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Interactions Between Nutrient Availability and Soil Moisture in Tropical Calcareous Soils from Yucatan, Mexico

Edith Aguila Alcantara, Holm Tiessen

Georg-August-Universität Göttingen, Institute of Plant Production and Agroecology in the Tropics and Subtropics, Germany

Abstract

As the strong seasonality in the tropics affects soil moisture, this factor can be an important limiting factor for nutrient availability in calcareous tropical soils. Based on this sentence, we assess in red and black calcareous tropical soils from Yucatan, Mexico; the interaction between two soil moisture levels (100%WHC and 50 % WHC) and the availability to plants of five nutrients (Ca^{2+}, Mg^{2+}, K^{+}, PO_4^{3-}, and NO_3) using ion exchange membranes. Three different land uses were identified: forests, milpas, and homegardens. Because of the extreme soil variability, which appears as a mosaic of black and red soils, the sampling was based on a random design, with colour differentiation. The experiment was conducted during 45 days under controlled laboratory conditions. Soils were placed in two caps with a resin membrane in between and joined with the help of tweezers. Resin membranes were replaced every five days, and the removed membranes were extracted in 0.5 N HCl. Extracts were kept at 4°C, and cations were analysed by atomic absorption Ca^{2+} and Mg^{2+}, and K^{+} by flame emission spectroscopy. Anions were measured by colourimetric analyses. The availability of all nutrients, except phosphorus, was lower at full moisture compare to 50 % WHC in both soil types. For instance, nitrate decreased 40 % when soil water content reached full moisture, while phosphate availability increased around 90 %. Homegardens presented higher content of phosphate and potassium, while nitrate was more available in forests. Related to the differences between both soil types, it was found that nitrate, phosphate and potassium content was lower in red soils compare to the black group, but magnesium was higher. Summarizing, fertility problems of these soils have been caused by low levels of phosphate and potassium, and their interactions with the available water.

Keywords: Calcareous tropical soils, ion exchange membrane, nutrient availability, resin, soil moisture, water content, Yucatan

Contact Address: Edith Aguila Alcantara, University of Göttingen, Crop Sciences - Agronomic in the Tropics, Albrechtthaerweg 20-C, 37075 Göttingen, Germany, e-mail: edithaa72@yahoo.es