Risk of nitrate leaching in organic agriculture with legume as nitrogen source

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NutriNet

Introduction

For nitrogen (N) supply to crops, organic agriculture relies on organic fertilizers and N-fixing plants (legumes). The gradual decomposition of incorporated organic material releases N more slowly as compared to more readily available N from mineral fertilizers used in conventional agriculture. However, the timing and extent of organic fertilizer incorporation is crucial as organic matter decomposition and respective N release should be synchronized with N demand of the following crops.

Materials

Within the practice-based research network NutriNet, we monitored available nitrate (NO_3^-) and ammonium (NH_4^+) in 0-30 and 30-60 cm soil depth at three different farms under organic management in **central Germany**. These farms used different types of legume and catch crops with different time points and intensity of incorporation.

Klein Rodensleben:
clayey silt, pH 6.6

Schkölen:
heterogeneous and stony, clayey silt to sandy loam, pH 6.4-6.8

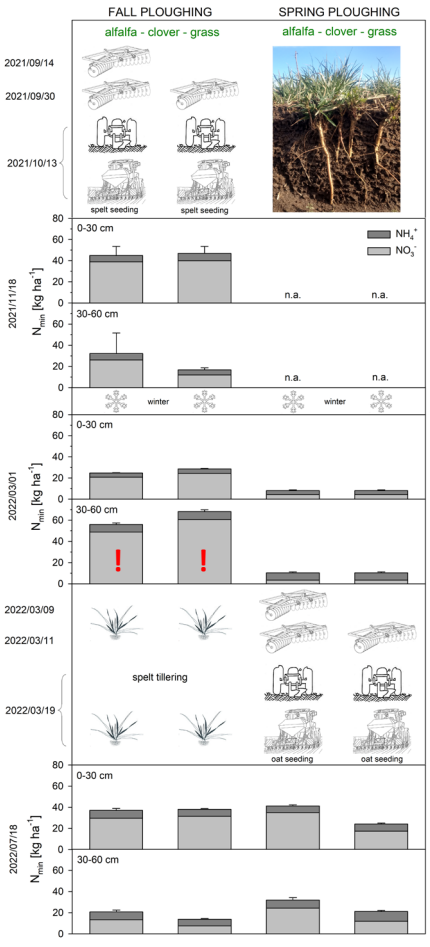
Hornburg:
clayey silt, pH 7.0

Methods

- Extraction of exchangeable NH_4^+ and NO_3^- from fresh soil samples with 0.0125 mol L^{-1} $CaCl_2$
- Photometric quantification of N-NH_4^+ and N-NO_3^- in extracts
- N_{min} = N-NH_4^+ + N-NO_3^-
- Water content of fresh samples was accounted for
- Calculation of N_{min} stocks via estimated bulk densities

Treatments, Results & Discussion

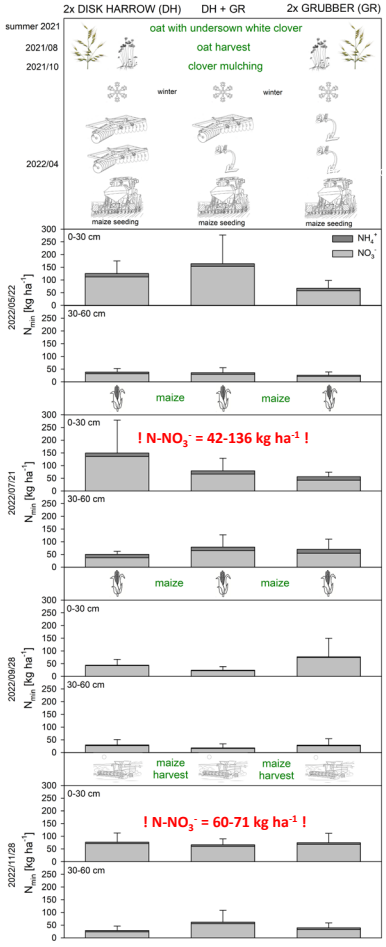
Klein Rodensleben



Legume incorporation in late summer increased risk for nitrate leaching in the following spring

Maintaining legume, however, bears risk of too slow soil drying in spring

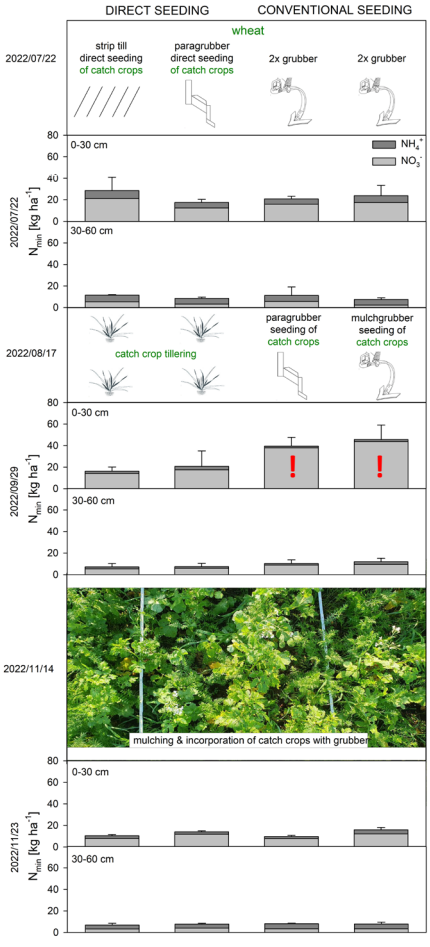
Schkölen



Intensity of clover incorporation before maize seeding had no significant effect on N_{min}

Large N_{min} stocks at the end of July when largest demand of maize has already passed → hampered N_{min} uptake?

Hornburg



Early catch crop development through direct seeding decreased risk of nitrate leaching in late summer

Catch crops resulted in low nitrate stocks in winter

Conclusions

Risk of NO_3^- leaching in winter through early legume incorporation can be reduced by direct seeding of catch crops

Nitrogen nutrition of maize fertilized with clover biomass seems problematic as also shown by other field trials of NutriNet

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