

# On-farm evaluation of nitrogen leaching rates from organic crop rotations under consideration of the previous crop, with special emphasis on legumes

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## Introduction

Legume supported crop rotations are of high importance in organic farming due to the biological nitrogen fixation as well as the high crude protein content, which is needed in animal production. The cultivation of legumes is depending on the farm management type, e.g. cash crop or dairy cow farm. For the evaluation of legume based cropping systems especially the risk of nitrogen leaching is important for a sustainable production. In this study the  $\text{NO}_3\text{-N}$ -load during the winter seepage period is evaluated for a cash crop and a dairy cow rotation that comprises different types and shares of legumes in mono- and intercropping.

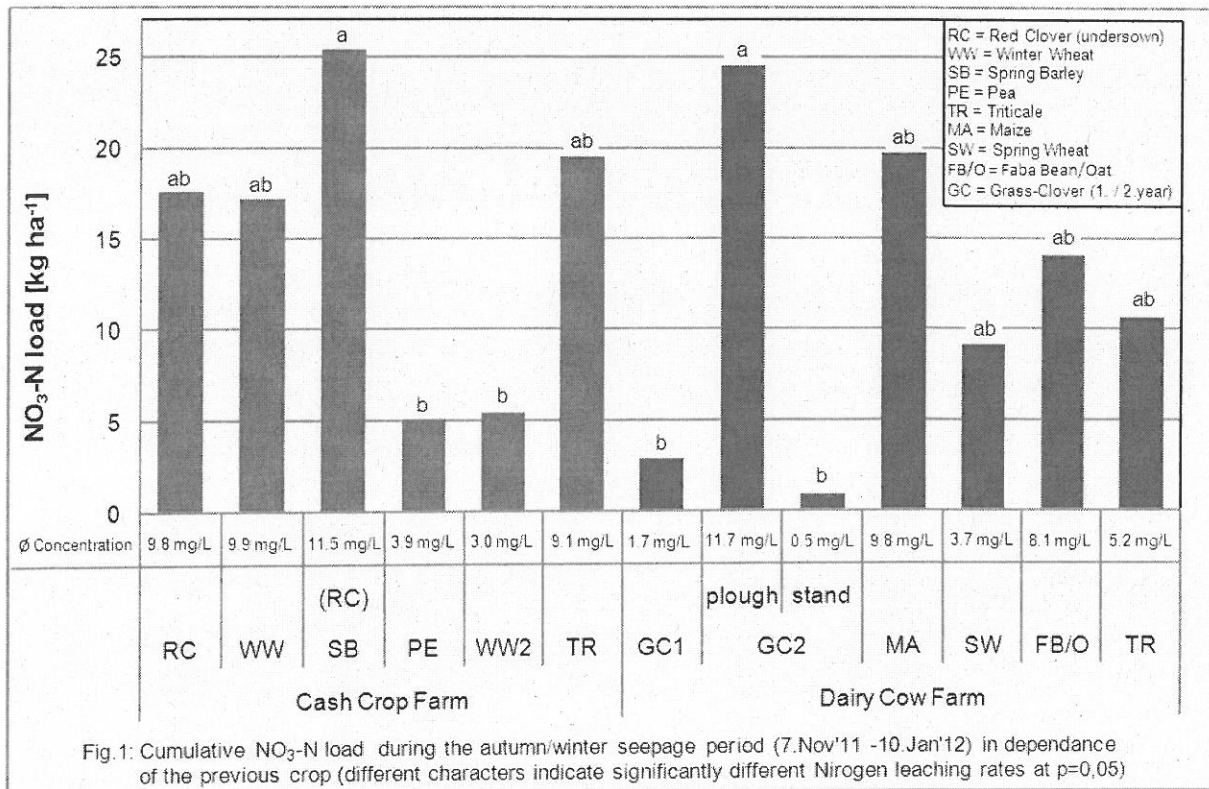
## Materials and methods

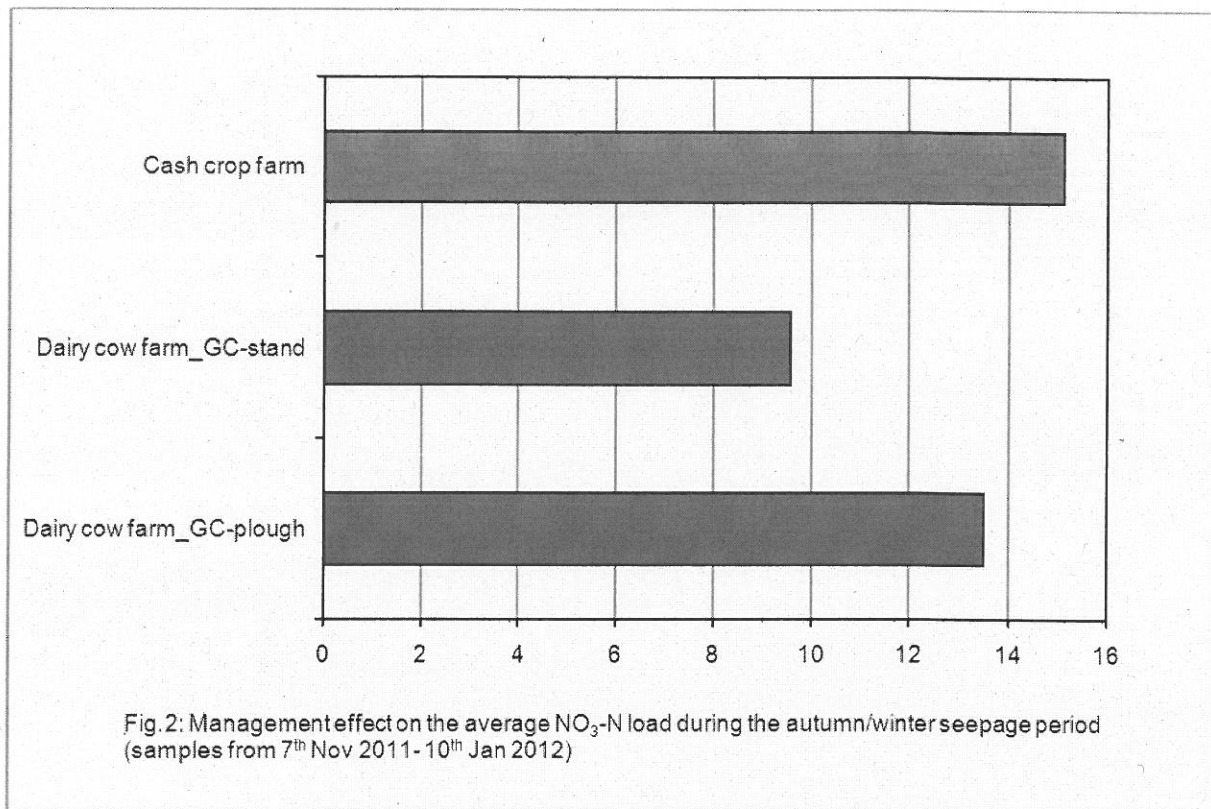
The seepage water was collected by an in-situ sampling with ceramic suction cups that allow continuous extraction of soil solution during the autumn/winter seepage period. The ceramic suction cups have been

installed at four georeferenced monitoring points after ploughing/seeding before winter. They were installed in 70cm depth to assess the leaching rate below the rooting zone with a threefold repetition at each of the four monitoring points per field. From the 3 suction cups per point and depth a mixed sample was taken weekly during the complete winter seepage period (7th Nov 2011 – 21st Mar 2012) to assess the nitrogen concentration in the seepage water. The ecological evaluation covers all fields of the cash crop and dairy cow farm. The analysis of the nitrate concentration is done by a photometric autoanalyzer to calculate the  $\text{NO}_3\text{-N}$ -load with help of the seepage rate that is assessed by a model of the German Weather Service (DWD). Data were analyzed using the GLM-procedure in SAS 9.2.

## Results

In the first sampling period until the 11th January the accumulated seepage rate was 153mm, whereas most rainfalls occurred in December 2011. The field with the



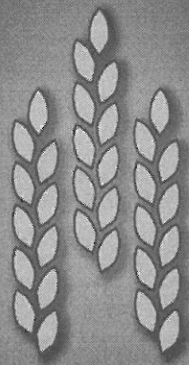


biannual grass-clover stand of the dairy cow rotation was divided up in two parts – the first one was ploughed in autumn, the second one in spring before the maize is sown. The significant highest N-load was observed after the autumn-ploughed biannual grass-clover (GC<sub>2</sub>-p), whereas the spring-ploughed biannual grass-clover (GC<sub>2</sub>-s) showed the lowest N-load, which was comparable to the grass-clover after the first year of cultivation (GC<sub>1</sub>) (Fig. 1). The negative effect on the nitrogen leaching by autumn ploughed grass-clover in comparison to spring ploughing is also apparent from the average leaching rates of the complete crop rotations under different management practices (Fig. 2). Though no fertilization is done in the cash crop rotation, the average nitrogen load is about 2 kg ha<sup>-1</sup> superior than in the dairy cow rotation with the autumn ploughed grass clover, but the differences between the different managed crop rotations were not significant for the calculated period (7<sup>th</sup> Nov. 2011 to 11<sup>th</sup> Jan 2012). This might be due to the extreme leaching rate after summer barley, caused

by a highly developed undersown red clover stand. In contrast, the pea (PE) and the winter wheat (WW<sub>2</sub>) field showed the lowest nitrogen loss. The low N-load of the pea field is a possible indicator of an insufficient biological nitrogen fixation and high export rates by harvest. In the first two years of the cash crop rotation the N-load after red clover (RC) and winter wheat (WW) was on a medium level and comparable to the N-load of triticale (TR) in the 6<sup>th</sup> year of the cash crop rotation.

### Discussion

The present results reconfirm that the nitrate-nitrogen leaching rate could be reduced if grass-clover stands are ploughed in spring compared to ploughing in autumn, at the beginning of the seepage period. The cultivation of grain legumes showed no higher N-load compared to the other crops like wheat, maize or triticale. Further evaluations will be done when the sample analysis is completed.

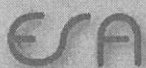


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