Effect of urease and nitrification inhibitors on N_2O emissions, ammonia volatilization and crop yield in a rape crop

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Abstract

A field experiment was conducted in an Oilseed rape (*Brassica napus L.*) crop in central Spain. We evaluated three different fertilizer treatments: conventional fertilizer (urea), fertilizer with urease inhibitor and fertilizer with urease and nitrification inhibitors. Nitrous oxide (N_2O) emissions, ammonia (NH_3) volatilization and yields were measured. Our results indicated that the urease and nitrification inhibitors were effective to decrease N_2O emissions but not NH_3 volatilization under rainfed Mediterranean conditions.

Keywords: double inhibitor, NBPT, micrometeorological technique

1. Introduction

The rising world population and renewable energy policies are increasing oilseed demand. However, the formation and emission of nitrous oxide (N_2O), both directly and indirectly (e.g. derived from ammonia (NH_3) previously volatilized) could partially offset the climate benefits associated to bioenergy production (Köbke *et al*., 2018). In this context, mitigation practices should be achieved without compromising yields.

2. Materials and Methods

A field experiment was performed in central Spain in a rainfed oilseed rape (*Brassica napus* L.) crop under Mediterranean climate. A randomized complete block design with three replicates was established for N_2O measurements. Regarding NH_3 volatilization, we arranged a total of six randomised plots (40m x 36m) with two replicates per treatment. The application of fertilizers was adjusted to provide 120 kg total N ha^{-1} for all treatments. The different fertilizer treatments were: 1) Urea (U); 2) U + N-(n-butyl) thiophosphorictriamide, NBPT (UI); 3) U + NBPT + (2-(3,4-dimethyl-1H-pyrazol-1-yl) succinic acid isomeric, DMPSA (U+DI). Nitrous oxide emissions and yields were measured. The integrated horizontal flux method was used for micrometeorological quantification of volatilized NH_3.

3. Results and Discussion

3.1 Nitrous oxide emissions

The NBPT significantly reduced N_2O losses from U by 86%. Similar and higher values have been reported before (85% in rainfed, Abalos *et al.* (2012) and 27% in irrigation conditions, Sanz-Cobena *et al*. (2012); respectively). As observed by these authors, the U+DI was not more effective than the NBPT alone.

3.2 Ammonia volatilization

The highest cumulative volatilized NH_3 was 2.46 kg NH_3-N ha^{-1} for UI. No significant differences were observed between U and U+DI. The NH_3 emission factors (0.9 and 2.1% of U/U+DI and UI, respectively) were 10 times lower

than the expected for this type of agroecosystems (e.g. Sanz-Cobena *et al*., 2014). Our results suggest that precipitation (236 mm the first 30 days after N fertilization) may be important for the abatement of NH_3 since the fertilizer is incorporated to deeper soil layers where diffusion of NH_3 after hydrolysis hardly occur.

4. Conclusion

The NBPT and U+DI mitigated yield-scaled CO_2 eq. emissions reducing the environmental impact of an energy crop. Regarding NH_3 losses, the effectiveness of NBPT was masked by unusual rainy conditions.

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