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Zinc diffusion and extractability as affected by zinc carrier and soil chemical properties

A.S. Modaihsh
Department of Soil Science, College of Agriculture, University of King Saud, Riyadh, Kingdom of Saudi Arabia

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Abstract

This work was carried out to evaluate the effect of soil chemical properties, Zn carrier and time elapsed after fertilizer application on the diffusion and extractability of Zn. A soil block technique was used to study zinc diffusion and DTPA extractability from ZnEDTA and $ZnSO_4$ fertilizers in three soils that varied in texture, $CaCO_3$ content, organic matter content, and pH using Zn^{65} tracer. ZnEDTA diffused readily in all soils, moving 20–25 mm from the fertilizer layer after three days. The rate of Zn diffusion and the extractability of Zn, however, varied among the soils and were lowest in Baha soil with the highest clay content, organic matter, and CEC despite its lower pH. The high pH and $CaCO_3$ content in Dirab soil did not restrict the diffusion or reduce the extractability of ZnEDTA in this soil. On the other hand, the diffusion of Zn from $ZnSO_4$ fertilizer was largely restricted in all soils and was confined to 5 mm from the fertilizer layer after 13 d. The extractability of $ZnSO_4$ fertilizer was largely affected by soil pH and $CaCO_3$ content and was lowest in Dirab calcareous soil. Organic matter amendment at 5% (as alfalfa) considerably reduced the diffusion and the extractability of $ZnSO_4$ in both Dirab calcareous and Bakyria noncalcareous soils. The application of 1% (w/w) elemental S reduced soil pH and increased Zn diffusion from $ZnSO_4$ fertilizer in Bakyria soil but had slight effect on Dirab calcareous soil.

Introduction

Zinc deficiency is common in soils of Saudi Arabia [1]. The Crop response to Zn fertilization varied with the source of Zn fertilizer, soil chemical properties, and the method of fertilizer application [2, 18]. The uptake of Zn and other micronutrient cations by plants is markedly influenced by their diffusion rate to absorbing roots [15]. Chelating agents have been shown to contribute largely to Zn movement in soil [4, 5, 7]. In some cases, however, using Zn chelates showed no advantage over inorganic forms of Zn fertilizers where Zn deficiency was easily corrected using mineral forms of fertilizer Zn [14]. Zinc diffusion and mobility in soil, and Zn extractability by DTPA were shown to be affected by soil properties [3, 11, 23]. The purpose of this work was to evaluate Zn diffusion and extractability from $ZnSO_4$ and ZnEDTA fertilizers as affected by soil chemical properties and time after fertilizer application, using Zn^{65} tracer. The study was carried out in three soils that varied in texture, CEC, organic matter $CaCO_3$ content, and pH. These soils represent intensively cultivated areas in Saudi Arabia. A soil block technique was used to study the diffusion of Zn from fertilizer layers.