Abstract

The role of soil phosphorus (P) in the eutrophication of fresh water systems is well established. It is crucial therefore to assess the potential loss of P from soil in the various scenarios where soil can come into contact with water. To date, such assessment has often been based on soil P tests that are used for agronomic purposes (e.g. fertilizer recommendations). The purpose of this work was to examine the usefulness of one such test (viz. the Olsen test, which is based on extraction with bicarbonate) for predicting not only the amount of soil P available to plants, but also that which can be desorbed to water in a group of 32 Portuguese soils, of which 29 were acid and 3 calcareous. To this end, we (i) assessed the total amount of phytoavailable P in soil by successively pot-cropping Chinese cabbage, buckwheat and rye; and (ii) measured the amount of phosphate-P desorbed to a dilute electrolyte mimicking fresh water over periods of up to 218 days at soil:solution ratios of 1:100, 1:1000 and 1:10000. Total phytoavailable P and Olsen P were found to bear a quadratic relationship, with Olsen's extractant underestimating the content in phytoavailable P of soils with high Olsen P contents relatively to soils with low contents. The "change point" at which phytoavailable P began to increase rapidly per unit change in Olsen P was 53 mg Olsen P kg^{-1} soil. For the acid soils, a significant quadratic relationship was found between the amount of P desorbed to water and Olsen P at the three soil:solution ratios studied. However, these relationships became less significant when only the soils with an Olsen P value of less than 50 mg kg^{-1} were considered. For the acid soils, the change point at which P input to water began to increase rapidly per unit change in Olsen P was 20, 61 and 57 mg kg^{-1} at the 1:100, 1:1000 and 1:10000 ratio, respectively. At comparable Olsen P values, the calcareous soils released more phosphate to water than the acid soils. On the basis of

our results, we suggest the following environmental threshold values for Olsen P: 20 mg kg^{-1} for P desorption scenarios where the soil:solution ratio is high (e.g. drainage water) and 50 mg kg^{-1} for desorption scenarios where the soil:solution ratio is low (e.g., runoff, water in reservoirs). Both values are higher than the agronomic threshold above which plants are well supplied with P.