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Factors affecting the estimation of available phosphorus to plants

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Usual P indices for agronomic and environmental purpose imply chemical extraction of soil phosphorus. These extractions provide an estimate of the amount of soil P in potential equilibrium with a surrounding solution, which can be considered the amount of releasable P and thus that potentially available for plants. Soil factors affecting the dynamics of P in soil can affect the relationship between P in solid phase and P in soil solution determine the amount of potentially available P and the accuracy of the chemical methods to estimate it. The main objective of this work was to study which factors related to P dynamics can affect the estimation of total plant available P in a group of soils of similar genesis and under the same management. To this end, P sorption capacity of soil was characterized by doing sorption isotherms at 6 days. Data were fitted to he Langmuir equation and sorption maximum capacity –Xm-, surface affinity factor –k-, and P buffer capacity –PBC- were estimated. Total plant available P (TPAP) in soil was estimated as the cumulative P uptake for a final concentration of 0.02 mg P L–1 in the soil solution, which is the external P requirement typical for field crops. Phosphorus concentration in the soil solution was estimated as that in the 1:10 soil:0.002 M CaCl2 extract. Phosphorus extractions using bicarbonate (Olsen) and anion exchange resin in chloride form at 1 hour (AER) were performed as indices of P availability in soil. The initial P concentration in the soil solution and the PBC at 1 mg P L–1 were found to explain 55 % of the variance in TPAP, thus revealing the significance of the PBC in determining the availability to plants of soil P. Total plant available P was better predicted by the anion exchange resin-extractable P (AER-P) (65% of variance explained) than by Olsen P (not significantly related to TPAP), probably because resin is sensitive to solution P concentration and also takes into account the effect of P buffering capacity of soil, which are factors related to TPAP. By contrast, Olsen P is more closely related to P quantity factor (amount of P in solid phase in equilibrium with the solution) than is to PBC. Only when the affinity factor in the Langmuir equation (k) was considered besides Olsen P, accurate estimates of TPAP were achieved. This suggests that those factors affecting P concentration in the solution in equilibrium with a given P quantity, such as PBC or the affinity of the soil surfaces for P, influence availability of P to plants. Thus, these properties must be taken into account in the performance of rational strategies for P fertilizer management.