Low nitrate leaching determined by threshold for cover crop biomass

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Abstract

We investigated nitrate leaching during four years in a long-term crop rotation experiment, and the effect of legume-based cover crops (CC). Cover crops reduced nitrate leaching by approximately 60%, but this effect varied from year to year; variation in CC biomass best explained the reduction in nitrate leaching. To reduce nitrate leaching to a low and stable level a minimum amount of CC biomass was needed.

Keywords: catch crops, N balance, legumes

1. Introduction

Nitrate leaching from agricultural soils is one of the main sources of N pollution of ground- and surface waters. Strategies to reduce it include the reduction of N surplus and targeted measures, as the use of CC. Legume-based CC can provide additional services, such as increasing N availability to the following crops. Since the ability of CC to take up soil mineral N is related to their growth, variations in their effect on nitrate leaching have to be taken into account (De Notaris et al., 2018).

2. Methods

We studied nitrate leaching during the fourth cycle (2011-2014) of a long-term crop rotation experiment, established in 1997 at Foulum, Denmark. Two organic and one conventional cropping systems were included. Treatment factors were +/− animal manure (M) and +/− CC in the organic systems, which included a green manure ley (OGM) or a grain legume (OGL) in the crop sequence. The conventional system (CGL) had the same sequence as OGL, +/− non-legume CC. For each treatment, four crops were present each year. Nitrate leaching was measured through ceramic suction cups, installed at 1m depth in each plot. Water samples were analyzed for nitrate content and the EVACROP model was used to calculate drainage and thus nitrate leaching. CC samples were taken in November for DM and N analysis.

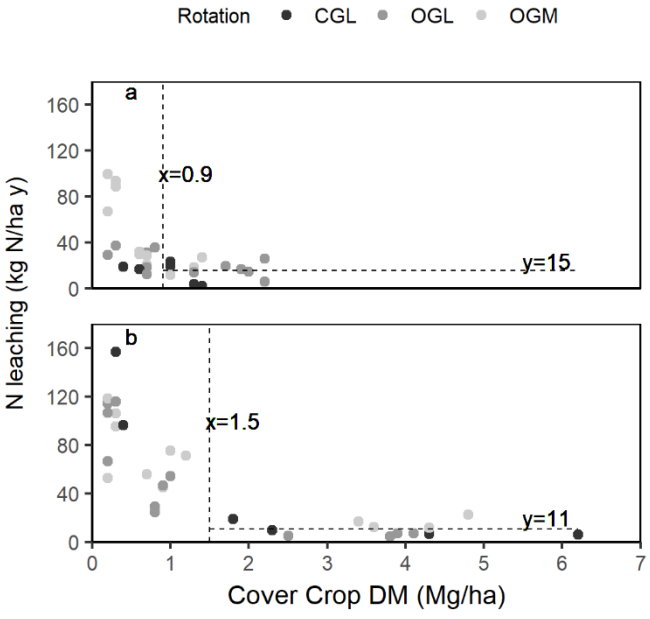

Fig. 1: Nitrate leaching in relation to CC aboveground dry matter in a) spring wheat and b) potato. Dashed lines indicate crop-specific thresholds (x) and residual leaching (y).

3. Results and discussion

From a crop rotation perspective, in organic and conventional systems CC reduced nitrate leaching by approximately 60%, corresponding to an average of 23 kg N ha^{-1} y^{-1}. This was similar for legume and non-legume CC. Different crops had different levels of nitrate leaching. Potato and spring wheat had the greatest, due to their position in the crop sequence and residual effects. In these crops, CC reduced nitrate leaching, but this effect varied from year to year mainly due to different CC growth. We identified thresholds in CC biomass, above which nitrate leaching was reduced to a low and stable level (Fig.1). Thresholds depended on the potentially leachable nitrate.

We conclude that when CC growth is not sufficient to take up the potentially leachable nitrate, leaching is more dependent on factors such as weather and residual N from previous crops.

References

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