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Effect of sulfate fertilization on soil biota in grassland columns

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Sulfur (S) is an important macronutrient element in plant nutrition as a component of protein, enzymes, enzyme cofactors as well as being the major constituent of the amino acids cysteine and methionine. Organically bound S is the predominant form of S in the soil constituting up to 95% of S in agricultural soils. The most important form of S in terms of plant nutrition is inorganic sulfate which forms only about 5% of the total soil S content. Air pollution was the major source of S (as SO_2) for plants, with up to 80% of the S obtained from this source. However, common effects of S limitation on crops such as chlorosis, yield reduction, and decrease in crop quality are becoming increasingly evident as atmospheric S supply has decreased in recent years. Recent research has shown that organically-bound S in soils is also plant-bioavailable, likely due to interconversion of organic S forms to inorganic sulfate by soil microbes. In this study, soil columns were setup in a greenhouse using moderate S (equivalent to Wisconsin S soil availability index of below 30) soils. The columns were planted with Lolium perenne and fertilized with 0 (control), 5 (low), 10 (medium) and 20 (high) kg/ha sulfate S alongside a full complement of other nutrients. Results after 14 weeks of management show a significant decrease ($P<0.05$) in aryl sulfatase activity, mycorrhizal hyphal and arbuscular colonization rates in the high and medium S treatments but no significant effect on bacterial abundance of heterotrophs and aromatic sulfonate-utilizing bacteria upon S fertilization. In addition, soil from the top 20 cm of the column had significantly higher sulfatase activity compared to the bottom 20 cm. The medium and high S treatments had significantly higher grass dry matter yield compared to the control and low S treatments. All S treatments significantly shifted the bacterial community structure compared to the control. Overall, our preliminary results suggest that applying 5 kg/ ha S had similar effects on the soil biota as the control while the application of medium and high S had similar effects on most parameters. Moreover, this study has shown that S should not be overlooked in grassland nutrition as is often the practice. Further analyses are underway to trace the fate of the applied S, nematode abundance, bacterial diversity and function. Studies like ours are important to feed data into mathematical models on biotic S cycling which serves as predictive tool for fertilizer use in agriculture.