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 Garrish, Missouri Grazing Manual

CHARACTERISTICS OF SUCCESSFUL 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
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 endophyte 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

<table>
<thead>
<tr>
<th>Variety</th>
<th>4/30/02</th>
<th>7/12/02</th>
<th>9/11/02</th>
<th>1/14/03</th>
<th>Total 02</th>
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<td>17095</td>
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<td>6001</td>
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<td>4527</td>
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<td>5336</td>
<td>2205</td>
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<td>16136</td>
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<td>4182</td>
<td>2595</td>
<td>1265</td>
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<td>1072</td>
<td>1952</td>
<td>390</td>
<td>625</td>
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Tall Fescue Variety Trial at TAREC

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<th>9/11/04</th>
<th>Total 03</th>
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<td>3640</td>
<td>10804</td>
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<td>KY31 (E+)</td>
<td>5072</td>
<td>2531</td>
<td>3857</td>
<td>10460</td>
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<tr>
<td>KY31 (E-)</td>
<td>5284</td>
<td>1459</td>
<td>3642</td>
<td>10367</td>
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<tr>
<td>Quincy</td>
<td>5841</td>
<td>1655</td>
<td>4147</td>
<td>11643</td>
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<tr>
<td>Potomac</td>
<td>5317</td>
<td>904</td>
<td>1673</td>
<td>7894</td>
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<td>LSD (0.05)</td>
<td>520</td>
<td>325</td>
<td>533</td>
<td>858</td>
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</table>

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

  [Diagram showing stockpiling Cool-Season Grasses from January to December]
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

<table>
<thead>
<tr>
<th>Variety</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
<th>TDN</th>
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<td>12</td>
<td>61</td>
<td>31</td>
<td>59</td>
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<td>Cheyenne</td>
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<td>31</td>
<td>59</td>
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<td>KF-194</td>
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<td>55</td>
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<td>65</td>
</tr>
<tr>
<td>Cd90160</td>
<td>15</td>
<td>54</td>
<td>24</td>
<td>66</td>
</tr>
<tr>
<td>SunGrazer</td>
<td>16</td>
<td>53</td>
<td>24</td>
<td>67</td>
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<tr>
<td>Mohawk</td>
<td>15</td>
<td>55</td>
<td>25</td>
<td>66</td>
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<tr>
<td>Wrangler</td>
<td>16</td>
<td>57</td>
<td>27</td>
<td>63</td>
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<td>LSD (0.05)</td>
<td>1.0</td>
<td>1.5</td>
<td>1.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Persistence: Cold Tolerance

Million dollar question!!!

Spring Green Up-4/18/2003
Selecting a Variety

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

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

Extreme cold will kill all varieties!!!
Materials and Methods

- ‘Wrangler’ bermudagrass sod
- 0 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

- 2003-05
- 467 lb N/A

\[ y = 38.04 + 43.05x - 0.0442x^2 \]
\[ r^2 = 0.80 \ P < 0.001 \]

Nitrogen Profit Maximization

<table>
<thead>
<tr>
<th>Hay Price</th>
<th>Nitrogen price ($/lb)</th>
</tr>
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<tbody>
<tr>
<td>1000</td>
<td>8.30</td>
</tr>
<tr>
<td>2000</td>
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<tr>
<td>3000</td>
<td>6.09</td>
</tr>
<tr>
<td>4000</td>
<td>5.69</td>
</tr>
<tr>
<td>5000</td>
<td>5.29</td>
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</tbody>
</table>

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

First Harvest in 2002 (50 days after seeding)

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

<table>
<thead>
<tr>
<th>Variety</th>
<th>DM Yield</th>
<th>NDF</th>
<th>ADF</th>
<th>CP</th>
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<tbody>
<tr>
<td></td>
<td>BT</td>
<td>SD</td>
<td>BT</td>
<td>SD</td>
</tr>
<tr>
<td>----------------</td>
<td>----------</td>
<td>------</td>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>ton/A</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Trical 336 (T)</td>
<td>3.39</td>
<td>7.95</td>
<td>52</td>
<td>65</td>
</tr>
<tr>
<td>Trical 498 (T)</td>
<td>2.64</td>
<td>6.50</td>
<td>52</td>
<td>65</td>
</tr>
<tr>
<td>Sison (W)</td>
<td>2.76</td>
<td>6.75</td>
<td>50</td>
<td>56</td>
</tr>
<tr>
<td>Jackson (W)</td>
<td>3.24</td>
<td>6.59</td>
<td>52</td>
<td>55</td>
</tr>
<tr>
<td>Roane (W)</td>
<td>3.19</td>
<td>6.36</td>
<td>52</td>
<td>56</td>
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<tr>
<td>Wheeler (R)</td>
<td>3.27</td>
<td>3.94</td>
<td>50</td>
<td>55</td>
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<tr>
<td>Early Grazer (R)</td>
<td>3.02</td>
<td>3.81</td>
<td>46</td>
<td>56</td>
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<td>SS 76-30 (O)</td>
<td>2.20</td>
<td>4.98</td>
<td>48</td>
<td>51</td>
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<tr>
<td>Rodgers (O)</td>
<td>2.18</td>
<td>4.99</td>
<td>47</td>
<td>52</td>
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Annual Ryegrass Varieties 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

<table>
<thead>
<tr>
<th>Variety</th>
<th>4-19-04</th>
<th>5-17-04</th>
<th>7-7-04</th>
<th>Total 2004</th>
<th>Regrowth</th>
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<tbody>
<tr>
<td>Marshall</td>
<td>5328</td>
<td>3664</td>
<td>1972</td>
<td>10964</td>
<td>2.25</td>
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<tr>
<td>Rio</td>
<td>5359</td>
<td>3391</td>
<td>2153</td>
<td>10903</td>
<td>1.75</td>
</tr>
<tr>
<td>Zorro</td>
<td>3849</td>
<td>3343</td>
<td>2849</td>
<td>10041</td>
<td>5.00</td>
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<tr>
<td>Passerel Plus</td>
<td>4588</td>
<td>3426</td>
<td>1473</td>
<td>9487</td>
<td>2.75</td>
</tr>
<tr>
<td>Domino</td>
<td>3559</td>
<td>3350</td>
<td>2457</td>
<td>9366</td>
<td>5.00</td>
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<tr>
<td>Surrey II</td>
<td>4411</td>
<td>3278</td>
<td>1630</td>
<td>9320</td>
<td>1.75</td>
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<td>Big Daddy</td>
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<td>823</td>
<td>661</td>
<td>641</td>
<td>1141</td>
<td>0.94</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Legume</th>
<th>%N Fixed</th>
<th>Value of Fixed N/TL/A (lb)</th>
<th>Value of End N/TL/A (lb)</th>
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<tbody>
<tr>
<td>Alfalfa</td>
<td>15-25%</td>
<td>85-160</td>
<td>90-180</td>
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<tr>
<td>Red Clover</td>
<td>15-35%</td>
<td>60-90</td>
<td>45-120</td>
</tr>
<tr>
<td>Ladino Clover</td>
<td>30-40%</td>
<td>50-80</td>
<td>45-65</td>
</tr>
<tr>
<td>Annual</td>
<td>15-45%</td>
<td>25-80</td>
<td>35-90</td>
</tr>
</tbody>
</table>

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

Southern Piedmont AREC Field Day
First Week in August

• Year-round grazing requires management
BUILDING A GRAZING SYSTEM FOR SMALL RUMINANT PRODUCTION

Chris D. Teutsch and S. Ray Smith
Southern Piedmont AREC and University of Kentucky
cdeutsch@vt.edu or 434 292-5331

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 maintenance 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.

![Diagram of growth curves of cool and warm-season grasses.]

**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 possesses 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>
<thead>
<tr>
<th>Grass Species</th>
<th>Life cycle</th>
<th>Heat &amp; drought</th>
<th>Wet soils</th>
<th>Grazing</th>
<th>Soil acidity</th>
<th>Seedling vigor</th>
<th>Sod forming ability</th>
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<tr>
<td>Tall Fescue E+</td>
<td>CSPb</td>
<td>Ee</td>
<td>G</td>
<td>E</td>
<td>G</td>
<td>G</td>
<td>G</td>
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<tr>
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<td>F</td>
<td>G</td>
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<td>G</td>
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<td>P</td>
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<td>F</td>
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<td>F</td>
<td>E</td>
<td>F</td>
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<td>P</td>
<td>F</td>
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<tr>
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<td>CSP</td>
<td>G</td>
<td>E</td>
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<td>E</td>
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<td>P</td>
<td>E</td>
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<td>P</td>
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<td>F</td>
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<td>F</td>
<td>G</td>
<td>G</td>
<td>P</td>
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<td>P</td>
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<td>P</td>
<td>E</td>
<td>E</td>
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<td>G</td>
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<td>Pearl Millet</td>
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<td>P</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>P</td>
</tr>
<tr>
<td>Sorghum</td>
<td>SA</td>
<td>E</td>
<td>P</td>
<td>F</td>
<td>P</td>
<td>G</td>
<td>P</td>
</tr>
<tr>
<td>Sorghum-Sudan</td>
<td>SA</td>
<td>E</td>
<td>P</td>
<td>F</td>
<td>P</td>
<td>G</td>
<td>P</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>CSP</td>
<td>E</td>
<td>P</td>
<td>P-G</td>
<td>P</td>
<td>G</td>
<td>P</td>
</tr>
<tr>
<td>Birdsfoot Trefoil</td>
<td>CSP</td>
<td>G</td>
<td>G</td>
<td>F</td>
<td>G</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Red Clover</td>
<td>CSP</td>
<td>G</td>
<td>F</td>
<td>G</td>
<td>F</td>
<td>E</td>
<td>P</td>
</tr>
<tr>
<td>Sericea Lespedeza</td>
<td>WSP</td>
<td>E</td>
<td>F</td>
<td>F-G</td>
<td>E</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>White Clover</td>
<td>CSP</td>
<td>P</td>
<td>G</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>G</td>
</tr>
<tr>
<td>Annual Lespedeza</td>
<td>WSA</td>
<td>G</td>
<td>F</td>
<td>G</td>
<td>E</td>
<td>F</td>
<td>P</td>
</tr>
</tbody>
</table>

Information was adapted from Southern Forages Third Edition, 2002.

CSP = cool-season perennial, WA = winter annual, WSP = warm-season perennial, SA = summer annual

E = excellent, G = good, F = fair, P = poor

Perennial ryegrass (*Lolium perenne*), smooth bromeagrass (*Bromos inermis*), prairie bromeagrass (*Brómos Willdenovii*) 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.

<table>
<thead>
<tr>
<th>Legume Species</th>
<th>N Fixed</th>
<th>Value of Fixed Nitrogen ($/A/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb/A/year</td>
<td>N cost=$0.40/lb</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>150-250</td>
<td>60-100</td>
</tr>
<tr>
<td>Red Clover</td>
<td>75-200</td>
<td>30-80</td>
</tr>
<tr>
<td>Ladino Clover</td>
<td>75-150</td>
<td>30-60</td>
</tr>
<tr>
<td>Annual Lespedeza</td>
<td>50-150</td>
<td>20-60</td>
</tr>
</tbody>
</table>

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*) is 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 lespezea is well established. Like alfalfa, this species must be rotationally grazed to be persistent.

**Annual lespezeas (Kummerowia stipulacea and Kummerowia striata)** are summer-annual legumes that are well adapted to Virginia. In the past, annual lespezea 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 fertilizer 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 maintenance 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)** is 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 oleracea*), **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.