Timothy and timothy mixtures as a pasture crop

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The presentation

- Part A = herbage production
- Part B = nutritive value and animal production
- Results originate from a series of experiments conducted in Finland 1997-2006
- Some other results originating from Scandinavia, New Zealand and Scotland will be referred
- The basic principles found in Finnish experiments can be applied to other Scandinavian countries
Background: growth processes

- Herbage mass, kg DM/ha
- Organic matter digestibility, g/kg OM
- Leaf area index, m²/m²
- Number of tillers/m²
- Tiller weight, g DM/tiller
- Tiller initiation rate T/d
- Tiller death rate T/d
- Leaf Appearance Rate (LAR), mm tiller⁻¹ d⁻¹
- Leaf Elongation Rate (LER), mm tiller⁻¹ d⁻¹
- Leaf:Stem -ratio
- Leaf Senescence Rate (LSR), mm tiller⁻¹ d⁻¹
- Leaf Life Span (LLS), d, DD
A grass species well suited for grazing

• has ability to adapt on different defoliation systems
• has a good regrowth ability,
• has an even dry matter production throughout grazing season.
• has a high nutritive value, mostly through a high proportion of leaves.
• has to be winterhardy in Nordic countries.
Leaf elongation (LER) and leaf senescence rate (LSR)
- primary tillers of timothy and meadow fescue
(From Virkajärvi & Järvenranta 2001)

• In spring Timothy has a higher LER Gross than MF = higher tissue flow
• LER net important
• Senescence dependent on LAI
# Tiller dynamics of timothy and meadow fescue

*Reproduced from Virkajärvi 2003*

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>All tillers in cut 1 m²</th>
<th>All tillers in cut 2 m²</th>
<th>Proportion of vegetative tillers</th>
<th>Surviving tillers m²</th>
<th>New tillers m²</th>
<th>New tillers per a tiller</th>
<th>LAR, leaf per tiller per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>T</td>
<td>2,983</td>
<td>4,488</td>
<td>0,56</td>
<td>1,662</td>
<td>2,826</td>
<td>0,95</td>
<td>0,13</td>
</tr>
<tr>
<td>2000</td>
<td>MF</td>
<td>3,075</td>
<td>4,242</td>
<td>0,87</td>
<td>2,688</td>
<td>1,554</td>
<td>0,51</td>
<td>0,083</td>
</tr>
<tr>
<td>T:MF ratio*100 %</td>
<td>97</td>
<td>106</td>
<td>64</td>
<td>62</td>
<td>182</td>
<td>187</td>
<td>157</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>T</td>
<td>3,004</td>
<td>3,717</td>
<td>0,34</td>
<td>1,006</td>
<td>2,711</td>
<td>0,90</td>
<td>0,13</td>
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<tr>
<td>2001</td>
<td>MF</td>
<td>4,308</td>
<td>4,721</td>
<td>0,72</td>
<td>3,106</td>
<td>1,615</td>
<td>0,37</td>
<td>0,083</td>
</tr>
<tr>
<td>T:MF ratio*100 %</td>
<td>70</td>
<td>79</td>
<td>46</td>
<td>32</td>
<td>168</td>
<td>241</td>
<td>157</td>
<td></td>
</tr>
</tbody>
</table>

Turnout rate of tillers is higher in timothy than in MF.
Seasonal changes in the growth rate of timothy
(MTT unpublished)

Flexible grazing system needed
Effect of vegetative tillers on regrowth rate
(from Virkajärvi 2004)

Generative sward (June–July) Vegetative sward (July – August)

\[ y = 0.0181x + 64.6 \]
\[ R^2 = 0.80 \]

\[ y = -0.0002x + 62.6 \]
\[ R^2 = 0.0 \]
Growth stage distribution of tillers at silage stage - Timothy cv ‘Iki’

(Simon & Park 1981 scale)
Growth stage distribution of tillers at silage stage - Meadow fescue cv. 'Ilmari'

vegetative
65%

generative
Growth stage distribution of tillers at silage stage - Tall fescue cv ‘Retu’
Regrowth rate
Cut 23/6, Regrowth 1/7 2005 (10 days)
Regrowth rate of timothy and meadow fescue

(Virkajärvi 2003)

Regrowth rate, kg DM ha$^{-1}$d$^{-1}$

Regrowth

- time/development stage
- Soil moisture
- Cutting height

Defoliation height, cm
The effect of cutting height on tiller density of timothy cut at pasture stage

(Virkajärvi unpublished)

No adaptation in tiller density to low cutting height
General findings

- Stem formation process beneficial for HM production
- Short defoliation interval leads to lower DM yields
- Bulk density and sward height affect intake rate of the grazing animals
- Timothy has a high preference by grazing cattle
- Timothy is winterhardy in general
A summary of comparison of timothy and perennial ryegrass pasture

<table>
<thead>
<tr>
<th></th>
<th>Timothy</th>
<th>Perennial ryegrass</th>
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</thead>
<tbody>
<tr>
<td>Herbage mass, kg ha⁻¹ DM</td>
<td>2000 - 3500</td>
<td>1700 - 5900</td>
</tr>
<tr>
<td>Tiller density, tillers m⁻²</td>
<td>1700 - 5300</td>
<td>5000 - 15000</td>
</tr>
<tr>
<td>Pre grazing sward height, cm</td>
<td>25 - 40</td>
<td>12 - 24</td>
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<tr>
<td>Proportion of leaves in live material</td>
<td>0.46 - 0.68</td>
<td>0.50 - 0.87</td>
</tr>
<tr>
<td>Bulk density kg DM m⁻³</td>
<td>0.68 - 0.92</td>
<td>1.7 - 5.5</td>
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<tr>
<td>Organic matter digestibility, g kg⁻¹</td>
<td>767 - 806</td>
<td>750 - 820</td>
</tr>
<tr>
<td>OM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Animal production

That’s interesting but what about me?
In Vitro Organic Matter Digestibility and proportion of leaves

\[ y = 6.9561 \ln(x) + 49.983 \]
\[ R^2 = 0.5157 \]
Cross section of timothy stem in different cutting times

<table>
<thead>
<tr>
<th>Date</th>
<th>D value</th>
<th>NDF</th>
<th>INDF</th>
<th>LIG</th>
<th>INDF:LIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>14/6</td>
<td>639</td>
<td>705</td>
<td>79</td>
<td>28</td>
<td>2.9</td>
</tr>
<tr>
<td>21/6</td>
<td>581</td>
<td>702</td>
<td>150</td>
<td>45</td>
<td>3.4</td>
</tr>
<tr>
<td>29/6</td>
<td>559</td>
<td>674</td>
<td>176</td>
<td>42</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Photographs: Seppänen & Saarelainen 2006
Vertical distribution of leaf and OMD,
(example 18th June, 1997, 2nd rotation)

High pre grazing sward height acceptable
Effect of herbage allowance on milk production

Response 0.16 kg ECM/cow/d per 1 kg DM herbage allowance
Relative herbage allowance and HM utilization

Despite the differences in sward structure, the HA x HM utilization relationship seems similar.
Effect of turn out date on sward height

Only a few days difference in turnout may affect the pasture drastically.
Nutritive value:
D-value of timothy dominated pastures in experiments at North Savo 1997 - 2004

The D-value can be maintained at a good level most of the grazing season
A grass species well suited for grazing:  **Timothy**

- can adapt on different defoliation systems  
  - No

- has a good regrowth ability  
  - No, especially not in dry conditions

- has an even dry matter production throughout grazing season  
  - No

- has a high nutritive value, mostly through a high proportion of leaves.  
  - Yes, but not because of leaves

- has to be winterhardy in Nordic countries  
  - Yes
Animal production: Milk yield 2003
Night grazing vs. indoor feeding

Indoor group:
Silage + 2 h/d exercise

Grazing group:
Silage indoors + grazing
12 h/d night time

Both groups 9 kg/d concentrates
Effect of feeding system on net returns per farm compared to zero grazing

Seppälä et al. 2006 & Seppälä et al. unpublished

Economic model includes
Labour demand
capital costs
etc.

Animal welfare studies are carried out but not included

Better flexibility, decreased risk and consequently higher utilization of part time grazing not included
Animal production from timothy dominated pastures

• 14 % higher daily LW gains for lambs than perennial ryegrass (Davies & Morgan 1982 UK)
• in mixtures with PRG and clover, has been a reason for high milk solids yield (Thom et al. 1998 NZ).
• herbage intake levels of 17 - 18 kg DM/cow/day recorded (no concentrates)
• a linear response of 0.8 - 1.0 kg energy corrected milk (ECM) per 1 kg concentrate DM found up to 9 - 10 kg concentrates/cow/day (production level 25 - 35 kg ECM/cow/d)
Conclusions

• Despite the relatively low adaptation for grazing, timothy can be used efficiently in pastures, especially in mixtures.
• Response to herbage allowance follows the general rule.
• The growth processes lead to specific management options:
  - early turnout
  - high pre-grazing sward heights
  - utilization of stem formation process
  - flexible grazing systems with large variation in rotation length
  - use of concentrates
• Part-time grazing is an alternative to full time grazing (labour demand, flexibility).