

Below ground C and N transformation processes in perennial grass-clover mixtures with impact on the farming system and the environment

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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 – 2004-2005

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 ^{15}N - and ^{14}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 is currently under review 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 (^{14}C and ^{15}N) root and leaf material from grass and clover respectively was investigated in field mezotrons during two growth seasons. During the 2005 growth season leaf material was harvested and in May and September 2005 a number of mezotrons was excavated and incubated plant material, soil and roots were separated.

Progress - 2006

The paper based on the 2004 field experiment was finished and submitted for Soil Biology & Biochemistry during 2006.

The second field experiment was finished late August 2006. During winter 2005-2006 soil solution was sampled on 5 occasions and analysed for ^{14}C and ^{15}N in inorganic and organic fractions. During the growth season of 2006 leaf material was harvested and in April and August mesotrons were excavated and separated like in 2005. Samples from 2005 have been analysed, whereas samples from 2006 are yet to be prepared and analysed. The preliminary results show leaching of ^{15}N labeled DON and DIN, whereas no ^{14}C was leached during the 2005-2006 winter period. In 2005 degradation of residues was faster for leaf material compared to root material, also clover residues were degraded faster than grass residues. Both ^{15}N and ^{14}C were detected in aboveground plant material. A thorough analysis of the results from the experiment will be performed when data from the 2006 growth season is available.

Plans – until March 31st 2007

Samples from the 2006 growth season will be prepared and analysed, whereafter a paper will be written based on the results.

The PhD-thesis is to be written and handed in hopefully before Christmas 2006. Defence of the thesis is expected in early spring 2007.

Before March 31st 2007 efforts will be made to get either a job in the private sector or funding for further research.

Publications

Rasmussen, Jim and Høgh-Jensen, Henning (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

Rasmussen, Jim and Høgh-Jensen, Henning (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