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Slow-release fertilizers from liquid digestate: amount and speciation of the N leached in a laboratory column experiment

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The inefficient management of fertilizers is dramatically impairing the soil, water, and atmosphere quality. Efficient alternative methodologies for granting adequate N availability to crops while reducing the nutrient losses in the environment are urgently needed. In this work, we present a column leaching experiment in which the amount and speciation of the N lost by different slow-release fertilizers were investigated, in comparison to traditional fertilizers (urea and liquid digestate). The slow-release alternatives are produced by recovering N from liquid digestate and represented by NH_4 -enriched zeolite-rich tuff and struvite. Four treatments were tested consisting in sandy soil fertilized with urea, liquid digestate, NH_4 -enriched zeolite tuff and struvite. N amount and speciation was accounted in eight flushing events over 38 days (Total Kjeldahl N, Organic-N, NH_4^+ -N, NO_3^- -N, NO_2^- -N).

Results showed that urea and liquid digestate fertilized columns lost the majority of N within the first 2 flushing events as organic N and NH_4^+ -N, respectively. On the contrary, struvite and NH_4 -enriched zeolite fertilized columns lost homogeneously fewer N and with a more balanced speciation over the entire experiment length. The mass balance outlined that, native soil N was mined in urea and liquid digestate treatments while in the soil fertilized with slow-release alternatives a fraction of N from the fertilizers was still present. These two slow-release alternatives thus representing a way to recycle N from liquid digestate and to use it more efficiently, minimizing N losses.