Enhancing phosphorus retention within vegetated buffer strips using amendments

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Summary

Vegetated buffer strips (VBSs) are widely used to reduce the transfer of a range of pollutants, particularly phosphorus (P), from agricultural land to water bodies. However, past research has shown that VBSs are less effective for dissolved P removal from runoff compared to particulate P. There is also concern regarding the long-term saturation of VBS soil with P after which P release to runoff may occur. This research aimed to examine how the immobilization of different forms of P, particularly soluble reactive P, can be enhanced through the application of industrial by-products (IBPs) to VBS soil. A combination of batch, mesocosm and field-scale experiments was used to test the feasibility of this approach using a series of locally available IBPs in the UK, including different types of water treatment residuals (WTRs), and Caphouse ochre. Screening the IBPs through batch experiments demonstrated that aluminium-based WTR (Al-WTR) and ochre had the highest maximum P sorption capacity and rate, and were able to remove P from solutions under a wide range of pH conditions without adverse environmental impacts. Further, mesocosm experiments showed that amending VBS soil with either Al-WTR or ochre can significantly reduce dissolved P concentrations in surface runoff. However, unlike Al-WTR, the effectiveness of ochre declined over repeated runoff events due to erosion of ochre by runoff flow. Finally, field experiments demonstrated the periodic release of dissolved P from VBS soil to surface runoff which can be effectively controlled through amending VBS soil with Al-WTR. Nevertheless, the effectiveness of Al-WTR decreased through time likely due to the development of preferential flow paths as well as burying of Al-WTR with freshly deposited sediments in the VBSs. However, a better understanding of the processes responsible for reduced effectiveness of Al-WTR for P removal is required for the effective management of VBSs.

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