EFFECTS OF ALTERNATIVE PHOSPHORUS SOURCES ON NITROGEN LEACHING AND N_2O EMISSIONS IN ALFISOLS

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ABSTRACT

Fall-applied phosphorus (P) fertilizers such as monoammonium phosphate (MAP) also add ammonium-N to the soil. During the non-growing season, this N can be lost through nitrate leaching after nitrification and through nitrous oxide (N_2O) emissions from nitrification and denitrification, which contribute to water quality impairment and greenhouse gas emissions. We compared MAP with three alternatives: triple superphosphate (TSP), an N-free P fertilizer; MAP with a nitrification inhibitor (MAPI); and dairy manure solids separated by dissolved air flotation (DAF). We measured their effects on soil N, nitrate leaching, and N_2O emissions in a poorly drained Alfisol. The study was conducted from 2023 to 2026 at the Agronomy Research Center in Carbondale, IL, as a randomized complete block design with four replications and an unfertilized control. Three-year cumulative soil ammonium-N and nitrate-N were similar among DAF, MAP, and MAPI and were greater than under TSP and the control. Three-year cumulative N leaching was 43% lower under TSP and the control than under DAF, MAP, and MAPI. Cumulative N_2O-N emissions followed the same pattern, with greater losses under DAF, MAP, and MAPI than under TSP and the control. The nitrification inhibitor did not reduce soil nitrate, leaching, or N_2O emissions relative to MAP. Daily N_2O-N fluxes were generally highest in March and April. Fall application of an N-free P source (TSP) reduced non-growing season N losses, whereas DAF and MAPI produced N losses similar to MAP.

Keywords: Monoammonium phosphate; triple superphosphate; dissolved air flotation; nitrification inhibitor; non-growing season; nitrate