N source and tillage management: Effect on nitrous oxide emissions and barley yields in a rainfed Mediterranean area

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Abstract

A *split plot* field experiment was conducted in a barley (*Hordeum vulgare* L.) crop in central Spain. The main factor was tillage (conventional tillage *versus* no tillage), while in the subplots we evaluated three treatments: conventional fertilizers (urea and calcium ammonium nitrate), fertilizers with urease and/or nitrification inhibitors, and a control. Nitrous oxide (N_2O) emissions and yields were measured. Our results indicated that the combination of no tillage and the use of urease and/or nitrification inhibitors was an effective management to decrease yield-scaled emissions (without yield penalties and even increasing yields under NT) under rainfed Mediterranean conditions.

Keywords: tillage, DMPSA, NBPT

1. Introduction

The interactions between tillage management (no tillage or reduced tillage *versus* conventional tillage) and the use of urease and/or nitrification inhibitors have been explored in several meta-analyses (e.g., Thapa et al., 2016), but little information exists so far at field scale.

2. Materials and Methods

A field experiment was conducted in central Spain in a calcareous silty loam soil wth low organic matter content, in a rained barley (*Hordeum vulgare* L.) crop under Mediterranean climate. Our treatments included an unfertilized control, conventional fertilizers (urea, U, at seeding and calcium amamonium nitrate, CAN, at dressing), and fertilizers with inhibitors (the double nitrification – DMPSA- urease inhibitor –NBPT- with U, and DMPSA with CAN) in an *split plot* design, being the tillage management (no tillage, NT, and conventional tillage, T) the main factor. Nitrous oxide (N_2O) emissions and yields were measured. Total N rate for fertilized plots was 120 kg N ha^{-1} (40 + 80).

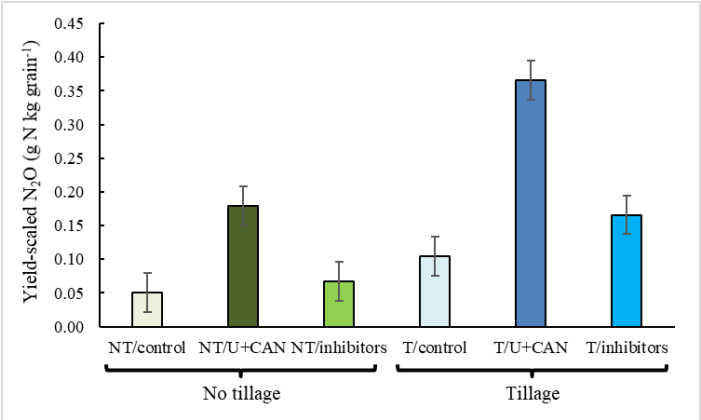

Fig. 1: Yield-scaled N_2O emissions in the different tillage-fertilizer combinations.

3. Results and Discussion

Nitrous oxide emissions decreased in the order: conventional fertilizers > fertilizers + inhibitors > control and T > NT. This could be a result of higher N uptake (by 50%), crop biomass (by 65 %) and grain yield (by 60%) in NT plots in comparison to T, since it has been suggested that the higher N acquisition is linked to lower N losses, including those of N_2O (Bowatte et al., 2018). Emission factors were < 0.1 % for treatments with inhibitors, and 0.24 % - 0.50 % for fertilizers without inhibitors. Excluding the emission peak after tillage, the amount of N emitted per kilogram of N applied was higher for basal (autumn, U) than for dressing fertilization (spring, CAN). Highest emissions were observed two months after harvest, following a rainfall event of 35 mm, highlighting the relevance of soil rewetting after summer in rainfed semi-arid areas (Bergstermann et al., 2011). Fertilized plots increased grain yields with respect to control, while no significant differences between conventional fertilizers and fertilizers with inhibitors were reported.

4. Conclusion

The combination of NT and the use of urease and/or nitrification inhibitors was an effective management to decrease yield-scaled emissions under rainfed Mediterranean conditions.

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