Good for soil, grim for the air: More than third of fertilizer use breaking UK Government emissions thresholds

July 20 2023

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Some nitrogen fertilizer types spread on UK farmland are ending up in the atmosphere, with the worst offenders emitting on average 18% of the

applied nitrogen fertilizer as ammonia gas into the air.

In a study published in *Environmental Chemistry,* researchers from the University of Birmingham reviewed ammonia emissions from different synthetic nitrogen fertilizers. They found that uninhibited urea fertilizers, usually used to increase crop production, were the worst culprits for ammonia emissions. In some cases, the amount of fertilizer that ended up emitted into the atmosphere was 77%.

Emissions from these types of fertilizers are often exceeding the expected current maximum emissions factor of 8% being used to estimate national ammonia emission inventory from agriculture.

The data suggest that 34% of synthetic non-urea fertilizers studied are exceeding these thresholds, and in the UK, agriculture is the dominant source of ammonia emissions accounting for around 85% emission annually.

Professor Sami Ullah from the University of Birmingham and senior author of the paper said, "Among plant available nitrogen species, ammonium in soils is a key nutrient for crops upon which our food security depends. The uptake efficiency of crops for nutrients including ammonium is relatively poor, ranging from 20% to 50% on average globally, so a substantial amount of the applied fertilizer is prone to losses from soils including ammonia volatilization into air."

"While ammonia is a very good nutrient to have in soils, its emission into air is a grim matter. Emissions of ammonia pose numerous ecological and human health concerns."

"For example, plant species like mosses and lichens in peatbogs and forests are vulnerable to excessive ammonia being re-deposited back on land, which threatens ecological functioning in otherwise nitrogen-scarce

natural ecosystems. Once in air, ammonia can also react with other atmospheric pollutants forming particulate matter, which results in serious health problems in humans."

Grand challenge

Ammonia emissions reduction, particularly from agricultural ecosystems is a grand challenge as emission reductions of only 14% have been achieved since 1980, and the UK Government's ammonia emission reduction target for 2020 has not been met.

In the study, emissions from synthetic nitrogen fertilizers were reviewed by fertilizer type, land use and soil characteristics to identify areas for policy and management emission reduction interventions. The findings shows that ammonia emissions ranged from -4.0 to 77.0% of the applied nitrogen fertilizer types.

The research team noted that urease and combined urease and nitrification inhibitors (chemicals added to fertilizers that reduces nitrogen gas losses including ammonia emission from soils) significantly reduced emissions by 74.5% and 70 %, respectively, compared to uninhibited urea fertilizers.

Lead author Catrin Rathbone from the University of Birmingham said, "Ammonia emissions are a significant problem in the UK, this shows that extensive field studies are needed to improve our understanding of this grand challenge."

"A series of interventions are needed such as selecting crop types with high nutrient use efficiencies, testing soils before fertilization to match crop demands with available fertilizers and even considering the economic feasibility of emerging nano-fertilizer technologies to achieve efficiency, sustainable production and air quality protection."

More information: Catrin Rathbone et al, Ammonia emissions from nitrogen fertilised agricultural soils: controlling factors and solutions for emission reduction, *Environmental Chemistry* (2023). DOI: 10.1071/EN23010