Effects from plant type and glyphosate application on mineralization of nitrogen from catch crops at constant and variable winter temperatures

Jorge F. M. Vélez[1], Iris Vogeler Cronin[1]

[1] Department of Agroeclogy, Aarhus University, Tjele, Denmark

E-mail: jorge_mv@agro.au.dk

Abstract

Plant residue decomposition plays a vital role in soil fertility and nitrogen leaching in agriculture, especially in connection with the use of catch crops between main crops. A low temperature incubation experiment was carried out using three types of catch crops (a grass, a legume and a brassica), two constant temperatures compatible with the autumn-winter season in Northern Europe (15 °C, 2 °C) and one variable temperature (changing between 15 °C and 2 °C on equal time intervals). The grass and the legume catch crops were furthermore subjected to two glyphosate treatments (application two weeks before clipping and no application). Destructive sampling was carried out at 0, 1, 2, 4, 8 and 20 weeks of incubation, where both nitrate and ammonium contents in soil were determined. Finally, DEA analysis was carried out on the middle and edge sections of all samples after 20 weeks of incubation. The results show no immediate signs of non-linear effects from temperature variations (e.g. lags or rushes in microbial activity) on plant residue turnover rates at low temperatures. Localized denitrification associated to plant residue, however, seems to be important at both constant and variable temperatures. Little to no effects were observed from Glyphosate application.

Keywords: Catch crops, incubation, nitrate leaching, denitrification.

1. Background

Degradation and decomposition of plant residue, together with soil organic matter (SOM) mineralization, are fundamental processes in maintaining or creating fertility in the soil. This is of particular importance during the autumn-winter season, as plant residue decomposition can have a big influence on nitrate leaching, denitrification and soil fertility in the following growing season. Most laboratory studies investigating plant residue turnover, however, consist of incubations at or above room temperature, and temperature fluctuations are almost never considered (Cookson, Cornforth and Rowarth, 2002). This does not necessarily reflect organic nitrogen mineralization rates during the colder seasons.

Furthermore, application of glyphosate herbicides to control catch crops is common practice in reduced till operations. This might stimulate withering of green plant tissues, causing the redistribution of nitrogen to hardier parts of the plant, potentially affecting decomposition rates in the soil.

2. Experimental design

The experimental units consisted of 250 cm^3 stainless steel cylinders packed with sieved soil and a layer with 1 g of plant residue FW, incubated for a maximum of 20 weeks.

The plant residues consisted of hairy vetch (Vicia villosa ‘Hungvillosa’), ryegrass (Lolium perenne ‘Mathilde’) and fodder radish (Raphanus sativus var. Oleiformis ‘Brutus’). The Glyphosate treatment consisted of one application of Glyphomax HL at a rate of 2-3 L/ha two weeks prior to clipping. Additionally, a control treatment consisting of only soil was included to account for background decomposition of soil organic matter (SOM).

All smples were kept at approximately 22% w/w water content, corresponding to 97% of water content at pF=2, for the duration of the experiment.

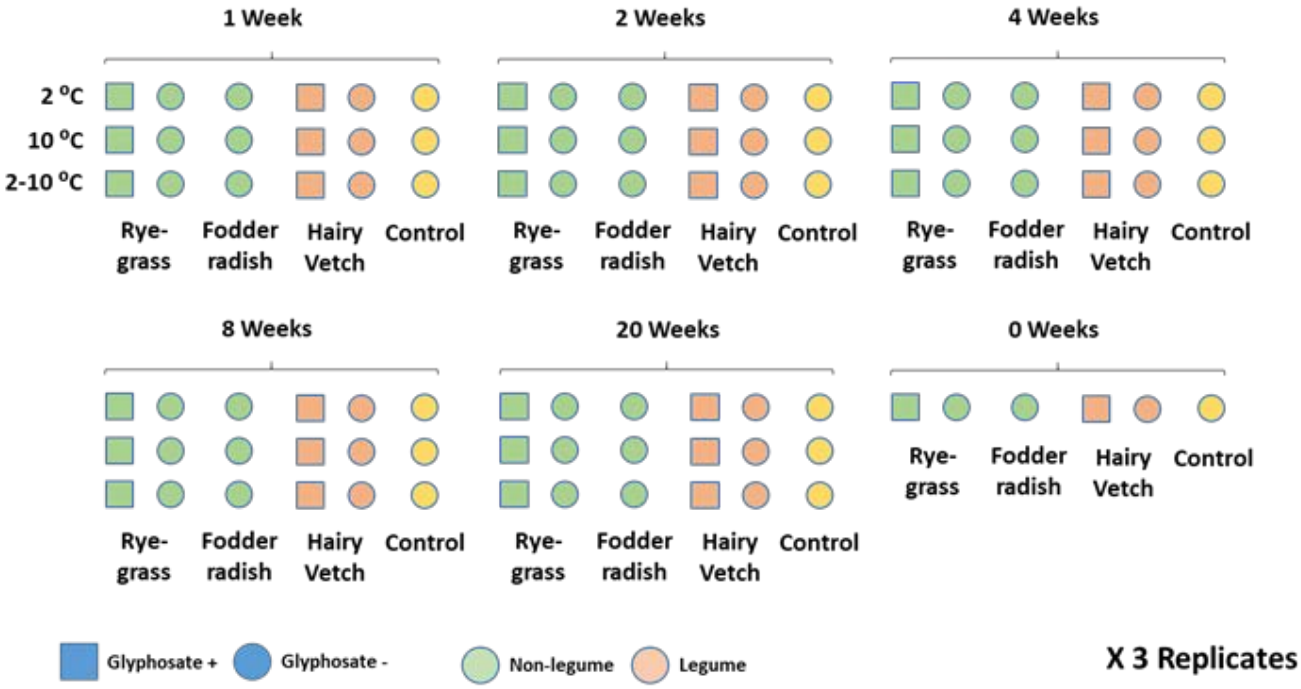

Figure 1: Diagram of the experimental design.

Acknowledgements

This study contributes to the project VIRKN, financially supported by The Ministry of Environment and Food of Denmark under the Green Development and Demonstration program (GUDP).

References

Cookson, W. R., Cornforth, I. S. and Rowarth, J. S. (2002) 'Winter soil temperature (2–15 8C) effects on nitrogen transformations in clover green manure amended or unamended soils; a laboratory and field study', *Soil Biology and Biochemistry*, (34), pp. 1401–1415.