Extraction of mineral-bound phosphates from runoff sediments using fungal exudates for nutrient recycling

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Abstract

Phosphorus is a finite resource that is critical for ensuring a sustainable food supply for the growing global population. However, bound phosphorus in eroded soil and runoff particulates from agricultural sources accounts for losses of around 8 million metric tons per year or 46 % of total global mined phosphorus input and is also considered a major cause of eutrophication and toxic algal blooms in surface waters. On the other hand, runoff sediments represent an untappped source of recoverable phosphorus that could be recycled as fertilizer nutrients and potentially reduce the demand for mined sources. This poster will present preliminary findings on our study involving the use of organic acids exuded by fungi for extracting and recovering phosphorus (as phosphate ions) bound into the mineral fraction of runoff sediments discharging into eutrophic surface water bodies. Samples of runoff sediments were intercepted from selected discharge points into two eutrophic watersheds in Southwest MI. The sediments were characterized for their total phosphorus content and mineral-bound phosphorus speciation. Runoff sediments were treated using synthetic mixtures of organic acids and fungal fermentation broths with organic acids produced *in situ.* Levels of phosphate liberation and changes in the phosphorus speciation of the runoff sediments after treatment were monitored. The results indicate that organic acids produced by *Aspergillus niger* ATCC 6275 such as oxalate and citrate can extract a significant amount of phosphates bound to the iron, aluminum, and calcium mineral fractions of Macatawa watershed runoff sediments. These findings demonstrate the feasibility of the proposed technology for phosphorus recovery from nonpoint nutrient pollution sources such as runoff sediments. It will help develop an effective, efficient, economical, and environmentally benign system that will benefit the community, agriculture and food production systems, and the environment in terms of resource security and environmental sustainability.

Keywords: Phosphorus, resource recovery, water quality, sustainability