Production and botanical composition of leys in a long-term cropping system experiment in Northern Sweden

Parsons, D., Zhou, Z. and Palmborg, C.
Background

• Agricultural land use in Sweden was historically dominated by leys (a forage phase in a crop rotation)
• During the second half of the 20th century, farming activities became increasingly specialized in Sweden, leading to the separation of cropping farms and livestock farms.
• Concern arose as to how this specialization would influence soil properties and crop yields
• A cropping system experiment was initiated in the 1950s in Northern Sweden, and is one of the oldest of SLU’s long-term experiments.
Agricultural Land Use, Northern Sweden (2015)

- Leys and pastures
- Cereal
- Fallow
- Other green fodder
- Potatoes
- Unspecified
- Other annual crops
- Energy crop

Total of 4 Northern counties
### Experimental Locations

<table>
<thead>
<tr>
<th>Site</th>
<th>Initial year</th>
<th>Latitude and longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Röbäcksdalen</td>
<td>1958</td>
<td>63.81 N 20.24 E</td>
</tr>
<tr>
<td>Offer</td>
<td>1956</td>
<td>63.14 N 17.75 E</td>
</tr>
<tr>
<td>Ås</td>
<td>1955</td>
<td>63.25 N 14.56 E</td>
</tr>
</tbody>
</table>
• Monthly average temperatures
• Monthly accumulated precipitation (half falls as snow)
• Annual precipitation is 558 mm (Ås), 606 mm (Offer) and 637 mm (Röbäcksdalen)
Cropping systems

• A: Livestock-focused system.
  – Five years of ley and one year of barley with ley under-sown.

• B: Also focused on livestock production
  – Typical length ley (three years) with three years of annual fodder crops.

• C: Balanced between crop and livestock production
  – Shorter than normal ley (two years) and four years of annual crops (including cereals, grain legumes, and potatoes).

• D: Completely annual cropping system
  – One year of ley cultivated as a green manure
  – The results are not included in this presentation.
Crop rotations of the four cropping systems at Röbäcksdalen, Offer and Ås. The crops in parentheses are those grown after 1987, when the plan was revised.

*a Manure (20 t/ha) was applied in the autumn.*
Other details

- All six phases of each cropping system were present each year.
- Two replicates per site.
- Ley species used were red clover (*Trifolium pratense* L.), timothy (*Phleum pratense* L.) and meadow fescue (*Festuca pratensis* Huds.)
- Leys were initially sown under barley and harvested two times per year.
- Soil, plant, and manure samples are stored.
Comparison of soil physical and chemical properties between ley dominated (A and B) and annual crop dominated systems (C and D)

Source: Zhou et al. 2018
Revisions to experiment

- 1987
  - Change in crops (updated to reflect current cropping options)
  - Reduced to one replicate

- 1994
  - Reduced to one site (Offer)

For simplicity, this presentation will focus on Offer, but the results are similar for the other sites.
Aims

• Aims of overall experiment
  – Examine the effect of increasing annual cropping on yield and soil characteristics.

• Aim of this presentation
  – To assess the long-term effects of the different cropping system treatments on the yield and composition of the ley phase
Boxplot of first to fifth year ley yields, in cropping systems A, B, and C. The box and whiskers represent the 5\textsuperscript{th}, 25\textsuperscript{th}, 50\textsuperscript{th}, 75\textsuperscript{th} and 95\textsuperscript{th} percentiles.
Percentage clover content in the first harvest of first to fifth year leys. Error bars are one standard error.
Percentage clover content in the first and second harvest of first to fifth year leys. Data for cropping systems A, B, and C are combined. Error bars are one standard error.
Conclusions

• There were minimal effects of cropping system treatments on ley yields, suggesting that systems with an annual cropping focus can still include a productive ley component.
• Ley yields are relatively stable regardless of the cropping system.
• Results confirm the dynamics of ley clover content within and between years.
• It is a challenge to maintain the legume component in longer term leys.
• Side note: Agricultural in Northern Sweden has not (as was feared) become dominated by annual crops
Acknowledgements

• Staff from Ås, Offer and Röbacksdalen since the beginning, for their work on the management and measurement of the experiment.
• The experiment is financed by the Faculty of Natural Resources and Agricultural Sciences, SLU.
• Data and material from Röbäcksdalen, SITES (Swedish Infrastructure for Ecosystem Science), a national coordinated infrastructure, supported by the Swedish Research Council.