Improving the Viability of Dairy Farms Through Advanced Forage Selection and Management

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Introduction
Over the last several years conventional dairy farms have been struggling to stay afloat because of severely depressed milk prices and increasing input costs. Dairy producers are interested in feeding high forage rations to improve herd health and reduce feed costs. The mission of the Dairy Center of Excellence (DCE) is to create research partnerships between UVM and local farms, with the goal of increasing the economic viability of Vermont agriculture. This project proposes to focus on several areas outlined by the DCE, USDA NIFA as well as local farms that will increase farm viability through animal nutrition and health maintenance, and forage research. The long term goal of this project is to improve the economic sustainability of Vermont dairy producers by reducing their reliance on or enhancing their utilization of purchased concentrates accomplished through the selection and production of genetically superior forage germplasm.

Background
Farm grown forages are the backbone of all Vermont dairy farms and perennial cool season grasses grow exceptionally well in our climate. Genetic variation among forage species and varietal selection within a specie has been shown to impact fiber content of feed. Fiber digestibility, a relatively new means to measure quality, has not been evaluated on forage material extensively (Hoffman, 2003). This quality trait alone may be limiting our dairy producers in the amount of forage that can be fed (Oba, 1999). Many research projects have documented that improved fiber digestibility can increase milk production and lower the amount of concentrate fed. Species variation in NDF and digestible NDF was documented in a Vermont study conducted in 2002 and 2003 evaluating changes in fiber content of cool season grasses during the first growth (Bosworth et. al., 2005). Across two locations and two years, we generally found orchardgrass to have higher digestible NDF as compared to reed canarygrass or timothy even though total NDF was typically higher for the orchardgrass since it matures more rapidly than the other grasses. However, there have been no studies under Vermont conditions to evaluate variation in fiber content and digestibility of the Lolium / Festuca group of grasses.

Objectives

- Determine genetic differences in fiber content and digestibility of five cool season grass species managed for high quality.
- Evaluate fiber content and fiber digestibility variation from harvest timing and environment.
- Evaluate prediction models for better determining optimum harvest strategies.
Methodology

A field study at two locations was planted in August 2011 at the Borderview Farm in Alburgh (Partner Farm through the DCE), and UVM Miller Farm in South Burlington. The experimental design was be a nested design with five replications. Main effect (whole plot) treatments include five grass species

- Late-maturing orchardgrass (*Dactylis glomerata*)
- Tall fescue (*Schedonorus phoenix*)
- Festulolium (*Lolium X Schedonorus*)
- Meadow fescue (*Schedonorus pratensis*)
- Perennial ryegrass (*Lolium perenne*)

Sub treatments include five cultivars for each grass specie, randomly arranged within each whole plot. Cultivar selection was based on recommendations from grass breeding programs at Cornell and the University Of Wisconsin as well as from commercial grass breeders.

Plots were fertilized with a total of 150 to 200 lbs. of N/acre/year split three times applied at first green up and after the first and second harvest. In 2013, plots were also fertilized with P and K to assure adequate soil test levels. Plots were harvested four times in 2012 and three times 2013 and 2014, respectively, using a Carter small plot harvester and/or hand clippers with a quadrat to a stubble height of 3 inches.

Measurements included sward height, dry matter yield and forage quality (NDF, NDFd, ADF, CP). Prior to each hay harvest, two quadrat samples were collected from each plot when the grasses reached approximately 10 inches in height. These were used to determine the rate of change in quality as each grass developed. Diseases were rated one to two times per year.

Results

Yield and Persistence

There was no consistency in superior yield performance amongst cultivars or species across locations and years (Table 1). In 2012, the first full production year, tall fescue had a significantly higher yield at the South Burlington location which is on a well-drained sandy loam soil, whereas, orchardgrass yielded the highest at the Alburgh site, a gravely loam soil. Again, tall fescue had a higher yield in 2013 in South Burlington but was lower the following year. Meadow fescue was intermediate in yield at both locations across years. Although festulolium yielded well in the first year, it had severe winter injury in 2013 such that it was no longer evaluated after 2012. Perennial ryegrass had the poorest yield in 2012 but was also not evaluated in later years due to winter injury that severely set back the stand.
Table 1. Total seasonal dry matter yields averaged across the five cultivars for each respective grass species at the two locations.

<table>
<thead>
<tr>
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<th>2013</th>
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<th>2014</th>
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<td></td>
<td>S. Burlington</td>
<td>lbs. dm/a</td>
<td>Alburgh</td>
<td>lbs. dm/a</td>
<td>S. Burlington</td>
<td>lbs. dm/a</td>
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<tr>
<td>Tall Fescue</td>
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<td>3.7 b</td>
<td>3.1 a</td>
<td>2.6 a</td>
<td>3.0 b</td>
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<td>2.4 a</td>
<td>2.7 c</td>
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<td>4.3 a</td>
<td>2.2 b</td>
<td>2.4 a</td>
<td>3.3 a</td>
<td></td>
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<tr>
<td>Perennial Ryegrass</td>
<td>4.0 c</td>
<td>3.4 c</td>
<td>**</td>
<td>**</td>
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<td></td>
</tr>
<tr>
<td>Festulolium</td>
<td>5.1 b</td>
<td>3.6 bc</td>
<td>**</td>
<td>**</td>
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<tr>
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<td>3</td>
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* means with the same letters are not significantly different

** severely winter injured in 2013

Quality

In 2014, plots were sampled using quadrats at two to three points in time for each growth period starting when the grass sward was approximately 10 inches tall and sampling until anticipated harvest time (boot stage in the first cut), Figures 1 and 2. As expected, total fiber (NDF) increased and NDF digestibility decreased as grasses matured. The three grasses had similar rates of change in the first growth period; however, meadow fescue was about 5 days delayed compared to tall fescue or orchardgrass at the Hort farm site (Fig. 1) but similar at Borderview (Fig. 2). In aftermath harvests, tall fescue was lower in NDF digestibility compared to meadow

Figure 1. Changes in neutral detergent fiber (NDF) and NDF digestibility (48 hour) of three grasses (OG – orchardgrass, TF – tall fescue, MF – meadow fescue) during three growth periods in 2014 at the Horticulture Research Farm. Note – these are averages of four replications and five cultivars for each grass species.
fescue and differences with orchardgrass was not always consistent. Overall, meadow fescue was consistently higher in NDF digestibility relative to the other grasses when sampled at the same time. Generally, the rate of decline was similar amongst grasses.

**Figure 2.** Changes in neutral detergent fiber (NDF) and NDF digestibility (48 hour) of three grasses (OG – orchardgrass, TF – tall fescue, MF – meadow fescue) during three growth periods in 2014 at the Borderview Research Farm. Note – these are averages of four replications and five cultivars for each grass specie.

There were no differences in NDF or NDFd among cultivars for either tall fescue or meadow fescue. However, ‘Athos’ orchardgrass, which matured later than the other cultivars, did have a delay in NDF accumulation and decline in NDF digestibility in the first two cuts compared to the other four cultivars (Figure 3) giving it a wider window for harvesting a high quality forage.

**Figure 3.** Changes in neutral detergent fiber (NDF) and NDF digestibility (48 hour) of five cultivars of orchardgrass during three growth periods in 2014 at the Horticulture Research Farm. Note – these are averages of four replications for each cultivar.
Conclusions

Overall, meadow fescue showed a delay in fiber accumulation and a higher fiber digestibility compared to tall fescue and sometimes compared to orchardgrass. Generally, there were more differences in fiber accumulation and fiber digestibility between grass species than amongst cultivars of the same species. The one exception was ‘Athos’ orchardgrass which clearly had a delay in fiber accumulation resulting in higher NDF digestibility when compared at the same target harvest dates. However, the rate of decline in fiber digestibility was similar across species and cultivars; therefore, timing of harvest would still be critical to achieve high quality but the delayed cultivars can provide a wider opportunity to harvest in a timely manner and/or be more compatible when grown with a legume.

Citations

