

Assessing phosphorus extractability by Olsen P and AL-P tests in acid soils after P fertilization with compost versus mineral fertilizer

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Material and methods

Experiment

An incubation experiment was performed during 140 days. The soil used was a low-P dystric Regosol and the fertilizers used were a compost obtained through aerobic composting of sewage sludge mixed with sawdust (CP) and single superphosphate (SSP). The P application rates (kg P ha⁻¹) were: 6.5, 13, 26 and 52. Because the standard regulation of maximum application rate of 170 kg N ha⁻¹ through organic amendments the rate of 26 kg P ha⁻¹ was set by adding 19.5 kg P ha⁻¹ in the form of SSP to the compost, and the 52 kg P ha⁻¹ rate by adding 39 kg P ha⁻¹ in the form of SSP. Both the compost and the SSP were added to the soil and maintained at 25°C and at 70% of field capacity.

Methods

After incubation, a composite soil sample was taken of each treatment and replication and analysed for AL-P and Olsen-P. P forms in the compost and in the SSP were also analysed by a sequential fraction method (Traoré et al., 1999): the first extraction was performed with H₂O (H₂O-P), the second with 0.5 M NaHCO₃ (pH 8.5; NaHCO₃-P), the third with 0.1 M NaOH (NaOH-P) and fourth with 1 M HCl (HCl-P).

- Pi in either H₂O or NaHCO₃ fractions is considered easily available to crops;
- NaOH-Pi is considered mainly bound to Fe and Al oxides or metal-organic complexes, and thus considered moderately labile;
- HCl has Pi bound mainly to Ca in low-solubility precipitates, such as apatite or octacalcium phosphate which are considered stable P forms.

Results

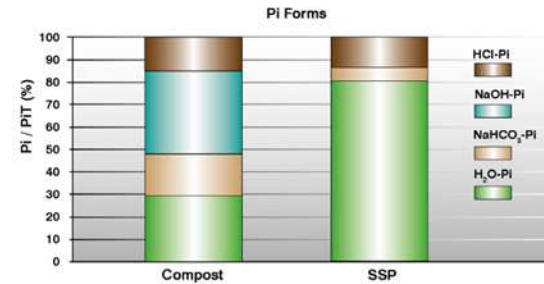


Figure 1. P forms (Pi/PIT, %) in the compost (CP) and in the single superphosphate (SSP)

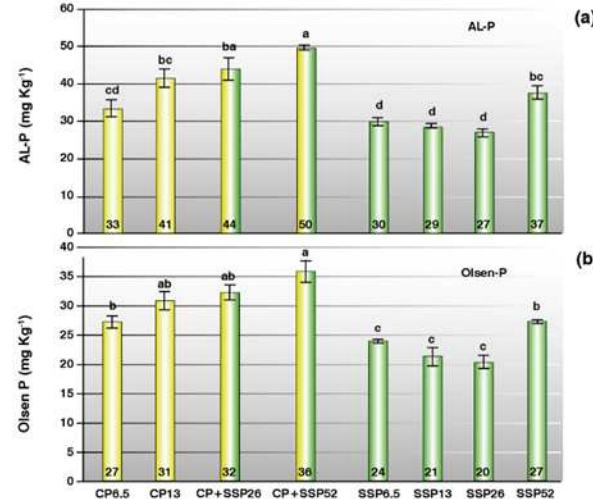


Figure 2. P quantified by (a) ammonium lactate method (AL-P) and by (b) Olsen method (Olsen-P)

Conclusions

- CP had almost 50% of the total amount of Pi in forms easily available to crops and 37% in forms considered moderate labile, mainly bound to Fe and Al oxides or metal-organic complexes.
- Contrary to this, in SSP the forms of Pi considered easily available to crops represent almost 86% of the total amount of P, with a trace amount of NaOH-Pi fraction.
- The HCl-Pi fraction was similar between CP (15%) and SSP (13%).
- Compost increased soil P availability in comparison with mineral fertilization (SSP) at similar rates of soil P fertilization.
- Compost+SSP simultaneous application increased soil P availability when compared with SSP fertilization.
- CP organic matter content decreases soil P sorption therefore, there is an increase in P availability in CP treatments.