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"Filling gaps and removing traps
for sustainable resource management"

Soil Phosphorus and Crop Phosphorus Use Efficiency as Affected by Residue Return on Weathered Soils of West Africa

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Abstract

Most soils in West Africa are acutely deficient in Phosphorus (P); therefore, sustainable P management is important in order to restore their capacity to supply adequate P, improve crop P use efficiency, and sustain crop production. Thus, we investigated the impacts of alternative management practices on soil available phosphorus (Pcal), soil P balance (Pb), and crop P use efficiency (Pe) under maize-cotton rotation system on four weathered soils [Ferric Lixisol (FL), Eutric Plinthosol (EP), Haplic Lixisols (HL), and Plinthic Lixisol (PL)] of West Africa. To this end, on-farm trials were set up in a strip-split plot layout, where 2 levels of tillage (contour ridge tillage, and reduced tillage) were considered as main-plot factor, and sub-plot factors included 2 levels of crop residue management (with and without), and 2 levels of N fertiliser doses (control and recommended dose). After 5 cycles of maize-cotton rotation (2012–2016), Pcal in the topsoil layer were significantly affected by single and interactive effects of soil and residue management. The highest content of Pcal was recorded on HL (64.4 kg ha^{-1}), while both FL and EP had the lowest content (27.1 kg ha^{-1}). Returning crop residues caused an 34.8 % increase in Pcal when averaged across soil types. Also, both Pe and Pb of cotton and maize varied according to soil and crop residue management and their interactions. Pe trends of both cotton and maize were ranked as: HL > PL > EP > FL. As expected, Pb showed the reversed pattern. With the retention of crop residues on surface soils, Pe of cotton and maize improved by 8 % and 8.5 %, respectively. We concluded that soils derived from volcanic materials (high clay content) attributed to poor topsoil Pcal and crop Pe compared to those derived from sandstone (low clay content) materials. Additionally, retention of crop residues led to improved Pcal and crop Pe by acting as an additional source of soil P and protecting surface soil from erosion. Hence, we suggest that returning residues can be a viable measure to manage soil P and sustain crop production in weathered soils of West Africa.

Keywords: Cotton-maize rotation, crop residue, phosphorus use efficiency, soil available phosphorus, West Africa

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