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 stabile organic material. A better understanding of the processes involved in the C and N dynamics, especially the role of organicly 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

Progress - 2004

The aim of the 2004 studies have been to investigate the origin of C and N from both grass and clover, to investigate the composition of C and N in a general sence by dividing it into inorganic and organic bound pools, and if possible to look for transfer of C and N between the two species.

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 labeling period of 5 days and at regular intervals thereafter porewater from the root zone was collected. The canopy was harvested three times during the experimental period with an interval between harvesting of three weeks. At the end of the experimental period the mezotrons were excavated and divided into soil and plant compartments.

In order to model the water transport in the mezotrons bromide was added before the leaf labeling, and in order to have a surplus of porewater the mezotrons was irrigated at regular intervals.

Porewater samples were imidiatly analysed for total content of ^{14}C-labelled compounds. Still analysis of ^{15}N content of the porewater has to be undertaken together with measurements of inorganic parameters like pH and content of bromide. Also the analysis of ^{14}C and ^{15}N in soil and plant material has only been performed on very few samples at this point.

The preliminary results show that ^{14}C from both grass and clover can be found in the percolating porewater and the trends are that the amount of ^{14}C is higher from grass than clover. The leaching of ^{14}C was highest during the labelleling period and after the first harvest of the canopy where a puls of ^{14}C was observed. The first results from the analysis of plant material show that both ^{14}C and ^{15}N are transfered between the species, but whether this is due to transfer in the root system or in the canopy has not been elucidated so far.

Plans - 2005

The plans for 2005 awaits the results from the 2004 experiments, but similar studies to the ones in 2004 with grass and clover in monoculture might be undertaken in order to go deeper into the composition of the C and N from the plants.

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