Reducing NH_3 volatilization and N_2O emissions from agricultural soils

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Abstract

Increasing use and availability of urea-based nitrogen fertilizers have resulted in increased ammonia volatilization from agricultural soils (Drury et al. 2017; Woodley et al. 2018, 2020). Urease inhibitors or improved application methods have been found to reduce losses by ~50%, however, a combination of methods is required to reduce losses even further. When ammonia volatilization losses are reduced, N_2O emissions have increased. A holistic nitrogen application approach is required to mitigate both ammonia and N_2O emissions from agricultural soils. This research focuses on methods which reduce gaseous N losses while improving crop nitrogen use efficiency.

Keywords: urease and nitrification inhibitors, nitrogen application methods

1. Introduction:

Regulatory and economic factors have resulted in urea and UAN fertilizers becoming the dominant N fertilizer sources in Canada. The objectives of the research were to reduce N losses to ammonia volatilization and N_2O emissions and thereby enhance N uptake and crop yields. Effective N management strategies should contribute to reduced N fertilizer application to crops.

2. Methods

Three research trials utilizing improved N sources (urea and UAN with/without urease and nitrification inhibitors), application methods (broadcast, broadcast and incorporated, injected in single and double bands) and N rates (0, 50%, 75%, 100% and 150% of recommend rates) were investigated in 3 studies over a 6-year period. Maize was grown in a clay loam soil in southern Ontario, Canada. Soil inorganic N, growing season N_2O emissions were measured over the growing season. Wind tunnels were used to measure ammonia volatilization losses for 28 days after N application. Crop yields and N uptake were related to the N treatments.

3. Results

Ammonia volatilization losses were high when N was applied as a side-dress application. Urease inhibitors and N placement were effective at reducing N losses and increasing crop N uptake and yields. Pollution swapping occurred when only urease inhibitors were applied but when both urease and nitrification inhibitors were used together, both ammonia volatilization as well and N_2O emissions were reduced. Recent studies have focused on improved placement methods at both recommended and reduced N application rates.

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