CAN LONG-TERM EXPERIMENTAL PLOTS DEMONSTRATE THE SUSTAINABILITY OF DIFFERENT PHOSPHORUS INPUTS?

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During the past 20 years, there has been a constant reduction in mineral fertiliser use due to price increases, environmental concerns and an increase in crop removal, leading to a phosphorus (P) budget decrease. These changes can lead to a decrease in soil P content, as already observed in some regions in Wallonia, and with P being an essential element for plant growth, this trend is not compatible with yield maintenance. Different studies have examined whether current cropping systems are sustainable, but long-term data are rarely available to understand the influence of cropping systems on soil behaviour or leaching risks or to choose adequate indicators of P. We studied two long-term fertilisation experiments to see whether they could provide answers to these questions for our soils.

The experiments were established in 1967 and 1959 to evaluate the effect of three P and K soil levels and different inputs on yield on a loamy soil at the Walloon Agricultural Research Centre in central Belgium. Soil samples were taken from the plots and analysed in the laboratory to determine different P indicators (degree of P saturation, total P, inorganic P, available P and water-soluble P) and edaphic parameters (total organic carbon (TOC), pH).

The results showed that all indicators were coherent with P levels and correlated with yields, but no differences could be found between fertiliser types. Zero P input caused a mean yield decrease of 7%, while doubling the amount of P removed by crops increased yield by 2% in comparison with plots with input corresponding to crop export. Thus the zero P-input option is rarely economically profitable in the long-term and providing double the amount of P removed is never financially sustainable. Analysis of deeper horizons did not indicate any substantial leaching into these levels, even in plots with double P inputs. Indeed, soil P content at depth in double P export plots was similar to that in plots with no P inputs or soils under forest cover.

So, to conclude, long-term experimental plots can provide the answers to different agronomic and also environmental questions. Moreover, they can help study the sustainability of cropping systems in real situations and determine appropriate P management.