Fertilizer Phosphorus Fractions and their Availability to Maize on different Landforms on a Vertisol in the Coastal Savanna Zone of Ghana

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Abstract

A trial was conducted to investigate the fractionation and availability of fertilizer phosphorus to maize on a Vertisol on four different landform technologies in the coastal savanna zone of Ghana. The phosphorus fractions were determined through sequential extraction and correlated with bicarbonate extractable phosphorus and maize dry matter yield. Two main inorganic phosphate fractions, calcium bound phosphate which formed 75%, and iron bound phosphate, 2% of the total inorganic phosphate in the soil, were significantly influenced by the type of landform used. The calcium bound phosphate and the iron bound phosphate independently and significantly correlated with the total inorganic phosphate. The iron bound phosphate constituted the major phosphate fraction in the flat bed while calcium phosphate constituted the major phosphate fraction in the Ridge, Ethiopian and Camber beds. Addition of the fertilizer may have caused greater formation of iron-bound phosphate in the Flat and the Ridge beds than the Ethiopian and the Camber beds. Unlike aluminium-bound phosphate both calcium-bound and iron-bound phosphate independently correlated significantly with maize dry matter yield.

Introduction

The Vertisols of the Accra Plains, generally referred to as Tropical Black Earth, is classified as Calcic Vertisols (FAO/UNESCO, 1990). These soils occupy a total area of about 1,630 km^2 in the coastal savanna zone and 190 km^2 in the interior savanna of Ghana (Brammer, 1967; Adu & Stobbs, 1981). Though they constitute one of the productive soils, the major constraint affecting increased farming activities on these fertile soils include difficulty in tilling the soil, nutrient management problems and lack of technology for the conservation and the shedding of excess water.

The Vertisols in Ghana are derived from hornblende gneiss. The soil has total phosphorus (P_T) of 150-298 mg kg^{-1} and available phosphorus (P) content of 0.1-3.5 mg kg^{-1} (Acquaye & Owusu-Bennoah, 1989). Though Tandon & Kanwar (1984) considered Vertisols that contain less than 5.0 mg kg^{-1} $NaHCO_3P$ as deficient in available P, fertilizer trials on Vertisols in the coastal savanna zone of Ghana gave no significant response to P fertilizer application (Oteng, 1974). The lack of response to fertilizer P application on Vertisols could be attributed to various factors including high P sorption capacity of the soil, soil moisture conditions and, perhaps, P transformation into sparingly soluble forms.

To ensure successful cultivation of the Vertisols, various landform technologies