

## Estimation of critical Olsen P values in reclaimed marsh soils from southwestern Spain

Antonio Delgado<sup>1</sup>, María del Carmen del Campillo<sup>2</sup>, José Torrent<sup>2</sup>

<sup>1</sup> *Universidad de Sevilla, Sevilla, Spain* <sup>2</sup> *Universidad de Córdoba, Córdoba, Spain*  
*adelgado@us.es*

Chemical indices to assess soil P for environmental or agronomic purposes are based on the estimation of the amount of P that is in equilibrium with the surrounding solution, and can thus be potentially released and taken up by plants or algae. However, the P buffering capacity (PBC) varies widely between soils so different amounts of sorbed P can be in equilibrium with the same solution P concentration.. This obviously affects the critical level for a soil P availability index, below which plants cannot take up sufficient P for optimal growth. It is well established that the PBC is a key factor determining the critical value of any soil P test, and should thus be considered for making P fertilizer recommendations. The main objective of this work was to study the effect of different soil properties, in particular PBC, on the critical Olsen P values for fertilizer response in a group of calcareous soils from a reclaimed marsh area in the Guadalquivir River Valley (southwestern Spain). To this end, Olsen P and P in the solution (estimated as that in the 1:10 soil:0.002 M CaCl<sub>2</sub> extract) were determined after each crop in a pot experiment in which four consecutive crops were grown. The “critical” Olsen P level for each soil was then estimated from the relationship between Olsen P and P concentration in solution (linear relationship;  $R^2 > 0.93$  and  $P < 0.01$  in all cases) for the Olsen P value corresponding to 0.02 mg P L<sup>-1</sup>, which is the external P requirement typical for field crops. The P sorption capacity of the soil was characterized by constructing sorption isotherms at 6 days. Data were fitted to the Langmuir equation and sorption maximum capacity,  $X_m$ , surface affinity factor,  $k$ , and P buffer capacity, PBC (slope at 1 mg P L<sup>-1</sup>), were estimated.

The estimated critical Olsen P value ranged from 2.3 to 14.8 mg kg<sup>-1</sup>. This range is much wider than that reported for calcareous clayey soils from southern Spain and limits the usefulness of Olsen P as a P available test for the studied soils. The estimated critical level for Olsen P was related to PBC (exponentially,  $R^2 = 0.63$ ,  $P < 0.01$ ). PBC is related not only to soil's P sorption properties but also to the degree of saturation of the P-sorbing surfaces (as estimated by the saturation index, SI, calculated as the ratio of Olsen P to clay) ( $R^2 = 0.55$ ,  $P < 0.01$ ). This explains the positive linear relationship between the estimated critical Olsen P levels and SI [ $Y = 1/(-0.06 + 0.008 \text{ SI})$ ,  $R^2 = 0.68$ ,  $P < 0.001$ ]. The estimated critical levels for Olsen P decrease with increasing the Na/Ca mole ratio in the soil:water 1:1 extract ( $R^2 = 0.84$ ,  $P < 0.001$ ) because soils with a high Na/Ca ratio in the solution can maintain a higher P concentration in solution with lower amounts of P sorbed than soils with low Na/Ca ratios. Thus, estimates of the critical values for Olsen P above which response to fertilizer application is unlikely depend on those soil properties which affect the relationships between quantity and intensity factors. In particular, the P saturation of the P-sorbing surfaces seems to play a relevant role through its effect on PBC. The simple SI based on the initial Olsen P and the clay content (an estimate of the P-sorbing capacity of soil) can be useful in defining the critical Olsen P values in calcareous soils —in which the widely used test based on oxalate extraction of P-reactive soil components does not perform well. .