# Analysis of the nitrate leaching risk for different fertilizers on permanent grassland in the Persephone project

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## Introduction

In the context of the Perséphone Project «Intégration de la filière biogaz dans la nouvelle Bio-économie: 2017-2019», financed by the European Regional Development Fund 2014-2020 INTERREG VA «Greater Region» and national co-funding, the partners studies five experimental sites assessing the impact of various organic and chemical fertilization schemes.

The fertilization potential[1] of biogas residues and its capacity to enhance mineralisation[2] is demonstrated but its impact on soil activity, physicochemical properties and nitrate leaching risk is not yet well known.

The aim of this study is to compare the impact of the type of fertilization on grass yield, soil microbial activity and diversity and evolution of soil physicochemical properties.

Thus, the main objective is to assess the environmental impact of organic- or chemical-based fertilization schemes on a permanent mown meadow.

## Materials and Methods

Four different fertilizers were tested in three sites (Emmels (Be), Grendel (Be), and Laneuvelotte (Fr)) and compared to a control not receiving fertilizer application. The fertilizers applied were (i) the local biogas residues at a concentration of 350 units of total N/ha, (ii) biogas residues of Faascht farm (Grendel, Be) at 230 U of N/ha, (iii) local liquid manure at 230 U of N/ha, and (iv) ammonium nitrate at 230 U of N/ha.
Nitrogen leaching risk measurements took place in February, before fertilizer application, and in October, after the last forage harvest. The soil sampling depth was 90 cm and the soil nitrate content in the 0-30 cm, 30-60 cm, and 60-90 cm horizons was analysed.
The grass yield is expressed in dry matter per hectare per year. This yield is the sum of the tree cuttings of the meadow. One in mid of May, one mid of July and one in the end of September.
This study will help to assess the value of biogas residues as organic fertilizers and to evaluate their environmental benefits.
Statistical analyses were performed using R studio software (R version 3.4.3 (2017-11-30)).

## Results

The ANOVA test performed showed that the level of nitrate leaching differed according to the fertiliser treatments ($p<0.001$).

The chemical-based fertilization mode (ammonium nitrate 230 U of N/ha) showed the highest risk of nitrate leaching with 101,64 Kg of N-$NO_3$/ha ($p<0.001$, Tukey's post-hoc test, Chart 1). It has also showed the highest grass yield with 6,41 t of dry matter per ha/year.

On the other hand, the level of nitrogen leaching did not differ significantly between the two biogas residues, the liquid manure, and the control ($p>0.05$). There was only a tendency to observe a higher nitrate leaching for the liquid manure at 230 U of N/ha and for the biogas residues applied at 350 U of N/ha compared to the control (no application of N) and the biogas residue applied at 230 U of N/ha. Grass yields of the tree organics fertilization are approximately 1t of dry matter ha/year highest than the one observed in control plot.

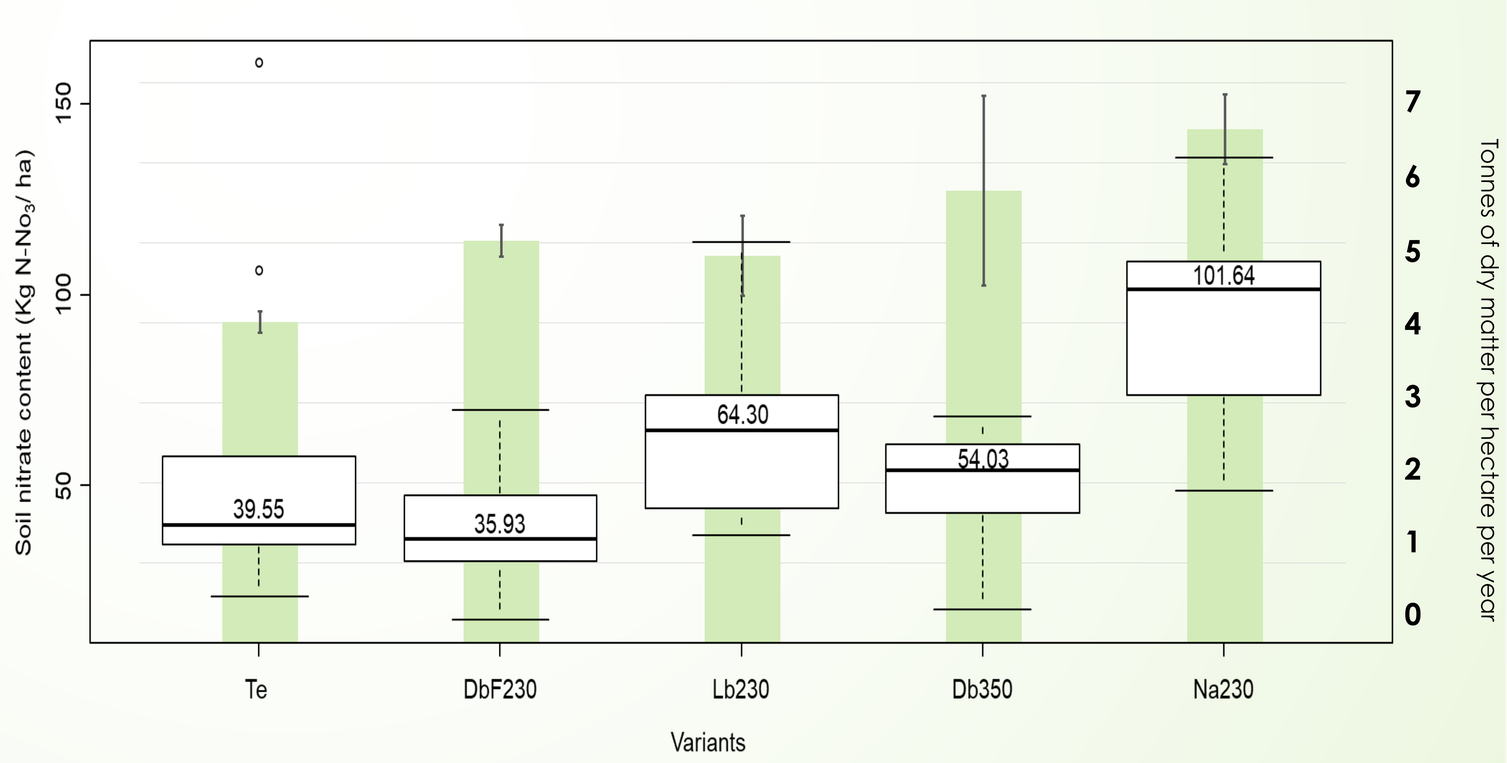


**Chart 1.** *Box plot of soil nitrate content (U=Kg N-$NO_3$ / ha) and bar plot of the yield (dry matter per hectare) after the application of four different fertilizers. Caption: Te = Control (0 U N/ha), DbF230 = Biogas residues of Faascht farm at 230 U N/ ha, Lbl230 = local manure at 230 U N/ ha, Db350= local biogas residues at 350 U N/ ha, Na230 = ammonium nitrate at 230 U N/ ha*

## Conclusions

- Our data show that the use of biogas residues and manure do not increase the values of nitrogen leaching compared to control plots only exposed to atmospheric nitrogen deposition, even at a very high dose of 350 U N/ha under the form of biogas residues.
- In addition, it is important to note that part of the nitrogen originating from biogas residues and manure contributes to the building up of soil organic matter. The release of this organic nitrogen depends on the turnover of microbial biomass, ammonification and nitrification. These biological processes are retroactive in regard to the fertilization and highly depend on weather conditions.
- Organic and mineral fertilization trials will be pursued throughout the following years to confirm or reject the hypothesis that the organic matter, present in biogas residues and manure, has a long-term potential to mitigate nitrogen leaching risk.

## References

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