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PERSPECTIVE

Natural composition in the retention of phosphorus in eutrophic and dystrophic terrestrial ecosystems

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Phosphorus is a crucial nutrient in terrestrial ecosystems, influencing primary productivity and ecosystem health. However, its retention and cycling vary significantly between eutrophic and dystrophic systems. This paper examines the role of natural composition—specifically soil properties, vegetation types, and microbial communities—in phosphorus retention within these contrasting ecosystems. Eutrophic ecosystems, characterized by high nutrient levels, often experience phosphorus accumulation and potential eutrophication, while dystrophic ecosystems, with low nutrient availability, exhibit limited phosphorus retention and often struggle with nutrient deficiencies. Understanding the natural mechanisms governing phosphorus retention can inform management practices aimed at maintaining ecosystem health and preventing nutrient-related issues. Key factors influencing phosphorus retention include soil texture, organic matter content, pH levels, and the diversity and function of soil microbiota. The study synthesizes current research on these factors and proposes management strategies tailored to the specific needs of eutrophic and dystrophic ecosystems.

Keywords: Phosphorus retention, eutrophic ecosystems, dystrophic ecosystems, soil composition, organic matter, soil pH, microbial communities, nutrient cycling.

Introduction

Phosphorus (P) is an essential nutrient that significantly influences the productivity and ecological balance of terrestrial ecosystems. Its role in various biological processes underscores the importance of understanding how it is retained and cycled within different environments. Eutrophic ecosystems, often enriched with nutrients due to external inputs such as agricultural runoff, contrast sharply with dystrophic ecosystems, which are characterized by nutrient scarcity and low soil fertility. This paper explores the natural composition factors affecting phosphorus retention in these contrasting systems, highlighting how soil properties, vegetation types, and microbial communities contribute to phosphorus dynamics. Soil texture, defined by the proportion of sand, silt, and clay, influences phosphorus retention. Soils with high clay content tend to have greater phosphorus retention due to their higher Cation Exchange Capacity (CEC) and ability to adsorb phosphate ions. Conversely, sandy soils, with lower CEC, are less efficient at retaining phosphorus (Regelink, I. C., et al., 2021).

Description

Organic matter plays a critical role in phosphorus cycling. It enhances phosphorus retention by forming complexes with phosphorus and increasing soil aggregation. In eutrophic ecosystems, excessive organic matter from nutrient-rich sources can lead to phosphorus accumulation and potential leaching. In dystrophic ecosystems, low organic matter content limits phosphorus availability and retention. Soil pH affects phosphorus solubility and availability. In acidic soils, phosphorus can form insoluble complexes with iron and aluminum, reducing its availability. Conversely, alkaline soils may cause phosphorus to bind with calcium, also limiting its availability. The pH levels in both eutrophic and dystrophic ecosystems influence the phosphorus retention capacity and its effectiveness as a nutrient source. Different plant species have varying phosphorus uptake capacities. In eutrophic ecosystems, fast-growing plants may rapidly deplete available phosphorus, potentially leading to nutrient imbalances. In dystrophic ecosystems, vegetation often includes species adapted to low phosphorus conditions, which can influence the cycling and retention of phosphorus in the soil (Jindo, K., et al., 2023).

Plant root systems affect phosphorus dynamics through root exudates and mycorrhizal associations. Eutrophic ecosystems may have denser root systems that enhance phosphorus uptake but also contribute to phosphorus leaching when plant growth exceeds nutrient availability. Dystrophic ecosystems may rely on specialized root adaptations and mycorrhizal fungi to maximize phosphorus acquisition and retention. Microbial communities play a crucial role in phosphorus cycling through processes such as mineralization, immobilization, and solubilization. In eutrophic ecosystems, microbial activity may be heightened due to the abundance of organic matter, potentially leading to increased phosphorus cycling and potential losses. In dystrophic ecosystems, microbial communities are often adapted to low nutrient conditions and can efficiently recycle phosphorus, but their activity may be limited by the low availability of organic substrates. Specific microbial functions, such as the activity of phosphate-solubilizing bacteria and mycorrhizal fungi, directly impact phosphorus retention (Cheng, W. P., et al., 2004). Eutrophic ecosystems might experience shifts in microbial communities due to high nutrient availability, while dystrophic ecosystems rely heavily on specialized microorganisms to optimize phosphorus utilization (Debska, B. O. E. N. A., et al., 2009).

Understanding the natural composition factors influencing phosphorus retention in eutrophic and dystrophic ecosystems is essential for developing effective management strategies. In eutrophic systems, managing nutrient inputs and enhancing phosphorus retention through soil amendments and vegetation management can help mitigate potential negative impacts. In dystrophic systems, strategies to improve soil fertility through organic matter addition and appropriate fertilization can support better phosphorus retention and ecosystem health. The retention of phosphorus in terrestrial ecosystems is intricately linked to natural composition factors, including soil properties, vegetation types, and microbial communities. Eutrophic and dystrophic ecosystems exhibit distinct phosphorus dynamics due to their inherent differences in nutrient availability and soil characteristics. By understanding these factors, we can better manage phosphorus retention and address nutrient-related challenges in diverse ecological contexts (Nardi, S., et al., 2021).

Conclusion

Phosphorus retention is a fundamental aspect of nutrient cycling in terrestrial ecosystems, and its dynamics are profoundly influenced by the natural composition of the environment. In eutrophic ecosystems, where nutrient levels are elevated, phosphorus retention is shaped by high soil organic matter, diverse vegetation, and active microbial communities. However, this can also lead to phosphorus accumulation and potential environmental issues such as eutrophication if not managed properly. In contrast, dystrophic ecosystems, characterized by low nutrient availability, face challenges in retaining phosphorus due to limited organic matter, lower soil fertility, and specialized plant and microbial adaptations. The interplay of soil texture, organic matter, pH, plant root systems, and microbial functions all contribute to the efficiency of phosphorus retention. Understanding these factors enables targeted management strategies that address the specific needs of each ecosystem type. In eutrophic systems, practices that reduce excess phosphorus input and enhance soil phosphorus management are crucial. In dystrophic systems, improving soil fertility through organic amendments and careful fertilization can support better phosphorus availability and retention.

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Conflict of Interest

The authors declare no conflict of interest.

References

Regelink, I. C., Egene, C. E., Tack, F. M., Meers, E. (2021). Speciation of P in solid organic fertilisers from digestate and biowaste. Agronomy, 11 :2233.

Jindo, K., Audette, Y., Olivares, F. L., Canellas, L. P., Smith, D. S., Paul Voroney, R. (2023). Biotic and abiotic effects of soil organic matter on the phytoavailable phosphorus in soils: A review. Chemical and Biological Technologies in Agriculture, 10 :29.

Cheng, W. P., Chi, F. H., Yu, R. F. (2004). Effect of phosphate on removal of humic substances by aluminum sulfate coagulant. Journal of Colloid And Interface Science, 272153-157.

Debska, B. O. E. N. A., Szombathova, N. O. R. A., Banach-Szott, M. A. G. D. A. L. E. N. A. (2009). Properties of humic acids of soil under different management regimes. Polish Journal of Soil Science, 42 :131-138.

Nardi, S., Schiavon, M., Francioso, O. (2021). Chemical structure and biological activity of humic substances define their role as plant growth promoters. Molecules, 26 :2256.

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