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Cation retention properties of recent volcanic ash soils of Papua New Guinea

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Abstract

In Papua New Guinea, the biggest cash crop is oil palm, which is largely grown on soils formed in recent volcanic ash. Once N deficiency is overcome, cation deficiencies, especially Mg, become significant in these soils. The aim of this work was to examine the soil cation exchange properties that influence Mg retention and release. The soils have variable cation exchange capacity (CEC), negligible anion exchange capacity and pH_{CaCl2} values of 5-6. Mean pH buffering capacity is about 2.5 $cmol_c$/kg per pH unit, and is largely due to organic matter. Fertiliser trials have shown that addition of NH_4SO_4 at commercial rates acidified surface soil by about 0.5-1 unit over 11-16 years, enough to reduce CEC considerably. Where Mg nutrition problems occur, they result from a predominance of exchangeable Ca in the soils. Preliminary examination of mineralogy showed a dominance of anorthite, an easily weathered Ca-rich aluminosilicate primary mineral. Excess exchangeable Ca appears to be out-competing applied Mg for exchange sites, rendering soluble sources of Mg ineffective in this high rainfall environment (2,000-5,000 mm p.a.). Analysis of soil solutions and selectivity experiments also showed a two-fold preference of exchange surfaces for Ca over Mg in virtually all soils. K/Ca selectivity was influenced by parent material, organic matter content and pH. Experiments are underway to find alternative means of supplying adequate Mg to the palms.