (i.e. half the 2 g for a 1 g dose).
- Gel caps can be purchased from a pharmacy or the web. If you will be using a calf balling gun, a #12 capsule fits, though it is much bigger than needed for the dose. A small bolus will work with pet balling/pilling guns.

DOSAGE

- To prevent possible copper toxicity, especially in sheep, the lowest possible dose of COWP should be used.
- Doses that have proven effective are 0.5 to 1.0 g per lamb or kid and 1 to 2 g per ewe or doe. Dosage is based on age not weight.
- The 2 g goat boluses are okay for adults, but too much for young animals. The 4 g boluses are too much for deworming purposes.



Gel capsule sizes **Image by:** Joan Burke

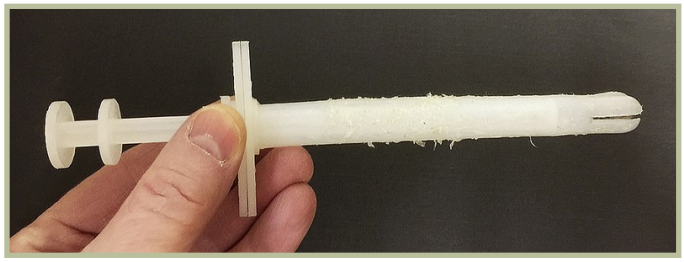
FREQUENCY

- You can administer COWP again after 4 to 6 weeks, if an animal needs treatment.
- You can treat several times; however, it is not known if copper will accumulate to dangerous levels if this is done in several consecutive years. According to research, it is relatively safe to do this for market animals at the 1 g dose (Burke and Miller, 2006).

COWP gel caps Image by: Susan Schoenian

ADMINISTERING COWP CAN BE TRICKY

- Never put your fingers in the animal's mouth. The molars are strong and can administer a very painful bite.
- Use the appropriate size balling gun for the size of capsule you are using. This will lessen the problem of boluses falling out before you have dosed them. A bit of peanut butter will help to keep the bolus in place until dosing.
- Because of those strong molars, plan to have extra balling guns. If an animal clamps down hard enough, it may destroy the plastic gun.
- You may also improvise a balling gun using a very small PVC pipe, combined with a small wooden dowel and a rubber band.
- Remember to be gentle. Try to be patient. You will grow more proficient with practice, but expect your first efforts with COWP boluses to be awkward and frustrating. If you lose patience and use too much force, you may injure the animal.



Balling/pilling Gun Image by Susan Schoenian

WHAT RESULTS CAN I EXPECT?

- Deworming effects are rapid (within 7 days), but short-lived, because only the adult worm is killed by COWP.
- Fecal egg counts may climb again after 3 to 4 weeks, even sooner if animals are carrying a large load of immature larvae (Vatta et al., 2012). Use the FAMACHA© system to monitor.
- When COWP were combined with albendazole (Valbazen®) or levamisole (Prohibit®), worm control was more effective, as there was a reduction in both immature and adult barber pole worms and intestinal worms, even in a population of resistant worms (Burke et al., 2016).
- Similar results can be expected from the different commercial sources of COWP: Copasure® (Animax Ltd), Ultra-Cruz® (Santa Cruz Animal Health) or Pharmplex (Australia) (Burke et al., 2016).
- While there is scientific evidence that COWP reduce barber pole worm infection in sheep and goats, effectiveness is impacted by factors such as the ratio of barber pole worms to other parasite species and digestive function or gut pH (diarrhea may reduce effectiveness). (Burke, 2018).

PRECAUTIONS

- Copper may accumulate to unsafe levels in the liver, especially in sheep. It is important to know the copper status of your animals. Liver samples of animals that die or are harvested for meat can be analyzed for copper levels. This information can be used to see if COWP can be used safely in your flock or herd.
- Once you start using COWP for worm control, you should periodically check livers to see if copper levels are still at safe levels (20-100 mg/kg wet for sheep, 20-150 mg/kg wet for goats). (Puls, 1988).
- While checking livers is the best way to determine the copper status of your animals, it is also important to know all the dietary sources of copper. You can check soil, water, and feedstuffs to determine the amount of copper and other minerals your animals are consuming and the risk of copper toxicity. The levels of molybdenum and sulfur are also important as they affect the absorption of copper.
- The maximum tolerable copper concentration for sheep is 15 mg/kg (ppm) dry matter when diets contain normal molybdenum (1-2 mg/kg DM) and sulfur (0.15-0.25 percent) (NRC, 2007). The ratio of copper to molybdenum should be 10:1 or less to prevent copper toxicity. The maximum tolerable copper level for goats has not been established (NRC, 2007). Until further research has been done, it is recommended that the cattle level (40 mg/kg) be used. (NRC, 2007).

WHAT IS COPPER TOXICITY?

When copper exceeds safe levels, it accumulates in the liver. Sulfur and molybdenum in the diet impact the amount of copper that is safe. Sheep are known to accumulate copper more than other animals. In simplistic terms, when the liver is "full", and more copper is ingested, the excess copper can "spill" into the bloodstream, causing death of red blood cells, thus resulting in anemia, weakness, and death. The urine may appear red, tissues may appear yellow. Treatment is difficult and if one animal is suffering from copper toxicity, it is likely that others in the herd or flock will soon follow.

FOR MORE INFORMATION

For more detailed information on using COWP, go to www.wormx.info. Select Copper Oxide Wire Particles from the Topics drop-down menu.

LITERATURE CITED

Burke, J.M. (personal communication, February 2, 2018) .

Burke, J.M., and J.E. Miller. 2006. Evaluation of multiple low doses of copper oxide wire particles compared with levamisole for control of *Haemonchus contortus* in lambs. *Veterinary Parasitology* 139: 145-149.

Burke, J.M., J.E. Miller, T.H. Terrill, E. Smyth, and M. Acharya. 2016. Examination of commercially available copper oxide wire particles in combination with albendazole for control of gastrointestinal nematodes in lambs. *Veterinary Parasitology*. 215: 1-4.

NRC. 2007. *Nutrient Requirements of Small Ruminants. Sheep, Goats, Cervids, and New World Camelids.* National Academy Press, Washington DC.

Puls, R., 1988. Mineral Levels in Animal Health. Diagnostic Data. Sherpa International, Clearbrook, British Columbia, Canada.

Vatta, A.F., P.J. Waller, J.B. Githiori, and G.F. Medley. 2012. Persistence of the efficacy of copper oxide wire particles against *Haemonchus contortus* in grazing South African goats. *Veterinary Parasitology* 180: 159-166.

Smaller doses can be made from larger boluses.

Image by Susan Schoenian

You can weigh the capsules or eyeball them.

Image by Susan Schoenian

Fact sheets in the *Best Management Practices for Internal Parasite Control in Small Ruminant* series were written and reviewed by members of the American Consortium for Small Ruminant Parasite Control. They are for educational and informational purposes only. No practice described in the fact sheets stands alone as a method to control internal parasites. Each producer needs to implement the appropriate combination of practices that will achieve satisfactory control of internal parasites in their flock or herd. The fact sheets are not meant as a substitute for professional advice from a veterinarian or other animal science professionals. Some treatments described in the fact sheets may require extra label drug use, which requires a valid veterinarian-client-patient relationship. For a complete list of fact sheets, go to https://www.wormx.info/bmps.

AUTHOR:

Linda Coffey, M.S.
NCAT-ATTRA, Fayetteville, Arkansas

REVIEWERS:

Joan Burke, Ph.D.
USDA ARS, Dale Bumpers Small Farms Research Center, Booneville, Arkansas

Adriano Vatta, BVSc
Zoetis, Kalamazoo, Michigan

Jim Miller, DVM
Louisiana State University, Baton Rouge, Louisiana

Susan Schoenian, M.S.
University of Maryland Extension, Keedysville, Maryland

Niki Whitley, Ph.D.
Fort Valley State University, Fort Valley, Georgia

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.

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

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

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 Goats 0.4	Sheep oral drench	high	Sheep 11 days Goats 14 days**	9 days**	Cattle injectable formulation not recommended
Doramectin	AM	No	No	Sheep 0.2 Goats 0.4	Injectable	high	ND	NE	Not recommended because long residual activity promotes resistance
Moxidectin	AM	Yes	No	Sheep 0.2 Goats 0.4	Sheep oral drench	low to moderate	Sheep 14 days Goats 17 days**	8 days**	Kills Ivermectin-resistant *Haemonchus*. Minimize use to preserve efficacy
Levamisole	I/T	Yes	No	Sheep 8.0 Goats 12.0	Soluble drench powder	low to moderate	Sheep 3 days 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 Goats 5.0[b]	Paste Suspension Feed block Mineral Pellets	high	Goats 6 days[c] (for suspension only)	0 days[c] (for suspension only)	[a]Approved in Big-horned sheep. [b] Label dose is 5.0 mg/kg but 10 mg/kg is recommended for goats. [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 Goats 20	Paste Suspension	high	Sheep 7 days 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*****

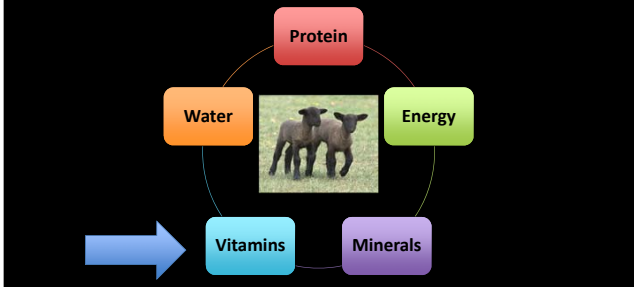
NC STATE EXTENSION

Mineral and Vitamin Nutrition

Deidre Harmon
Livestock Specialist
Department of Animal Science
NC State University

NC STATE EXTENSION

Nutritional Considerations: What's Needed?



NC STATE EXTENSION

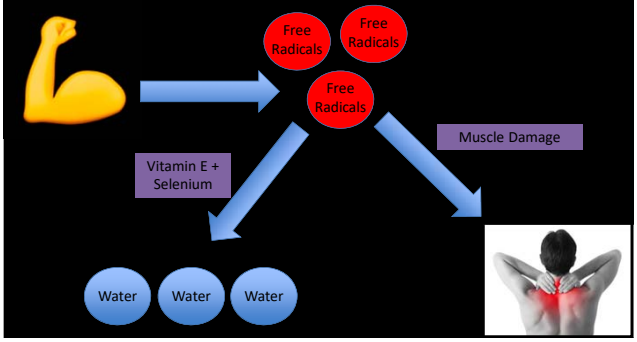
Fat Soluble Vitamins

- Deficiencies most often occur
  - Stored forages
  - Spoiled fats and other feedstuffs
  - Animals housed indoors

Vitamin	Function	Deficiency Symptoms	Sources
A	Nerve tissue development, eyesight, bone formation, reproduction	Poor performance, night blindness, reproductive failures	Green feeds/forages, stored in liver
D	Utilization of calcium and phosphorus, bone and teeth formation	Stunted growth, bone disorders (rickets), lameness	Sunshine, synthesized in skin
E	White muscle disease, growth performance, reproduction	Utilization dependent on selenium	Green feeds/forages
K	Blood coagulation	Failure of blood to clot	Body synthesizes

NC STATE EXTENSION

Vitamin E and White Muscle Disease



NC STATE EXTENSION

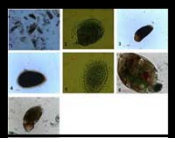
Best Management Practices for Vitamin E

- White muscle disease most prominent between birth and day 35
- Quality, green pasture = no problem
- No green forage = supplementation
  - Feed Ewes > 100 IU/hd/d in late gestation and lactation
  - Be weary of minerals stored for over 90 days

NC STATE EXTENSION

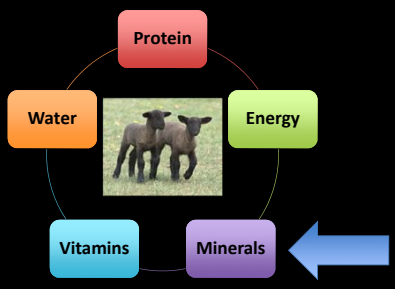
Vitamins

- Water Soluble – B complex & vitamin C
  - Not stored in tissues, constant supply needed
  - Vitamin B's: Rumen microbes
  - Vitamin C: tissue synthesis



NC STATE EXTENSION

Nutritional Considerations: What's Needed?

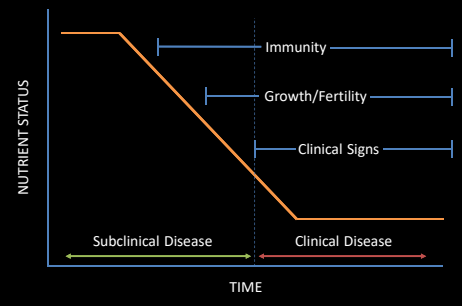


Mineral Concepts to Consider

- Basic understanding of mineral nutrition.
- Does poultry litter solve my mineral needs?
- Is the silver bullet bag of minerals out there?
- You get what you pay for.

NC STATE EXTENSION

How Do We Know We Have A Problem?



Redrawn from S. Wikse, 1992, Texas A&M University Beef Cattle Short Course

NC STATE EXTENSION

How Do We Visualize Mineral Nutrition?

NC STATE EXTENSION

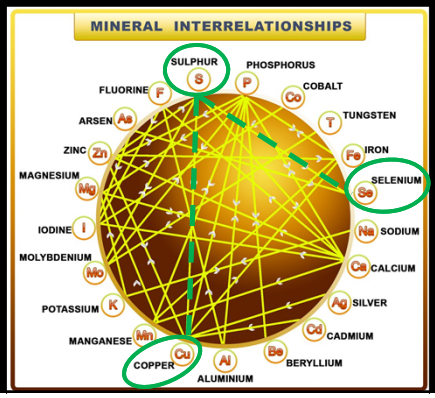
How Do We Visualize Mineral Nutrition?

White Muscle disease (WMD), also known as stiff lamb disease. Lamb unable to stand as a result of tissue degeneration.

Courtesy of O.H. Muth, Oregon State University

NC STATE EXTENSION

Trace Mineral Interactions



Miller, 1979

NC STATE EXTENSION

Trace Mineral Interactions

Byproducts of the ethanol industry are high in Sulfur

Corn Gluten Pellets 0.58 % S

Distillers Grain w/ Solubles 0.66 % S

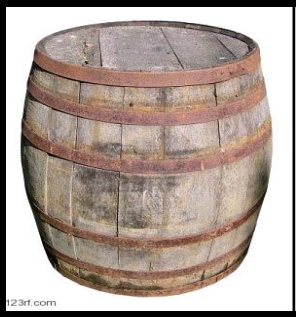
Copper Antagonist	Deficient	Ideal	Marginal	High	Maximum Tolerable Concentration
Iron (ppm)	Below 50	50-200	>200-400	>400	1000
Sulfur (%)	Below 0.10	0.15-0.20	>0.20 – 0.30	>0.30	0.40
Molybdenum (ppm)	----------	Below 1	1-3	Above 3	5

Miller, 1979

NC STATE EXTENSION

Mineral Nutrition

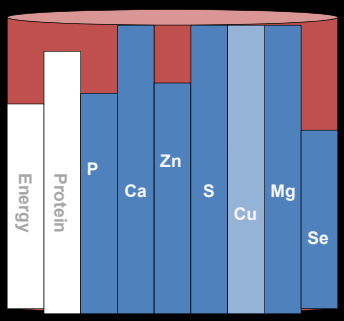
- Slats = minerals
- Water capacity = Animal Performance
- Animal performance is only as good as the most limiting nutrient



NC STATE EXTENSION

Mineral Nutrition

- Slats = minerals
- Water capacity = Animal Performance
- Animal performance is only as good as the most limiting nutrient



NC STATE EXTENSION

Minerals

Macro (major - %)	Micro (minor - ppm)
Calcium (Ca)	Iron (Fe)
Phosphorus (P)	Manganese (Mn)
Magnesium (Mg)	Copper (Cu)
Potassium (K)	Selenium (Se)
Sodium (Na)	Zinc (Zn)
Chlorine (Cl)	Iodine (I)
Sulfur (S)	Cobalt (Co)
	Molybdenum (Mo)

Stage of production and level of performance greatly influences animal requirements

NC STATE EXTENSION

Macromineral Requirements

Mineral	Requirement	Max Tolerable Level
	----------%----------	
Calcium	0.20-0.82	-------
Phosphorus	0.16-0.38	-------
Magnesium	0.12-0.18	-------
Potassium	0.50-0.80	-------
Sodium	0.09-0.18	-------
Sulfur	0.14-0.26	-------
Chloride	-------	-------

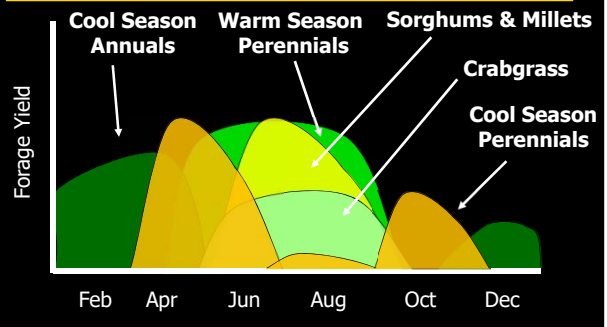
NC STATE EXTENSION

Micromineral Requirements

Mineral	Requirement	Max Tolerable Level
	----------ppm of DM----------	
Iodine	0.10 – 0.80	50
Iron	30-50	500
Zinc	20-33	750
Manganese	20-40	1,000
Copper	7-11	25
Selenium	0.10 – 0.20	2
Cobalt	0.10 – 0.20	10
Molybdenum	0.50	10
Fluorine	-------	60-150

NC STATE EXTENSION

Forage Distribution In The Southeast



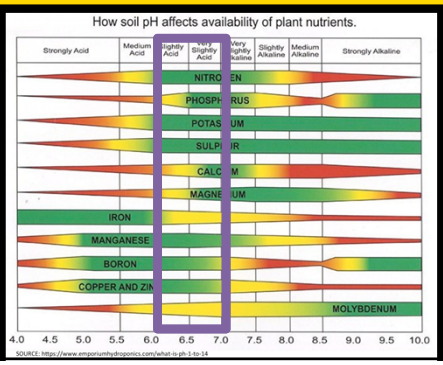
NC STATE EXTENSION

Forage Mineral Concentrations Vary Based On

- Soil pH

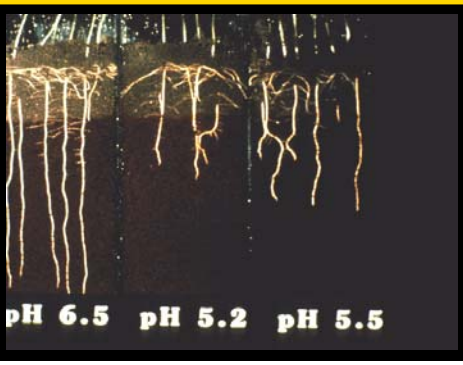
NC STATE EXTENSION

How Soil pH Affects Availability of Plant Nutrients



NC STATE EXTENSION

Soil pH and Root Development



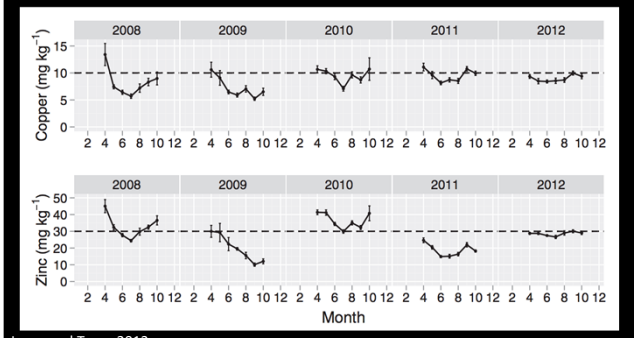
NC STATE EXTENSION

Forage Mineral Concentrations Vary Based On

- Soil pH
- Year

NC STATE EXTENSION

Yearly Variations in Forge Mineral Concentrations in Virginia



Jones and Tracy, 2013

NC STATE EXTENSION

Forage Mineral Concentrations Vary Based On

- Soil pH
- Year
- Season

NC STATE EXTENSION

Seasonal Mineral Concentrations in Virginia Fescue Pastures

Mineral	April	May	June	July	August	September	October
P (%)	0.28^{a}	0.27^{a}	0.25^{b}	0.21^{c}	0.24^{bc}	0.25^{b}	0.24^{b}
K (%)	2.21^{a}	2.21^{a}	2.07^{ab}	1.59^{c}	1.57^{c}	1.96^{b}	1.97^{b}
S (%)	0.23^{a}	0.20^{b}	0.19^{cd}	0.16^{e}	0.19^{d}	0.21^{b}	0.20^{bc}
Mn (ppm)	105.4^{a}	96.2^{abc}	79.5^{c}	85.8^{bc}	92.2^{ab}	87.1^{abc}	87.0^{bc}
Cu (ppm)	11^{a}	8.9^{b}	7.9^{cd}	7.2^{d}	8.2^{bc}	8.7^{b}	9.0^{b}
Zn (ppm)	34.2^{a}	30.2^{b}	25.8^{c}	23.3^{c}	24.9^{c}	25.7^{c}	26.8^{c}

General Trends:

P, K, S, Mn, Cu, Zn: Highest in spring, lowest in summer, partial recovery in fall

Mg: Lowest in spring, highest in summer, low in fall

Jones and Tracy, 2013

NC STATE EXTENSION

Seasonal Mineral Concentrations in Virginia Fescue Pastures

Sheep Requirements	Mineral	April	May	June	July	August	September	October
0.16-0.38	P (%)	0.28^{a}	0.27^{a}	0.25^{b}	0.21^{c}	0.24^{bc}	0.25^{b}	0.24^{b}
0.50-0.80	K (%)	2.21^{a}	2.21^{a}	2.07^{ab}	1.59^{c}	1.57^{c}	1.96^{b}	1.97^{b}
0.14-0.26	S (%)	0.23^{a}	0.20^{b}	0.19^{cd}	0.16^{e}	0.19^{d}	0.21^{b}	0.20^{bc}
0.20-0.82	Ca (%)	0.54^{a}	0.45^{e}	0.51^{cd}	0.47^{de}	0.52^{abc}	0.53^{ab}	0.49^{bcd}
0.12-0.18	Mg (%)	0.23^{de}	0.22^{e}	0.25^{c}	0.24^{cd}	0.28^{b}	0.30^{a}	0.27^{b}
20-40	Mn (ppm)	105.4^{a}	96.2^{ab} ^{c}	79.5^{c}	85.8^{bc}	92.2^{ab}	87.1^{abc}	87.0^{bc}
7-11	Cu (ppm)	11^{a}	8.9^{b}	7.9^{cd}	7.2^{d}	8.2^{bc}	8.7^{b}	9.0^{b}
20-33	Zn (ppm)	34.2^{a}	30.2^{b}	25.8^{c}	23.3^{c}	24.9^{c}	25.7^{c}	26.8^{c}

Jones and Tracy, 2013

NC STATE EXTENSION

Forage Mineral Concentrations Vary Based On

- Soil pH
- Year
- Season
- Forage species

NC STATE EXTENSION

Mineral Content of Pennsylvania Forages

Mineral	Legume Forage	Mixed, Mainly Legume	Grass Forage	Mixed, Mainly Grass
P (%)	0.30	0.29	0.22	0.23
Ca (%)	1.18	1.02	0.49	0.65
K (%)	2.55	2.26	1.68	1.79
Mg(%)	0.24	0.22	0.16	0.18
Na (%)	0.024	0.018	0.014	0.013
Mn (ppm)	44.1	48.1	76.4	57.3
Fe (ppm)	221.7	222.0	184.4	192.3
Zn (ppm)	18.1	27.2	27.6	26.5
Cu (ppm)	13.1	13.1	12.9	12.0

General Trends:

Legumes > Grasses in Ca, K, Mg, Cu, Zn, Co

Legumes < Grasses in Mn, Si

Adams, 1975

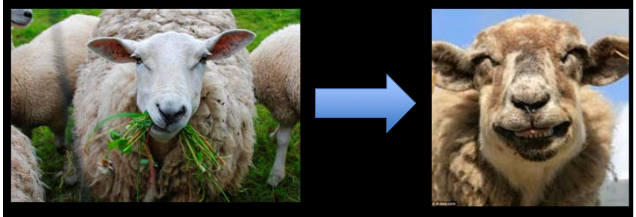
NC STATE EXTENSION

Forage Mineral Concentrations Vary Based On

- Soil pH
- Year
- Season
- Forage species
- Forage maturity
- Environment

NC STATE EXTENSION

Forage Mineral Concentrations and Utilization



NC STATE EXTENSION

Mineral Bioavailability

- Forage mineral is not 100% available
- Bioavailability = portion of mineral absorbed and utilized
- Minerals come in many forms
- Minerals may be bound in insoluble complexes (lignin)

Mineral	Forms in Plants
Calcium	Calcium phosphate; calcium oxalate; possibly bound to pectin and lignin
Phosphorus	Inorganic phosphate; RNA; phospholipids; other phosphate esters; phytic acid
Sulfur	Sulfur amino acids; other organic sulfur-containing compounds; sulfate
Magnesium	Chlorophyll; bound to lignin
Sodium	Sodium ion
Potassium	Potassium ion
Chlorine	Chloride ion
Zinc	Anionic complexes
Copper	Neutral or anionic complexes
Selenium	Selenomethionine; selenate
Manganese	Organic chelates
Iron	Porphyrins; anionic complexes; ferric hydroxide
Iodine	Iodide ion
Silicon	Solid silica in plant cell wall; silicic acid
Molybdenum	Molybdenum-containing enzymes; molybdate ion

NC STATE EXTENSION

Mineral Bioavailability

- Bioavailability is dependent on:
  - Maturity
  - Grass species
  - Growing conditions (stressors)
- Bioavailability is hard to measure
- Labs report total forage mineral concentration
- Slow improvements

Proportions of minerals in cell wall

Mineral	Tall Fescue	White Clover
	----- Percent of total mineral -----	
Phosphorus	4.9	5.0
Sulfur	3.6	5.2
Calcium	14.1	45.0
Magnesium	6.5	14.2
Potassium	1.7	0.9
Manganese	22.5	93.8
Zinc	29.0	45.4
Copper	26.5	40.6

Ruminal release of minerals from forages

all Fescue[a]	Switchgrass[b]	Bermudagrass[c] (*Cynodon dactylon* L.)	Alfalfa[c]
---------- Percent disappearance ----------			
71.0	30.3	78.1	59.3
91.9	83.9	96.5	95.2
95.7	82.5	99.9	99.9
88.3	60.8	65.3	85.1
81.9	47.2	NM[d]	NM[d]
NM[d]	NM[d]	75.8	92.9
NM[d]	NM[d]	62.1	79.4

NC STATE EXTENSION

Common Mineral Nutrition Problems – Selenium Deficiency

Clinical and Subclinical Problems	Solutions
• White muscle disease • Reproductive failure – Embryonic mortality (weeks 3-4) • Hypothermia (indirectly) – Cannot burn brown adipose tissue to generate body heat • Poor performance • Reduced disease resistance	• Forage analysis – Deficiencies – Antagonisms • Evaluate supplementation • Monitor mineral suppl. intake – Read tag – Add salt to regulate intake – Mix with carrier and hand feed

NC STATE EXTENSION

Common Mineral Nutrition Problems – Copper Toxicosis

Clinical and Subclinical Problems	Solutions
• Copper accumulates in liver • Bloody diarrhea • Yellowish eyes • Yellow body fat	• Sheep specific supplements • Check molybdenum levels – CU:MO ratio range of 6:1 up to 10:1 • Remove all stressors

NC STATE EXTENSION

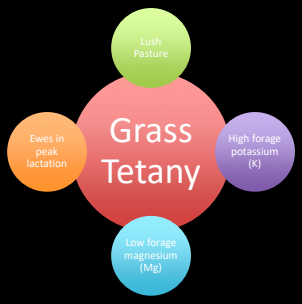
Common Mineral Nutrition Problems – Iodine Deficiency

Clinical and Subclinical Problems	Solutions
• Enlarged thyroid gland (goiter) • Lambs born weak, dead, or without wool • Mature ewes have decreased reproductive efficiency	• Potassium iodide supplementation • Replace white salt with iodized salt or trace mineral salt – Look for 140 ppm mineral

NC STATE EXTENSION

Common Mineral Nutrition Problems – Magnesium Deficiency

- Grass Staggers
- Lactation increases Mg needs
  - Start at least 6 weeks prior to lambing
- Supplement for fall and spring flush



NC STATE EXTENSION

Common Mineral Nutrition Problems – Sulfur Toxicity

- Sulfur Toxicity (Polioencephamalacia)
- Damage to grey matter of the brain
- Dietary feed resources (max. Sulfur concentrations)
  - 0.3% grain-based (Corn co-products and molasses)
  - 0.5% forage-based (sulfate based fertilizers)
  - Water less than 600 mg/L sulfate (Springs)
- Antagonistic
  - Binds Cu reducing absorption
  - Lowers Se digestibility
  - Inhibits Se incorporation into enzymes
  - Reduces Mn & Cu retention

NC STATE EXTENSION

Common Mineral Nutrition Problems – Milk Fever

- Hypocalcemia (Milk Fever)
- High in legumes than grasses
- Corn based diets and corn co-products are low in calcium
- Dietary Ca:P ratio near 2:1

Factors	Situations
Low calcium intake, especially for dry ewes	Heavy alfalfa hay feeding fertilized with potassium (cation/ion imbalance)
Low phosphorus intake	Inadequate supplementation; high forage - low grain (i.e. pasturing dry cows).
Excessive phosphorus intake	Over supplementation; excessive grain feeding.
Excessive vitamin D	Over supplementation can lead to calcification of tissues and result in heart failure.
Low magnesium intake	Failure to balance low magnesium forages, i.e. corn silage, grasses, and small grains.
High potassium intake as it affects anion-cation balance	Forages high in potassium content - over 1.5% on a dry matter basis.
Selenium or vitamin E deficiency	White muscle disease; lack of supplementation.

NC STATE EXTENSION

I'm using poultry litter for fertilizer, so I don't need to feed any phosphorus, right???

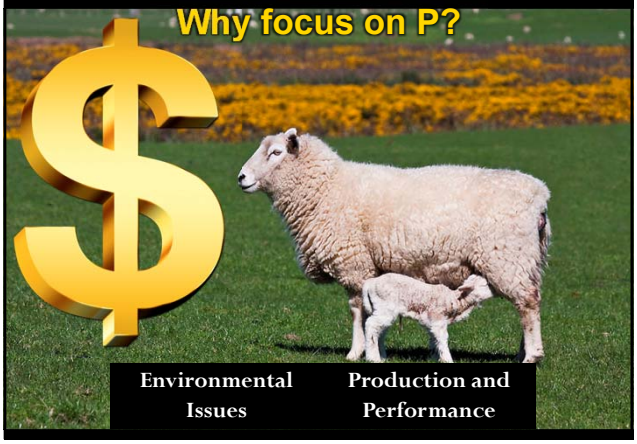
NC STATE EXTENSION

Estimating the Phosphorus Status of Grazing Beef Cattle in Virginia

Deidre D. Harmon, Scott J. Neil, Mark A. McCann
Department of Animal and Poultry Sciences
Virginia Tech

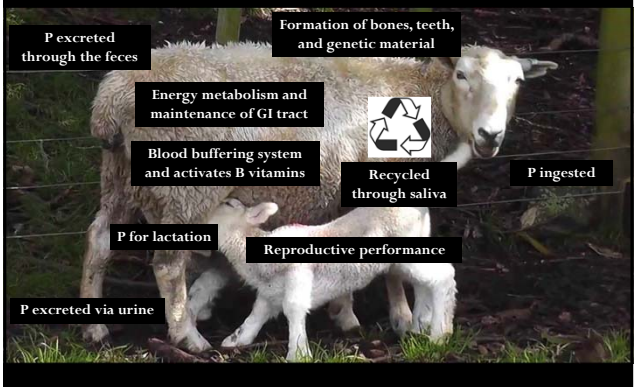
NC STATE EXTENSION

Why focus on P?



NC STATE EXTENSION

Why focus on P?



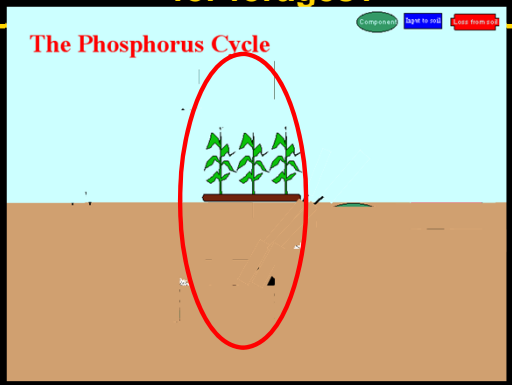
NC STATE EXTENSION

What are our sources of P for sheep?

- Forage
- Feed
- Mineral

NC STATE EXTENSION

What are our sources of P… for forages?



Mineral Nutrition is like your pay check

Income Taxes

Insurance

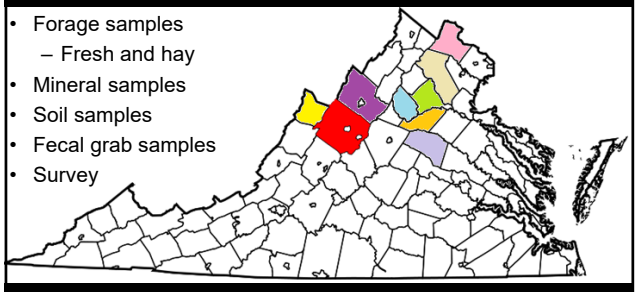
Leaching and runoff

Organically bound in soil

NC STATE EXTENSION

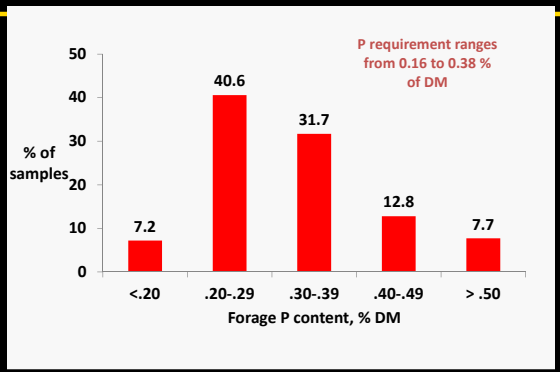
Estimating P Status of Grazing Beef Cattle

- Forage samples
  - Fresh and hay
- Mineral samples
- Soil samples
- Fecal grab samples
- Survey



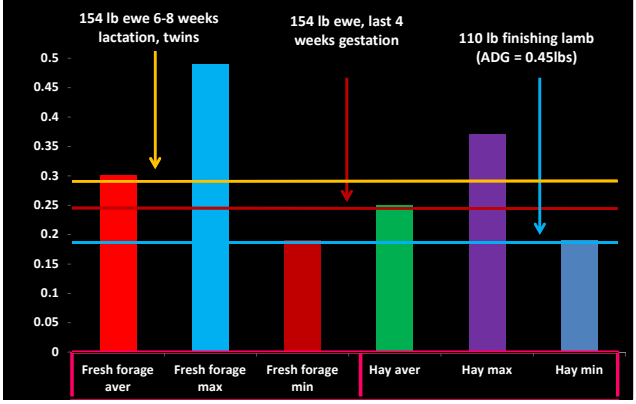
NC STATE EXTENSION

Phosphorus Forage Sample Distribution



NC STATE EXTENSION

Phosphorus Forage Sample Distribution



NC STATE EXTENSION

Phosphorus Survey Conclusions

- Many producers have adequate amounts of P already in their forages and soils
- Except in very poor quality forages, supplementation is usually not needed

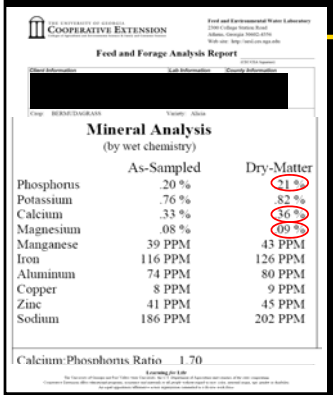
NC STATE EXTENSION

Where Do We Start With Selecting A Mineral?

- What is the stage of production?
- Did you have the forage tested?
  - Best starting place
- Any supplement?
  - May give us some minerals
- READ THE TAG

NC STATE EXTENSION

What's in the forage?



Cooperative Extension

Feed and Forage Analysis Report

[redacted]

Mineral Analysis
(by wet chemistry)

	As-Sampled	Dry-Matter
Phosphorus	.20 %	.21 %
Potassium	.76 %	.82 %
Calcium	.33 %	.36 %
Magnesium	.08 %	.09 %
Manganese	39 PPM	43 PPM
Iron	116 PPM	126 PPM
Aluminum	74 PPM	80 PPM
Copper	8 PPM	9 PPM
Zinc	41 PPM	45 PPM
Sodium	186 PPM	202 PPM

Calcium:Phosphorus Ratio 1.70

- P = 0.16 – 0.38%
- Ca = 0.20 – 0.82%
- Mg = 0.12 – 0.18%

NC STATE EXTENSION

What's our strategy?

Mineral Analysis
(by wet chemistry)

	As-Sampled	Dry-Matter
Phosphorus	.20 %	.21 %
Potassium	.76 %	.82 %
Calcium	.33 %	.36 %
Magnesium	.08 %	.09 %
Manganese	39 PPM	43 PPM
Iron	116 PPM	126 PPM
Aluminum	74 PPM	80 PPM
Copper	8 PPM	9 PPM
Zinc	41 PPM	45 PPM
Sodium	186 PPM	202 PPM
Calcium:Phosphorus Ratio	1.70	

Phosphorus:
- Can't add any without adding Ca (maintain ratio)

Magnesium:
- K is slightly higher than requirement

NC STATE EXTENSION

Calculating mineral needs

Phosphorus:
- Requirement = 0.30% → 15% adj = 0.35%
- DMI = 3.85 lb/d
- Mineral intake = 1 oz OR ~1.62% of DMI

Forage Mineral Req

0.984*(0.30%) + 0.0162*(x%) = 0.35%

x = 3.5%

- Additional Ca to maintain >2:1 ratio
  = 3.5 x 2 = ~7% Ca

NC STATE EXTENSION

What about a supplement?

- Several supplements used today are high in phosphorus
  - Corn gluten feed, distillers grains, brewer's grains, wheat middlings
  - Saves $$ on P, and make mineral shopping easier

NC STATE EXTENSION

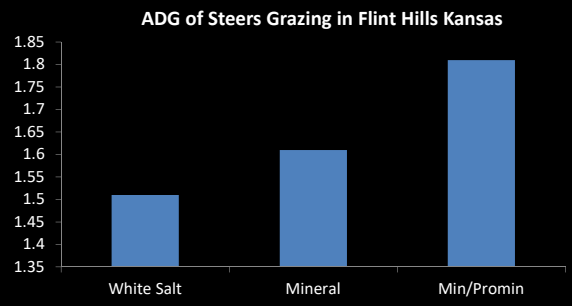
My flock isn't consuming the right amount

- Read the tag
- 100 ewes x 1 oz = 100 oz ÷ 16 oz = 6.25 lb/day
  6.25 lb x 7 days = 44 lb/week
- Not consuming enough:
  - Mix into supplement
  - Add flavor enhancer (cottonseed meal, distillers grains, etc.)
- Consuming too much:
  - Mix into supplement
  - Only put out a weeks worth at a time each week
  - Mix additional salt

Focus On Mineral Management

- Placement
- Mineral Feeders
- Intake

White Salt – Is It Enough?



Barnhardt et al., 2007 KS Beef Report

Cattle Red Trace Mineral Blocks

Mineral Source	% in Block
Sodium Chloride	98.24%
Ferrous Carbonate	0.526%
Zinc Oxide	0.486%
Manganous Oxide	0.334%
Reddish Brown Iron Oxide	0.252%
Copper Sulfate	0.120%
Mineral Oil	0.020%
Calcium Iodate	0.011%
Cobalt Carbonate	0.0108%
Artificial Flavor	0.005%

98% SALT

Trace Mineral Salt w/Selenium

- Ingredients List
  - Typically listed greatest quantity to smallest quantity

NC STATE EXTENSION

Take Home Message

- Group feed based on production stage.
- Know your forages.
- Know your supplement
- Hand pick the mineral to fit biggest deficiencies

NC STATE EXTENSION

Questions?

Weekly Sheep and Goat Sales
New Holland Sales Stables, New Holland, Pennsylvania

Tom Stanley, Extension Agent, Farm Business Management

Why New Holland

The New Holland Sales stables sells the largest volume of sheep and goats on the East Coast. Virtually all of sheep and goats sold through New Holland go to a diverse array of ethnic communities scattered throughout the Northeastern United States. In 2018 alone, the Monday sale of sheep and goats had volumes of over 139,000 head of sheep and lambs and over 95,000 goats. As a result of this volume, New Holland as the bellwether of sheep and goat pricing on the East Coast. The weekly weighted average price report for the Monday sheep and goat sale published by the USDA Market News Service is an excellent resource for pricing information and is the foundation of this paper.

Disclaimers

The New Holland Sales Stables is a live 'out-cry auction' and there is an abundance of anecdotes surrounding the personalities, cultural demographics, and sale procedures at the New Holland sheep and goat sales. Based on interviews with producers and marketing agents that frequent the New Holland weekly sheep and goat sale, there are three topics that appear to most impact Virginia sheep and goat producers whether they use the New Holland Sales Stables to market their animals or for price discovery.

The first of these are discrepancies in prices received and those that appear in the market report. In weeks with large volumes of sheep and lambs (over 3,500 head of sheep) the sale will stretch beyond the time USDA data collection agents have to devote to the sale so the prices at the end of the sale are not always captured in the weekly report. This issue appears to have been alleviated to a degree in 2017 and 2018 when New Holland management has moved more sheep sales to Tuesday morning when volumes are high (close-to or above 4,000 head of sheep and lambs).

Closely related to this first point is the sale order. For producers that sell sheep and goats through New Holland, where their animals come in the sale order is a critical determinant in the number of buyers bidding on the animals and the price paid. On this point in particular, there a many anecdotes related to sellers jockeying for position in the sale order and the level of participation from buyers at different points in the sale.

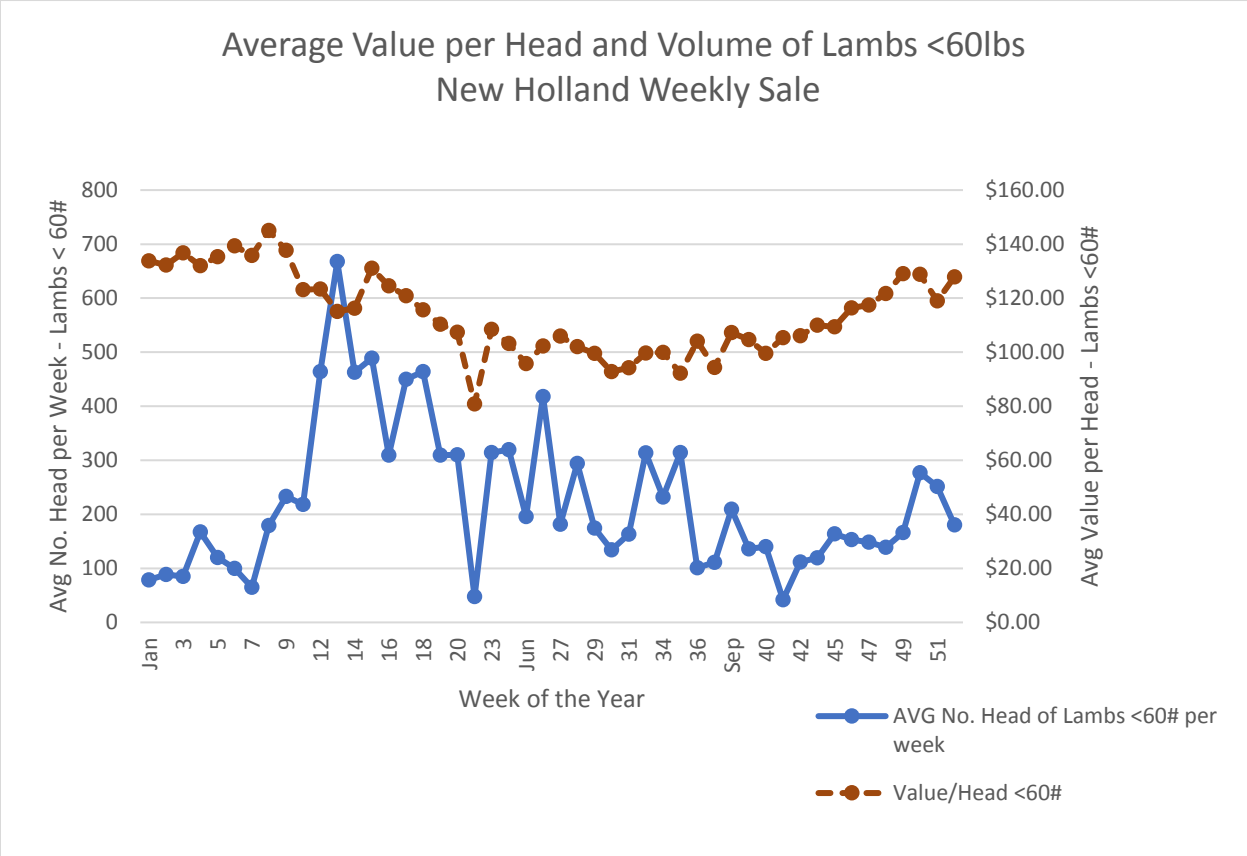
Finally, of particular interest to any shepherd whose lambs or goats may have to travel a significant distance to reach New Holland Pennsylvania, is the question of weight shrinkage. Some producers report significant weight shrink between when the animals leave the farm and what they weigh when they exit the sale ring and settlement checks are written. Here again are numerous anecdotes that are difficult to verify and cannot be captured by a market price report. New Holland Sales Stables will provide hay and water to animals that arrive Saturday or Sunday for an up-coming sale. However, active presence of the seller or seller's agent to insure appropriate penning of the animals that allows them access to the hay and water is critical for the animals to benefit from these provisions.

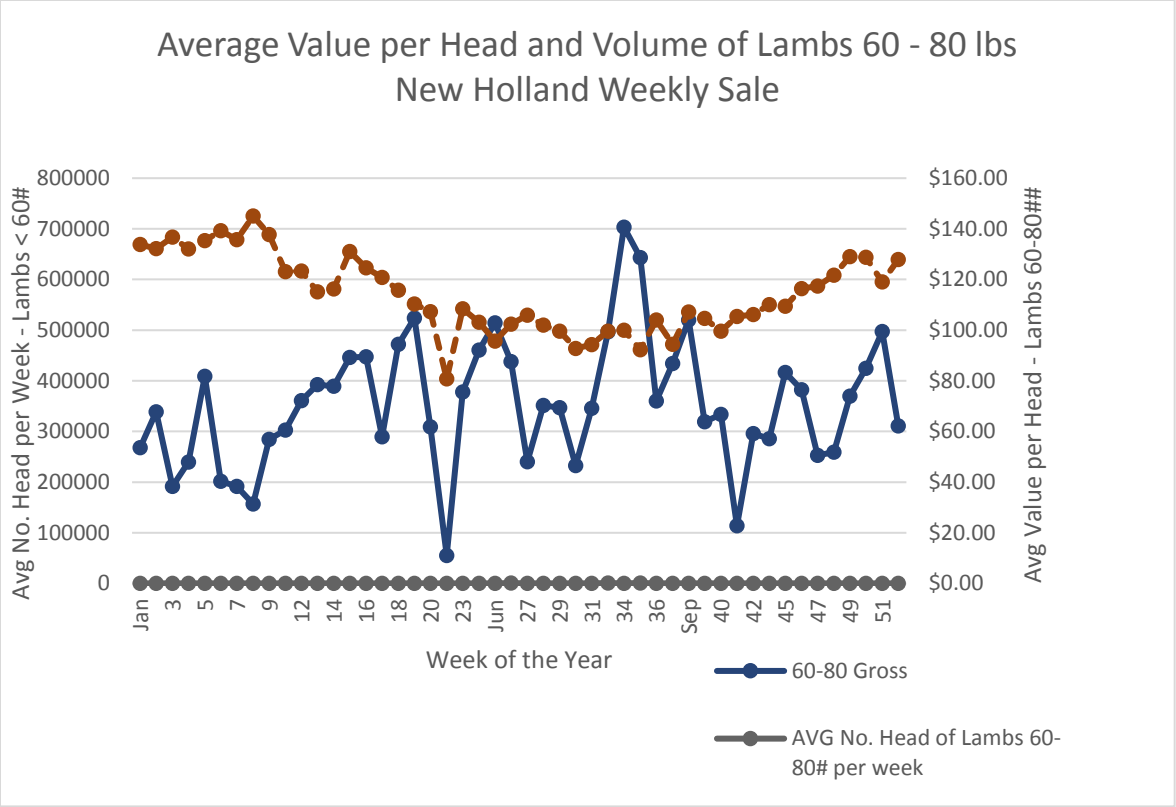
Price Histories and Patterns

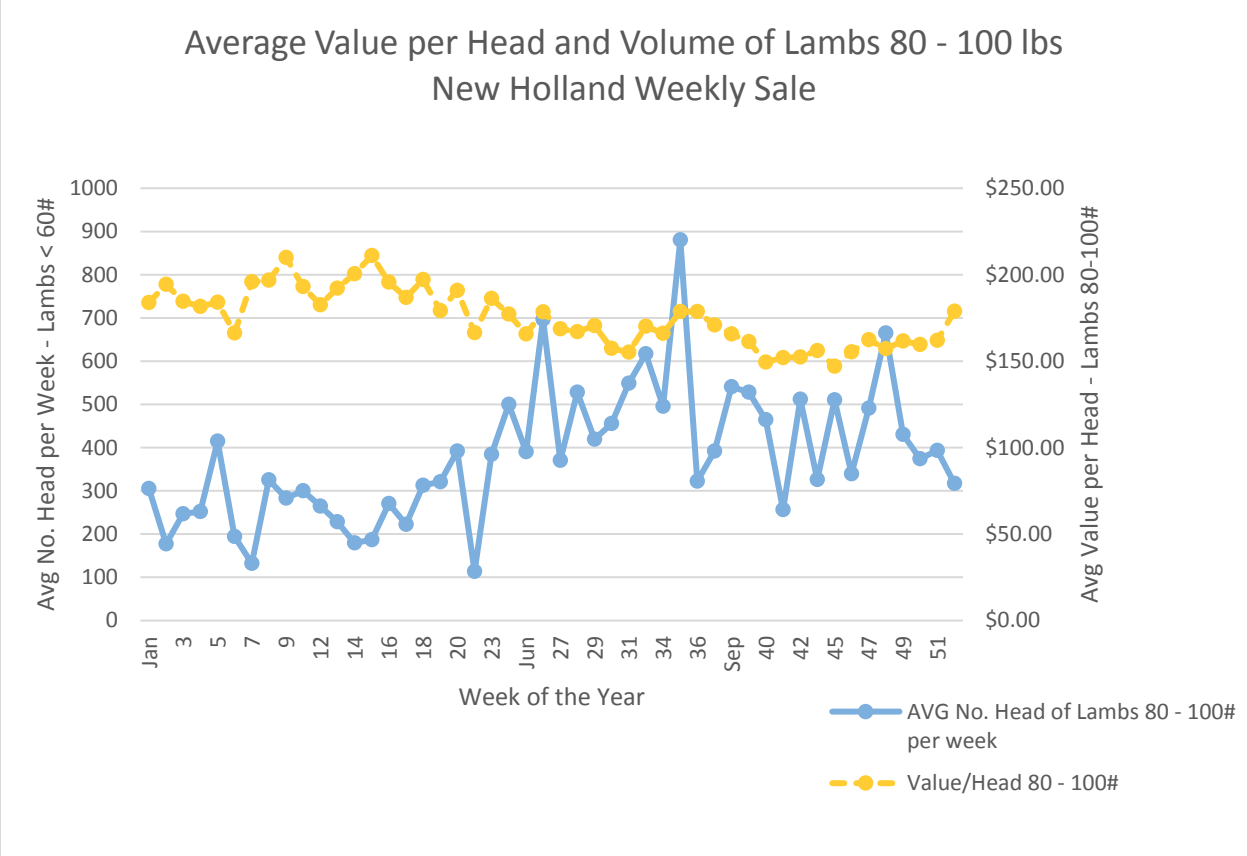
All disclaimers aside, the USDA Market News report for New Holland's weekly sale remains a valuable resource and this paper attempts to highlight some very general price patterns. This author looks forward to devoting more time to more in-depth analysis of these data. Each group of animals reported on the weekly USDA New Holland Sales report constitutes a line of data, each line with a number of head, low weight, high weight, weighted average weight, low price, high price, and weighted average price and sometimes a note. After some data editing to remove redundancies and duplicates, that still leaves 22,000 lines of data for the period 2013 – 2018!

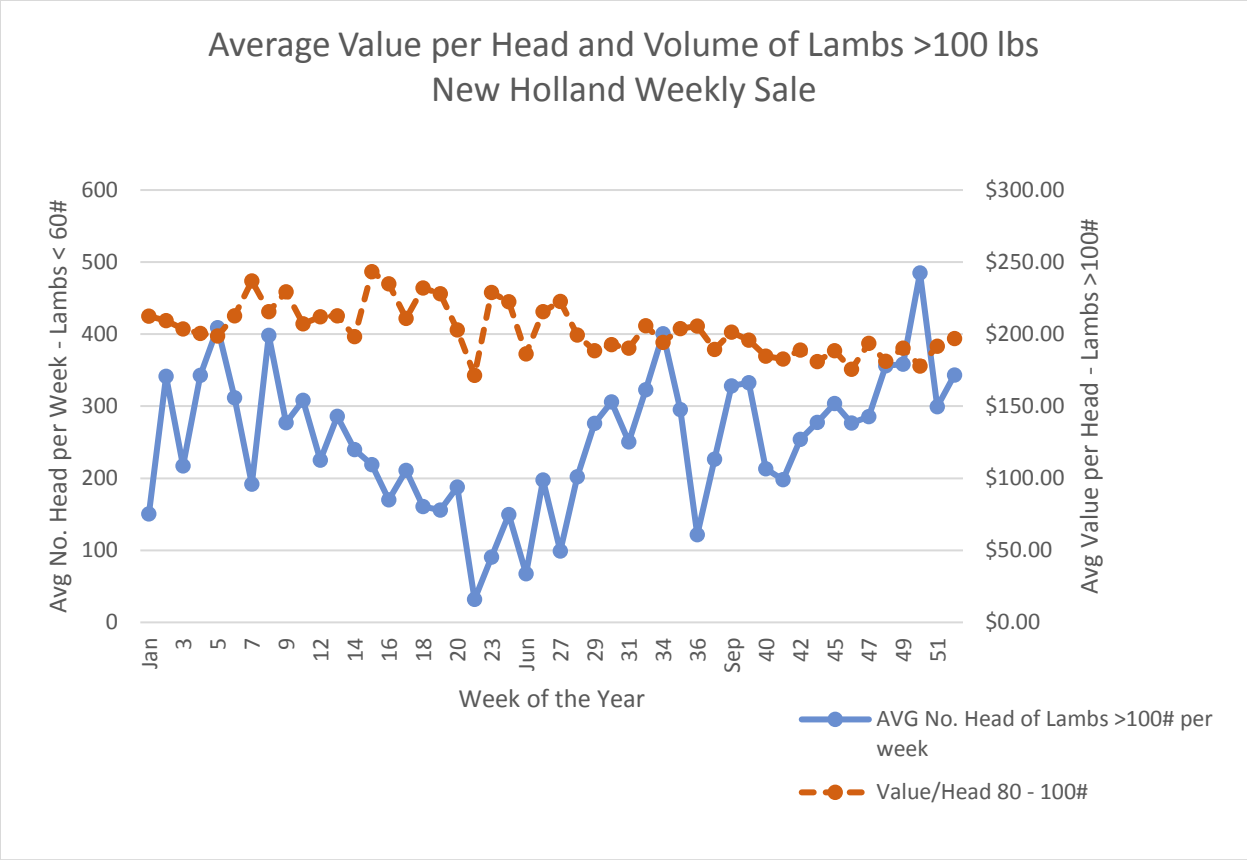
In the period covered by this paper 2013 - 1018, the Islamic holiday of Eid ul-Adha (the 'festival of sacrifice') moved from mid October to late August. The three weeks prior to this holiday are characterized by very heavy sale volumes of sheep and goats.

LAMBS



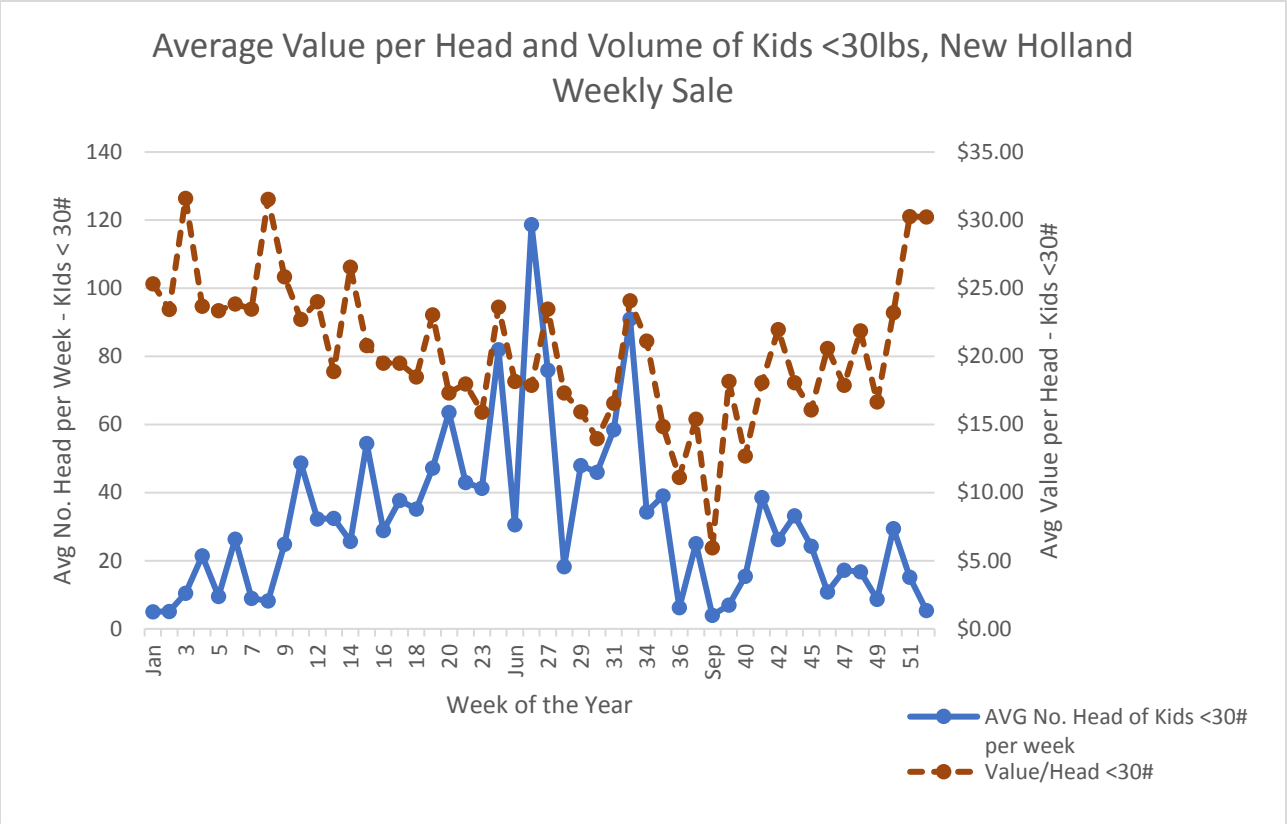

Average Value per Head and Volume of Lambs 60 - 80 lbs
New Holland Weekly Sale
Avg No. Head per Week - Lambs < 60#
800000
700000
600000
500000
400000
300000
200000
100000
0
$160.00
$140.00
$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00
Avg Value per Head - Lambs 60-80##
Jan 3 5 7 9 12 14 16 18 20 23 Jun 27 29 31 34 36 Sep 40 42 45 47 49 51
Week of the Year
60-80 Gross
AVG No. Head of Lambs 60-80# per week

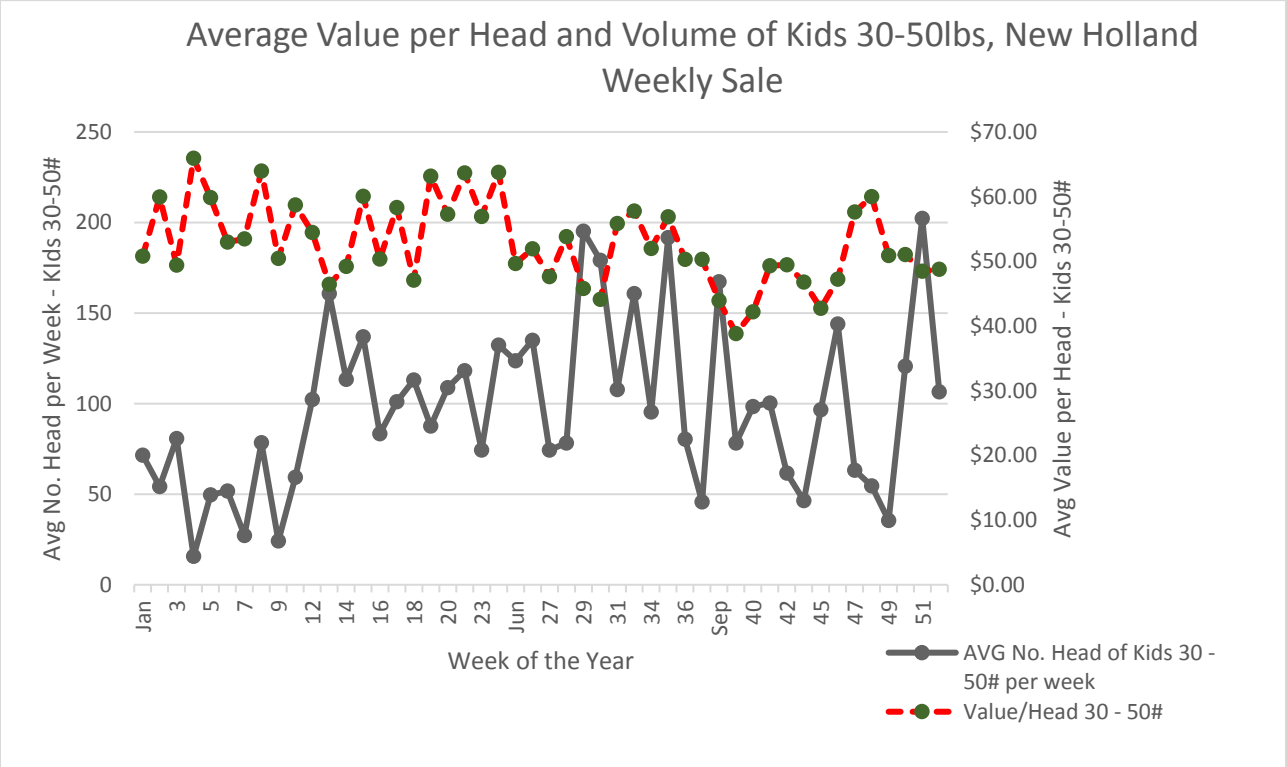

Average Value per Head and Volume of Lambs 80 - 100 lbs
New Holland Weekly Sale
Avg No. Head per Week - Lambs < 60#
1000
900
800
700
600
500
400
300
200
100
0
$250.00
$200.00
$150.00
$100.00
$50.00
$0.00
Avg Value per Head - Lambs 80-100#
Jan 3 5 7 9 12 14 16 18 20 23 Jun 27 29 31 34 36 Sep 40 42 45 47 49 51
Week of the Year
AVG No. Head of Lambs 80 - 100# per week
Value/Head 80 - 100#

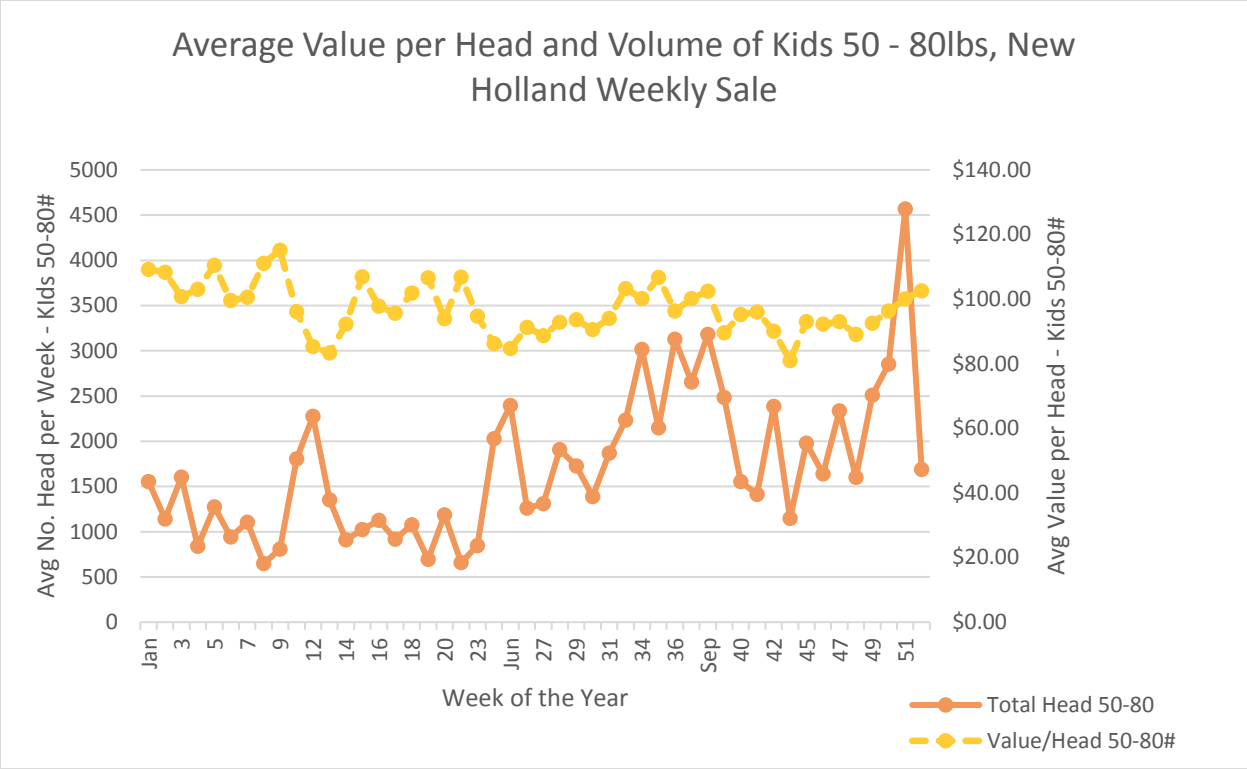


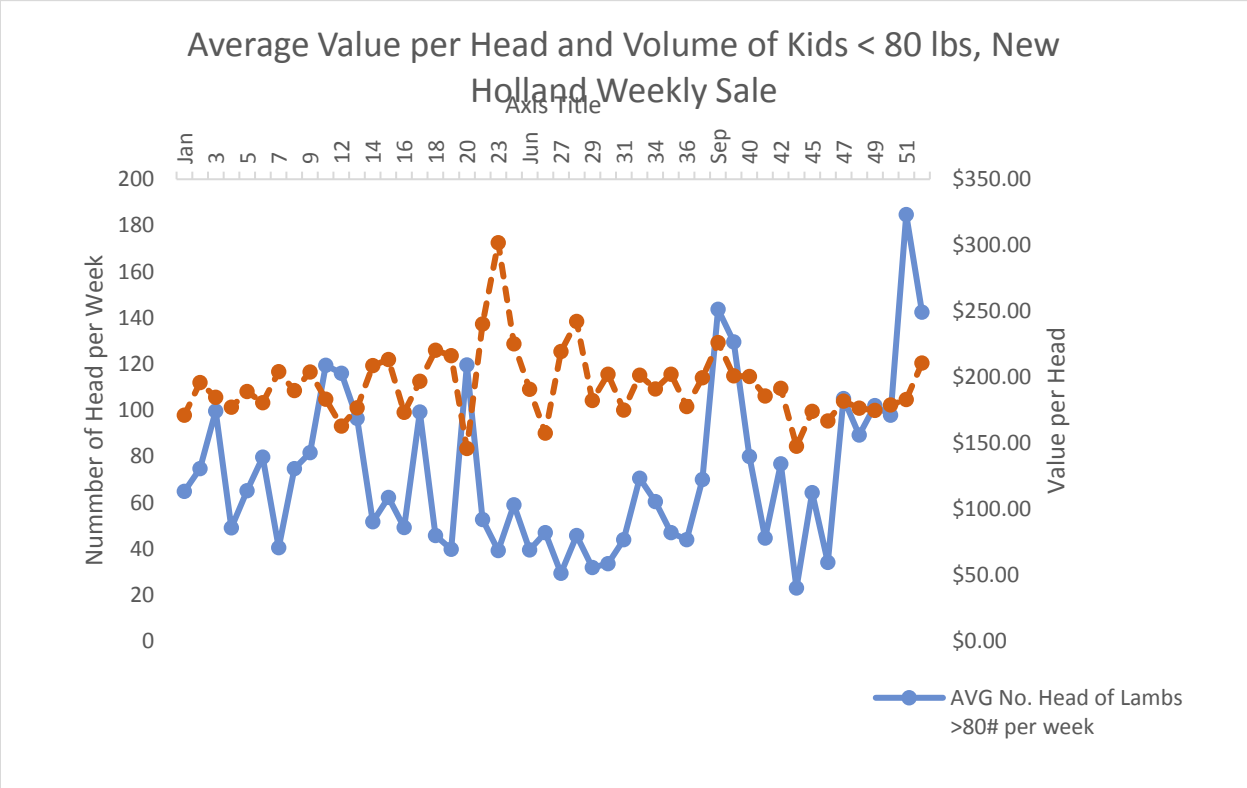
When looking at these charts for lambs, it is important to pay close attention to the price scale on the right-hand axis. The values are expressed as "value per head" to facilitate comparisons across weight categories. In general, all weight categories are subject to significant swings in number of head for sale from week to week. All categories, with the exception of the heaviest lambs, appear to have a low supply period in January, February, and early March.

Kids


Average Value per Head and Volume of Kids <30lbs, New Holland Weekly Sale
Avg No. Head per Week - KIds < 30#
Avg Value per Head - Kids <30#
Week of the Year
AVG No. Head of Kids <30# per week
Value/Head <30#


Average Value per Head and Volume of Kids 30-50lbs, New Holland Weekly Sale
Avg No. Head per Week - KIds 30-50#
Avg Value per Head - Kids 30-50#
Week of the Year
AVG No. Head of Kids 30 - 50# per week
Value/Head 30 - 50#





Just as with the lambs, it is important to pay close attention to the price scale on the right-hand axis. The values are expressed as "value per head" to facilitate comparisons across weight categories. In general, all weight categories are subject to significant swings in number of head for sale from week to week. All categories, with the exception of the heaviest kids, appear to have a low supply period in January, February, and early March.

Lambing Time Management and Obstetrics

DR. HOLLIE SCHRAMM
ASSISTANT CLINICAL PROFESSOR
VIRGINIA-MARYLAND COLLEGE OF VETERINARY MEDICINE

Lambing Management

-**Time investment is key**
- How often will you check ewes?

-**Important for financial success**
- lbs of lamb weaned per ewe

-**Must save as many lambs as possible to maximize profits**

*What are your goals for lamb mortality (# dead)?

Lambing Management

The largest percent of lambs are lost at or shortly after birth

-Difficult births
-Starvation
-Hypothermia

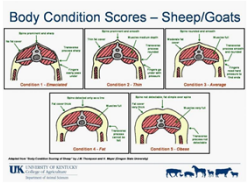
-Starvation and hypothermia can be corrected by the manager

Preventing Lamb Loss

Adequate nutrition particularly in 3rd trimester

Condition at lambing is the most important determinant of lamb survival (effect on birth weight)

Lambs need BAT (brown adipose tissue)
- First source of energy of lamb
- Utilized to produce heat
- Ewe must have adequate BCS and mineral supplementation for lamb to have BAT



Body Condition Scoring

For Spring Lambing

Group	Timing	Ideal BCS
Breeding Ewes	Pre-Breeding	3
	Midpregnancy	2.5-3
	Pre-Lambing **Lambing**	3 **3+**
	Weaning/Drying off	2+
Rams	Pre-Breeding	3-3.5
	Summer	2+

Research and BCS

Oregon State University

-Ewes with a body condition score of 3 to 4 at lambing lost fewer offspring and weaned more pounds of lamb than those with a condition score of 2.5 or less

-There was a 33% difference in total weight of lamb weaned (64 versus 85 pounds per ewe) between ewes with pre-lambing body condition scores of 2.5 to 3.5

Fat and Thin Ewes Reasons and Consequences

Why are ewes too thin?

- Inadequate nutrition, parasitism, inadequate bunk space, inadequate grouping of animals, wasting diseases, chronic diseases, genetics, high milk production (multiple lambs), old (need to be culled)
- This sets them up for: failure to conceive, less lbs lamb weaned, pregnancy toxemia, parasitism and disease

Why are ewes too fat?

- Were not culled, poor milk production (low wean wt), overfed in early-midgestation, dominant ewes
- This sets them up for: pregnancy toxemia, fatty liver, dystocia, vaginal prolapse

Pre-Lambing Reminders

-Vaccinate ewes with CD&T vaccine 4-6 weeks prior to parturition

-Shear wooled ewes about 1 month prior to lambing or crutching (remove wool around vulva and udder)

-Consider famacha check or deworming prior to lambing because of peripaturient rise in worm eggs near time of lambing (feed higher protein diet prior to lambing)

-Consider feeding a coccidiostat during late gestation and early lactation

-Daily exercise is important prior to lambing

-Minimize stressors (adequate bunk space, stable grouping, parasite control, excellent nutririon, adequate mineral supplementation)

Lambing Facilities

-Must be CLEAN and DRY

-Eliminate drafts

-Lambing jugs (pens): Need enough for 10% of herd (5x5 for larger ewes)

Lambing on pasture

-Lamb on clean, well rested pasture

-Access to shelter is necessary

-Jug ewes with problem births

**Don't leave in lambing jugs too long (exposure to parasites/ventilation concerns)

Who is most likely to have problems with difficult birth?

-Yearling mothers

-Obese animals

-Lack of exercise in late pregnancy

-Inadequate nutrition

**Do not intervene as long as progress is being made

Causes of Dystocia

-Failure of cervix to dilate or dilate completely

-Lamb with large head or shoulders (fetal disproportion)

-Twins coming simultaneously

-Ewe disturbed during the initial stage of lambing

-Lamb(s) in abnormal presentation, position, or posture (malpresentation)

Others include vaginal prolapse and deformities

Stages of the Birthing Process

Stage 1 (1-8 hours): Cervical dilation

-Separate from herd, uneasiness

-Kicking and pawing at ground

-Lying down and getting up frequently

-Urinating or attempts at it

-Some vaginal discharge

*Intervene if stage 1 is longer then 8 hours

Stages of the Birthing Process

Stage 2 (1/2-2 hours)- 15-30 mins per lamb

-Lamb in birth canal

-Active contractions

-Appearance of water sac, feet

*Intervene when:
- Active labor for 30 minutes and no progress
- Water sac observed for >1 hour and no pushing
- Swelling from tongue of lamb, 3 feet, a tail
- Ewe is showing signs of severe distress or fatigue

Stages of the Birthing Process

Stage 3 (1/2-1 hour)

-Passing of the fetal membranes

-When should you be concerned?

Tips for Examination

-Clip excess or dirty wool from around anus

-Remove all dirt around vulva and anus

-Scrub hands or arms before entering vulva and wear OB sleeves

-Apply liberal amounts of lube (put handfuls into vagina/uterus before manipulating)

-Shape the hand into a natural wedge

-Push forward in between contractions

-Determine presentation, position and posture

*Best to manipulate lambs with ewe standing or elevating hindquarters

Normal Birth Presentation

Determine Presentation, Position, and Posture

Presentation: Head first (anterior)

Position: Right-side up (dorsal-sacral)

Posture: Right limb flexed back

How is this corrected?

Breech Lambs

P: Butt first (posterior)

P: Upside down (dorsal-pubic); Right side up (dorsal-sacral)

P: Hindlimbs facing head of dam

P: Hindlimbs first (posterior)

P: Right side up (dorsal-sacral)

P: Hindlimbs exiting pelvis

More common with 2+ lambs

Determine if front or hindlimbs coming through first

Front limbs: Joints flex in the same direction

Hind limbs: Joints flex opposite of each other

Make sure limbs are connected to head/shoulder that is present

With twins+ any combination of front and hind limbs may be present

If unable to determine the 3 p's or unable to successfully correct the problem within 20 mins seek professional help

What are the 3 P's? How is this corrected?

Obstetrics Pointers

-Stretch vulva up over head when lamb is coming out

-If large lamb, rotate the lamb so the hips (and potentially shoulders) are in a diagonal position coming through the pelvis

-Pull the lamb when the ewe is having contractions

-After pulling lamb use straw or stick to stimulate lamb (pressure point just inside the nose)

-Check for spares (more lambs) and tears

-Be clean and don't muck around too long (lambs will die or uterus will tear)

-Questions about delivering lambs, additional pointers????

Post-Lambing Management

-Make sure ewe licking and grooming ALL lambs

-Within a few hours of birth, make sure lambs have nursed and ingested COLOSTRUM
- Clear wax plug if needed
- Milk into mouth and help latch
- Make sure full belly on palpation

Post-lambing Management

-Place in lambing jug (mismothering can cause losses), unless pasture lambing
- Can take up to 6 hours for a ewe to recognize her lamb(s)
- Twice as long for lamb to recognize its mother
- Low chance for survival if not accepted by ewe

-Dip navel (7% iodine)

-Tag lambs

-Give injectable selenium/vitamin E (if desired)

-Check health status multiple times throughout day for first few days

*Give intranasal vaccine if respiratory disease is a problem in pre-weaned lambs

Colostrum

-Supplies the energy, proteins (antibodies for immunity), and fat to help the lamb thermo-regulate

-Timely ingestion of colostrum is key for thermo-regulation

-The ability to absorb antibodies from colostrum diminishes as its body temperature becomes colder

-Stress from cold or a difficult birth can interfere with optimum absorption
- Can lead to problems with
  - Scours
  - Pneumonia
  - Other infections

Colostrum Supplementation

-Ideally use stored colostrum from sheep (frozen colostrum)
- Thaw in warm water bath

-Can also use cow/goat colostrum or colostrum replacer

-Give 20-25 mL (cc) per lb of body weight (7-8 ounces to a 10 lb lamb)
- Approximately 30 mL per ounce
- ~200 mL for a 10 lb lamb

**Lambs must be >99 F to absorb colostrum (be aware of hypothermia)

Why do Lambs get Hypothermic/Starved?

-Fails to nurse (ingest colostrum) shortly after birth

-Secondary to dystocia

-Prolonged birth

-Poor mothers (must lick and dry lamb off)

-Cold weather, particularly windy or precipitation (drafts in barns, etc)

-Lambs born to ewes with poor nutrition during gestation

-Lambs born to ewes in poor BCS (don't have or can't utilized BAT)

Indications of Hyporthermia/Starvation

-Hunched posture

-Hollowed out sides

-No suckle reflex

-Excessive calling

-Skin Tent

-Down or slow to rise

-Unresponsive, flat-out

First Determine if a Lamb is Cold

-Put fingers in mouth and feel if cold

-Take a rectal temperature (put thermometer deep into rectum)
- Normal temperature soon after birth 102-103 F
- Definitely must warm up is <100 (dry off first)
- Don't feed colostrum if lamb is <99

- Is lamb able to stand or suckle?

*Don't tube a cold lamb, it will probably lead to death……

Dry off lamb

If Temperature >99 F and can Stand

- Collect milk or colostrum from dam and feed (use altenative source if necessary)
-Feed by stomach tube
-Put in warming box until temp reaches 101
-Return to mother

-**If temp is <99, still standing**
- Warm up first to 99 F ad then feed by stomach tube

For Newborn Lambs
If temp <99 and unable to stand/swallow

-Put in warming box (checking temp every 20 mins)
-Collect colostrum from mother
-Tube feed at 99
-Warm to 101
-Return to Mother if bright and standing well

-**If lamb is >5 hours of age**
- Can give IP injection of dextrose or put sugar on the tongue before placing in warming box

Hypothermia: How to Warm Lambs up

-Warming box or crate
-Heat lamp, electric blanket, warm water bottle, heated towels
-Warm water bath
-Floor board of the truck with heaters
-Near fireplace in the house/garage

Warming Box

*Warm to 101-102 and make sure it maintains body temperature

Any Questions?

Tips for Making Sound Financial Decisions on the Farm

Dr. Alex White
Dairy Science
Virginia Tech
axwhite@vt.edu

Goals, blah, blah, blah….

- You MUST know your goals for the operation
  - Increase profit/ewe by 15% by …
  - Increase lambing percentage to 170% by …
  - Expand by 50 ewes over the next 3 years…
- Having clear goals helps you make better decisions
  - Specific, Measurable, Time-frame
  - Make them visible!!

Good Records are Essential

- Your record system should:
  - Be accurate
  - Be usable
  - Provide you with information to make better:
    - Production decisions
    - Financial decisions
    - Tax management decisions
  - Be treated as a management tool, not a chore

Financial Records

- Cash Records
  - Revenues
    - Sales of lambs, culls, wool
  - Operating Expenses (Variable)
    - Feed, vet, repairs, marketing, etc.
  - Overhead Expenses (Fixed)
    - Rent, interest, liability insurance, property taxes, etc.
- Receivables & Payables

Financial Records

- Debt/Credit Records
  - Lender, loan type, principal outstanding, terms
- Balance Sheet
  - January 1 of every year
  - Helps with loan renewals
  - Helps with accrual adjustments
- Income Statement (Schedule F, P&L)
  - Use it for management decisions, not just for taxes

Recordkeeping Systems

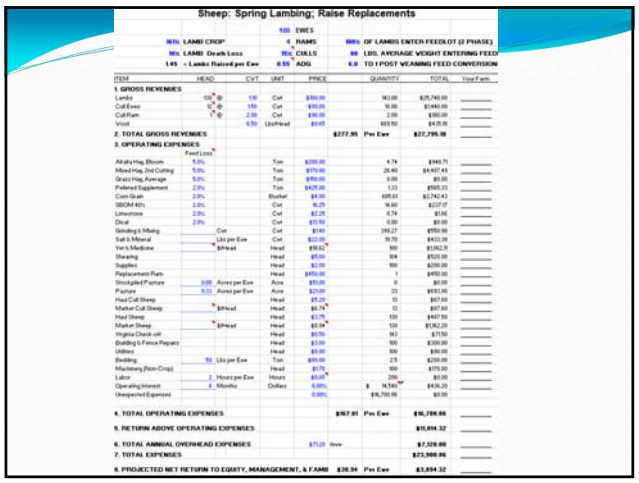
- Quickbooks - allows enterprise accounting
- Quicken – easy but limited
- Red Wing – better for crop farms
- Handwritten ledgers
- "Establishing and Using a Farm Financial Record-Keeping System"
  - http://www.agecon.okstate.edu/quicken/files/pb1540.pdf

Using Those Darned Records

- For Management Decisions:
  - Enterprise Budget
    - List of all revenues and expenses related to each specific aspect of your operation
      - Feeder lambs, market lambs, goats, crops, etc.
    - Helps with calculating breakevens & sensitivity
  - Cash Flow Statement
    - List of all cash inflows and outflows by month
      - And by enterprise or expense category!

Enterprise Budgets

- For each distinct aspect of your farm
- List all revenues
  - Sale of lambs, culls, wool
- List all expenses
  - I like to separate them by Operating vs Overhead when possible
  - Operating = feed, vet, repairs, marketing, supplies
    - Expenses you have direct control over
  - Overhead = rent, prop. taxes, interest, insurance


Sheep: Spring Lambing; Raise Replacements

100 EWES

96% LAMB CROP | 4 RAMS | 100% OF LAMBS ENTER FEEDLOT (2 PHASE)

5% LAMB Death Loss | 95% CULLS | 90 LBS. AVERAGE WEIGHT ENTERING FEED

1.45 = Lambs Raised per Ewe | 0.55 ADG | 6.0 TO 1 POST WEANING FEED CONVERSION

ITEM	HEAD	CWT	UNIT	PRICE	QUANTITY	TOTAL	Your Farm
1. GROSS REVENUES							
Lambs	135	1.50	Cwt	$189.00	143.00	$25,740.00	
Cull Ewes	12	1.50	Cwt	$95.00	18.00	$1,440.00	
Cull Ram	1	2.00	Cwt	$90.00	2.00	$180.00	
Wool		4.50	Lbs/Head	$4.65	909.50	$4,75.18	
2. TOTAL GROSS REVENUES					$277.95 Per Ewe	$27,795.18	
3. OPERATING EXPENSES							
	Feed Loss						
Alfalfa Hay, Bloom	5.0%		Ton	$200.00	4.74	$948.71	
Mixed Hay, 2nd Cutting	5.0%		Ton	$170.00	26.40	$4,487.45	
Grass Hay, Average	5.0%		Ton	$150.00	0.00	$0.00	
Pelleted Supplement	2.0%		Ton	$429.00	1.33	$569.33	
Corn Grain	2.0%		Bushel	$4.00	685.61	$2,742.43	
SBOM 48%	2.0%		Cwt	$6.25	16.00	$237.07	
Limestone	2.0%		Cwt	$2.25	0.74	$1.66	
Dival	2.0%		Cwt	$10.50	0.00	$0.00	
Grinding & Mixing		Cwt	Cwt	$1.40	399.27	$559.98	
Salt & Mineral		Lbs per Ewe	Cwt	$22.00	16.70	$423.38	
Vet & Medicine		$/Head	Head	$19.62	100	$1,962.31	
Shearing			Head	$5.00	104	$520.00	
Supplies			Head	$2.00	100	$200.00	
Replacement Ram			Head	$450.00	1	$450.00	
Stockpiled Pasture	0.00	Acres per Ewe	Acre	$70.00	0	$0.00	
Pasture	0.33	Acres per Ewe	Acre	$21.00	33	$693.00	
Haul Cull Sheep			Head	$5.20	13	$67.60	
Market Cull Sheep		$/Head	Head	$6.74	13	$87.60	
Haul Sheep			Head	$3.75	139	$467.50	
Market Sheep		$/Head	Head	$9.94	139	$1,952.20	
Virginia Check-off			Head	$0.50	143	$71.50	
Building & Fence Repairs			Head	$3.00	100	$300.00	
Utilities			Head	$9.00	100	$90.00	
Bedding	50	Lbs per Ewe	Ton	$80.00	2.5	$200.00	
Machinery (Non-Crop)			Head	$1.75	100	$175.00	
Labor	2	Hours per Ewe	Hours	$0.00	200	$0.00	
Operating Interest	6	Months	Dollars	6.00%	$ 14,540	$436.20	
Unexpected Expenses				0.00%	$16,700.86	$0.00	
4. TOTAL OPERATING EXPENSES					$167.01 Per Ewe	$16,700.86	
5. RETURN ABOVE OPERATING EXPENSES						$10,614.32	
6. TOTAL ANNUAL OVERHEAD EXPENSES				$73.20 Anne		$7,320.00	
7. TOTAL EXPENSES						$23,900.86	
8. PROJECTED NET RETURN TO EQUITY, MANAGEMENT, & FAMILY					$38.94 Per Ewe	$3,894.32	

Enterprise Budgets

- Where do I get the numbers?
- Your record system should provide all you need
- In Quickbooks, use "tags" and "classes"
  - It will automatically generate your enterprise budgets
  - See Farm Credit of the Virginias for a training module!
- Use the VCE budgets as a starting point
  - Customize them to your operation
  - And build your record system so that it will help in the future!

Enterprise Budgets

- Return Above Operating Expenses
  - RAOE = Total Revenues – Total Operating Expenses
  - Always want this to be positive
    - If not, you are losing money on every lamb you sell
  - RAOE = funds that are available to pay the Overhead costs
    - And hopefully yourself!

Enterprise Budgets

- To improve RAOE:
  - Increase your revenues
    - More pounds sold (How?)
      - What about the slide?
    - Higher price (more premiums or less discounts) (How?)
  - Decrease your operating costs w/o hurting production
    - Look at your 5 largest costs first
    - Look for "cheap fixes"
      - Reduce feed loss

Let's Look at the Budget

- What would you change to improve the profitability of this enterprise?
  - Production factors
  - Pricing
  - Top 5 expenses:
    - Mixed Hay
    - Corn
    - Vet & Medicine
    - Marketing
    - Alfalfa Hay

Short Run Breakeven Price

- SR Breakeven Price for Lambs
  - Assuming cull & wool income is constant

  = (Total Lamb Revenue – RAOE) / Pounds Sold

- Use this for marketing decisions
  - Compare to your expected market price
  - Use as a floor for forward contracting or futures/options contracts

Example of SR Breakeven Price

- From the adapted VCE budget:

Total Lamb Revenue	$25,740
RAOE	$11,014
Pounds sold (lambs only)	143 cwts

SR BE Lamb Price = ($25,740 - $11,014) / 143 cwts
= $102.98/cwt

Remember – this only covers operating costs!
It doesn't cover Overhead or your labor

Long Run Decisions

- You must cover all expenses to stay in operation long term
  - **And to avoid recreational lambing!**
- Return Above Total Expenses
  - Aka Return to Equity, Management & Family Labor

  = Total Revenues – Total Expenses

  What's left over is your reward for this operation

Long Run Breakeven Price

- LR Breakeven Price for Lambs
  - Assuming cull & wool income is constant

  = (Total Lamb Revenue – RATE) / Pounds Sold

- Use this for marketing decisions
  - Compare to your expected market price
  - Use as a floor for forward contracting or futures/options contracts

Example of LR Breakeven Price

- From the adapted VCE budget:

Total Lamb Revenue	$25,740
RATE	$3,894
Pounds sold (lambs only)	143 cwts

SR BE Lamb Price = ($25,740 - $3,894) / 143 cwts
= $152.77/cwt

Remember, this doesn't include your salary!

Sensitivity Analysis

- No one knows what the future will bring
- So we take our best guess and add a fudge factor
- I use a 10-20% fudge factor for operating expenses
  - Total your Operating Expenses and multiply by 20%
  - Add these to your total to account for the unexpected
- Then see how that will impact your "bottom line"

Sensitivity Analysis – Example

- Total Operating Expenses $16,780
- RATE $3,894
- A 20% increase = $3,356
  - The new RATE is now $538 > $0 That's good!
- How much can your Mixed Hay price increase?
  - **SR: $270/ton increase to $440/ton**
    - RAOE / Tons of Mixed Hay Fed
  - **LR: $147/ton increase to $317/ton**
    - RATE / Tons of Mixed Hay Fed

Long Run Decisions

- Fighting points:
  - **Depreciation isn't a cash expense so why include it?**
    - If you have loans, treat Dep. as your principal portion
    - If you don't have loans, treat Dep. as what you should be setting aside to replace the depreciated assets
  - **I don't know what the price or costs are going to be.**
    - Take you best guess, calculate your breakevens, and/or throw a 10-20% fudge factor into your operating expenses

Long Run Decisions

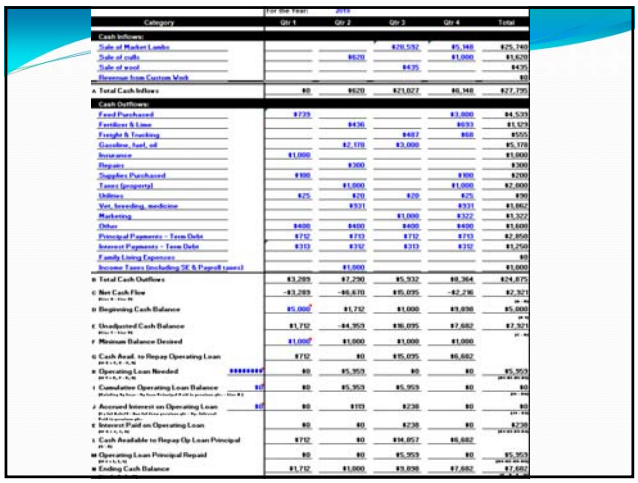
- More fighting points:
  - **I don't know what my expenses are.**
    - **You need a better record keeping system**
    - Use the VCE budget as a rough starting point
  - **But I don't want to pay taxes on the profits**
    - FYI - You need to spend $4 to save $1 in income taxes
    - 3 choices – write a check to:
      - Uncle Sam & Uncle Ralph
      - Your equipment dealer
      - Yourself – through an IRA or SIMPLE or SEP retirement plan

The Cash Flow Statement

- The most important financial statement for a manager
- Helps you:
  - See when you have a cash surplus or deficit
  - Determine when to schedule your loan payments
  - Figure out when you'll have cash for a capital purchase or down payment
  - Estimate the size of your operating line of credit
  - See how you can shift cash flows to make life easier
  - Plan your upcoming year

Cash Flow Statement

- That's nice, but how do I build one for my farm?
  - Use your record system
    - Especially your checkbook register
    - Then, ask Doc White for his spreadsheet (axwhite@vt.edu)
  - Use Quickbooks' "budget" feature
  - Take your best guess



Category	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Total
Cash Inflows:					
Sale of Market Lambs			$20,592	$5,148	$25,740
Sale of culls		$620		$1,000	$1,620
Sale of wool			$435		$435
Revenue from Custom Work					$0
A Total Cash Inflows	$0	$620	$21,027	$6,148	$27,795
Cash Outflows:					
Feed Purchased	$739			$3,800	$4,539
Fertilizer & Lime		$436		$693	$1,129
Freight & Trucking			$487	$68	$555
Gasoline, fuel, oil		$2,170	$3,000		$5,170
Insurance	$1,000				$1,000
Repairs		$300			$300
Supplies Purchased	$100			$100	$200
Taxes (property)		$1,000		$1,000	$2,000
Utilities	$25	$20	$20	$25	$90
Vet, breeding, medicine		$931		$931	$1,862
Marketing			$1,000	$322	$1,322
Other	$400	$400	$400	$400	$1,600
Principal Payments – Term Debt	$712	$713	$712	$713	$2,850
Interest Payments – Term Debt	$313	$312	$313	$312	$1,250
Family Living Expenses					$0
Income Taxes (including SE & Payroll taxes)		$1,000			$1,000
B Total Cash Outflows	$3,289	$7,290	$5,932	$8,364	$24,875
C Net Cash Flow	-$3,289	-$6,670	$15,095	-$2,216	$2,921
D Beginning Cash Balance	$5,000	$1,712	$1,000	$3,038	$5,000
E Unadjusted Cash Balance	$1,712	-$4,959	$16,095	$7,682	$2,921
F Minimum Balance Desired	$1,000	$1,000	$1,000	$1,000	
G Cash Avail. to Repay Operating Loan	$712	$0	$15,095	$6,682	
H Operating Loan Needed	$0	$5,959	$0	$0	$5,959
I Cumulative Operating Loan Balance	$0	$5,959	$5,959	$0	$0
J Accrued Interest on Operating Loan	$0	$119	$238	$0	$0
K Interest Paid on Operating Loan	$0	$0	$238	$0	$238
L Cash Available to Repay Op Loan Principal	$712	$0	$14,857	$6,682	
M Operating Loan Principal Repaid	$0	$0	$5,959	$0	$5,959
N Ending Cash Balance	$1,712	$1,000	$3,038	$7,682	$7,682

Cash Flow Example

- Look at the example cash flow
  - Simplified version
- How much of an operating LOC should you request?
  - When will you be able to repay your LOC?
- What changes might you make to your operation?

Other Financial Tools

- Partial Budgets
  - A great help in analyzing changes to your operation
  - Weigh the "good side" against the "bad side"
- Financial Ratios
  - Use the same ratios your lenders use to help you improve your operation
    - Operating Expense/Receipt Ratio < 70%
    - Asset Turnover (Revenues/Assets) > 40%
    - Debt Coverage Ratio > 125%
    - ROA > 8%
    - Working Capital/Expenses > 25%

So What?

- Take time to work with your finances
- Set goals
- Build a record system that helps you make better decisions
- Enterprise budgets are great tools
  - Breakevens & sensitivity analysis make them better!
- No farm/business should be w/o a cash flow statement

Virginia Cooperative Extension

2018 - Adapted by A. White PUBLICATION 446-048

Sheep: Spring Lambing; Raise Replacements

100 EWES

161% LAMB CROP	**4 RAMS**	**100% OF LAMBS ENTER FEEDLOT (2 PHASE)**
10% LAMB Death Loss	**15% CULLS**	**80 LBS. AVERAGE WEIGHT ENTERING FEEDLOT**
1.45 = Lambs Raised per Ewe	**0.55 ADG**	**6.0 TO 1 POST WEANING FEED CONVERSION**

ITEM	HEAD	CWT	UNIT	PRICE	QUANTITY	TOTAL	Your Farm
1. GROSS REVENUES							
Lambs	130 @	1.10	Cwt	$180.00	143.00	$25,740.00	
Cull Ewes	12 @	1.50	Cwt	$80.00	18.00	$1,440.00	
Cull Ram	1 @	2.00	Cwt	$90.00	2.00	$180.00	
Wool		6.50	Lbs/Head	$0.65	669.50	$435.18	
2. TOTAL GROSS REVENUES					**$277.95 Per Ewe**	**$27,795.18**	
3. OPERATING EXPENSES							
	Feed Loss						
Alfalfa Hay, Bloom	5.0%		Ton	$200.00	4.74	$948.71	
Mixed Hay, 2nd Cutting	5.0%		Ton	$170.00	26.40	$4,487.49	
Grass Hay, Average	5.0%		Ton	$150.00	0.00	$0.00	
Pelleted Supplement	2.0%		Ton	$425.00	1.33	$565.33	
Corn Grain	2.0%		Bushel	$4.00	685.61	$2,742.43	
SBOM 48%	2.0%		Cwt	16.25	14.60	$237.17	
Limestone	2.0%		Cwt	$2.25	0.74	$1.66	
Dical	2.0%		Cwt	$13.50	0.00	$0.00	
Grinding & Mixing	Cwt		Cwt	$1.40	399.27	$558.98	
Salt & Mineral	Lbs per Ewe		Cwt	$22.00	19.70	$433.38	
Vet & Medicine	$/Head		Head	$18.62	100	$1,862.11	
Shearing			Head	$5.00	104	$520.00	
Supplies			Head	$2.00	100	$200.00	
Replacement Ram			Head	$450.00	1	$450.00	
Stockpiled Pasture	0.00 Acres per Ewe		Acre	$51.00	0	$0.00	
Pasture	0.33 Acres per Ewe		Acre	$21.00	33	$693.00	
Haul Cull Sheep			Head	$5.20	13	$67.60	
Market Cull Sheep	$/Head		Head	$6.74	13	$87.60	
Haul Sheep			Head	$3.75	130	$487.50	
Market Sheep	$/Head		Head	$8.94	130	$1,162.20	
Virginia Check-off			Head	$0.50	143	$71.50	
Building & Fence Repairs			Head	$3.00	100	$300.00	
Utilities			Head	$0.90	100	$90.00	
Bedding	50 Lbs per Ewe		Ton	$80.00	2.5	$200.00	
Machinery (Non-Crop)			Head	$1.78	100	$178.00	
Labor	2 Hours per Ewe		Hours	$0.00	200	$0.00	
Operating Interest	6 Months		Dollars	6.00%	$ 14,540	$436.20	
Unexpected Expenses				0.00%	$16,780.86	$0.00	
4. TOTAL OPERATING EXPENSES					**$167.81 Per Ewe**	**$16,780.86**	
5. RETURN ABOVE OPERATING EXPENSES						**$11,014.32**	
6. TOTAL ANNUAL OVERHEAD EXPENSES				$71.20 /ewe		**$7,120.00**	
7. TOTAL EXPENSES						**$23,900.86**	
8. PROJECTED NET RETURN TO EQUITY, MANAGEMENT, & FAMILY LABOR					**$38.94 Per Ewe**	**$3,894.32**	

9. Price Sensitivity Analysis

		Percent Change in Total Gross Receipts						
		-25%	-10%	-5%	0%	5%	10%	25%
		--- Net Cash Return over Total Variable Costs per Ewe ---						
	-10%	$57.44	$99.13	$113.03	$126.92	$140.82	$154.72	$196.41
Percent	-5%	$49.05	$90.74	$104.64	$118.53	$132.43	$146.33	$188.02
Change in	0%	$40.66	$82.35	$96.25	**$110.14**	$124.04	$137.94	$179.63
Total Variable	5%	$32.26	$73.96	$87.86	$101.75	$115.65	$129.55	$171.24
Costs	10%	$23.87	$65.57	$79.46	$93.36	$107.26	$121.16	$162.85
	25%	($1.30)	$40.40	$54.29	$68.19	$82.09	$95.99	$137.68

5% Table Sensitivity

Developed by Virginia Cooperative Extension Farm Business Management Staff

10. FEED RATIONS (AS-FED BASI

Feed	Unit		E. Gestation	Ewes Flush	Ewes L. Gestation	Ewes Lactation	Rams	Feeder Lambs <60#	Market Lambs
Number Head =			100	100	100	100	4	148	145
Days Fed =			76	19	45	19	120	61	55
Alfalfa Hay, Bloom	Lbs/Head/Day		0.00	0.00	0.00	0.00	0.00	1.00	0.00
Mixed Hay, 2nd Cutting	Lbs/Head/Day		2.50	0.00	4.20	5.00	6.00	0.00	0.00
Grass Hay, Average	Lbs/Head/Day		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pelleted Supplement	Lbs/Head/Day		0.00	0.00	0.00	0.00	0.00	0.00	0.33
Corn Grain	Lbs/Head/Day	56	0.00	0.75	1.00	1.47	1.00	0.55	2.97
SBOM 48%	Lbs/Head/Day	100	0.00	0.00	0.00	0.23	0.00	0.11	0.00
Limestone	Lbs/Head/Day	100	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Dical	Lbs/Head/Day	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00

11. ANNUAL DEBT SERVICE

Item	Amount Borrowed	Percent Interest	Length of Loan	Percent to Sheep	Annual Payment
Ewes	0	10.00%	0	100%	$0.00
Item Name	0	0.00%	0	100%	$0.00
Item Name	0	0.00%	0	100%	$0.00
			TOTAL ANNUAL DEBT PAYMENTS		**$0.00**

12. ANIMAL HEALTH PROGRAM

100 EWES			**4 RAMS**					
Ivermectin Drench	150	Lbs	6	3 ml./26 Lbs	72.95	/Liter	$7.58	
Ovine Vibrio	5	cc	1	Dose @	0.57	/Dose	$0.57	
8 Way Booster	2	cc	1	Dose @	0.63	/Dose	$0.63	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
SUB-TOTAL EWES & RAMS								$912.66
153 LAMBS								
Ivermectin Drench	78	Lbs	3	3 ml./26 Lbs	72.95	/Liter	$1.97	
BO-SE	0.5	cc	1	Dose @	0.27	/Dose	$0.27	
8 Way	5	cc	1	Dose @	1.58	/Dose	$1.58	
8 Way	2	cc	1	Dose @	0.63	/Dose	$0.63	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
SUB-TOTAL LAMBS								$680.80
15 REPLACEMENT EWES								
Ivermectin Drench	80	Lbs	1	3 ml./26 Lbs	72.95	/Liter	$0.67	
Ovine Vibrio	5	cc	1	Dose @	0.57	/Dose	$0.57	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
Other				Dose @		/Dose	$0.00	
SUB-TOTAL REPLACEMENT EWES								$18.65
Your Farm Veterinarian			1	Trip(s) @	$250	Per Trip		$250.00
TOTAL HEALTH COST FOR EWE FLOCK								**$1,862.11**

Trade and brand names are used only for the purpose of providing information. Virginia Cooperative Extension does not guarantee or warrant the standard of any product named to the exclusion of others which also may be suitable.

Cash Flow Statement

For the Year: 2019

	Category		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Total
	Cash Inflows:						
	Sale of Market Lambs				$20,592	$5,148	$25,740
	Sale of culls			$620		$1,000	$1,620
	Sale of wool				$435		$435
	Revenue from Custom Work						$0
	Other Cash Inflows (Transfers, Misc., etc.)						$0
	Non-Farm Income						$0
A	Total Cash Inflows		$0	$620	$21,027	$6,148	$27,795
	Cash Outflows:						
	Car & Truck Expenses						$0
	Chemicals						$0
	Conservation Expenses						$0
	Custom Hire						$0
	Employee Benefits						$0
	Feed Purchased		$739			$3,800	$4,539
	Fertilizer & Lime			$436		$693	$1,129
	Freight & Trucking				$487	$68	$555
	Gasoline, fuel, oil			$2,178	$3,000		$5,178
	Insurance		$1,000				$1,000
	Labor hired						$0
	Pension & Profit-Sharing						$0
	Rent or lease - M&E						$0
	Rent/lease - other						$0
	Repairs			$300			$300
	Seeds & Plants Purchased						$0
	Storage & Warehousing						$0
	Supplies Purchased		$100			$100	$200
	Taxes (property)			$1,000		$1,000	$2,000
	Utilities		$25	$20	$20	$25	$90
	Vet, breeding, medicine			$931		$931	$1,862
	Marketing				$1,000	$322	$1,322
	Other		$400	$400	$400	$400	$1,600
	Capital Purchases (Cash)						$0
	Principal Payments - Term Debt		$712	$713	$712	$713	$2,850
	Interest Payments - Term Debt		$313	$312	$313	$312	$1,250
	Family Living Expenses						$0
	Income Taxes (including SE & Payroll taxes)			$1,000			$1,000
B	Total Cash Outflows		$3,289	$7,290	$5,932	$8,364	$24,875
C	Net Cash Flow (Line A - Line B)		-$3,289	-$6,670	$15,095	-$2,216	$2,921 (A - B)
D	Beginning Cash Balance		$5,000	$1,712	$1,000	$9,898	$5,000 (D 1)
E	Unadjusted Cash Balance (Line C + Line D)		$1,712	-$4,959	$16,095	$7,682	$7,921 (C + D)
F	Mininum Balance Desired		$1,000	$1,000	$1,000	$1,000	
G	Cash Avail. to Repay Operating Loan (If E > F, E - F, 0)		$712	$0	$15,095	$6,682	
H	Operating Loan Needed (If F > E, F - E, 0)	8.00% APR	$0	$5,959	$0	$0	$5,959 (H1+H2+H3+H4)
I	Cumulative Operating Loan Balance (Existing Op Loan - Op Loan Principal Paid in previous qtr. + Line H)	$0	$0	$5,959	$5,959	$0	$0 (I4 - M4)
J	Accrued Interest on Operating Loan (I x Int Rate/4 + Acc Int from previous qtr - Op. Interest Paid in previous qtr.	$0	$0	$119	$238	$0	$0 (J4 - K4)
K	Interest Paid on Operating Loan (If G > J, J, G)		$0	$0	$238	$0	$238 (K1+K2+K3+K4)
L	Cash Available to Repay Op Loan Principal (G - K)		$712	$0	$14,857	$6,682	
M	Operating Loan Principal Repaid (If L > I, I, L)		$0	$0	$5,959	$0	$5,959 (M1+M2+M3+M4)
N	Ending Cash Balance (Line E + H - K - M)		$1,712	$1,000	$9,898	$7,682	$7,682 (E + H - K - M)

Ration Balancing 101

Scott P. Greiner, Ph.D.
Extension Animal Scientist, Sheep
Virginia Tech

Nutrition of the flock is a key component the sheep enterprise. Proper nutrition is vital for health and optimum performance of both the breeding flock and lamb crop. Additionally, feed costs represent the largest component of the sheep enterprise budget. Therefore, cost-effective strategies which meet the nutritional demands while keeping costs in check are key. Proper ration balancing is important for both of these aspects.

Ration formulation and balancing is a multi-step process, yet does not need to be complicated. These steps include: 1) accurately describing the sheep to be fed, and knowing their corresponding nutritional requirements, 2) describing your feedstuffs and their nutritional value, and 3) balancing the ration to meet the nutritional needs of the sheep. Within each of these steps are several key components which will be described in this article.

Describing the Sheep & their Nutritional Requirements

There are several factors that affect the nutritional needs of the sheep, the primary factors include: 1) age, 2) size (weight), 3) body condition, and 4) stage of production (maintenance, gestation, lactation, growth rate). Additionally, health status (including parasite load), weather, activity level, and other environmental factors may also influence nutritional requirements and management. However, the answers to such questions as Is the ewe pregnant? If so, which stage of pregnancy is she in? If lactating, how many lambs is she nursing? When will the lambs be weaned? should provide the shepherd the information necessary to make decisions relative to nutritional needs. The ewe's nutritional needs change throughout the production cycle (lactation > pregnancy > breeding > maintenance). Similarly, nutritional needs of growing lambs change with the stage of maturity and growth rate. Generally, nutritional requirements are highest for young lambs and decrease for older lambs and higher growth rates increase nutritional requirements.

Fundamentally, nutritional requirements are described based on stage of production and weight. For ewes stage of production is defined as lactation vs. gestation, etc. along with number of lambs nursed. For lambs nutritional requirements are based on age and growth rate. In all cases, body weight of the animal further defines nutritional requirements (coupled with described stage of production). Therefore, an accurate weight is a necessary component of ration balancing.

Table 1 describes nutrient requirements of ewes based on stage of production and body weight. These requirements are shown in pounds of nutrient required per day. For example, a 175 pound ewe which is nursing twins requires 4.7 lb. of TDN (energy), along with 0.98 lb. of crude protein daily to meet her nutritional requirements. This TDN and CP can be supplied through a variety of feedstuffs (next steps), however based on her stage of production (nursing twins) and weight, we can determine her nutritional requirements. Table 1 also shows that 175 lb. ewe nursing twins will consume 6.6 lb. of dry matter daily. This is simply how much feed we would expect her to eat daily on a dry basis. For all practical purposes, dry feeds and forages contain approximately 90% dry matter. Dry matter is feed with no moisture, however all feeds contain some water/moisture (~10% for dry feedstuffs like hay and grain). Therefore, on as as-fed basis (how we will measure feed and deliver to the sheep) this ewe will eat approximately 7.3 pounds (6.6 divided by 0.90 = 7.3). Nutrient requirements are expressed on a dry matter basis to account for differences in moisture between feeds. An example to help understand this is comparing a grape to a raisin. Both have exactly the same nutritional content, just the grape has a much higher water content (and grapes are therefore heavier than raisins). So on a

weight basis, we would need to eat more pounds of grapes than raisins to provide the same nutrition.

Table 2 shows nutrient requirements expressed as a percentage of total diet. These values are obtained by dividing individual nutrients requirements by dry matter intake. For example, above we indicated the 175 lb. ewe nursing twins requires 4.7 lbs. of TDN. So if we divide these 4.7 lb. by her intake of 6.6 lbs., her total diet needs to be 71% TDN. So if we feed her a ration that is 71% TDN and she consumes 6.6 lbs. of dry matter of this diet, she meets her requirement.

Table 3 is nutrient requirements for ewe lambs. Ewe lambs have additional nutritional requirements than mature ewes to account for their additional needs for growth, since they are not yet mature.

Feedstuffs and their Nutrient Content

The second step includes knowledge of available feedstuffs and their nutritional value. Multiple resources exist for these values. See the attached supplement sheet for a list of common feeds and their average values for various nutrients. While variation does exist for many feeds, typically these book values are applicable to common grain and protein feeds (corn, oats, soybean meal, etc.). Consequently, when balancing rations these values can be used. One exception can be by-product feeds such as corn gluten, as they can be variable in nutrient content related to the source of the feed and processing methods.

While book values for common grains and supplements are typically used to balance rations, forages and hays are highly variable in their nutritional content. Therefore, a for An important aspect of nutritional management is knowing the quality of forages that will be utilized, most importantly hay. To properly balance rations and formulate diets, an accurate forage analysis should be conducted on all harvested feeds (hays and silage). There can be significant variation in hays harvested from the same field from one year to the next, and from one cutting to another. Having accurate hay analysis will both save feed costs and improve the ability to adequately balance rations. Consult with your local Extension agent for assistance in sampling your forages. Don't guess, forage test!

Balancing Rations

With description of sheep we are feeding, and description of feeds we are using, we can balance the ration. There are several methods which can be used, ranging from very simple approaches which can be done by hand to the use of complex computer programs. We will concentrate on some simple approaches which can be applied by most.

Assume we have the 175 lb. ewe nursing twins described earlier. Lets also assume we had our hay tested, and results provided our hay is 63% TDN and 15.5% crude protein on a dry matter basis. If we provide this hay free-choice, we would expect the ewe to eat 6.6 lbs. of dry matter (from Table 1). If she eats 6.6 lbs. of dry matter which is 60% TDN, she will consume 4.2 lbs. of TDN daily (6.6 x .60 = 4.0). This is a little short of her requirement of 4.7 lb. of TDN found in Table 1. Therefore we will need to supplement this had with additional TDN. Corn is typically a cheap source of TDN, and corn contains 87% TDN. So to supply the additional 0.7 lbs. of TDN the ewe needs to meet her requirement, we would need to provide her 0.8 lbs of corn to meet her TDN needs (0.7 divided by 87% = .6). Keep in mind our math is on a dry matter basis, so assuming corn is 90% dry matter, we need to feed her 0.9 lbs. of corn as fed. So feeding her 1 lb. of corn will do it, assuming she continues to eat the same amount of hay. Of course, how much hay she is actually eating is important- as eating more or less than the 6.6 pounds we estimated will change our math and determination of how much supplemental corn she needs. This underlines the importance of monitoring intakes and having a solid estimate of hay consumption to properly balance rations. The hay used in this example is above average in quality, and supplementing TDN during lactation is common need to meet ewe requirements.

The other important component in this example is crude protein. Using the same approach, the ewe will get approximately 1.0 pound of CP from the 6.6 pounds of hay she is consuming (6.6 x 15.5% = 1.0). This meets her requirement based on Table 1. If our hay was lower in CP (which is not uncommon), we would need to take similar approach as we did with TDN to estimate the additional CP we would need to supplement to meet the ewes needs. When both TDN and CP are needed, feeds such as corn gluten which are nutrient dense for both TDN and CP are viable options.

Another approach to ration balancing can be to determine the nutrient content needed in a supplement to be fed. For example, assume from our hay testing and doing math similar to above we determine our ewes need an additional ~2.0 lbs. of TDN and additional 0.5 lbs. CP to meet their requirements. If we want to purchase or mix a supplement to match this hay and meet the requirements of the ewes we can determine the nutritional profile this supplement needs to contain. Assume we want to feed the supplement at a rate of 3.0 pounds per head per day. So to provide 2.0 lbs. of TDN in 3.0 of feed, the feed needs to be 67% TDN (2.0 divided by 3.0 = 67%). Similarly, that same feed needs to be 16% CP (0.5 divided by 3.0 = 16%). We can then purchase or mix a supplement according to these specifications (to be fed at a rate of 3 lbs per head per day along with our hay).

Several simple ration balancing spreadsheets have been developed for sheep. Advantages of these programs include the ability to evaluate several options for supplementation, incorporating cost factors, and more comprehensive ration balancing capability for minerals and micro-nutrients compared to doing so by hand. A sample of such programs include:

- University of Maryland (free)- https://www.sheepandgoat.com/spreadsheets
- North Dakota State (free)- https://www.ag.ndsu.edu/ansc/faculty-biographies/sheep-ration-balancer-bauer/view
- Iowa State BRaNDS ($100+)- https://store.extension.iastate.edu/Product/BRaNDS-Sheep-Companion-Module-Standard-Edition

Perhaps as important as the ability to balance rations, these tools provide the ability to evaluate what is being fed against nutritional requirements (same as for calculations done by hand outlined earlier). Doing so can identify shortcomings in a ration and identify deficiencies which may limit performance. Just as importantly, these tools can evaluate a ration to determine if sheep are being overfed. Overfeeding is expensive, and can potentially cause health issues such as pregnancy toxemia in gestating ewes. Therefore basic ration balancing and evaluation skills are beneficial for all shepherds.

General Tips- Formulating Rations

Commercial bagged/purchased feeds certainly offer many advantages in terms of ease of use and convenience. Furthermore, typically these feeds are formulated to provide a balanced nutritional profile of major nutrients (TDN, CP), minerals, and vitamins. Keep in mind that these commercial feeds should be formulated for sheep, as sheep have some unique nutritional needs not common to other species.

Mixing feeds at home, or working with a local feed mill to do so are also viable options. Keep in mind that when mixing your own feed, all important nutrients need to be evaluated and included properly to provide a balanced diet. In general, home mixes for the ewe flock are simpler compared to growing lamb rations. Some general tips when mixing your own rations:

Minerals and Vitamins- both the macro minerals (calcium and phosphorus) and micro minerals (selenium, copper, etc.) are important. Feed grade limestone is commonly added to rations at rate of 0.5-1.0 for additional calcium required by ewes and growing lambs, and to insure proper Ca:P ratios (prevention of urinary calculi). Most energy feeds are high in phosphorus and need complimented with added calcium. A trace mineral supplement to provide micro minerals and vitamins is recommended for lactating ewe and growing lamb rations. Such

supplements are available commercially and can be added to mixed rations at recommended inclusion rate. White salt is commonly added at rate of 0.5% of total ration. Ammonium chloride added at rate of 0.5% of ration can assist with preventing urinary calculi in growing lambs.

By product feeds- many of these feeds, like corn gluten feed, are excellent sources of nutrition economically. However, they can be variable in nutrient content. Work with your supplier to obtain a nutrient analysis for use in formulating rations. Typically, these feeds are low in calcium and require supplementation accordingly. Many mills also have commodity mixes, which may contain several of these feedstuffs mixed together. Also be sure to get the nutrient analysis of these products.

Table 1. Daily Nutrient Requirements of Mature Ewes[a]

Stage of Production	Body Wt. (lb.)	Wt. gain or loss (lb.)	DM intake/day[b] (lb.)	Energy TDN (lb.)	Protein (lb.)	Ca (g)	P (g)	Vit. A (IU)	Vit. D (IU)	Vit. E (IU)
Maintenance	150	.02	2.6	1.5	.25	2.5	2.4	3290	378	18
	175	.02	2.9	1.6	.27	2.7	2.8	3760	441	20
	200	.02	3.1	1.7	.29	2.9	3.1	4230	505	22
Flushing	150	.22	4.0	2.3	.36	5.7	3.2	3290	378	27
(2 wk. prebreeding &	175	.22	4.2	2.5	.38	5.9	3.6	3760	441	28
1st 4 wk. breeding)	200	.22	4.4	2.6	.39	6.1	3.9	4230	505	29
1st 15 wk. gestation	150	.07	3.1	1.7	.29	3.5	2.9	3290	378	21
	175	.07	3.3	1.8	.31	3.8	3.3	3760	441	22
	200	.07	3.5	1.9	.33	4.1	3.6	4230	505	24
Last 4 wk. gestation	150	.40	4.0	2.3	.42	6.2	5.6	5950	378	27
(130-150% lamb crop)	175	.40	4.2	2.4	.44	6.3	6.1	6800	441	28
	200	.40	4.4	2.5	.77	6.4	6.5	7650	505	30
(180-225% lamb crop)	150	.50	4.2	2.8	.47	7.6	4.5	5950	378	28
	175	.50	4.4	2.9	.49	8.3	5.1	6800	441	30
	200	.50	4.6	3.0	.51	8.9	5.7	7650	505	32
Lactation (1st 8 wk.)	150	-.06	5.5	3.6	.73	9.3	7.0	5950	378	38
Nursing single	175	-.06	5.7	3.7	.76	9.5	7.4	6800	441	39
	200	-.06	5.9	3.8	.78	9.6	7.8	7650	505	40
Nursing twins	150	-.13	6.2	4.4	.94	11.2	8.4	7000	378	42
	175	-.13	6.6	4.7	.98	11.4	8.8	8000	441	45
	200	-.13	7.0	5.0	1.01	11.6	9.2	9000	505	48
Nursing triplets	150	-.20	6.5	4.9	1.04	12.2	9.0	8000	378	47
	175	-.20	7.2	5.2	1.08	12.4	9.4	9000	441	50
	200	-.20	8.0	5.5	1.11	12.6	9.6	10,000	505	53

[a]Values adopted from National Research Council for Sheep, 6th Ed.

[b]To convert dry matter to an as-fed basis, divide by percent dry matter.

Table 2. Daily Nutrient Concentrations in Diets for Mature Ewes[a]
(175 lb. body weight)

Stage of Production	DM intake/day[b] (lb.)	Energy TDN (%)	Protein (%)	Ca (%)	P (%)
Maintenance	2.9	55	9.3	.19	.21
Flushing	4.2	60	9.0	.31	.19
1st 15 wk. gestation	3.3	55	9.4	.25	.21
Last 4 wk. gestation					
(130-150% lamb crop)	4.2	57	10.5	.33	.32
(180-225% lamb crop)	4.4	66	11.1	.41	.25
Lactation (1st 8 wk.)					
Nursing single	5.7	65	13.3	.37	.28
Nursing twins	6.6	71	14.8	.38	.29
Nursing triplets	7.2	72	15.0	.38	.29

[a]Values adopted from National Research Council for Sheep, 6th Ed.
Values converted from Table 1 by dividing requiremet by DM intake.
[b]To convert dry matter to an as-fed basis, divide by percent dry matter.

Table 3. Daily Nutrient Requirements of Ewe Lambs[a]

Stage of Production	Body Wt. (lb.)	Wt. gain or loss (lb.)	DM intake/day[b] (lb.)	Energy TDN (lb.)	Protein (lb.)	Ca (g)	P (g)	Vit. A (IU)	Vit. D (IU)	Vit. E (IU)
1st 15 wk. gestation	110	.30	3.3	1.9	.35	5.2	3.1	2350	277	22
	130	.30	3.5	2.0	.35	5.5	3.4	2820	333	24
	155	.28	3.7	2.2	.36	5.5	3.7	3290	389	26
Last 4 wk. gestation	110	.35	3.5	2.2	.42	6.3	3.4	4250	277	24
(100-120% lamb crop)	130	.35	3.7	2.4	.42	6.6	3.8	5100	333	26
	155	.33	4.0	2.5	.43	6.8	4.2	5950	389	27
(135-175% lamb crop)	110	.50	3.5	2.4	.45	7.8	3.9	4250	277	24
	130	.50	3.7	2.6	.46	8.1	4.3	5200	333	26
	155	.47	4.0	2.7	.46	8.2	4.7	5950	389	27
Lactation (1st 8 wk.)	110	-.10	4.6	3.3	.62	6.5	4.7	4250	277	32
Nursing single	130	-.10	5.1	3.6	.65	6.8	5.1	5200	333	34
	155	-.10	5.5	3.8	.68	7.1	5.6	5950	389	38
Nursing twins	110	-.22	5.1	3.7	.71	8.7	6.0	5000	277	34
	130	-.22	5.5	4.0	.74	9.0	6.4	6000	333	38
	155	-.22	6.0	4.3	.77	9.3	6.9	7000	389	40

[a]Values adopted from National Research Council for Sheep, 6th Ed.
[b]To convert dry matter to an as-fed basis, divide by percent dry matter.

Outstanding Sheep Producer Award Recipients

2017 – Burke Simmons, Augusta County
2016 – Cecil King, Pulaski County
2015 – Larry & 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