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Christophe Dambreville, Stéphanie Hallet, Christophe Robin, Thierry Morvan, Jean-Claude Germon, et al.. Compared effects of long term applications of pig slurry and ammonium nitrate on the structure and activity of the denitrifying community in a maize planted soil. Meeting Cost action 856 'Ecological aspects of denitrification with emphasis on agriculture', Mar 2004, Marburg, Germany. 2004. hal-04511370

**HAL Id: hal-04511370**

**<https://hal.univ-lorraine.fr/hal-04511370>**

Submitted on 19 Mar 2024

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# Compared effects of long term applications of pig slurry and ammonium nitrate on the structure and activity of the denitrifying community in a maize planted soil

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## Introduction

Denitrification is an alternative respiratory process by which nitrogenous oxides ( $\text{NO}_3^-$  and  $\text{NO}_2^-$ ) are reduced to dinitrogen gases ( $\text{N}_2\text{O}$  and  $\text{N}_2$ ). In soils, denitrification plays an important role in the global nitrogen cycle and contributes to the emission of  $\text{N}_2\text{O}$ , a greenhouse gas. Carbon compounds of manures and slurries are known to stimulate the potential denitrifying activity of soils (Paul & Beauchamp, 1989), but their impact on the denitrifying community remain unknown.

So, the aim of this study was to compare the effects of long term applications of pig slurry or a mineral fertilizer on the structure and activity of the denitrifying community.

## Results and Discussion

|                          | Bulk soil<br>( $\mu\text{g N g}^{-1} \text{sol h}^{-1}$ ) | Rhizospheric soil<br>( $\mu\text{g N g}^{-1} \text{sol h}^{-1}$ ) |
|--------------------------|---|---|
| $\text{NH}_4\text{NO}_3$ | 0,114   | 0,356   |
| Pig slurry               | 0,239   | 0,523   |

Tab. 1. Potential denitrifying activity with acetylene (2%) during a 5-hours incubation.

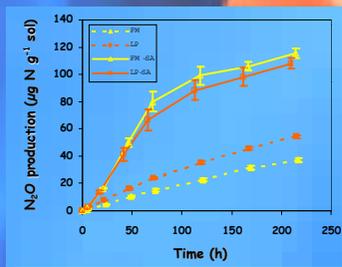


Fig. 1. Denitrifying activity with acetylene (2%). LP: pig slurry, FM: mineral fertilizer, SA: rhizospheric soil

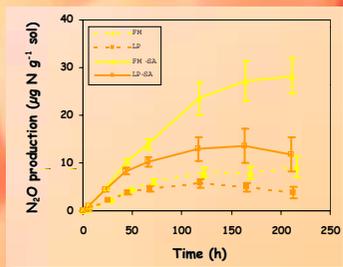


Fig. 2. Production of  $\text{N}_2\text{O}$  during denitrification. LP: pig slurry, FM: mineral fertilizer, SA: rhizospheric soil

## Materials and Method

Samples were collected from two experimental plots, cropped with maize, and fertilized during the last 10 years with ammonium nitrate ( $100 \text{ kg N ha}^{-1} \text{ an}^{-1}$ ) or pig slurry. The effect of the fertilizers on the activity and the structure of the denitrifying community were studied both on the rhizospheric and bulk soil.

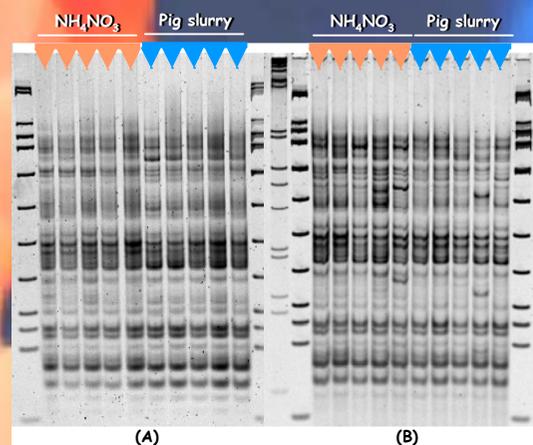
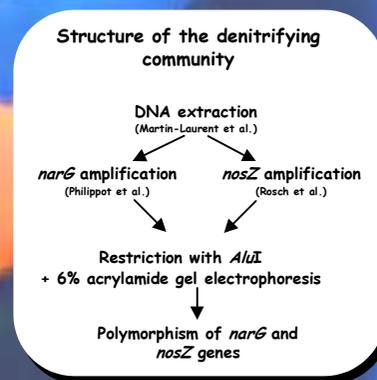
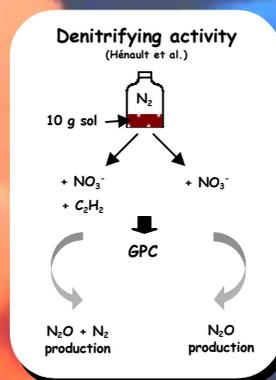


Fig. 3. Comparison of the *AluI* RFLPs of the *narG* PCR products obtained from the bulk (A) and the rhizospheric (B) soil.

- The applications of pig slurry during 10 years have stimulated the potential denitrifying activity of the soil of 210 % compared to the soil fertilized with ammonium nitrate. The positive effect of pig slurry was observed in both the bulk and the rhizospheric soil ( $\alpha 2.5 \text{ p} < 0.05$ ).
- The potential denitrifying activity have also been stimulated into the rhizospheric soil. The effect of the rhizosphere and the pig slurry were additive (Tab. 1).
- The amount of  $\text{N}_2\text{O}$  produced from denitrification was not influenced by the type of fertilizer during the first hours of incubation (Fig. 2). However, after this period (45 h), the amount of  $\text{N}_2\text{O}$  produced from denitrification is smaller in the soil fertilized with pig slurry compared with the soil fertilized with ammonium nitrate while the potential denitrifying activity had been stimulated. Similar results were observed in the rhizospheric soil suggesting that the applications of pig slurry compared with the mineral fertilization induce a reduction of the amount of  $\text{N}_2\text{O}$  produced from denitrification.
- In return, the denitrifying community and also the production of  $\text{N}_2\text{O}$  have been higher in the rhizospheric soil than in the bulk soil (Fig. 2). Thus, the  $\text{N}_2\text{O}/\text{N}_2$  ratio does not seem to be modified by the activity of the maize roots. The effect of the pig slurry was also observed in the rhizosphere leading to a net reduction of the  $\text{N}_2\text{O}$  produced.

The restriction patterns of *narG* show a low variability between each replicate. They have not emphasized a strong effect of the type of fertilizer on the structure of the nitrate-reducing community either in the bulk and the rhizospheric soil.

The impact of those fertilizers on the  $\text{N}_2\text{O}$ -reducing community is currently evaluated.

To conclude, the applications of pig slurry stimulate the denitrifying activity and reduce in the same time the  $\text{N}_2\text{O}/\text{N}_2$  ratio of the process in anaerobiosis. The rhizosphere also stimulates this activity without any modification of the  $\text{N}_2\text{O}/\text{N}_2$  ratio. Moreover, the applications of the pig slurry and the rhizosphere does not seem to modify strongly the structure of the nitrate-reducing community. Currently, this work is continued with the investigation of the influence of the type of fertilizer on the structure of the  $\text{N}_2\text{O}$ -reducing community. Whether the effect observed with the pig slurry could be recovered for other manures or slurries is an interesting question.

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