

# Effect of Nitrification Inhibitors on Nitrogen Transformations in Soils with Different Textures –

## An Incubation Study

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### Introduction

Nitrification inhibitors were developed to reduce nitrogen (N) losses from agricultural soils and increase N use efficiency (1). Different soil textures can considerably affect the efficacy of inhibitors. Although it wasn't broadly studied in a laboratory with controlled environmental conditions.

### Objectives

The aim of this study is to evaluate the effect of common nitrification inhibitors in soils with different textures (sand, loam, and clay) under controlled environmental conditions and to compare the effectiveness of different inhibitors.

### Materials and Methods

Clayey, loamy, and sandy soils were sourced from different sites in Manitoba. Soils were sampled from 0-25 cm depth in 4 replications (n=4). Treatments were injected in the amount of 66 ul using a syringe.



- UAN rate – 60 mg N kg<sup>-1</sup> dry soil
- 400 g of dry soil weight/1L jar
- 65% WFPS
- 20°C
- Soils were analyzed for extractable N (NH<sub>4</sub><sup>+</sup>/NO<sub>3</sub><sup>-</sup>) on various days: 1, 3, 7, 9, 14, 21, and 28<sup>th</sup>.
- Extraction by 2M KCl solution and the resulting extracts were analyzed for extractable N concentrations using a Technicon auto-analyzer.

| TEXTURE | TREATMENTS |     |              |       |           |             |
|---------|------------|-----|--------------|-------|-----------|-------------|
| CLAY    | Control    | UAN | Pronitridine | DCD   | DMPP      | Nitrapyrin  |
| LOAM    |            |     | (6L per m    | (2L   | (1.1L per | (2.7L/ha    |
|         |            |     | tonne UAN)   | per m | m tonne   | area basis) |
| SAND    |            |     |              | tonne | UAN)      |             |
|         |            |     |              | UAN)  |           |             |

### Results and Discussion

- Nitrapyrin was the most effective inhibitor, significantly reducing nitrification in clay and sand (Fig. 1);
- DND has also significantly reduced nitrification in clay and sand, but it is less noticeable than for nitrapyrin;
- DMPP and pronitridine were not effective during this laboratory experiment;
- The most rapid nitrification was observed in loam;
- A non-significant result between treatments in loam can be explained by the huge unexpected variability between repetitions.

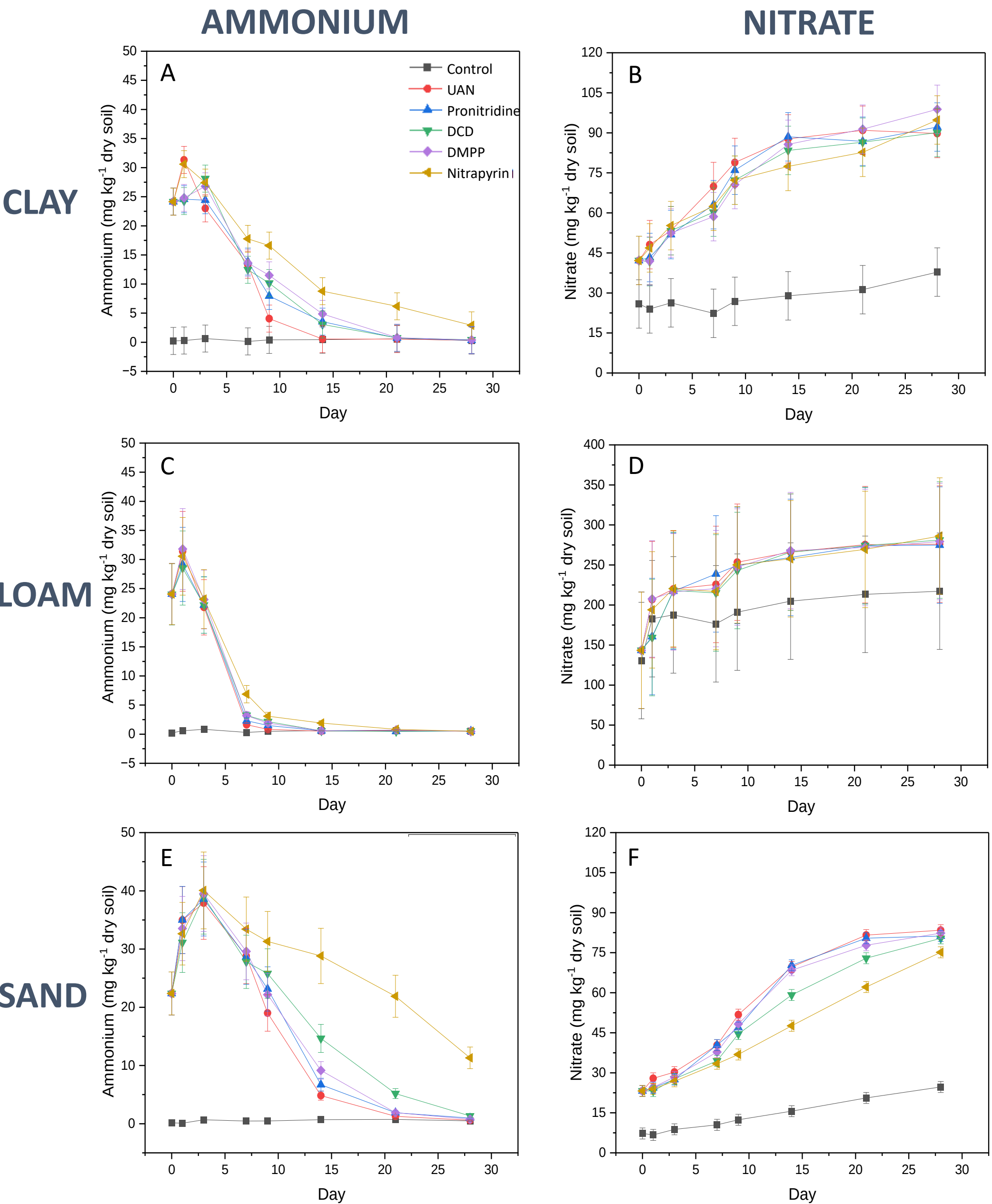


Figure 1. Effect of nitrification inhibitors on ammonium (N-NH<sub>4</sub><sup>+</sup>) and nitrate (N-NO<sub>3</sub><sup>-</sup>) concentrations (mg kg<sup>-1</sup> dry soil) in clay (A, B), loam (C, D), and sand (E, F) soils. Error bars represent the standard errors of the means (n = 4).

### Results and Discussion

Ammonium results: According to two-way ANOVA, there was a significant statistical difference ( $p < 0.0001$ ) between textures for each treatment. However, interaction analysis (soil texture x day) shows that the texture x day interaction is significant for all treatments except control. Post hoc Tukey HSD test showed significant differences between textures within each treatment, except loam-clay in UAN and pronitridine. During the first 14 days, there was a significant difference in ammonium concentration among days in each treatment. Only the texture factor showed a statistical difference for nitrate data. In all treatments, the difference was significant between clay-loam and sand-loam. Although, the difference in concentrations between days or the texture x day interaction was non-significant ( $p > 0.05$ ).

### Conclusion

Overall, the results showed that soil texture affected ammonium and nitrate concentration in soils, and the difference in concentrations was eliminated after two weeks. Notably, this study showed different results from the field-conducted (2) one, where most of the inhibitors showed positive results in reducing the nitrification process. A difference in the banding application of fertilizers in the field, and small amounts of fertilizer solution injections using a 100 ul syringe in the laboratory study could play a decisive role. The method is considered to be further developed in the next study in order to reproduce the nitrification inhibitors' effects in laboratory conditions.

### References

1. Abalos D, Jeffery S, Sanz-Cobena A, Guardia G, Vallejo A. (2014). Meta-analysis of the effect of urease and nitrification inhibitors on crop productivity and nitrogen use efficiency / Agriculture, Ecosystems & Environment, V. 189, P. 136-144.
2. Di, H.J. & Cameron, Keith. (2002). The use of a nitrification inhibitor, dicyandiamide (DCD), to decrease nitrate leaching and nitrous oxide emissions in a simulated grazed and irrigated grassland. Soil Use and Management. 18. 395 - 403. 10.1111/j.1475-2743.2002.tb00258.x.

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