Evaluation of Teff as a Forage Crop in New York

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Creative Component for Master of Science of Agronomy Program at Iowa State University

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What is Teff?

• Teff (*Eragrostis tef.*) warm season annual cereal grass native to Ethiopia
• Fine stemmed tufted grass 11 to 47 inches tall
• Fibrous, shallow and massive root system
• About 1.25 million seeds per pound
More about Teff

• In its native habitat, maximum production occurs with a growing season rainfall of 17 to 22” and temperature range of 50 to 85°F

• Adapted to drought stressed to waterlogged soil conditions
Teff History

• Primarily grown as a cereal crop in Ethiopia
• Can be grown for forage or pasture
• Teff flour is used for a flat bread called Injera
• Also used as an ingredient in home-brewed alcoholic drinks
• The straw is preferred binding material for walls, bricks and clay containers
Where does teff fit in NY?

- Following winter cereal forage, straw or grain crop or spring cereal forage crop
- Emergency hay, pasture or silage crop
- Summer annual cover crop
- Rotation break crop when renovating a perennial grass or alfalfa stand or pasture
- Stand alone annual hay crop for market
Teff Stand Establishment

- Seed with grain drill or cultipacker seeder
- Emerges from the soil quickly 3 to 4 days with a fine, firm seedbed
- Current seeding rate recommendation is 4 to 5 pounds per acre
  - This may need to be adjusted in the future based on a 2007 Cornell University study
2007 NY Seeding Rate Study

- Two teff varieties planted at 3, 6, and 9 lbs/acre with 6 replicates each
- No varietal differences detected among different seeding rates
### Seeding rate influence on DM yield for each cutting

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seed Rate (lbs/ac)</th>
<th>Cutting 1 (t/ac)</th>
<th>Cutting 2 (t/ac)</th>
<th>Cutting 3 (t/ac)</th>
<th>Season Total (t/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>1.22b</td>
<td>1.69a</td>
<td>1.74c</td>
<td>4.65c</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1.44a</td>
<td>1.61a</td>
<td>1.95b</td>
<td>5.00b</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>1.45a</td>
<td>1.64a</td>
<td>2.04a</td>
<td>5.13a</td>
</tr>
</tbody>
</table>

Means within a column followed by different letters are different by LSD (0.05) (Cherney, 2008)
Teff Harvest Management

- Forage can be harvested in 50 days or less from planting and another 40 to 45 days between subsequent cuttings
- Cutting height of 3 to 4 inches necessary to promote vigorous regrowth
- Mows easily with sickle or disc type mower conditioners
## 2007 Harvest Intervals

<table>
<thead>
<tr>
<th>Location</th>
<th>Plant to 1&lt;sup&gt;st&lt;/sup&gt; (days)</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; to 2&lt;sup&gt;nd&lt;/sup&gt; (days)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; to 3&lt;sup&gt;rd&lt;/sup&gt; (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Lawrence</td>
<td>48</td>
<td>35</td>
<td>49</td>
</tr>
<tr>
<td>Tompkins</td>
<td>52</td>
<td>23</td>
<td>42</td>
</tr>
<tr>
<td>Columbia</td>
<td>57</td>
<td>17</td>
<td>---</td>
</tr>
<tr>
<td>Jefferson</td>
<td>60</td>
<td>66</td>
<td>---</td>
</tr>
</tbody>
</table>
Why the differences between 1\textsuperscript{st} and 2\textsuperscript{nd} cutting intervals?

<table>
<thead>
<tr>
<th>Location</th>
<th>Harvest dates</th>
<th>Cutting interval</th>
<th>Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Lawrence</td>
<td>7/17 to 8/21</td>
<td>35</td>
<td>2.66”</td>
</tr>
<tr>
<td>Tompkins</td>
<td>7/17 to 8/09</td>
<td>23</td>
<td>3.40”</td>
</tr>
<tr>
<td>Columbia</td>
<td>8/3 to 8/20</td>
<td>17</td>
<td>1.66”</td>
</tr>
<tr>
<td>Jefferson</td>
<td>7/31 to 10/04</td>
<td>66</td>
<td>2.78”</td>
</tr>
</tbody>
</table>
Teff Forage Quality

- With timely harvest and proper N rate
  - Expected Crude Protein will be between 15 to 16% of DM
    - NDF 64.2%*
    - NDFD 48 hr 69.3%*

*Based on 263 forage samples
Fertilizer Recommendations

- Apply P and K similar to perennial cool season grass establishment
- Response to N is limited
- Apply ~50 lbs actual N/Ac
  - NY data is consistent with Oregon State University, Montana State University and University of Kentucky
- Lodging is a problem with higher N rates
- Can be grown with manure alone
2006 N Rate Influence on Yield

2006 Trial Locations - Single Cut

Nitrogen Rate (lbs N/acre)

Yield (tons DM/acre)

0 50 75 100

b a a a
2007 N Rate Influence on Yield

2007 Nitrogen Trial - Locations with Two Cuts

Yield (tons DM/acre)

Nitrogen Rate (lbs N/acre)

First Cut  Second Cut

0  0  0  0
50 50 50 50
75 75 75 75
100 100 100 100

Values followed by the same letter do not differ significantly at the 0.05 level of probability.
2007 N Rate Influence on Yield

2007 Nitrogen Trial-Locations with Three Cuts

Yield (tons DM/acre)

Nitrogen Rate (lbs N/acre)

First Cut
Second Cut
Third Cut

0 50 75 100

b b b a a a a a a
## 2006 Nitrogen Rate Effect on Forage Quality*

<table>
<thead>
<tr>
<th>N Rate (lbs/ac)</th>
<th>CP (%)</th>
<th>NDF (%)</th>
<th>NE(_i) (Mcal/lb)</th>
<th>48 hr dNDF % of NDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>11.46c</td>
<td>63.80b</td>
<td>.544 b</td>
<td>68.37a</td>
</tr>
<tr>
<td>50</td>
<td>14.26b</td>
<td>61.21a</td>
<td>.572ab</td>
<td>69.18a</td>
</tr>
<tr>
<td>75</td>
<td>16.15a</td>
<td>60.28a</td>
<td>.579a</td>
<td>67.81a</td>
</tr>
<tr>
<td>100</td>
<td>17.16a</td>
<td>60.30a</td>
<td>.575a</td>
<td>68.50a</td>
</tr>
</tbody>
</table>

Means within a column followed by different letters are different by LSD (0.05)

*2006 N rate studies in Jefferson, St. Lawrence and Columbia Co.
## 2007 Nitrogen Rate Effect on Forage Quality*

<table>
<thead>
<tr>
<th>Cutting</th>
<th>N Rate</th>
<th>CP %</th>
<th>NDF%</th>
<th>NE&lt;sub&gt;1&lt;/sub&gt;</th>
<th>dNDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>0</td>
<td>12.83</td>
<td>c</td>
<td>67.03 b</td>
<td>.538 b</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>16.79</td>
<td>b</td>
<td>66.02ab</td>
<td>.551ab</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>18.49</td>
<td>ab</td>
<td>64.35a</td>
<td>.569a</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>20.00</td>
<td>a</td>
<td>64.01a</td>
<td>.573a</td>
</tr>
<tr>
<td>Second</td>
<td>0</td>
<td>9.99</td>
<td>c</td>
<td>68.58 c</td>
<td>.502 c</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>14.74</td>
<td>b</td>
<td>65.32 b</td>
<td>.552 b</td>
</tr>
<tr>
<td></td>
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<td>16.60</td>
<td>b</td>
<td>63.28ab</td>
<td>.572ab</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>19.01</td>
<td>a</td>
<td>62.75a</td>
<td>.582a</td>
</tr>
</tbody>
</table>

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*2007 N rate studies in Jefferson, St. Lawrence, Tompkins, and Columbia Co.*
## 2007 Nitrogen Rate Effects on Forage Quality*

<table>
<thead>
<tr>
<th>Cutting</th>
<th>N Rate</th>
<th>CP %</th>
<th>NDF%</th>
<th>NE&lt;sub&gt;1&lt;/sub&gt;</th>
<th>dNDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third</td>
<td>0</td>
<td>9.75</td>
<td>73.20</td>
<td>.452</td>
<td>68.87</td>
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<td></td>
<td>50</td>
<td>15.61</td>
<td>68.55</td>
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<td>.535</td>
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<tr>
<td></td>
<td>100</td>
<td>18.33</td>
<td>67.68</td>
<td>.535</td>
<td>69.75</td>
</tr>
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</table>

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*2007 N rate studies in St. Lawrence and Tompkins Co. locations only*
3 years of NY Teff Observations

- Rivals average NY grass hay yields
- Produces high quality forage in 50 days
- Herbicides may not be necessary
- Grows on a wide range of soil types
- Plant no deeper than ¼ inch
- Easily established with conventional seeding methods (Brillion or Grain Drill)
  - FIRM SEEDBED IS CRITICAL
- Rapid regrowth after cutting
- No insect or disease problems
Future Teff Research Needed

• Continue seeding rate studies
  – Critical to examine effect on 3rd cutting
• Variety Trials
• One more N rate study?
• Establishment method comparison
• Pasture use- grazing study
Any Questions?