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REGULAR ARTICLE

Release of non-exchangeable $^{15}NH_4^+$ from subgrade, decomposed granite substrates and uptake by non-mycorrhizal and mycorrhizal California native annual grass, *Vulpia microstachys*

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Abstract Release rates of recently fixed NH_4^+ from non-exchangeable interlayer sites in 2:1 silicate minerals were determined for decomposed granite (DG) saprolites from three locations in California, USA. Recently-fixed NH_4^+ release from the DG substrate was quantified by extracting diffused NH_4 with H-resin, as well as a native, annual grass Vulpia microstachys. The NH_4 release data varied with via the method of extraction, which included H-resin pre-treatments (Na+ or H+) and V. microstachys uptake (mycorrhizal inoculated or uninoculated). After 6 weeks (1008 h), more NH_4 was recovered from fixed interlayer positions by the H-resins as compared to uptake by V. microstachys. The H treated H-resins recovered more released NH_4 (≈94 mg NH_4 - N kg^{-1} or (12%) of total fixed NH_4) in two of the three DG samples as compared to the Na treated resins, (which recovered 70-78 mg NH_4 - N kg^{-1} (or 9-10%) of the total fixed NH_4). The V. microstachys assimilated 8-9% of the total fixed NH_4 with mycorrhizal inoculum as compared to only 2% without a mycorrhizal inoculum, over the same time period. The fixed NH_4^+ release kinetics from the H-resin experiments were most accurately described by first order and power function models, and can be characterized as biphasic using a heterogeneous diffusion model. Uptake of both the ^{15}N and ambient, unlabelled N from the soils was closely related to plant biomass. There was no significant difference in percent of N per unit of biomass between the control and mycorrhizal treatments. The findings presented here indicate that observed, long-term NH_4 release rates from DG in studies utilizing resins, may overestimate the levels of fixed NH_4 made available to plants and microorganisms. Additionally, the study suggested that mycorrhizae facilitate the acquisition and plant uptake of fixed NH_4, resulting in markedly increased plant biomass production.

Keywords Ammonium fixation . Arbuscular mycorrhiza. Cation exchange resin . Decomposed granite . Revegetation

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Introduction

Decomposed granite (DG) saprolites exposed during road construction are challenging to revegetate. These materials are categorized as erosive regolith or C horizon materials and are characterized by low levels of organic matter, low water holding capacity (high infiltration), nutrient deficiency (of N, P, and some-