Planning Forage Systems

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and
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University of Georgia
Pasture-based Systems often appear Complex
Concepts

- Simple... Allows owner to manage and grow scale
- Repeatable... Must work across a wide variety of conditions
- Profitable... Have to make $ to remain in business
Production Planning

- A pretty ordinary thing in successful business models
Key Factors for Managing Forage Systems

- Understand what nutrients your cows need and when they need them
  - Calving season of most importance
- Select forages that fit your climate, soils, calving season
  - Prepare a pasture growth budget
  - Develop plans for forage growth deficits and excesses
  - Monitor production frequently
- Optimize quality by grazing management
  - Turn in at ~2750 lb/acre for most species
  - Turn out at ~1150 lb/acre for most species
Monthly Dry Matter Demand

100 cow herd – 1,200 lb cows – 13,000 lb milk/cow/yr

15 Feb. Calving
15 Sept. Calving

Calve all the time
Cool Season Grasses

Forage Growth Rate

Feb  Apr  Jun  Aug  Oct  Dec

Perennial Ryegrass

Tall Fescue
Perennial Ryegrass

- Medium to high yield potential
- Fair to poor persistence (2 to 4 yrs.)
- Fair tolerance to:
  - poor drainage
  - low soil fertility
- Poor tolerance to:
  - drought
  - heat stress
  - cold temperatures
- Forage quality good to excellent if managed
**Tall Fescue**

- Medium to high yield potential
- Medium persistence
- Good tolerance to:
  - cold temperatures
  - poor drainage
- Fair tolerance to:
  - low soil fertility
  - drought
  - heat stress
- Good forage quality if using a cultivar with a beneficial endophyte or no endophyte
Milk Production from Tall Fescue

<table>
<thead>
<tr>
<th>Type</th>
<th>Intake</th>
<th>Milk Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>KY 31 Infected</td>
<td>15.6</td>
<td>34.3</td>
</tr>
<tr>
<td>KY 31 Uninfected</td>
<td>20.0</td>
<td>43.1</td>
</tr>
</tbody>
</table>

Strahan et al., 1987
# Cool-Season Grasses: Species or Management?

Summary of five studies

<table>
<thead>
<tr>
<th>Type</th>
<th>Initial Height - 6-10</th>
<th>Initial Height - 12-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Fescue (EF)</td>
<td>58.0</td>
<td>42.4</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>58.2</td>
<td>43.2</td>
</tr>
<tr>
<td>Perennial Ryegrass</td>
<td>59.2</td>
<td>44.5</td>
</tr>
</tbody>
</table>
Cool Season Grass with Legumes

Forage Yield

Feb Apr Jun Aug Oct Dec

Cool season grass
Red Clover
White Clover
Cool Season Grass with Alfalfa
The Benefit of Legumes in Grass Pastures

- **Orchardgrass**
- **Orchardgrass + Clover**

Graph showing composition:
- **lb milk/day**
- Months from Mar to Nov
Cool-season Grasses & Legumes: Grazing Management
Allocation of Pasture for Dairy Cattle

![Graph showing milk production and pasture allocation for dairy cattle across April to August.]
Pasture Budgeting

• What do you expect from your pasture?
  - When do you expect to get it?
  - How do you plan to deal with deficits in forage production?
  - How are you going to deal with excess forage production?
### Perennial Ryegrass/ Clover

#### Monthly Forage Balance

<table>
<thead>
<tr>
<th></th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ryegrass/Clover</td>
<td>4</td>
<td>97</td>
<td>168</td>
<td>86</td>
<td>39</td>
<td>11</td>
<td>51</td>
<td>33</td>
</tr>
<tr>
<td>Surplus/Deficit</td>
<td><strong>-45</strong></td>
<td><strong>43</strong></td>
<td><strong>101</strong></td>
<td><strong>16</strong></td>
<td><strong>-28</strong></td>
<td><strong>-52</strong></td>
<td><strong>-10</strong></td>
<td><strong>-25</strong></td>
</tr>
</tbody>
</table>

- **Perennial ryegrass/clover** – 100 acres
  - 5 t/a
- Stocking rate: 100 milking cows on 100 acres
- 15 Feb calving
- 10 lb grain/day
- 13,000 lb annual milk

Forage balance = 1 tons
Excess to be harvested = 160 tons
Excess to be fed back = 159 tons
# Tall fescue (non-toxic)/ Clover

<table>
<thead>
<tr>
<th>Monthly Forage Balance</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall fescue/clover</td>
<td>9</td>
<td>78</td>
<td>167</td>
<td>114</td>
<td>61</td>
<td>11</td>
<td>67</td>
<td>75</td>
</tr>
<tr>
<td>Forage Needed by Herd</td>
<td>49</td>
<td>54</td>
<td>67</td>
<td>70</td>
<td>67</td>
<td>63</td>
<td>61</td>
<td>58</td>
</tr>
<tr>
<td>Forage Surplus/Deficit</td>
<td>-40</td>
<td>24</td>
<td>100</td>
<td>44</td>
<td>-6</td>
<td>-52</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>

- Tall fescue/clover – 100 acres – 6.0 t/a
- Stocking rate: 100 milking cows on 100 acres
- 15 Feb calving
- 10 lb grain/day
- 13,000 lb annual milk

Forage balance = 93 tons
Excess to be harvested = 191 tons
Excess to be fed back = 98 tons
Nitrogen for Cool-season grasses

Forage Yield

April
June
August
October

Mostly Unneeded
Likely Profitable
**Tall fescue (non-toxic)/ Clover + 60 lb N/ acre in Early Spring**

<table>
<thead>
<tr>
<th>Monthly Forage Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Tall fescue/clover</td>
</tr>
<tr>
<td>Forage Needed by Herd</td>
</tr>
<tr>
<td>Forage Surplus/Deficit</td>
</tr>
</tbody>
</table>

- Tall fescue/clover – 100 acres – 7.0 t/a
- Stocking rate: 100 milking cows on 100 acres
- 15 Feb calving
- 10 lb grain/day
- 13,000 lb annual milk

*Forage balance = 206 tons
Excess to be harvested = 292 tons
Excess to be fed back = 89 tons*
Tall fescue (non-toxic)/Clover + 60 lb N/acre in August

<table>
<thead>
<tr>
<th>Monthly Forage Balance</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tall fescue/clover</td>
<td>12</td>
<td>78</td>
<td>166</td>
<td>114</td>
<td>68</td>
<td>31</td>
<td>128</td>
<td>93</td>
</tr>
<tr>
<td>Forage Needed by Herd</td>
<td>49</td>
<td>54</td>
<td>67</td>
<td>70</td>
<td>67</td>
<td>63</td>
<td>61</td>
<td>58</td>
</tr>
<tr>
<td>Forage Surplus/Deficit</td>
<td>-37</td>
<td>24</td>
<td>99</td>
<td>44</td>
<td>1</td>
<td>-32</td>
<td>67</td>
<td>35</td>
</tr>
</tbody>
</table>

Forage balance = 201 tons
Excess to be harvested = 268 tons
Excess to be fed back = 69 tons

- Tall fescue/clover – 100 acres – 6.7 t/a
- Stocking rate: 100 milking cows on 100 acres
- 15 Feb calving
- 10 lb grain/day
- 13,000 lb annual milk
Monthly Dry Matter Demand

100 cow herd – 1,200 lb cows – 13,000 lb milk/cow/yr

Jan Feb Mar April May Jun July Aug Sept Oct Nov Dec

1 Jan. Calving

15 Oct. Calving
Forage Distribution in the Southeast

Cool season Annual grass

Cool season Perennial grass

Forage Yield

Feb Apr Jun Aug Oct Dec
<table>
<thead>
<tr>
<th>Species</th>
<th>Crude Protein</th>
<th>NEL</th>
<th>Annual Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Mcal/lb</td>
<td>lbs DM/acre</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>10-30</td>
<td>0.52-0.80</td>
<td>11,000</td>
</tr>
<tr>
<td>Oats</td>
<td>8-28</td>
<td>0.50-0.75</td>
<td>6,000</td>
</tr>
<tr>
<td>Wheat</td>
<td>8-28</td>
<td>0.50-0.75</td>
<td>6,000</td>
</tr>
<tr>
<td>Rye</td>
<td>8-28</td>
<td>0.48-0.72</td>
<td>6,500</td>
</tr>
<tr>
<td>Arrowleaf</td>
<td>12-30</td>
<td>0.60-0.80</td>
<td>3,500</td>
</tr>
<tr>
<td>Crimson</td>
<td>12-30</td>
<td>0.60-0.80</td>
<td>3,500</td>
</tr>
</tbody>
</table>

Quality ranges approximate the typical values and are highly dependant upon forage maturity at grazing/harvest. Yields are approximate based on 3-yr averages from GA (grasses and legumes) and AL (legumes).
Winter Annual Grasses Differ in Forage Distribution

Contingent on Early Planting Date and Weather
Lesson Learned on Mixing Grass Species:
Yield is less than average of the two (not additive)
The distribution of growth is as wide as both.
Different Planting Arrangements

Pasture Cover (lbs/A)

- Ryegrass
- Rye/RG mix, alternating rows
- Rye/RG planted sep

Dates: 17-Jan, 6-Feb, 26-Feb, 18-Mar, 7-Apr, 27-Apr, 17-May
Perennial Ryegrass

- Blade (or leaf)
- Ligule
- Collar
- Leaf Sheath
- Stem
- Crown
- Tiller
- Roots

Primordium

Reproductive Shoot

For WS Grasses:
Most shoots are reproductive shoots
Differences in Growth

Relative Forage Yield vs. Days of Growth for:
- Sorghum x Sudan
- Typical T85 bermudagrass
- Weakened Bermudagrass
Forage Distribution in the Southeast

Forage Yield

Cool season Annual grass

Bermudagrass

Feb  Apr  Jun  Aug  Oct  Dec
## Differences in Forage Quality

<table>
<thead>
<tr>
<th>Forage</th>
<th>CP (%)</th>
<th>NE&lt;sub&gt;L&lt;/sub&gt; (Mcal/ lb)</th>
<th>NE&lt;sub&gt;L&lt;/sub&gt; (Mcal/ kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>25.6</td>
<td>0.73</td>
<td>1.61</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>18.2</td>
<td>0.66</td>
<td>1.46</td>
</tr>
<tr>
<td>Rye</td>
<td>24.4</td>
<td>0.80</td>
<td>1.76</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>29.2</td>
<td>0.78</td>
<td>1.73</td>
</tr>
<tr>
<td>Sorghum-Sudan</td>
<td>19.2</td>
<td>0.64</td>
<td>1.40</td>
</tr>
<tr>
<td>Alfalfa baleage</td>
<td>19.6</td>
<td>0.67</td>
<td>1.47</td>
</tr>
<tr>
<td>Alfalfa haylage</td>
<td>20.9</td>
<td>0.59</td>
<td>1.31</td>
</tr>
<tr>
<td>Corn silage</td>
<td>7.1</td>
<td>0.72</td>
<td>1.59</td>
</tr>
</tbody>
</table>

White et al., 2002 J. Dairy Sci. 85:95-104
Bermudagrass

- Common (seeded)
- Hybrids (sprigged)
  - Tifton (USDA-ARS & UGA)
- Typically very drought tolerant
- Aggressive and persistent
- Requires high fertility
Bermudagrass

- Not tolerant of shade or poorly-drained soils.

- Varieties differ:
  - Yield
  - Digestibility
  - Vigor during establishment
  - Rest requirement ("length of round")
  - Drying rate (hay)
Tifton 85
(hybrid of *C. dactylon* and *C. nlemfuensis*)
What is the difference in Coastal and Tifton 85?

Adapted from Mandebvu et al. (1999).
<table>
<thead>
<tr>
<th>Month</th>
<th>Rye/Ryegrass mix</th>
<th>Tifton-85</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DM (lb/A)</td>
<td>ME (kcal/lb)</td>
</tr>
<tr>
<td>Jan</td>
<td>463</td>
<td>1.19</td>
</tr>
<tr>
<td>Feb</td>
<td>956</td>
<td>1.20</td>
</tr>
<tr>
<td>Mar</td>
<td>2484</td>
<td>1.15</td>
</tr>
<tr>
<td>Apr</td>
<td>3606</td>
<td>1.14</td>
</tr>
<tr>
<td>May</td>
<td>1484</td>
<td>1.06</td>
</tr>
<tr>
<td>June</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>1203</td>
<td>1.24</td>
</tr>
<tr>
<td>Dec</td>
<td>1000</td>
<td>1.20</td>
</tr>
</tbody>
</table>
Forage Production and Demand Curves for a 650-Cow Dairy on 300 Acres

- Red line: cow requirements
- Yellow line: Forage production

Month of the Year:
- January (J)
- February (F)
- March (M)
- April (A)
- May (M)
- June (J)
- July (J)
- August (A)
- September (S)
- October (O)
- November (N)
- December (D)

Forage production (needs) vs. Total DM (lbs) from J to D:
- January: Low production, high demand
- February: Low production, high demand
- March: High production, high demand
- April: High production, high demand
- May: Low production, low demand
- June: Low production, low demand
- July: High production, high demand
- August: High production, high demand
- September: Low production, low demand
- October: Low production, low demand
- November: Low production, low demand
- December: Low production, low demand

Calving events indicated by upward arrows.

Forage production requirements: 40,000 lbs

Note: Graphical representation for better understanding of forage production and demand trends.
Forage Distribution in the Southeast

- Cool season Annual grass
- Bermudagrass
- Crabgrass
- P. Millet/ Sudex

Forage Yield

Feb  Apr  Jun  Aug  Oct  Dec
Warm Season Annual Grasses

Sorghum x sudangrass hybrid

Pearl Millet
Sorghum x sudan

- Highest yield potential
- High quality
  - Brown mid-rib (BMR) hybrids
- Harder to manage under grazing
Sorghum x sudan

Sorghum x sudangrass hybrid, second round. Difficulties getting a wedge in front of them.
Axillary bud regrowth in sorghum x sudangrass.
Pearl Millet

- More productive in drought conditions
- Can develop toxic nitrate levels
- No prussic acid toxicity concerns
- Less palatable
- Easier to manage under grazing
  - Irrigated pasture
Basal bud “tillering” in pearl millet.
Crabgrass
## Crabgrass

<table>
<thead>
<tr>
<th>Item</th>
<th>Harvest interval, days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Yield, dry lbs/ac</td>
<td>2,610</td>
</tr>
<tr>
<td>% DM</td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>15.6</td>
</tr>
<tr>
<td>NDF</td>
<td>61.3</td>
</tr>
<tr>
<td>ADF</td>
<td>35.7</td>
</tr>
<tr>
<td>TDN</td>
<td>62.6</td>
</tr>
</tbody>
</table>

Common crabgrass; Hay harvest residual height = ~2 inches; Regrowth after early July cutting.
A Simple System in the Transition Zone

- Tall Fescue
- Clover
- Crabgrass
- Cereal Rye

Forage Yield

Feb Apr Jun Aug Oct Dec
50% Tall Fescue/clover
50% Crabgrass - Cereal Rye

<table>
<thead>
<tr>
<th>Monthly Forage Balance</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Fescue/clover</td>
<td>4</td>
<td>39</td>
<td>83</td>
<td>57</td>
<td>31</td>
<td>6</td>
<td>34</td>
<td>38</td>
</tr>
<tr>
<td>Crabgrass - Cereal rye</td>
<td>51</td>
<td>45</td>
<td>0</td>
<td>45</td>
<td>66</td>
<td>54</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Forage Needed by Herd</td>
<td>49</td>
<td>54</td>
<td>67</td>
<td>70</td>
<td>67</td>
<td>63</td>
<td>61</td>
<td>58</td>
</tr>
<tr>
<td>Forage Surplus/Deficit</td>
<td>6</td>
<td>30</td>
<td>16</td>
<td>32</td>
<td>30</td>
<td>-3</td>
<td>-12</td>
<td>-6</td>
</tr>
</tbody>
</table>

- Tall fescue/clover – 50 acres – 6.0 t/a
- Crabgrass interseeded with rye in fall – 6.0 t/a
- Stocking rate: 100 milking cows on 100 acres
- 15 Feb calving
- 10 lb grain/day
- 13,000 lb annual milk

Forage balance = 93 tons
Excess to be harvested = 114 tons
Excess to be fed back = 21 tons
Monitoring pasture growth

- We often have little idea of how much feed we have or what might be coming.
- Monitoring forage in the pasture can help us make better decisions about fertilizer, supplements, renovations and stocking rates.
Pasture Monitoring Website

http://plantsci.missouri.edu/grazingwedge/
Report

Graph of current DM yield available in each paddock
Paddocks in red bars indicate that forage is too mature
Paddocks in green are ideal for grazing
Yellow bars indicate paddocks that are overgrazed

Estimated growth rate

Estimated DM yield on offer when stock are turned into a paddock

Estimated DM yield left when stock leave a paddock

Table of DM yield for each paddock
How I use it

If possible, I would mechanically harvest those paddocks in red

I would move stock to the paddock with the tallest green bar for grazing

I would shorten my rotation to avoid “yellow” paddocks

I use the “growth rate” calculation to roughly predict the future.

At growth rates over 75 lb/acre/day, I would not fertilize or encourage growth.

If I have a lot of green bars almost ready for grazing this week, I can bet that next week I’ll have too much forage.
Examining “Wedges”

Growth rate is limiting factor here

At current usage, forage will run out if growth rate does not improve

Options:
- Feed more supplements
- Decrease stocking rate
- Fertilize to improve growth rate

Growth rate is 33 lb/a/day
Autumn growth

Many paddocks available for grazing but rotation length will be short

Growth rate low, but unlikely to improve much due to time of year

Options:
- Graze what you can but it won’t last long
- Consider giving lactating livestock priority access to pasture
- Could increase supplements if you want to continue on pasture

Growth rate is 16 lb/a/day
What do you do about this?

Too much forage – If some paddocks are not harvested then all of the forage in the system will be of low quality.

Options:
- Harvest paddocks in red
- Graze the paddock with the tallest green bar
- Reduce or eliminate supplements so that stock will harvest forage

Growth rate is 63 lb/a/day
Monitor Pasture Growth

• Look at the entire system weekly
  - Does pasture growth meet your expectations?
  - How do current weather forecasts alter growth for the next week to two weeks?
  - How has your system responded historically at this time of year?
Key Factors for Managing Forage Systems

- Understand what nutrients your cows need and when they need them
  - Calving season of most importance
- Select forages that fit your climate, soils, calving season
  - Prepare a pasture growth budget
  - Develop plans for forage growth deficits and excesses
  - Monitor production frequently
- Optimize quality by grazing management
  - Turn in at ~2750 lb/acre for most species
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