Nitrogen Leaching in Sand-based Rootzones Amended with Inorganic Soil Amendments and Sphagnum Peat

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Abstract

Sand-based rootzones are specified for golf course putting greens because they resist compaction and maintain drainage, even under heavy traffic. Although sands provide favorable physical properties, nutrient retention is generally poor and soluble nutrients like nitrogen (N) are prone to leaching. Laboratory experiments were conducted to evaluate several inorganic soil amendments (clinoptilolite zeolite (CZ), diatomaceous earth, and two porous ceramics), which varied in cation exchange capacity (CEC), and sphagnum peat for their ability to limit N leaching. Columns (35 cm tall × 7.6 cm diameter) were filled with 30 cm of sand-amendment mixtures (8:2 v/v) and NH_4NO_3 was applied in solution at a N rate of 50 kg·ha^{-1}. Leaching was initiated immediately using 2.5 pore volumes of distilled water in a continuous pulse. Leachate was collected in 0.1 pore volume aliquots and analyzed for NH_4^+-N and NO_3^--N. All amendments significantly decreased NH_4^+ leaching from 27% to 88% which was directly proportional to the CEC of the amendments. By contrast, NO_3^- losses were consistently high, and no amendment effectively decreased loss compared to non-amended sand. Two amendments with the highest CECs, CZ and a porous ceramic, were selected to further study the effects of amendment incorporation rate, depth, and incubation time on N leaching. Ammonium but not NO_3^- leaching was decreased with increasing amendment rate of both products. At 10% amendment (v/v) addition, only 17% to 33% of applied NH_4^+ leached from the amended sands. Depth of amendment incorporation significantly affected NH_4^+ leaching, with uniform distribution through the entire 30 cm tall column being more effective than placement within the upper 2.5 or 15 cm. allowing the NH_4NO_3 to incubate for 12 or 24 hours following application generally did not affect the amount leached. These results suggest NH_4^+-N leaching is inversely related to CEC of the root-zone mixture and that uniform distribution of these CEC enhancing amendments in the root-zone mixtures reduced N leaching to a greater extent than non-uniform distribution.