

# Below ground C and N transformation processes in perennial grass-clover mixtures

Name: Jim Rasmussen  
University: University of Copenhagen  
Faculty: Faculty of Life Sciences  
Department: Department of Agricultural Sciences  
Supervisor: Henning Høgh-Jensen (KU-LIFE) / Jørgen Eriksen (AU-DJF) / Erik Steen Jensen (DTU-RISØ)  
Timescale: Defence on April 17<sup>th</sup> 2007  
E-mail/phone: [jjr@life.ku.dk](mailto:jjr@life.ku.dk) / 3528 3520  
Master's degree: Environmental Chemistry

## Background

The C and N dynamics in perennial grass-clover mixtures are not fully understood although such mixtures dominate temperate grassland. The co-existence of clover and grass involves both competition for and transfer of nutrients between the species. The nutrients may originate from leaky root systems, from a rapid turnover of the fine root systems, or from degradation of more stable organic material. A better understanding of the processes involved in the C and N dynamics, especially the role of organically bound C and N, will form the basis for better modeling of grass-clover mixtures and thereby optimizing the utilization of the nutrients which benefits both the farmer and the environment.

## Objective

The aim of the study is investigate the C and N dynamics in grass-clover mixtures with special attention to

- determine the origin of DOC and DON in grass-clover mixtures
- determine the composition of DOC and DON from the species
- investigate the transfer of C and N between grass and clover

## Status – 2004-2007

In 2004 the first field experiment was conducted with the aim to investigate the origin of C and N from both grass and clover related to the short term dynamics in the roots system deposition and turnover. In a second year grass-clover ley mezotrons were installed to depths of 20, 40 and 60 cm. Underneath the mezotrons suction cups were installed in order to collect porewater from the root zone. Grass or clover in the mezotrons was labeled using leaf labeling with <sup>15</sup>N- and <sup>14</sup>C urea. During the experimental period of app. 3 months percolation porewater from the root zone was collected, and the canopy was harvested at three times occasions. At the end of the experimental period the mezotrons were excavated and divided into soil and plant compartments. The experiment show that transfer of N between grass and clover is strongly related to the competition between the species and the activity of the of the plants receiving N. Further the experiment point to that DOC leached below the root zone does not originate from fresh root deposits. A paper based on the results from this experiment has been published in Soil Biology & Biochemistry.

In spring 2005 the second field experiment was initialted in order to study the medium term C and N dynamics in grass clover mixtures. The fate of dual-labelled (<sup>14</sup>C and <sup>15</sup>N) root and leaf material from grass and clover respectively was investigated in field mezotrons during two growth seasons. During the growth seasons leaf material was harvested, in May and September 2005 and April and August 2006 a number of mezotrons was excavated and incubated plant material, soil and roots were separated, and during the autumn and winter soil solution percolating the mezotrons was sampled on 5 occasions and

analysed for  $^{14}\text{C}$  and  $^{15}\text{N}$  in inorganic and organic fractions. The results show leaching of  $^{15}\text{N}$  labeled DON and DIN, whereas no  $^{14}\text{C}$  was leached during the 2005-2006 winter period. Degradation of residues was faster for leaf material compared to root material, also clover residues were degraded faster than grass residues. Both  $^{15}\text{N}$  and  $^{14}\text{C}$  were detected in aboveground plant material. A paper based on these results is prepared for submission to Plant and Soil.

The PhD-thesis was handed in just after Christmas 2006. Defence is to be held on April 17<sup>th</sup> 2007.

By March 1<sup>st</sup> 2007 an application was sent for the Danish research council asking for funding for further studies on the topic of the PhD-study.

### **Publications**

Jim Rasmussen and Henning Høgh-Jensen (2004) [Origin and composition of Dissolved Organic C and N from grass-clover mixtures](#). Poster presented at Cost Action 627 - Carbon Storage in European grasslands, Ghent, Belgium, June 3-6 2004

Jim Rasmussen and Henning Høgh-Jensen (2005) [DOC and DON from grass-clover – results from a field experiment](#). Poster presented at Cost Action 852 – Workshop in Grado, Italy, November 9-11 2005

Jim Rasmussen, Jørgen Eriksen, Erik Steen Jensen, Kim Esbensen and Henning Høgh-Jensen (2007) [In situ carbon and nitrogen dynamics in ryegrass-clover mixtures: Transfers, deposition and leaching](#). Soil Biology and Biochemistry, 39: 804-815

Jim Rasmussen, Birgitte Gjetterman, Jørgen Eriksen, Erik Steen Jensen and Henning Høgh-Jensen (*In prep*). Sources of organic and inorganic nitrogen leaching in perennial ryegrass-clover mixtures: *in situ* fate of applied dual  $^{15}\text{N}$ - and  $^{14}\text{C}$ -labelled plant material.