Friday, January 6

AM

9:00 **Virginia Sheep Producers Association Board Meeting (Open to the public)**

10:30 **Virginia Sheep Industry Board Meeting (Open to the public)**

PM

1:00 **"Sheep Forage and Grazing Management"**
Dr. Chris Teutsch, Dept of Crop & Soil Environmental Sciences, Virginia Tech

2:00 **"Practical Diets for the Sheep Flock"**
Dr. Warren Gill, Dept of Animal Science, University of Tennessee

3:00 **Break**

3:15 **"Co-Managing Sheep and Goats – Important Considerations"**
Dr. Brian Faris, Dept of Animal Science, North Carolina State University

4:00 **"Virginia Tech Research Update: Evaluation of Hair Sheep in Easy-Care Lamb Production Systems – Maternal Performance"**
Dr. Scott Greiner & Dr. Dave Notter, Dept of Animal & Poultry Sciences, Virginia Tech

4:30 **"Practical Lessons Learned the Hard Way"**
Producer Panel

6:00 **Social Hour and Commercial Exhibits**

7:00 **Lamb Dinner and Entertainment**

Saturday, January 7

AM

7:30 **Virginia Sheep Producers Association Annual Meeting (Breakfast)**
"Addressing the Needs of Eastern Producers"
Mr. Bill Sparrow, ASI Region II Representative, North Carolina
Mr. Bill Kuecker, Tennessee Sheep Producers Association

"Your Check-off Dollars at Work"
Mr. Joe Harper, American Lamb Board, Seneca Rocks, WV

10:30 **Alphin-Stuart Livestock Arena Concurrent Hands-On Sessions (30 minute sessions to be repeated)**

"Ewe Obstetrics"
Dr. Kevin Pelzer, VA-MD Regional College of Veterinary Medicine

"Sheep Selection 101"
Mr. Tracy Tomascik, Dept of Animal & Poultry Sciences, Virginia Tech

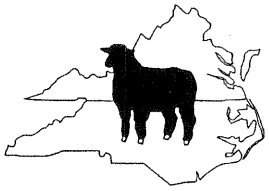
"Foot Care and Treatment"
Dr. Scott Greiner, Dept of Animal & Poultry Sciences, Virginia Tech

"Niche/Specialty Wool Preparation and Marketing"
Ms. Robin Freeman, Chesapeake, VA

12:00 **Lunch at the Alphin-Stuart Livestock Arena available from the Virginia Junior Sheep Breeders**

PM

2:00 **6th ANNUAL VIRGINIA BRED COMMERCIAL EWE LAMB SALE**
Alphin-Stuart Livestock Arena



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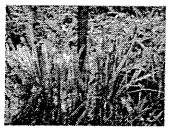
Building a Grazing System for Small Ruminant Production

Chris Teutsch
Southern Piedmont AREC





THINK SYSTEM

"…. a forage/livestock ***system*** cannot be managed effectively without a basic understanding of how the ***soil, plant, and animal components interact*** and how management decisions and climatic conditions affect those interactions."

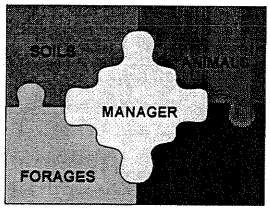
Jim Gerrish, Missouri Grazing Manual

CHARACTERISTICS OF SUCCESSEFUL GRAZIERS

PROACTIVE INSTEAD OF REACTIVE

KNOW WHERE THEY WANT TO GO (OBJECTIVES)
KNOW WHERE THEY ARE (RESOURCES)
PRIORITY (INCLINATIONS)

CONSIDER/EVALUATE NEW INFORMATION



→ INTEGRATE INTO ***THEIR*** SYSTEM"

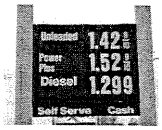
Production vs Profitability

- US agriculture production oriented
- More is better! Right?
- Focus on making profitable decisions
- Increasing profit
  - Increase the price we get for product
  - Increase amount of product produced
  - Decrease production costs
- Hay and supplements accounts for >50% of small ruminant budgets (VCE, 2005)

Amazing grazing!!!


=




Extending grazing = Lower production costs

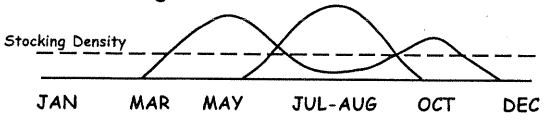
The Silver Bullet

Miracle Forage Species: Grows in the winter and summer, tolerates close and frequent grazing, excellent animal performance etc.

- A forage that solve all of our problems
- No replacement for good management!!!
- Verify claims: objective source

Introduction

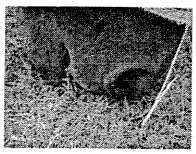
- Virginia located in 'Transition Zone'
- Cool-season grasses
  - grow well in spring and fall
  - limited growth in the summer



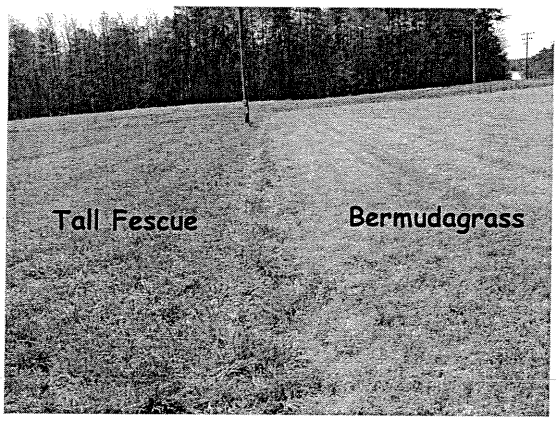
- Warm-season grasses
  - Grow well in summer
  - Limited growth in spring and fall

Forage Species for Virginia

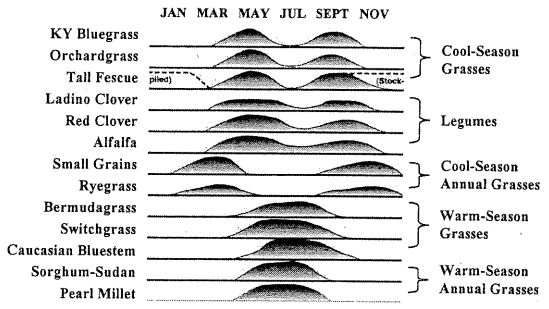
- Characteristics of forages species
  - regionally adapted
  - adapted to your soils
  - high yielding
  - high nutritive value
  - drought and heat tolerant
  - tolerant of close and frequent grazing
  - persistent



- What are the options?



Growth Curves for Common Forages



Adapted from Controlled Grazing of Virginia's Pastures, Publication 418-012

Tall Fescue

- Best adapted cool-season grass
- Positives
  - drought tolerant
  - forms tough sod
  - tolerates abuse
  - persistent
  - stockpiles well
- Negatives
  - less palatable
  - endophyte

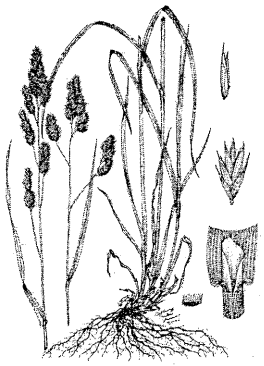
Learn to use it !!!

A New Chapter in the Endophyte Story

- Endophyte infected tall fescue
  - Reduced animal performance
  - Tolerance to drought and grazing
- Endophyte free tall fescue
  - Excellent animal performance
  - Poor persistence
- Novel Endophyte
  - Animal performance similar to endophtye free
  - Persistence similar to toxic endophyte
  - Long-term persistence data on farms
  - Seed cost limiting adoption

Orchardgrass

- High nutritive value
- Palatable
- Hay or Pasture
- Bunchgrass-forms open sod
- Does not tolerate close and frequent defoliation
- Limited summer growth
- Limited persistence
- Insect problems



Tall Fescue Variety Trial at TAREC

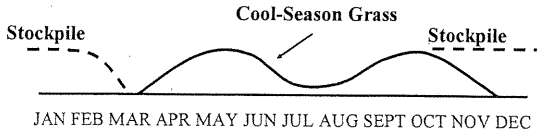
Variety	4/30/02	7/12/02	9/11/02	1/14/03	Total 02
	----------lb/A----------				
Max-Q	5486	5652	1725	4234	17095
KY31 (E+)	4143	6001	2287	4527	16968
KY31 (E-)	4458	5336	2205	4069	16136
Quincy	4540	3982	2028	4621	15171
Potomac	4182	2595	1265	1689	9731
LSD (0.05)	1072	1952	390	625	2825

Tall Fescue Variety Trial at TAREC

Variety	4/29/03	7/16/03	9/11/04	Total 03
Max-Q	5848	1315	3640	10804
KY31 (E+)	5072	2531	3857	10460
KY31 (E-)	5284	1459	3642	10367
Quincy	5841	1655	4147	11643
Potomac	5317	904	1673	7894
LSD (0.05)	520	325	533	858

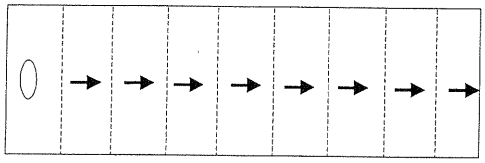
Stockpiling Cool-Season Grasses

- Stockpiling
  - allowing forage growth to accumulate
  - normally done in fall to extend grazing
  - best option for extending grazing in Virginia
- Seasonal Distribution



Utilizing Stockpiled Forage

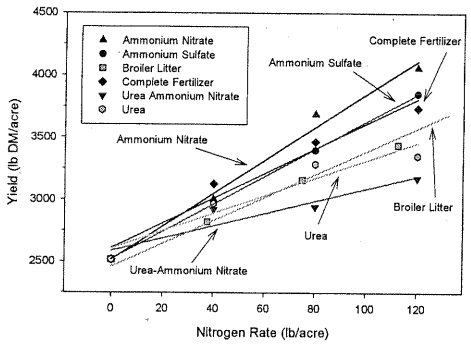
- Always utilize grass-legume mixture first
- Strip graze
  - maximizes utilization
  - only enough forage for 7-14 d
  - no back fence needed



Nitrogen Rate and Source Study

- Little information on effectiveness of nitrogen sources
- Applied 0, 40, 80, and 120 lb N/A in mid-Aug 2002, 2003 and 2004
- Nitrogen sources were ammonium nitrate (34%), ammonium sulfate (21%), broiler litter, complete fertilizer (18-9-9), urea ammonium nitrate (30%), and urea (46%)
- Plots were harvested in mid-December

Nitrogen Rate and Source



Bermudagrass (Wiregrass)

Weed or Wonder?

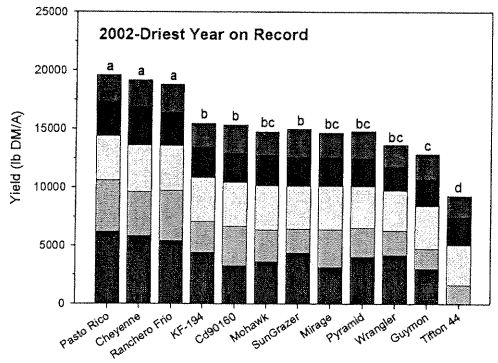
Bermudagrass History

- Origin: southeast Africa
- Imported to Georgia in 1751
- Tom Spalding's Dairy :
  - "If ever this becomes a grazing country it must be through the instrumentality of this grass."
- In 1800's called most important pasture grass in South
- Soon became a weed in row crops
- Today found in half of pastures in the south

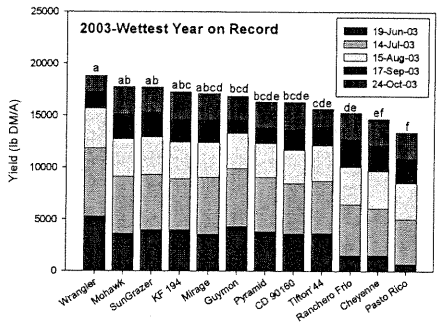
Seeded Bermudagrass

- Bermudagrass is adapted to Virginia
- Relatively little planted
- Sprigs and sprigging
  - do not have equipment and sprig sources
- Seeded bermudagrass
  - establish like any small seeded forage
  - no information on seeded varieties
- Cultivar
  - single pure variety
- Blend
  - mixture of several varieties, AZ common, giant
  - same trade name, but different mixture

First Production Year Yields



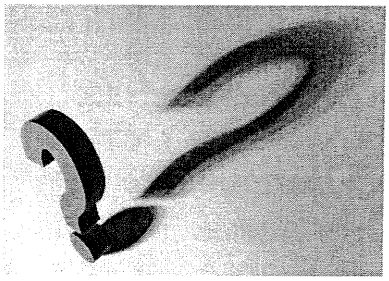
Second Production Year Yields



Forage Quality: August 15

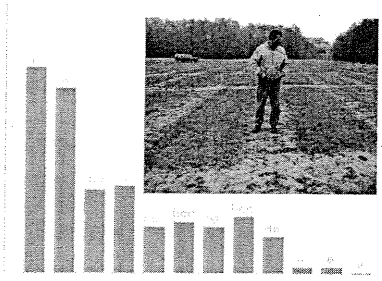
Variety	CP	NDF	ADF	TDN
	----------%----------			
Pasto Rico	12	61	31	59
Cheyenne	12	60	31	59
KF-194	14	55	25	65
Cd90160	15	54	24	66
SunGrazer	16	53	24	67
Mohawk	15	55	25	66
Wrangler	16	57	27	63
LSD (0.05)	1.0	1.5	1.2	1.3

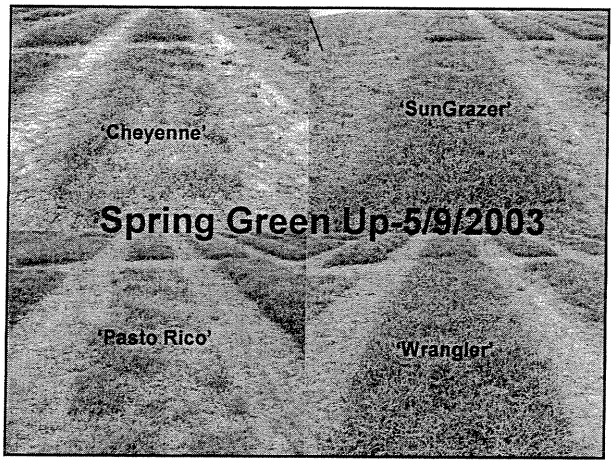
Persistence: Cold Tolerance



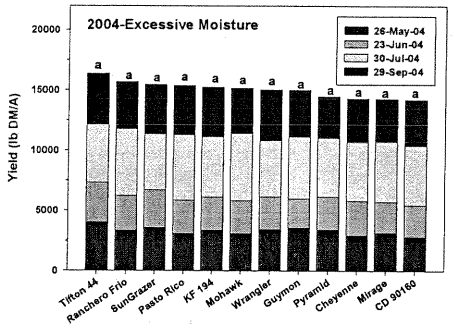
Million dollar question!!!

Spring Green Up-4/18/2003

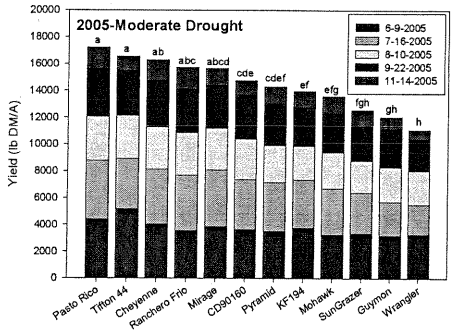




Third Production Year Yields



Fourth Production Year Yields



Selecting a Variety

- Yield is important
- Cold tolerance is more important
- Do not use varieties that include 'Giant' and/or 'Arizona Common'
- Disease resistance??????

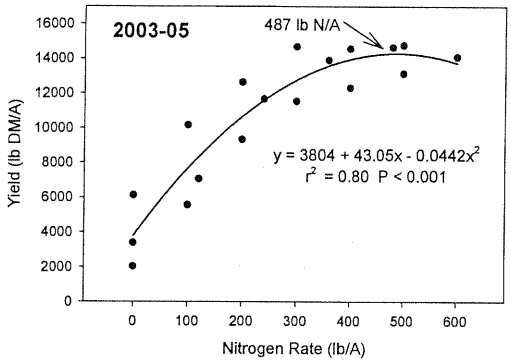
Extreme cold will kill all varieties!!!

Impact of Nitrogen Rate and Source on the Yield of Seeded Bermudagrass

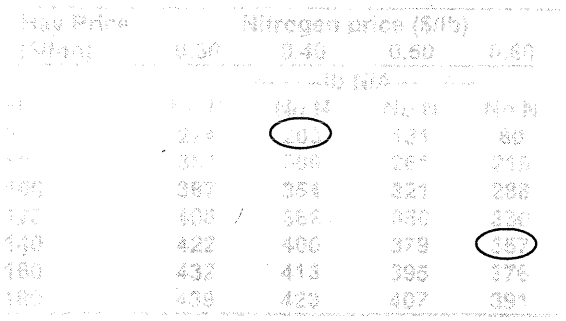
Materials and Methods

- 'Wrangler' bermudagrass sod
- O to 500 lb N applied as ammonium nitrate (30-30-30-10 split)
- Organic Sources-250 lb N/A at green up
  - *Pelleted biosolid* (Leesburg, VA)
  - *Digested biosolid* (Richmond, VA)
  - *Broiler Litter* (Amelia County, VA)
- Harvested and weighed plots

Seeded Bermuda Response to N Rate



Nitrogen Profit Maximization



Annual Forages

- Supply forage during summer

Profitable grazing systems will be based on well adapted perennial sods that are supplemented with annuals.

- Disadvantages
  - Establishment cost: $120 to $140
  - increased risk of stand failures
  - hard to cure

Sorghum Species

- Tall growing, coarse stemmed annual
  - Forage sorghum, sudangrass, sorghum x sudangrass hybrids
- Adapted to well-drained, fertile soils
- Does not tolerate acidity (pH 6.0 to 6.5)
- Variety Selection
  - little difference in yield
  - choose based on seed cost
- Nitrate accumulator
- Prussic acid concern!!!!

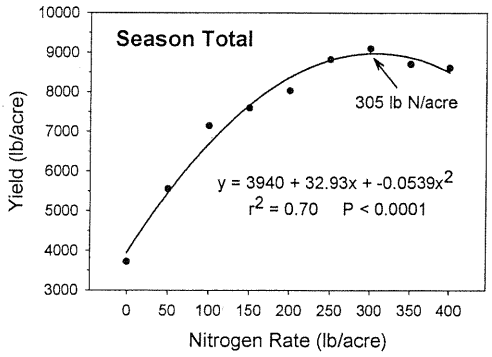
Pearl Millet

- Smaller stems and leafier
- Better adapted to acid soils(pH 5.5 to 6.5)
- More cold sensitive than sorghums
- Good drought tolerance
  - better on sandier soils than sorghums
- Grazing in 45-60 days
- Nitrate accumulator
- No prussic acid!!!
- Variety Selection
  - little difference in yield between varieties
  - based on seed cost and availability

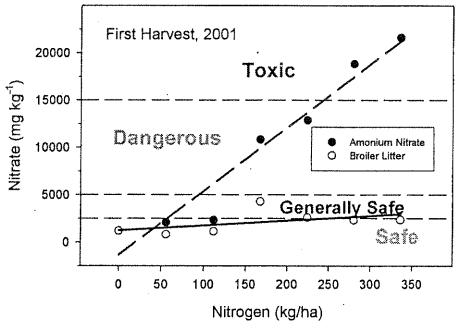
Crabgrass

- Well adapted to southern and eastern VA
- Annual that acts like a perennial (reseed)
- Double cropped with winter annual
- Species of opportunity
- Good yield potential
- Excellent forage quality
  - Higher than bermudagrass
- No prussic acid
- Nitrate accumulator
- 'Red River' only variety

Nitrogen Rate: Total Seasonal Yield

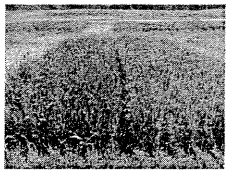


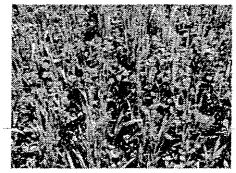
Nitrate Accumulation in Crabgrass



Small Grains for Forage

- Adapted statewide
- Grazed, silage or hay
- Double cropped with summer annuals
- Wheat most versatile
- Rye least exacting soil requirements, earliest
- Barley best on well-drained fertile soils
- Winter oats palatable, lower yielding





Small Grain Forage Trial

Variety	DM Yield		NDF		ADF		CP	
	BT	SD	BT	SD	BT	SD	BT	SD
	ton/A		%		%		%	
Trical 336 (T)	3.39	7.95	52	65	30	40	9.7	5.9
Trical 498 (T)	2.64	6.50	52	65	29	40	16.8	5.7
Sison (W)	2.76	6.75	50	56	27	33	15.6	6.8
Jackson (W)	3.24	6.59	52	55	30	33	15.6	6.3
Roane (W)	3.19	6.36	52	56	28	33	15.9	6.5
Wheeler (R)	3.27	3.94	50	55	28	33	18.4	14.8
Early Grazer (R)	3.02	3.81	46	56	25	33	18.0	14.4
SS 76-30 (O)	2.20	4.98	48	51	27	31	15.4	8.92
Rodgers (O)	2.18	4.99	47	52	26	30	15.9	9.6

Annual Ryegrass Variety Trials

Southern Piedmont AREC

Annual Ryegrass

- High yielding with excellent quality
- Can be grazed, hayed, or ensiled
- Regrows after cutting until June
- Adapted to wide range of soils
- Consistent production
- Requires nitrogen fertilization
- Overseed bermudagrass or double crop with summer annual
- Serious weed in small grains

Annual Ryegrass Variety Trial-2003

Variety	4-19-04	5-17-04	7-7-04	Total 2004	Regrowth
	--------lb/A--------				
Marshall	5328	3664	1972	10964	2.25
Rio	5359	3391	2153	10903	1.75
Zorro	3849	3343	2849	10041	5.00
Passerel Plus	4588	3426	1473	9487	2.75
Domino	3559	3350	2457	9366	5.00
Surrey II	4411	3278	1630	9320	1.75
Big Daddy	4280	3358	1325	8963	2.25
LSD (0.05)	823	661	641	1141	0.94

Why use legumes?

- Benefits of legumes
  - higher yields and forage quality
  - improved summer growth
  - free nitrogen
    - legumes >30% no additional N needed
    - always inoculate legume seed
  - dilution of endophyte infected tall fescue

Legume	N fixed lb/A/yr	Value of fixed N ($/A/year) N costing $.40/lb	N costing $.60/lb
Alfalfa	150-250	60-100	90-150
Red Clover	75-200	30-80	45-120
Ladino Clover	75-150	30-60	45-90
Annual Lespedeza	50-150	20-60	30-90

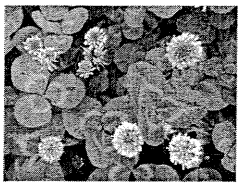
Alfalfa

- Long-lived perennial
- Deep tap-root
- Drought tolerance
- Fixes 150-250 lb N/yr
- Well-drained soils
- Needs high fertility
- Rotational grazing
- Does not frost seed
- Can cause bloat

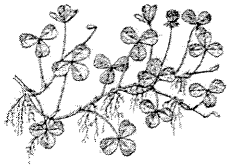
Red Clover

- Most important pasture legume
- Short-lived perennial
  - Common: 1-2 years
  - Improved: 2-3 years
- Good drought tolerance
- Excellent seedling vigor
- Easily established
  - frost seeding

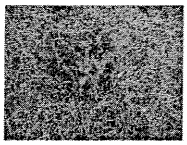
White Clover

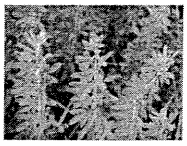


- Important in pastures
- Three types
  - small, medium, large
- Ladino or large type produces 3-5X
- Stolons
  - well adapted to grazing
- Poor drought tolerance
  - persists via reseeding
- Very high in quality



Sericea Lespedeza

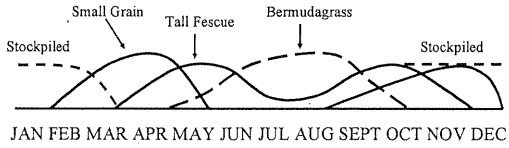




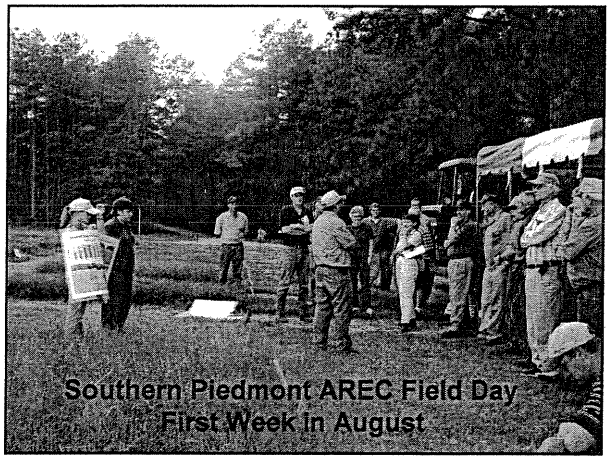
- Long-lived perennial, warm-season, nonbloating
- Well adapted to Virginia
- Extremely drought tolerant
- Tolerant of acid soils
- Newer cultivars
  - Lower tannins, finer stems, grazing tolerant
- Grazed rotationally
- Poor seedling vigor
- Establishment difficult

Putting it all together!

- Goal: Year-Round Grazing
- Potential System for SE Virginia



- <u>Year-round grazing requires management</u>



BUILDING A GRAZING SYSTEM FOR SMALL RUMINANT PRODUCTION

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Virginia is located in a region of the United States commonly referred to as the "transition zone." This region is located between the temperate north and the subtropical south and is marked by hot summers and mild winters. Cool-season grasses grow well in the spring and fall but have limited growth during the summer and winter months. In contrast warm-season grasses grow well during the three to four month summer period, but are unproductive for the remainder of the year. Although many producers view the seasonal distribution of forage production as a major challenge facing small ruminant production in Virginia, it is also an opportunity to utilize multiple species in a grazing system that can extend grazing and reduce production costs.

Profitability versus Production

American agriculture is notorious for emphasizing production rather profitability. The corn growers base awards on bushels per acre and dairyman on pounds of milk per lactation. More is better, right? This is partly right, more profit is better. In ruminant livestock production we need to always keep our eye on the bottom-line. There are three ways to increase profit: increase the price you get for your product, increase the amount of product that you make, or decrease your production costs. Of these three, we have very little control over the price we get for our product. In some cases we can increase production. However, it is very important to remember that there is a cost associated with increasing production and at some point it will exceed the increase in profit. Perhaps our best option to remain profitable is to decrease the cost of production.

In Virginia, winter feed constitutes more than 50 percent of ruminant livestock budgets. Much of this cost is associated with hay and silage feeding. The cheapest way to feed small ruminants is to let them harvest the forage. A sheep or goat is a mower-conditioner, tedder, rake, baler, and fertilizer spreader all wrapped up in one package. And the most amazing thing is that they harvest forage even if it is raining. Armed with this knowledge, it would seem logical that we design forage systems that allow our small ruminant forage harvesters to do what they do best: GRAZE. The remainder of this article is intended to provide the blocks from which you can build a grazing system that best fits the needs of your operation.

Choosing the Right Forage Species

Selecting the right forage species is one of the first steps in successful pasture management. When choosing a forage species it is important to consider the following questions:

Is the plant adapted to this region? In order for a pasture or hay seeding to be successful the plant must be well adapted to the region. If the plant is not well adapted to the area, even the

best pasture management practices will not result in a vigorous long-lived sod. In Virginia, plants that are well adapted to areas west of the Blue Ridge Mountains may not be well adapted to Southside Virginia.

Is the plant adapted to the soils present in the pasture? Soils can very greatly from pasture to pasture. Some plant species require deep fertile soils while others can persist well on shallower soils that are lower in fertility. Soil drainage is another important consideration. Some plant species require well-drained soils while other can persist on less than well-drained soils.

What is the yield and nutritive value? Choose a species and varieties that yield well and posses a high nutritive value. In some cases, species or varieties that have lower dry matter yield may actually yield more animal per acre because their digestibility is greater.

What is the desired end use? Some species are better adapted to haying type management, while others are more persistent under grazing. For example bermudagrass is well adapted to close and frequent defoliation, while orchardgrass will not persist under this type of management.

Is the plant tolerant of environmental stresses? Plants well adapted to Southside Virginia will posses good drought tolerance. If your pastures border creeks or rivers that flood regularly, then a plant with good flooding tolerance should be chosen.

Is the plant tolerant of grazing? Forage species differ greatly in their tolerance of close and frequent grazing. In continuously grazed pastures, forages with excellent grazing tolerance should be used.

What level of management does the plant require? Plants that are less tolerant of grazing and less well adapted to the region will require more management in order to persist. Therefore, it is important to match the management level of the producer and the requirements of the plant.

When does the plant grow? Cool-season grasses produce most of their growth in the spring and fall, but grow very little during the summer months. In contrast, warm-season grasses grow well during the summer months, but produce very little in the spring and fall.

Does the plant possess any antiquality factors that may restrict use? Some forage plants possess antiquality factors that limit their use by livestock. For example forages related to sorghum can cause prussic acid poisoning. Other plants like pearl millet or small grains are generally safe, but can in some cases cause nitrate poisoning.

Is this species persistent under my conditions? Profitable grazing systems are based on dependable sods that will persist for a reasonable time period. Sods that require frequent maintance and do not hold under your conditions will increase your production costs.

Cool-Season versus Warm-Season Grasses

The primary forage base in Virginia and other transition zone states is cool-season grasses. Cool-season grasses have optimum growth at approximately 70 degrees Fahrenheit.

High temperatures and intermittent rainfall during the summer months limit cool-season grass growth. This results in the production curve shown in Figure 1. If a set stocking density is used, pastures will be under utilized in the spring and fall and overgrazed during the summer months. Surplus forage could be harvested and fed during the summer months, but the high cost associated with hay and silage making makes this an unprofitable management decision in many cases.

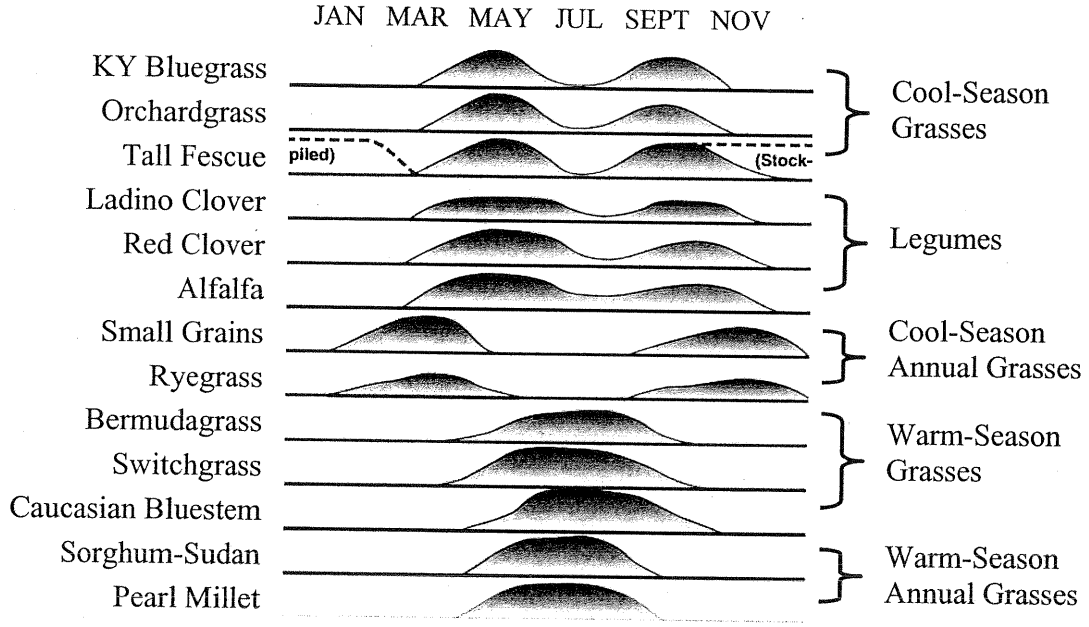


Figure 1. Typical growth curves of cool- and warm-season grasses growing in the transition zone of the United States. (Adapted from Controlled Grazing of Virginia's Pastures, Publication 418-012).

Warm-season grasses evolved from cool-season grasses and have optimum growth at approximately 90 to 100 degrees Fahrenheit. In the transition zone, warm-season grasses grow well during the summer months when cool-season grass growth is restricted. Warm-season species will produce approximately twice as much dry matter per unit of water used. Because warm-season grasses have optimum growth at higher temperatures and are more efficient at using water, they are a better choice to irrigate during the summer months than cool-season grasses. Cool-season grass growth can not be maintained through irrigation during the summer months.

Cool-Season Perennial Grasses

Tall Fescue (*Lolium arundinacea*) is the best-adapted cool-season grass for Virginia. It is a bunchgrass that forms a tight sod that is able to withstand trampling and close grazing better than most cool-season grasses (Table 1). It also tolerates poorly drained soils and drought. It does best on medium fertility soils with a pH of 5.8-6.2, but will persist on land that is acidic and low in fertility. Most tall fescue is infected with an endophyte that imparts grazing and drought tolerance to the grass, but produces toxins that negatively impact livestock performance.

Although tall fescue toxicosis is generally less severe in small ruminants, these toxins can cause decreased gains, fescue foot, reduced milk production, and reproductive problems.

The newest part to the tall fescue story is the discovery of a novel or friendly endophyte that appears to give tall fescue the persistent characteristics of the toxic endophyte, but does not produce the toxins associated with the animal disorders. Initial testing and on-farm trials in transition zone states show that animals grazing tall fescue infected with the novel endophyte performed similar to animals grazing endophyte free tall fescue. At this time there is little long-term data on the persistence and reinvasion of novel endophyte pastures. A major factor limiting adoption this new technology is seed cost. This cost may come down as additional novel endophyte cultivars are released in the next two to three years.

Orchardgrass (*Dactylus glomerta*) is a productive cool-season grass that possesses high nutritive value and good palatability. It grows in clumps and forms an open sod. This species can be used for hay and pasture, but requires better management than tall fescue. Orchardgrass will not persist under continuous grazing. It is fairly drought tolerant, but requires higher fertility to maintain productivity and persistence (Table 1). This grass is not as well adapted to the Southern Piedmont and Coastal Plain regions of Virginia as tall fescue and should be considered semi-permanent species in these areas.

Kentucky Bluegrass (*Poa pratensis*) is a cool-season grass that forms a tough sod that is capable of tolerating close and frequent grazing (Table 1). This species posses rhizomes, modified stems that grow just below the soil surface, that allows it spread and fill in damaged areas in the sod. It is commonly found in pastures in the Valley-Ridge region of Virginia. However, bluegrass is lower yielding than tall fescue and orchardgrass and goes dormant during the summer months. Bluegrass is best adapted west of the Blue Ridge Mountains. Although this species can be found in pastures in the Southern Piedmont and Coastal Plains regions of Virginia, its growing season is relatively short making it poor choice in these regions.

Reed Canarygrass (*Phalaris arundinacea*) is cool-season grass that is very tolerant of flooding, making it good choice for poorly drained soils. In Virginia, it is best adapted west of the Blue Ridge Mountains. It does not stockpile as well as tall fescue and bluegrass. Under good management, this coarse, sod-forming perennial grass spreads by short, scaly rhizomes, forming a thick sod. Reed canarygrass contains alkaloids that decrease palatability. Sheep appear to more sensitive to these alkaloids, refusing reed canarygrass at lower alkaloid concentrations than cattle. Low alkaloid cultivars should be used in small ruminant forage programs. These include 'Venture', 'Palaton', and 'Rival'.

Table 1. Characteristics of commonly used grass and legume species.[a]

Grass Species	----------Tolerance----------						
	Life cycle	Heat & drought	Wet soils	Grazing	Soil acidity	Seedling vigor	Sod forming ability
Tall Fescue E+	CSP[b]	E[c]	G	E	G	G	G
Tall Fescue E-	CSP	F	G	F	G	F	G
Orchardgrass	CSP	G	P	F	F	G	F
Kentucky Bluegrass	CSP	P	F	E	F	P	E
Timothy	CSP	F	P	P	F	G	P
Prairie Bromegrass	CSP	F	F	P	F	G	F
Smooth Brome	CSP	F	F	P	F	G	G
Reed Canarygrass	CSP	G	E	G	G	F	E
Perennial Ryegrass	CSP	P	P	E	F	E	P
Annual Ryegrass	WA	F	E	E	G	E	G
Oats	WA	F	F	G	F	G	P
Rye	WA	F	F	G	G	E	P
Wheat	WA	F	P	G	P	G	P
Bermudagrass	WSP	E	P	E	E	F	E
Caucasian Bluestem	WSP	E	F	G	G	P	F-G
Switchgrass	WSP	E	F	P	F	P	G
Crabgrass	SA	F	P	E	E	G	G
Pearl Millet	SA	E	P	F	E	E	P
Sorghum	SA	E	P	F	P	G	P
Sorghum-Sudan	SA	E	P	F	P	E	P
Alfalfa	CSP	E	P	P-G	P	G	P
Birdsfoot Trefoil	CSP	G	G	F	G	P	P
Red Clover	CSP	G	F	G	F	E	P
Sericea Lespedeza	WSP	E	F	F-G	E	P	P
White Clover	CSP	P	G	E	F	F	G
Annual Lespedeza	WSA	G	F	G	E	F	P

[a]Information was adapted from Southern Forages Third Edition, 2002.
[b]CSP=cool-season perennial, WA=winter annual, WSP=warm-season perennial, SA=summer annual
[c]E=excellent, G=good, F=fair, P=poor

Perennial ryegrass (*Lolium perenne*), **smooth bromegrass** (*Bromos inermis*), **prairie bromegrass** (*Bromos Willdenowii*) are other cool-season grasses that can be used in grazing systems in Virginia. While these grasses possess positive attributes, they are generally less well adapted and will require a higher level of management to persist on farms in Virginia.

Perennial Warm-Season Grasses

Bermudagrass (*Cynodon dactylon*) is highly productive warm-season grass that is well adapted to the southern and eastern parts of Virginia. This grass responds well to nitrogen fertilization and requires significant amounts of nitrogen for optimum growth (250-350 lb nitrogen/A). Bermudagrass possesses a stoloniferous growth habit that forms a dense sod that is very tolerant to close and frequent grazing (Table 1). It grows best at temperatures between 90 and 100 F, when the growth of cool-season grasses is severely limited. Although bermudagrass has ample growth during the summer, it is unproductive from early fall until late spring. This grass is best used in a grazing system with a perennial cool-season grass such as tall fescue. The use of bermudagrass in Virginia has been limited by vegetative establishment. The recent development of cold-tolerant seed varieties could facilitate wide scale adoption in transition zone states.

Caucasian bluestem (*Bothriochloa caucasia)* is an old world bluestem that is adapted to Virginia. This warm-season grass starts growth later than switchgrass, competing less with cool-season grasses for late spring utilization. Research in Virginia has shown that it can produce approximately 240 grazing days per acre. Animal performance is good, but somewhat lower than native warm-season grasses. Establishment can be difficult due poor seed quality and low seedling vigor. It does possess a lower growth habit than the native grasses, making it better adapted to close and frequent grazing. Performance in the Southern Piedmont region has been somewhat sporadic with some stands persisting well, while others have been overtaken by common bermudagrass. This may be related to grazing pressure during the summer months.

Switchgrass (*Panicum virgatum*), **eastern gamagrass** (*Tripsacum dactyloides*), **big bluestem** (*Andropogon gerardii*), and **indiangrass** (*Sorghastrum nutans*) are native warm-season grasses that can grown in Virginia. Although these grasses tend to be very drought tolerant, they do not tolerate close and frequent grazing making them less well adapted to small ruminant livestock production. The native grasses are well adapted to wildlife and could be incorporate in riparian zones and field borders to stimulate wildlife production. Wildlife can be a significant profit center, especially on farms near major urban centers.

Cool and Warm-Season Legumes

Incorporating legumes into a cool-season grass stands increases both yield and animal performance and improves forage availability during the summer months. They also dilute the toxins produced by the endophyte in tall fescue leading to improved growth and higher conception rates. In addition, legumes form a symbiotic relationship with *Rhizobium* bacteria in which nitrogen from the air is fixed into a plant available form. There is no need for nitrogen fertilizer when tall growing legumes make up more than 30% of the pasture. The value of nitrogen fixation from common pasture legumes is shown in Table 2. Legume seed should always be inoculated with the proper strain of nitrogen fixing bacteria before seeding.

Table 2. Value of legumes in terms of fixed nitrogen.

Legume Species	N Fixed	Value of Fixed Nitrogen ($/A/year)		
	lb/A/year	N cost=$0.40/lb	N cost=$0.50/lb	N cost=$0.60/lb
Alfalfa	150-250	60-100	75-125	90-150
Red Clover	75-200	30-80	38-100	45-120
Ladino Clover	75-150	30-60	38-75	45-90
Annual Lespedeza	50-150	20-60	25-75	30-90

Red clover (*Trifolium pratense*) is perhaps the most important pasture legume in Virginia. It is a short-lived perennial legume that must be reintroduced into pastures every two to three years. A strong attribute of this species is that it can be frost seeded into established pastures (Table 1). Red clover has a tap root that helps to increase summer growth of cool-season pastures. Research in Kentucky and Virginia has shown that improved varieties will persist two to three years, while common red clovers persist one to two years.

White Clover (*Trifolium repens*) is one of the most important pasture legumes in Virginia. It has a stoloniferous growth habit that is well adapted to grazing (Table 1). White clover can be grouped into small, medium, and large types. The large or ladino types are taller and produce three to five times as much dry matter. Therefore, ladino clover is recommended for pasture use. Although white clover is not drought tolerant, it persists in pastures through reseeding. White clover and other legumes should in most cases be grown in combination with grasses.

Alfalfa (*Medicago sativa*) is commonly referred to as the 'queen of forages'. Alfalfa is a highly productive legume that that possesses a deep tap root. This species is best adapted to well-drained, fertile soils and will not persist in poorly drained areas. Alfalfa has excellent drought tolerance and may be a good option for summer grazing in regions of Virginia where warm-season grasses are less well adapted. Although alfalfa is commonly used for hay and silage, it can be grazed rotationally. In recent years, grazing type alfalfas have been developed and would be an excellent choice for small ruminant grazing systems. Like other legumes, pure stands of alfalfa can cause bloat in ruminant livestock. Maintaining approximately 50-50 mixture of grass and legumes will greatly reduce the chances of bloat.

Birdsfoot trefoil (*Lotus corniculatus*) in a nonbloating legume that is better adapted to poorly-drained, low fertility soils than other commonly used legumes. Grown on well-drained fertile soils, birdsfoot trefoil is not as productive as alfalfa. Therefore, it is important that trefoil be grown where other legumes are not well adapted. Forage quality tends to be high due to smaller stems and tannin induced bypass protein. Trefoil is a short-lived perennial, with original plants persisting two to three seasons under good management. However, this species will produce volunteer stands when allowed to reseed. Stand establishment can be difficult due to poor seedling vigor. In Virginia, this species is best adapted in the Valley-Ridge region.

Sericea lespedeza (*Lespedeza cuneata*) is a nonbloating, warm-season perennial legume that is well adapted to Virginia. It possesses an extremely deep tap root that imparts excellent drought tolerance. It is resistant to many diseases and has few insect problems. Sericea thrives on acid soils that are low in fertility making it well adapted to pastureland in the southeastern

U.S. High tannin levels in older varieties greatly decrease palatability. Newer cultivars have lower tannin levels, finer stems, and increased grazing tolerance. Poor seedling vigor makes establishment difficult. In most cases, sericea must be planted in pure stands, with an adapted cool-season grass being drilled in once the lespedeza is well established. Like alfalfa, this species must be rotationally grazed to be persistent.

Annual lespedezas (*Kummerowia stipulacea* and *Kummerowia striata*) are summer-annual legumes that are well adapted to Virginia. In the past, annual lespedeza was widely used, but with the increased availability of lime and fertilizer it has been replaced with more productive cool-season legumes. This species can be frost seeded or drilled into closely grazed perennial cool-season grass pastures to increase summer forage availability and may be an excellent choice for rented pastureland where lime and fertilize inputs can not be justified.

Annuals versus Perennials

In Virginia, cool-season grasses produce ample forage in the spring and fall, but high and low temperatures limit summer and winter growth. Summer and winter annuals can fill this gap with relatively high quality forage when properly managed. Advantages to using annual grasses include fast germination and emergence, rapid growth, high productivity, and flexibility of utilization. Annuals can be grazed as needed and excess growth can be harvested as hay or silage. Major disadvantages include the high cost of annual establishment and the increased risk of stand failure due to variable rainfall during spring and fall establishment periods. In most cases, profitable small ruminant production will be based on perennial sods that require minimum maintance and supplemented with annuals as needed.

Winter Annuals

Wheat (*Triticum aestivum*) is one of the most versatile small grains for a farming operation. Due to its excellent winter hardiness, wheat can be sown later in the fall than barley has good potential for pasture, silage or hay production. Wheat will withstand wetter soils than barley or oats, but tends to be less tolerant of poorly drained soils than rye and triticale. Newer winter wheat varieties with Hessian fly resistance can be seeded as early as late August and produce an abundance of excellent fall grazing. Managed properly, wheat can be grazed in the fall, again in early spring, and finally harvested for hay or silage.

Barley (*Hordeum vulgare*) is generally more susceptible to winterkill than wheat, especially when it has been overgrazed. It should not be grazed as short or as late into the fall as wheat. Barley does best on fertile, well-drained soils. It is sensitive to acidic soil conditions and pH should be maintained above 5. Barley produces high quality silage or hay with a higher digestibility than other small grains, but lower yields. Good quality grazing can be obtained from early seeded barley.

Triticale (X *Triticosecale) i*s a high yielding forage crop that is gaining popularity throughout the country and particularly in the Midwest. Triticale generally has a higher forage yield, but lower quality than wheat. It is a cross between rye and wheat. As such, it is adapted to a range of soils. Tolerance to low pH is better than wheat, but not as good as rye.

Rye (*Secale cereale*) is the most cold tolerant and least exacting in its soil and moisture requirements of all small grains. Like wheat, rye can be sown in late August to provide fall grazing, excellent winter ground cover, and spring grazing. The rapid growth of rye, both in the fall and spring, makes it the most productive of the small grains for pasture. Rye is the earliest maturing of the small grains. The release of several grazing type ryes has provided better varieties for grazing and silage. Rye tends to be a more consistent producer of spring pasture than wheat, although it quickly becomes stemmy and unpalatable in late spring.

Winter Oats (*Avena sativa*) produce very palatable forage and are best adapted to well-drained clay or sandy loam soils. They do not perform as well under extremely dry or wet conditions as wheat or rye. Although oats produce high quality forage, yields tend to be lower than the other small grains. As a rule, the hardiest winter oat variety (Kenoat) is considerably less winter hardy than common wheat and barley varieties. However, in the southern US, oats will usually survive most winters. Similar to barley, winter oats must be seeded in mid-September to be well established before cold weather arrives.

Annual ryegrass (*Lolium multiflorum*) is a cool-season annual that can provide late fall, winter, and early spring grazing. Attributes of annual ryegrass include ease of establishment, high yields, high nutritive value, and later maturing than the small grains. In contrast to small grains, annual ryegrass continues to regrow in the spring until high temperatures limit growth in early summer. Annual ryegrass is commonly used to overseed summer pastures, thereby extending the useful season of this land area. It is adapted to all soil types and grows best at a pH of 5.7 or higher. The highest yields are obtained on fertile and well-drained soils with nitrogen fertilization.

Summer Annuals

Sorghum species (*Sorghum bicolor*) include sudangrass, sorghum, and sorghum-sudangrass hybrids. These species are tall growing coarse annuals that are best adapted to well-drained, fertile soils, but will grow on imperfectly drained soils when surface water is removed. These grasses do not tolerate low pH and require liming when grown on acid soils. The sorghum species contain prussic acid and can cause poisoning in ruminant livestock when young, drought stressed, or frosted forage is grazed. 'Piper' and 'Wheeler' are two sudangrass varieties that contain lower amounts of prussic acid. 'Piper' is probably the safest variety to graze. Extensive variety testing has shown little difference between varieties. Therefore, variety selection should be based on local availability and price and closer attention should be paid to management.

Pearl millet (*Pennisetum americanum*) has smaller stems and tends to be leafier than forage sorghum, sudangrass, and sorghum-sudangrass hybrids. It is better adapted to more acid soils and soils with a lower water holding capacity than the sorghum species. Pearl millet grows rapidly and will provide grazing in as little as 45 to 60 days. Unlike *Sorghum* species, there is no concern with prussic acid poisoning, so grazing can begin earlier. Dwarf varieties are available and tend to be better suited for grazing.

Crabgrass (*Digitaria species*) is commonly considered a weed, but possesses significant potential for supplying high quality summer forage. A primary advantage of crabgrass is that it is well adapted to Virginia and occurs naturally in most summer pastures, especially those that have been overgrazed. Crabgrass is best adapted to well-drained soils such as sands, sandy loams, loamy fine sand, loams, and silt loams that do not crack extensively. It can produce grazable forage in as little as 35 days, but normally 40 to 60 days is required. Like pearl millet, it does not contain prussic acid. Although crabgrass is an annual it acts like a perennial through reseeding. Therefore, it must go to seed at least once during the growing season. Shallow tillage in late winter or early spring incorporates the volunteer seed and guarantees a uniform stand.

Brassicas

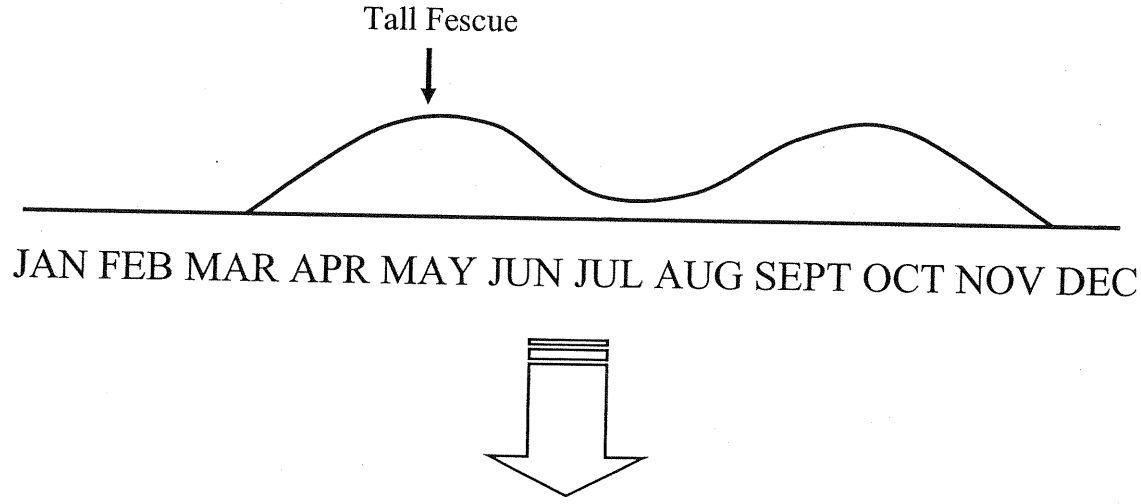
Brassicas include **kale** (*Brassica olleracea*), **rape** (*Brassica napus*), **swede** (*Brassica napus*), and **turnip** (*Brassica rapa*). Rape, turnip, or stemless kale can be planted in late spring to provide forage during the late summer period. Kale and swede can also be seeded in late spring, but will provide grazing in the late fall to early winter period. Rape and turnips can be planted in late summer to provide late fall and early winter grazing. All brassicas require well-drained, fertile soils and a near neutral pH for optimum production. Strip grazing is needed to maximize utilization of brassicas. If regrowth will be grazed, a back fence is required. Brassicas can be 90% digestible and can cause health disorders if not properly managed. Problems can be avoided by following several common sense recommendations: 1) introduce animals to brassica pastures slowly, 2) never turn hungry animals that are not adapted into brassica pastures, 3) brassicas should not make up more 75% of diet, and 4) allow access to grass pasture or dry hay at all times.

Putting the Pieces Together

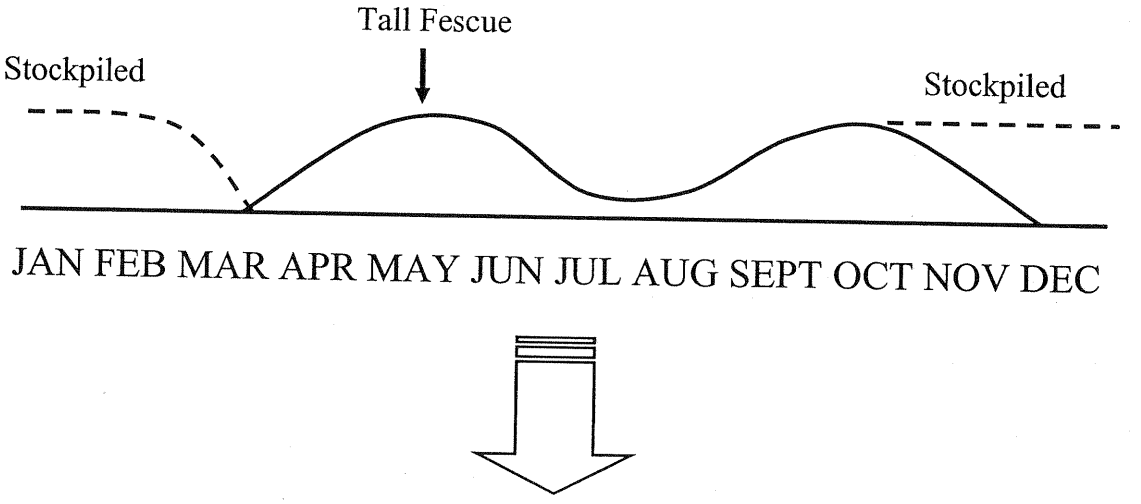
If you ever go onto two different farms and find two identical grazing systems, then one is wrong. Grazing systems are unique and dynamics entities that change and evolve as needs and experience level of graziers change. There is no one right or wrong grazing system. It is your job to build a system that meets your particular needs. Below you will find an example of a grazing system for Southside Virginia. I would like to add a word of caution. It is always easier to make a grazing system work on paper than it is in real life. It is important to be build flexibility into your grazing system that will allow you to cover all the bases if something does not go according to plans.

Example: A Grazing System for Southside Virginia

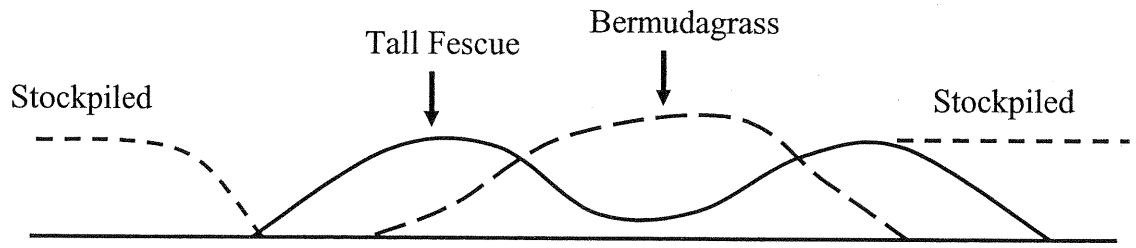
Start with a tall fescue-clover mixture. Note the summer slump in forage production and the need to feed hay during the winter months.

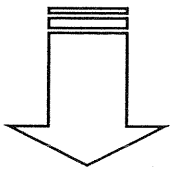


The first thing we can do to extend grazing is to actively stockpile tall fescue for winter grazing. This greatly increases the length of our grazing season. We still have a forage deficit in the summer months.

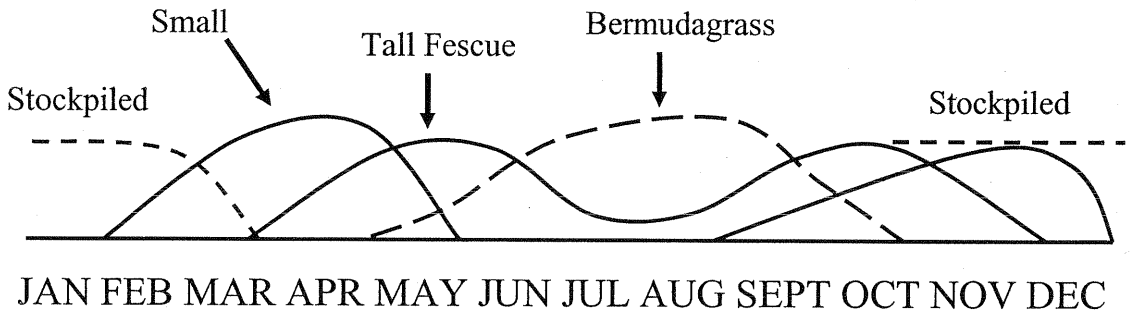


Next we add bermudagrass, a warm-season perennial grass that tolerates close and frequent grazing. The addition of bermudagrass levels off our seasonal distribution of forage by filling in the forage deficit during the summer months. We still have several short periods in the spring and fall that need to be filled in.





We then interseed a cool-season annual into the dormant bermudagrass sod. The result is a grazing system that comes very close to meeting our desired goal of year-round grazing.



Conclusion

In Virginia, high temperatures and intermittent rainfall in the summer and cool temperatures during the winter limit the growth of cool-season pastures. However, wide variety of both cool- and warm-season species can be grown in this region. Assembled into a forage system, these species can provide a year-round grazing in many years. Although these systems can significantly reduce production costs by decreasing the need for conserved forage, they do require a higher level of management.

EWE NUTRITION

Warren Gill
Professor, Animal Science
The University of Tennessee

Providing adequate nutrition for the ewe flock throughout the year is a very important aspect of total flock management, and one that is often overlooked. The fact that feed costs make up more than half of the total cost of production is a good reason why the nutrition program should receive close scrutiny. The shepherd must be alert to the changing nutritional needs of his or her ewes. The following are some of the factors that should be considered in determining the nutritional needs of a ewe:

1. Age
2. Size
3. Condition
4. Stage of production (maintenance, pregnancy or lactation).
5. Quality of the feedstuffs available and in what form they will be fed.
6. Season of the year.

In developing a feeding program for your ewe flock, take advantage of their ability to efficiently use large quantities of roughage and pasture. A sound feeding program should include maximum use of high-quality hay (legume or mixed), silage (corn, grass, or legume), or haylage.

Two of the most critical periods of the year, as far as nutrition is concerned, are late pregnancy and early lactation. If a ewe is expected to deliver large, strong, healthy lambs and provide a heavy flow of milk, adequate nutrition must be provided before and after lambing. A salt-mineral mixture formulated for sheep should be fed free-choice throughout the year. In areas where copper toxicity is a problem, use mineral mixture that is void of copper. If you are in a selenium deficient area, then you should use a mineral mixture that is supplemented with selenium.

Sheep should have plenty of clean, fresh water available at all times. During cold weather, keep water from freezing so that water intake is adequate.

Flushing the Ewes

Feeding a ewe so that it rapidly improves in condition from ten days to two weeks before breeding (commonly known as flushing) may increase the lambing percentage by 10 to 20 percent. However, this increase will not be as great if ewes are already in a high condition before breeding. Ewes that become too fat may not breed at all. To flush ewes, let them graze better pasture or feed them ½ to 3/4 pound of concentrate feed per head per day. Use some caution if flushing ewes by turning them onto lush legume pastures; during years of heavy

rainfall, such pastures may contain a high level of coumestrol, a plant estrogen that some suspect may cause delayed conception.

Feeding During Gestation

Whether you should give ewes supplemental feed during early pregnancy depends on the availability of feed in the form of pasture, stubble fields, and stalk fields. If the roughage supply in the fields is not adequate and the ewes are not at least maintaining their weight, feed one or two pounds of legume hay per head per day.

Feed a concentrate ration during the last four to six weeks of pregnancy to provide an additional supply of energy to meet the demands of the rapidly developing fetus. About 2/3 of the birth weight of a developing fetus is gained during the last six weeks of pregnancy. It is usually thought that a ewe should gain from 20 to 30 pounds during pregnancy.

Inadequate nutrition during the last six weeks of pregnancy may have the following results:

1. A higher percentage of ewes with pregnancy disease
2. A decrease in birth weights
3. Weaker lambs at birth
4. An increase in infant lamb mortality
5. Slower gaining lambs
6. Lower milk yields during lactation

The information in Table 1 will serve as a guide in determining how much feed your ewes will need in late pregnancy. Several different roughages are listed in combination with shelled corn. Remember that the amounts of feed listed in Table 1 are for ewes of two different weights, so pick the column that best fits your situation.

The exact amount to feed depends on the weight and condition of the ewes. Silage can be substituted for hay at the approximate rate of 2 ½ to 3 pounds of silage for each pound of hay replaced, depending of course on the moisture content of the silage. Keep in mind that corn silage is low in protein and calcium, so a protein-mineral supplement must be added unless half of your roughage is legume hay. Bunk management is also important since silage can spoil if it is allowed to accumulate in the feedbunk.

Table 1. Pounds of Daily Feed Consumption required to Meet Nutrient Requirements[a] When Shelled Corn and Various Roughages Are Fed to Ewes in Late Pregnancy

Feed Combinations	Ewe Weights[b]	
	130 Pounds	180 Pounds
Alfalfa hay	3.75	4.50
Shelled corn	.75	.75
Clover-timothy hay (50-50)	3.75	4.50
Shelled corn	.75	.75
Orchardgrass hay	4.00	4.75
Shelled corn	.75	.75
Alfalfa hayage (50% DM)	6.5	8.0
Shelled corn	.75	.75
Corn silage (30% DM)	6.75	8.75
Alfalfa hay	1.0	1.0
Soybean meal	.25	.25
Shelled corn	.50	.50

[a]Assuming that a salt-mineral mixture is fed free-choice
[b]Weights at breeding time with ewes in average condition

Feeding During Lactation

Lactation places a greater demand on the ewe than pregnancy and increases the level of nutrients needed (see Table 2). The difference in protein requirement indicated in Table 2 for ewes nursing singles or twins is .19 lb. per day. However, some nutritionists think that the protein requirement for ewes nursing twins is higher than indicated by NRC, particularly during the first 4 weeks of lactation. Some nutritionists recommend that a ewe nursing twins should receive approximately .25-.30 lb. more protein per day during the first four weeks of lactation than a ewe nursing a single lamb.

A ewe reaches peak milk production approximately 4 weeks after lambing, and then milk production begins to decrease. Weaning at 60 to 90 days is a common practice with some weaning at 35 to 42 days.

During the first 60 days of the lactation period, feed according to the amounts recommended in Table 3 for small and large ewes, nursing singles or twins. Separate the ewes with twins from the ewes with singles and feed accordingly. Keep in mind that the actual amount fed depends on the weight and condition of the ewes and that the feeding value of 2 ½ to 3 pounds of silage is about the same as 1 pound of hay.

By the time lambs are between 1 and 2 months of age, they will be eating quite a bit of the ewes' feed; you must allow for this to adequately meet the ewes' requirements.

After the first 60 days of lactation, reduce the amount of feed to the amount the ewes were being fed during late pregnancy. Additional feed at this time will only allow the ewes to put on excess fat and will increase the cost of production.

Table 2. Changes in Daily Total Digestible Nutrients (TDN) and Protein Requirements as a Ewe Progresses from Early Pregnancy Through Early Lactation[a]

Stage of Production	TDN	Protein
	Pounds	
Early pregnancy	1.5	.25
Late pregnancy	2.8	.47
Early lactation, single	3.6	.73
Early lactation, twins	4.0	.92

[a]National Research Council. 1985. Based on ewe weight at breeding time of 154 pounds.

Table 3. Pounds of Daily Feed Consumption Required to Meet Nutrient Requirements[a] When Shelled Corn and Various Roughages Are Fed to Ewes in Early Lactation

	Ewe Weights[b]			
	Nursing twins		Nursing a single	
	180 lb.	130 lbs.	180 lbs.	130 lbs.
Alfalfa hay	5.0	4.0	5.0	4.0
Shelled corn	2.25	2.0	1.5	1.5
Clover-timothy (50-50)	5.0	4.0	5.0	4.0
Soybean meal	.1	.1	0	0
Shelled corn	2.25	2.9	1.5	1.5
Orchardgrass hay	5.0	4.0	5.0	4.0
Soybean meal	.2	.2	.1	.1
Shelled corn	2.25	2.0	1.5	1.5
Alfalfa silage (30% DM)	10.0	7.5	10.0	7.5
Alfalfa hay	1.5	1.5	1.5	1.5
Shelled corn	2.25	2.0	1.5	1.5
Alfalfa haylage (50% DM)	8.5	7.0	8.5	7.0
Shelled corn	2.25	2.0	1.5	1.5
Corn silage (30% DM)	9.5	7.5	9.5	7.5
Alfalfa hay	1.5	1.5	1.0	1.0
Soybean meal	.30	.25	.25	.25
Shelled corn	1.75	1.50	1.25	1.25

[a]Assuming that a salt-mineral mixture is fed free choice.
[b]Weights at breeding time with ewes in average condition.

Table 4. Effect of Level and Source of Energy on the Performance of Lactating Ewes

	High Hay		Low Hay	
	Low energy	High energy	Low energy	High energy
Days fed	56	56	56	56
Initial weight (lbs.)	163.9	159.7	169.0	165.9
Weight changes (lbs.)	-17.4	-7.0	-19.4	-3.8
Daily Intake (lbs.)				
Hay	4.0	4.0	2.0	2.0
Corn	1.0	2.0	2.0	3.0
TDN	2.8	3.6	2.6	3.4
Lamb data				
Initial age (days)	3-5	3-5	3-5	3-5
Number lambs	40	39	38	37
Initial weight (lbs.)	12.5	12.3	13.4	13.2
ADG, first 40 days (lbs.)	.37[a]	.42[b]	.34[a]	.44[b]

[a,b]P<.05.

Five or six days before weaning, greatly reduce the feed and water intake of the ewes and remove the protein supplement if one was being fed. This will help to dry the ewes up more rapidly, force the lambs to eat more creep, and get the lambs on feed more easily after weaning.

As soon as the ewes can be turned out to pasture full time, no additional roughage or grain is needed as long as there is sufficient pasture, unless you are on an accelerated lambing program.

Feeding Replacement Ewe Lambs

There are many ideas as to the best way to develop ewe lambs from market weight to yearlings, and only limited research information to draw upon for answers. There is no ideal way to develop lambs into yearlings that will work for all sheepmen under all conditions.

In determining what type of a feeding program to follow, one must answer several questions. What is the genetic potential of my flock for yearling size? How hard do I want to push them? How much condition do I want on them? At what age do I want to use them for breeding purposes? And lastly, will I be entering some of them in shows or sales? The development of lambs into yearlings is one of many areas of management where the "eye of the master" reigns supreme. One must keep a close watch on the animals to know when to change the kind of ration, the amount being fed, or both.

Lambs that are to be bred, and show lambs should continue to be well fed after they reach market weight. Lambs that will not be used for breeding purposes until they are yearlings can be developed more slowly after they reach market weight; however, they do need to be well fed over the winter so they will be well-developed yearlings that have adequate size in relation to their genetic potential.

Two items that should not be forgotten when growing out replacement animals are to keep the feet well trimmed and to follow a good parasite-control program. Internal parasites can greatly cut down on the performance of these young growing animals.

When lambs are pushed hard for maximum growth, some may have rectal prolapses. Those that do should not be kept for breeding purposes but should be marketed.

Ewe lambs that are to be bred should be managed and fed as a separate unit from the time they reach market weight until they are bred for their second lambing.

Good management and adequate nutrition during pregnancy and lactation are very essential for ewes that will lamb as yearlings. This work also revealed that flushing these ewes during their second breeding season is very important. Ewes lambing in May (at 15 months of age) had little trouble nursing their lambs but when turned on pasture in July, after lactation, did not breed well in September. A short flushing period using 1/2-pound of corn proved to be very beneficial.

Forage Testing and Ration Balancing

Forage testing is another tool to allow sheep producers to refine and improve their nutritional management. For example, the rations which are presented in Table 2 and 3 are based on average values. As with many things, averages can be very misleading. It is much more desirable to have your forage(s) tested and work with your Extension agent or specialist or other experienced nutritionist to come up with a balanced ration that is the best fit for your flock.

Body Condition Scoring

Visual appearance of sheep for body condition provides a useful assessment for determining current and future feeding needs. Body condition can be determined by prominence of skeletal features, evidence of fat deposits, and general appearance of angularity versus blockiness. The degree of thinness reflects the severity of nutritional inadequacies. Nutritional stresses are the primary direct or indirect cause of failed or marginal performance, whether it be poor re-breeding, weak unhealthy lambs, low milk production and weaning weights, or disease and death.

Body condition scoring is an objective approach to evaluating and describing condition for a more precise appraisal of status and managerial implications. Scoring is done on a 1 to 5 scale. Body condition score 1 is at the extreme thin end of the scale relating to sheep being extremely emaciated with no fat, little muscle, obviously weak, and survival being at risk. Body

condition score 5 is on the very obese end of the scale and sheep are so round and heavy they have impaired mobility.

Condition Score 1: Very thin Spinous process very prominent and sharp; transverse process also easily felt and sharp; fingers can be pushed easily under ends; loin muscle shallow, concave; no fat over muscle, under skin.
Condition Score 2: Thin Spinous process prominent but less sharp; transverse process smoother on ends; fingers can be pushed with little pressure under ends; loin muscle more depth and fullness; no discernible fat covering.
Condition Score 3: Average Spinous process easily felt with finger pressure but smooth not sharp; transverse process smooth and fat covered; firm pressure needed to push fingers under edge; loin muscle full with cover of .15-.20 inches of fat.
Condition Score 4: Fat Spinous process can be felt with considerable finger pressure; transverse process cannot be felt, ends covered with fat; loin muscle full with cover of .25-.35 inches fat.
Condition Score 5: Very fat Spinous process cannot be felt; back broad with hollow; transverse process cannot be felt; loin very wide and thick over loin edge; evidence of fat around dock extending forward on rump. Fat covering over .4 inch over loin muscle, 1.0 inch or more over rib.

When evaluating body condition, make sure you are estimating the degree of fatness and flesh and not wool and gut fill. Some adjustment may also need to be made for age, as with advancing age more weight and condition is carried lower on the body rather than over the top line.

Once ewes have lost significant condition it takes a more complex and costly ration to put the weight back on than it would have to maintain weight

Feeding changes need to be made so there is no additional weight loss by thin ewes in late gestation and possibly some improvement by lambing, realizing many goats will calve at a borderline condition. It is critical that thin goats in late gestation be on a complete balanced nutritional program including appropriate protein, vitamin, and mineral supplements to meet their requirements to calve in good vigor and produce a strong healthy lamb.

To be a good shepherd, you must use your eyes, your hands, and a scale if one is available, to keep track of how the ewes are doing in terms of changes in weight and condition. By keeping up to date on the changes in your flock, you can alter your feeding program accordingly, and make the best use of your feed resources.

Lamb Nutrition Guide

<u>The Neo-natal Lamb</u>

1. Requires colostrum within 24 hours after birth.
2. Ewe or cow colostrum should be kept frozen and used as needed.

<u>The Nursing Lamb</u>

Early (simple-stomached) phase (0-3 weeks)

1. Milk replacers should contain 30-32 percent fat, 22-24 percent protein and 22-25 percent lactose.

2. Creep or starter rations should contain 18-22 percent pre-formed protein and be ground.
3. Selenium and vitamin supplementation may be needed.

Transitional Phase (3-8 weeks)

1. Lambs can be weaned to starter diets at 30 days.
2. Cracked or whole grains can be used in creep rations.
3. High quality hay can be used to supplement.

Creep Rations

The Weaned Lamb

1. Lambs can be weaned at 60-90 days.
2. Protein level in the "starter" ration should be 16-18 percent to compensate for "lost" milk protein.
3. Lambs should be maintained on the pre-weaning ration until weaning stress is over.
4. Rations for lambs fed in confinement should contain:
   15 - 16% natural protein
   10% high quality roughage
   70-73% TDN
   0.36% or more calcium*
   0.24% or more phosphorus*
   *Maintain a 1-1/2:1 or greater ratio Ca:P
5. Lambs moved to pasture may require supplemental energy (1-2% of body weight) to achieve acceptable gains.
6. Proper calcium-phosphorus ratios must be maintained to prevent urinary calculi and related problems.

The Finishing Lamb (80 pounds plus)

1. Lambs of this size can use a variety of feedstuffs.
2. When properly supplemented in the ration they can utilize non-protein nitrogen supplying up to 1/3 of the crude protein on the ration.
3. Protein level in the ration should be at least 12 percent.

UT Extension

University of Tennessee Soil and Forage Test Laboratory
5201 Marchant Drive, Nashville, TN 37211-5112

TO:

BEN POWELL
4233 POPLAR HILL ROAD
ANYTOWN, USA

FORAGE AND FEED

TEST RESULTS

DATE: DECEMBER 7, 2005

COUNTY: WILSON

Sample #	1A		2RB			
Lab #	15367		15368			
Sample type	ALFALFA HAY		FESCUE/MIXED GRASS HAY			
Moisture (%)	7.60		6.50			
Dry matter (%)	92.40		93.50			
	DM basis	**As-fed basis**	**DM basis**	**As-fed basis**	**DM basis**	**As-fed basis**
Protein (%)	21.47	19.84	10.91	10.20		
Fat(%)	2.36	2.18	2.45	2.29		
Fiber-ADF (%)	29.88	27.61	38.88	36.35		
Fiber-NDF (%)	39.70	36.68	64.10	59.93		
Calcium (%)	1.41	1.30	0.45	0.42		
Phosphorus (%)	0.35	0.32	0.24	0.22		
Magnesium(%)	0.24	0.22	0.14	0.13		
Potassium (%)	2.80	02.59	2.19	2.05		
TDN	69	63	58	54		
NEl (MCal/lb)	0.71	0.66	0.59	0.55		
NEm (MCal/lb)	0.73	0.67	0.56	0.52		
NEg (MCal/lb)	0.45	0.42	0.31	0.29		
RFV	154		85			

For the nursing ewes, it really balanced better with the added alfalfa - the extra protein helped.
175 lb ewe pregnant: 3 lb this hay plus 2 lb 13% Co-op feed.
175 lb ewe with singles: 3.5 lb his hay plus 3 lb Co-op feed or feed 4 lbs this hay plus 1 lb alfalfa and 1.5 lb 13% Co-op feed.
175 lb ewe with twins: 3.5 lb this hay plus 2 lb Co-op feed 1.0 lb alfalfa (I tried it with 13% feed and no alfalfa, but didn't work).

Comments:
For more information, please visit us on the web at http:// bioengr.ag.utk.edu/soiltestlab. If you have any questions with regard to the above information, contact your local Extension agent.

EWE OBSTETRICS AND NEWBORN LAMB MANAGEMENT

Kevin D Pelzer DVM, MPVM
Virginia-Maryland Regional College of Veterinary Medicine
Blacksburg, Virginia

It really doesn't matter what you do, ewes will decide for themselves when they want to lamb. You can, however, be prepared for lambing and the potential problems that can occur. The most common physical sign of impending lambing or parturition in the ewe is the udder begins to fill or bag up. If ewes have a short fleece, one may also observe a softening of the tissues around the dock. The vulva enlarges and a colorless mucous discharge, the cervical mucus plug, may be observed. Even observing these signs in ewes only gives one an approximate time of lambing as these observations may be present a week before lambing.

Parturition occurs in three stages. The first stage of parturition lasts from 2 to 12 hours, the time during which the cervix dilates. During this stage, ewes will try to isolate themselves. In a crowded barn, this may be in a corner or up against a wall. The ewe acts uncomfortable, getting up and down, lifting her lip, pawing the ground, and frequently urinating. Ewes do not "push" at this stage but the uterus is contracting causing dilation of the cervix. Some ewes seem to stare off into space and then go back to chewing their cud or eating.

The second stage of parturition is expulsion of the lamb. This stage is fairly quick, only lasting 1 to 2 hours. The water bag may be observed followed by the feet and the head. There should be steady progress once the water bag is observed or appearance of the feet. If the ewe strains longer than 45 minutes without producing a lamb, she should be checked for problems. Ewes may rest between delivering twins, but twins should be delivered within 45 minutes of the first delivery.

Cleanliness is important when examining a ewe for problems. Contamination of the uterus can lead to serious infection that will negatively impact the health of not only the ewe but also the newborn. Likewise, it protects the shepherd as well. The ewe's vulva should be cleaned with a mild soap and water solution. The shepherd should use an obstetrical sleeve and apply generous amounts of lubrication on the sleeve before entering the vagina.

The most common problem observed in ewes with dystocia, difficult birth, is fetal postural abnormalities. Normally, the lamb is born with the front legs extended followed by the head. The head should be 2 to 4 inches from the tip of the toes. If the head is right on top of the toes, the lamb may be "stuck" because the elbows are caught. Pulling on one leg at a time and fully extending the limb usually resolves this problem. If difficulty occurs in trying to manipulate the fetus, raising the hind quarters of the ewe sometimes allows the uterus to fall forward and reduces the ewe straining allowing for easier repositioning.

A common problem occurs when twins are trying to come out at the same time with each having a leg in the birth canal. One should follow each leg back to the chest to ensure that the legs presented are of the same lamb. If the head and 2 different legs are presented, it is best to

gently push the head back in and then replace the leg and retrieve the other matching leg. Be sure to guard the feet as they are sharp and can tear the uterus. In any ewe dystocia, always keep in mind that you may have more than one lamb coming out at the same time.

Sometimes the legs appear but the head seems to be missing. Again check to be sure the legs belong to the same lamb. The head may be turned back or down between the legs. In any case, by gently pushing back on the lamb's brisket, one will usually have enough room to manipulate the head into the proper position.

Sometimes a ewe may not strain but the membranes are present or the tail is present but no legs. When you examine the ewe, the lamb's butt is pushed up against the pelvis and the legs are extended forward. This is referred to as a true breech. Gently push the butt forward and reach under to grab one of the legs. Place a finger around the hock and gently retract, then reach forward and grab the foot. With the hand around the foot, guarding the toe from penetrating the uterine wall, bring the toe to the middle and push the hock to the side while lifting the toe into the vagina. Repeat with the other leg. Place the tail between the legs, this reduces the chances of tearing the uterus and remove the lamb.

The third stage of parturition is expulsion of the placenta. The placenta should pass within 8 hours of lambing. If the placenta retains, the ewe's appetite should be monitored as well as her temperature for a fever (>103.3). If the ewe goes off feed or develops a fever, she should be given penicillin. Mild traction can be applied to the placenta but it should not be torn. If the ewe remains bright, alert, and eating, nothing needs to be done and eventually the placenta will fall out.

Lambs should be born in a dry draft free environment to reduce the risk of hypothermia. Lambs attempt to stand and nurse within 30 minutes of birth. The ewe should have been crutched and clipped around the flank so the lambs have easy access to the teats. If lambs are being crushed, shearing may reduce this problem as ewes can't feel the lambs when overly fleeced. Lambs should nurse within the first 2 hours of birth. Lambs should receive 50ml of colostrum per kg of body weight (3/4 oz/lb) during the first 2 hours and a total of 200 – 250 ml/kg (3.5 oz/lb) during the first 24 hours of life. For example, an 8 lb lamb should receive 6 oz in the first 2 hours and 28 oz over the first 24 hours of life.

If a ewe does not have adequate amounts of colostrum, colostrum from another ewe may be used. If ewe colostrum is not available, goat or cow colostrum can be used. There is a chance for disease transmission to occur using goat or cow colostrum, eg. Johnes Disease, so investigation into the health status of the herd is important. Likewise, in rare cases some lambs fed cow colostrum may develop a hemolytic anemia. Commercial colostrum substitutes are available but their efficacy is not known.

Lambs should be placed in a claiming pen or lambing jug. This allows for proper bonding to occur as well as gives the shepherd an opportunity to observe the ewe and lambs for problems. Lambs should remain there a minimum of one day plus a day for every lamb. Ewes may ignore weak lambs or lambs born subsequent to the first of a litter, so even though the lambs are with the ewe, one must observe ewe lamb interactions.

The lamb's navel/umbilical cord should be dipped in a disinfectant. A 2% iodine, betadine, solution can be used as well as chlorohexidine. Chlorohexidine has been shown to provide some residual bacterial inhibition. Although tincture of iodine is commonly used, it may be too strong as it can cause burning of the tissues.

Lambs may need selenium supplementation if ewes are not properly supplemented. Feeding a quality trace mineral salt with the highest allowable selenium should provide the ewe and her lambs adequate selenium. If supplementation is given, lambs should receive 1/3 ml of BoSe.

Heat lamps may provide lambs needed warmth if the lambs are wet or sick. Lamps should be no closer than 4 feet from the ground. Positioning of the lamp is important as a misplaced lamp may set the barn on fire.

Fostering of lambs may be necessary in the case of triplets or inadequate milk production. Match lambs for size, color, and age. The closer to birth fostering occurs, the better the results. Placing fetal fluids on the adopted lamb may help the fostering process.
Colostrum should be hand fed before fostering to insure adequate passive transfer of immunoglobulins. When selecting the lamb to foster, pick the strongest of the lambs. Remove the ewe's lambs and return them after she accepts the new lamb. Do not separate the ewe from her lambs any longer then 2 –3 hours.

Bottle feeding may be necessary if fostering is not an option. Provide the lamb colostrum during the first 24 hours of life. A lamb milk replacer should be used. Lambs should be fed 4 times a day. The lamb should receive a total of 20% of its body weight a day. For example, a 10 lb lamb would receive 2 lbs of milk (2 pints) a day, 8 oz per feeding. The milk should be fed warm in order to avoid chilling of the lamb during the first week of life. If bloating is a problem, either try feeding cold milk replacer or feed smaller quantities at a time more frequently. The second week of life, lambs can be fed 3 times a day rather than 4. Lambs should be offered creep feed within a week of life and can be weaned when they weigh 20 lbs. More information is available at http://www.sheepandgoat.com/articles/artificialfeeding.html

Lambing Equipment Box
Bucket
Mild soap, Ivory
Towels
Obstetrical lubrication, KY Jelly, J-Lube
Obstetrical sleeves
Clean baling twine
Antiseptic to dip navels
Hair clips to use on umbilicus in case of hemorrhage.
Bottle nipples
Feeding tube
60 cc syringe to fit feeding tube

SHEEP SELECTION 101

Tracy Tomascik
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Animal selection has been described as part art and part science. The "perfect" animal for one may not fit the ideal described by the next person. Even though the ideal animal may be different for all of us, there are several considerations we should all be looking at to assess differences. As an overview, breeding sheep should be structurally and reproductively sound, highly productive and gain rapidly and efficiently. Additional traits to evaluate in selection of quality animals are frame, muscle, length, and capacity through their middle. Often, skeletal correctness and width of skeleton are overlooked but are still are important evaluation points. Generally, sheep that walk and stand with additional width at the ground are going to have more muscle than narrow based sheep. Additional capacity is also gained when sheep have more curvature and depth to their middle.

Structural Correctness

Skeletally correct sheep that take a long and relaxed stride when in motion have a greater adaptability to adverse or varied range conditions. Sheep with a poor design through their joints, poor feet setting and placement tend to be less productive than those that do not incur this additional strain. Flexibility in joints is desired but can become too weak and cause as much strain as joints that have little to none. To account for this, selection should be placed on joints with correct angulations and strength. One does this by evaluating the skeletal system or bone structure of the individual. When doing this I like looking at animals from the ground up. Feet and legs should be set at the corners of the animal and at the ground should point forward. The two joints that cushion most of the animal's weight are the pasterns and hock. Thus, they are very important in maintaining the soundness of the animal for the duration of production. Strength of the pastern depends on the length between the top of hoof and the base of the dewclaw. Typically, if the joint looks longer than normal it will also have more "set" to it. In badly set pasterns the dewclaws can be seen touching the ground. Eventually this can cause the animal to become lame. Sheep that have correct angulation to their hock will show flex when they travel. "Sickle hocked" and "cow hocked" are widely known as incorrect sets to the rear leg because it decreases the leg's stability. The knee of the sheep should be set vertically above the hoof when viewed the front and side. Knees that point forward "bucked over" or to the inside are undesirable due to instability that this causes. The angle of the scapula or shoulder can dictate the length of stride by the front legs. If the shoulder blade is set forward or more perpendicular than ideal the sheep has more difficulty reaching forward when moving. Another sign that indicates a steep set to the shoulder is the way the sheep carries its head. When the shoulder is laid back, ideally to around a forty-five degree angle, the sheep's neck will tie high into the top of the shoulder and allow it to carry its head high and appear alert. Sheep that are "down-headed" generally are set more perpendicular at their shoulder blade. The top of the sheep should be straight when you view it from the profile and carry this squareness through the dock area of the hip. Heavily boned, big-footed animals are more desired in order to give more stability and a more powerful look.

Frame

This is a direct indication of the growth potential of the individual and their offspring. Since breeding sheep produce market lambs, which are widely sold by the pound, one should always consider frame and growth as a genetic factor. Different production situations allow for different size ewes. Thus, large and small-framed ewes can produce profitable offspring when bred to a ram of exceptional complimentary and then marketed correctly. Large framed sheep produce lambs that grow fast and weigh heavier and thus are worth more money at the point in which they are marketed. With this mind-set, many times sheep are selected primarily on frame size because it correlates well with profit. However, if structure, muscle and capacity are neglected, over time, the production efficiency of the flock that retains replacements can decrease. Frame also correlates with the time of maturity of the individual and can be estimated by studying the length of the cannon and overall skeletal extension.

Capacity

This is evaluated by judging the overall volume that the animal posses throughout the rib cage or middle section. Sheep with more capacity have more area for gestation and holding more lambs as well as giving them a more productive and a more maternal look. Capacity starts at the chest floor with more width in this area being more desirable. Additional curvature in the lower fore rib and upper part of the rib cage is selected for. "Counterfeit" sheep are overly conditioned which creates the illusion of having more capacity than what is really there. A trained eye and experience allows one to see through this additional fat to find the true capacity. As an additional note, many times it is overlooked that sheep with more volume and capacity also weigh much heavier than those of the same frame size that lack in rib depth and shape.

Muscle

Muscle is evaluated in three primary sections on sheep being the rack, loin and leg. An experienced shepherd can make a good estimation of the amount of muscle that an individual has. However, to accurately judge the muscle that sheep have, they should be handled until one is comfortable with their visual estimation. Length, width and depth of muscle should be taken into consideration at all points. The forearm and shoulder should blend smooth but not lack muscle dimension. The rack is ideally wide and expressive. When measuring the loin, more length from the last rib to the hook bones is desired while additional width and depth create more total area of muscle. Finally, the hip and leg of the lamb should be measured by the length from hooks to pins and depth and circumference of muscle through the inner and outer portions of the leg. When handling the sheep, one should expect to find a hard and expressive muscle pattern.

Balance and Quality

This evaluation point is most effectively studied from the profile of the sheep. In female breeding sheep, the ewe should posses a broody and maternal look that is created by selection for capacity. Ideally, one should strive to find ewes that combine this with power, size and structural correctness. Femininity is found by selecting for refinement of the shape of the ewe's

face, head and neck. When the ewe is viewed from the side, she should transition through her neck, shoulder, middle rib section and hip with a smooth pattern and additional length. The top-line of the ewe is desired to be straight and the hip set squarely into it. Ewes that are short sided, weak in their top or steep in their hip are less attractive and thus should be selected against.

Rams should be stouter than the ewes. A powerful ram will be heavier structured, have more muscle and more masculine about his features. Rams can be coarser through their shoulder and head and still be desirable. Along with this, rams should be selected for added testicular size and be firm when handled.

Mouth Soundness

Breeding sheep should have a sound mouth and jaw design. The jaw should meet squarely and the front teeth in the lower jaw should be centered on the dental pad in the upper jaw. Jaw defects are highly heritable and can prevent sheep from gathering adequate forage. "Parrot-mouth" sheep have an over shot jaw while conversely a "Monkey-mouth" sheep has an undershot jaw.

Performance Records & Selection

Ram Selection: From a genetic standpoint, ram selection is the most important decision a sheep producer makes. The vast majority of genetic improvement in the flock is the direct result of ram selection. For flocks with small numbers of ewes, the importance of an individual ram is even further exaggerated- as one ram alone accounts for a large proportion of the genetics represented in each lamb crop. Relative to other production and management decisions, ram selection is an infrequent occurrence. However, these decisions have long-term impact relative to the productivity and profitability of the sheep enterprise.

The first step in ram selection includes thoughtful determination of the role of the ram in contributing to the existing flock genetics. The breeding system utilized, marketing system, management level, and feed/environmental resources are important considerations for determining this role. For example, traits of importance in rams will vary greatly if the ram will be used to sire replacement females vs. a ram that will be used strictly as a terminal sire. The following criteria should be considered:

Ideally ram selection would include evaluation of a complete performance record on potential rams. This performance record would include adjusted records (or EPDs generated through the National Sheep Improvement Program) for birth type, weights, fleece attributes, carcass merit, and dam lifetime production. Unfortunately, many times these records are not widely available. Although the heritability of condition of birth is low (single vs. twin vs. triplet), lambing percentage can be increased by selecting for multiple births over time. Of particular importance is the lifetime production of the dam, including number of lambs born per lambing and total weaning weight. Growth traits are typically expressed as weights measured at weaning (60-90 days), 120-days, and at a year of age. Weaning weights are a function of both growth genetics of the lamb and milk production of the dam, whereas post-weaning weights are

primarily a function of differences in individual growth genetics. Selection for growth needs to be in concert with selection for appropriate mature size.

Ewe Selection: In most breeding systems, replacement ewe lambs will be generated from within the flock. Therefore, attention to maternal traits in the rams siring potential replacements is critical. From the existing pool of potential replacements, the following are important considerations for selection:

Ewe lambs should be retained from highly productive dams. Identifying these dams through a record-keeping system is therefore the first step in identifying potential replacements. Dams that lamb early in the lambing season, produce multiple births, and excel in pounds of lamb weaned (reflective of milking ability) are the best candidates to produce replacements. In the absence of such records, identifying maternal potential in ewe lambs based solely on visual appraisal is difficult.

Preference should be given to ewe lambs born early in the lambing season (first 50 days). These ewe lambs are more likely to reach puberty earlier, breed, and lamb early as yearlings-thus keeping the subsequent lambing season short. Older ewe lambs are also more likely to reach target body weight by their first breeding season than young ewe lambs, and this coupled with age enhance their ability to breed as ewe lambs.

Production Records: Production records are important not only for selection, but also as a management tool. Basic performance records start with individual animal identification at birth. Simple records would include birth date, type of birth, and type of rearing. In many instances, individual lambs could be identified as to their dam as well as sire (or perhaps breed of sire in multiple sire breeding groups). These basic records can be very useful to the shepherd in terms of monitoring overall prolificacy of the flock, breed types and crosses within the flock, and individual reproductive performance of ewes. Additionally, the ability to identify an individual ewe and her lambs is an excellent management tool during lactation. More extensive performance records including individual birth and weaning weights of lambs as well as post-weaning growth measures would also be advantageous to commercial flocks. Addition of these records allows for calculation of ewe productivity (total pounds of lamb weaned), and provides the opportunity for more accurate selection for growth traits. To be used properly in selection, all records need to be adjusted to a common basis. Growth measures such as weaning weight need to be adjusted for sex, type of birth/rearing, lamb age, and age of dam. These adjustment factors are readily attainable from several sources, and rather simple to apply.

Finally, collection of performance records enables the shepherd to monitor the rate of progress in the flock. By doing so, proper emphasis can be placed on individual traits with selection and areas can be identified that may be responsive to management changes.

SHEEP FOOT CARE AND TREATMENT

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Sheep foot rot is an infectious, contagious disease of sheep that causes severe lameness and economic loss from decreased flock production. Control and elimination of the disease should be the goal of all sheep producers. Foot rot is caused by an interaction of two anaerobic (without oxygen), Gram (-) bacteria, *Bacteroides nodosus* and *Fusobacterium necrophorum*. *Fusobacterium necrophorum* is a normal inhabitant of the ruminant digestive tract and in wet weather may interact with another bacteria, *Corynebacterium pyogenes,* to produce foot scald, an infection of the skin between the toes. This infection sets up the foot for invasion by *Bacteroides nodosus*, which, working in conjunction with the *Fusobacterium*, produces the condition referred to as foot rot. Since *Bacteroides* can only live in the hoof of an infected animal or in the soil for no more than 10-14 days, it is possible through careful management procedures, to keep from introducing foot rot into a flock and to successfully control and/or eliminate the disease if the flock is infected.

Diagnosis

Lameness is usually the major sign of an infected animal, although sheep with an early infection may not exhibit lameness. The area between the toes first becomes moist and reddened. Then the infection invades the sole of the hoof, undermining and causing separation of the horny tissues. The infection causes a characteristic foul odor and may infect one or more feet at the same time. Not all lame sheep have foot rot. Before undertaking an eradication, treatment, or control program, it is best to consult a veterinarian for a positive diagnosis and advice. Other diseases that may be confused with foot rot are foot abscesses, foot scald, laminitis or founder, corns, traumatic injuries, and foreign bodies lodged between the toes.

Transmission

The bacteria that causes foot rot, *Bacteriodes nodosus*, is spread from infected sheep to the ground, manure, bedding, etc., where it is then picked up by noninfected sheep. Foot rot is introduced by purchase of an infected animal or by simply using facilities or trucks that have been contaminated by infected sheep. Spread occurs best when temperatures are from 40-70°F and the environment is wet. Since the organism doesn't survive long in the environment (< 2 wks), carriers in the flock will continue to reinfect the flock unless the animal is either culled or the organism is eliminated by proper treatment. Warm, wet weather, injury to interdigital skin, and overgrown hooves are predisposing factors. These factors, in combination with the presence of infective bacteria, lead to foot rot in sheep.

Prevention

It is always easier and less expensive to prevent foot rot than to treat it after it has become established. To remain disease free, there are five management principles that will help keep foot rot from being introduced into a clean flock.

1. Never buy sheep with foot rot or from a flock infected with foot rot, even if the animal(s) appear unaffected.

2. Avoid buying sheep at sale yards or livestock markets where clean and infected sheep may have been commingled or run through the same area.

3. Avoid using facilities (trails, corrals, dipping areas) where infected sheep may have been in the last two weeks.

4. Never transport sheep in a vehicle that has not been properly cleaned and disinfected.

5. Trim and treat the feet of all new arrivals, then re-examine them periodically during the 30-day isolation period.

Treatment

The control of foot rot is based on several management practices that decrease predisposing factors, and on the treatment and immunization of infected and susceptible sheep. The best results are obtained when several of the following methods are combined.

1. **Foot trimming**: This reduces the number of cracks and crevices where bacteria can hide, removes infected hoof, and exposes the organism to air and various medications. All affected tissue should be trimmed away. Many times, this involves removing a large portion of the hoof wall as well as the overgrown portion. This is necessary if the medication and oxygen are to reach the bacteria and kill them. Foot trimming should be done at least one to two times per year as a part of normal management practices, and more often in conjunction with footbaths in the control of foot rot. When trimming feet, it is important to disinfect the trimming instruments (foot shear, hoof parer, or knife) between animals to prevent spreading of the infection. During a severe outbreak, trimming without any other treatment may actually increase the severity of the disease.

2. **Footbaths/Footsoaks**: The most common solution commonly used in foot baths is zinc sulfate. For treatment, foot baths should be used 1-2 times per week for several weeks. They may also be used routinely after foot trimming and as a preventative. Zinc sulfate (10% solution = 16 pounds in 20 gallons of water) is perhaps the most effective and least toxic bath solution. Tag wool should be added to all the solutions to reduce splashing and wastage and to discourage consumption by the animal as it stands in the solution. A surfactant or wetting agent (detergent) can also be added to the baths to increase their penetration into the cracks and crevices of the hoof. Use of zinc sulfate or copper sulfate solutions as a foot soak (30-60 minutes of contact) increases their efficacy in a treatment program. When designing the foot bath area, it is important that length of contact with the solution be kept in mind. Sufficient sized baths/soaks are necessary to handle the flock and allow sufficient contact time with the solution.

3. **Dry chemicals**: Zinc sulfate (dry) can be placed in a box in an area sheep must walk through. This will not treat infected animals, but will help decrease the spread of the disease. Lime, disinfectants, or drying agents may be used around feed or water troughs to reduce moisture and decrease the spread of the disease.

4. **Injection of antibiotics**: Penicillin and streptomycin combinations used either as a one-shot treatment (1 ml/8 pounds) or every day up to ten days has been proven to be effective in treating foot rot. Procaine Penicillin G or long-acting penicillin products at the same dosage may also be effective. Single injections of long-acting tetracycline have also been successful in some cases. Use of any of these should be after consultation with or by a veterinarian and should never be used on animals that are intended for slaughter before an adequate withdrawal time.

5. **Topical medications**: There are several different medications that can be applied to the hoof immediately after paring that are helpful in controlling foot rot. Direct application of zinc sulfate solution is an option. Other commercially available topical medications may also be applied.

6. **Vaccination**: Vaccines for *Bacteroides nodosus* are approved for use in the U.S. They may range in effectiveness from 0-100 percent; most users report from 60-80 percent success. The vaccine works not only as a preventative but has been shown to be fairly effective as a treatment. A regimen of two vaccinations given subcutaneously on the neck just behind the ear 4-6 weeks apart is used. Vaccination before the start of the wet season is recommended, followed by a booster each year prior to the wet season if eradication efforts have not been successful. Abscesses are common at the injection site but should not be treated. These will usually break and drain on their own with no ill effects to the sheep. For this reason, vaccination of show animals or animals that may be going to slaughter soon may not be practical. As always, follow label directions carefully. In the eradication protocol, vaccination can be done six weeks prior to the start of the program and the booster can be given when processing is started. This can increase the immunity, and some healing may be taking place by the start of trimming. Some labor savings can be made by doing the first vaccination at the start of the eradication program. Also, there will be savings on vaccine because the clean group will not have to be vaccinated a second time. Discuss this process thoroughly with a veterinarian or an Extension Agent to determine the best approach.

Eradication

Using combinations of these procedures, foot rot can be eradicated. Eradication is difficult and requires commitment but is well worth the effort. Studies have shown eradication is possible using combinations of treatment programs. While no single treatment is highly effective alone, treatment protocols that include foot trimming along with foot bath regiment and vaccination are most effective. It must be a combination of the ones that best fit the facilities, management, and financial limitations of the flock owner/manager.

This overview excerpted from VCE Publication 410-428, "Control, Treatment, and Elimination of Foot Rot From Sheep," available at http://www.ext.vt.edu/pubs/sheep/410-028/410-028.html