Module 4.5-1   Soil test phosphorus responds to crop phosphorus balances in Argentina.

In Argentina, the Bray-1 extractable P (Pe) index has been calibrated and validated as the standard method for P fertilization recommendations. Because of the low recovery of fertilizer P by crops (usually <25% in the first year), this nutrient may accumulate in soils given applications of P fertilizer to each crop. Conversely, if rates applied are lower than crop removal, soil P availability is reduced, and this can ultimately lead to a decline in soil Pe levels.

The use of P balances is an interesting approach to estimate changes in Pe, and can aid growers to manage nutrients in a more efficient way. P balances are relatively simple to calculate because inputs and outputs can be quantified in most agricultural situations. A positive balance indicates P accumulation, while a negative balance indicates P depletion.

Research was conducted in the central Pampas region of Argentina, on soils cropped to a rotation of maize, soybeans and wheat. The source of P fertilizer was monoammonium phosphate (11-52-0), applied at planting in a band 5 cm below and beside the seed row of each crop. After 6 years, soil sampling to a depth of 20 cm showed a bilinear association between soil Pe levels and the net crop P balance (**Figure 1**). Usually low Pe soils have a rapid response to surplus rates of fertilization, manifested as an increase in soil Pe levels. This is a consequence of the low P fixation capacity of the Mollisolls of the Argentinean Pampas. Based on the results, it is possible to infer that the positive P balance required to increase the soil Pe by 1 mg/kg was 6.2 kg P_2O_5/ha.

Moreover, unfertilized soils exhibited little to no Pe depletion. The occurrence of a plateau at low Pe values could be a consequence of the supply from less soluble P fractions, the mineralization from organic P, and the crop uptake from deeper soil layers and subsequent deposition in the topsoil as crop residues.
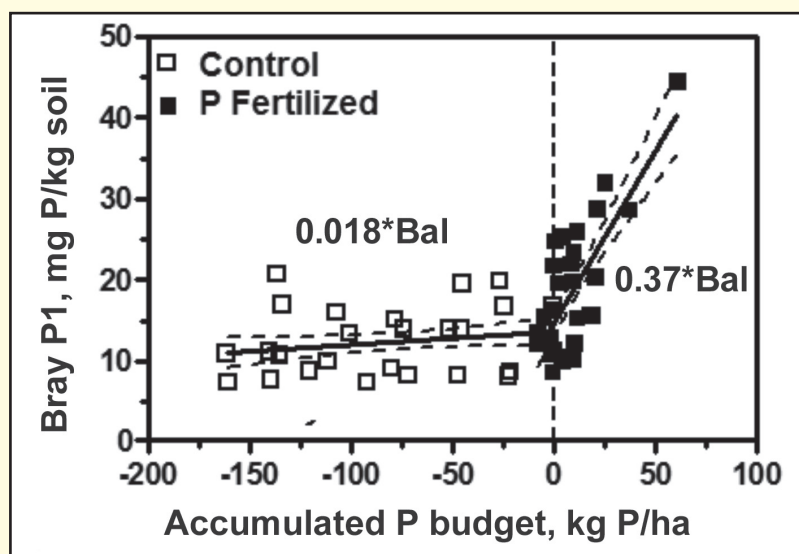

Figure 1. Relationship between Bray-1 extractable P and the accumulated P balance during the experiment (6 yr). The soil test levels along the vertical dotted line represent the conditions at the beginning of experiment. The data were measured from 4 low-P sites. Source: Ciampitti et al. (2011).

The importance of this approach is that it allows growers to estimate the magnitude of the positive P balance that is needed to increase Pe up to a target value. However, the moderate variation of Pe at negative P budgets should be carefully considered, because it is possible that growers do not become aware of the loss of soil P located in fractions that the Pe methodology does not quantify, leading to a progressive reduction of soil fertility.

References

Ciampitti I.A., F.O. Garcia, L.I. Picone and G. Rubio. 2011. Soil Sci. Soc. Am. J. 75: 131-142.