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Effect of Fe-EDDHA on Soybean and Distribution of Chemical Forms of Iron in Soils of Fars Province

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Introduction: Among essential plant micronutrients, iron (Fe) exerts the highest restriction to crop production in Fars Province. Determination of iron chemical forms is one of the accurate methods to study the status of this element (Fe) in the soil. Assessment of the relationships between the chemical forms and soil characteristic helps to describe the chemical changes of iron in the soil. In this study sequential extraction to determine iron forms in soils was conducted in order to provide a clear understanding of elements mobility and availability to plants. Trace elements in the soil are classified into 5 groups of chemical forms. These are the water-soluble and variable, adsorbed, chelate creating with complex compounds, secondary clay minerals, forms of insoluble metal oxide minerals, and primary minerals. Trace elements in the forms of water-soluble, changeable, adsorbed or chelates improve elemental balance in the soil and are known important for plant nutrition.

Materials and Methods: In a greenhouse experiment, the effects of Fe chelate (FeEDDHA) fertilizer levels on William cultivar of soybean (*Glycine max L.*) growth and chemical composition were studied using factorial and completely randomized design with 3 replications. Treatments were consisted of 10 soil samples and 3 levels of Fe applications (control, 5 and 10 mg.kg-1 as Fe EDDHA). The aerial parts of Soybean plant were harvested at 8 weeks after plant emergence.Furthermore, many physical and chemical soil properties and extractable iron content with DTPA and EDTA were determined. Furthermore, by using sequential extraction methods of Singh et al (1988), chemical forms of Iron for example, exchangeable iron (Exch-Fe), organic bounded iron (OM-Fe), amorph iron oxides bounded iron (AFeOX-Fe), crystal iron oxides bounded iron (CFeOX-Fe), carbonate and residual forms of iron in the studied soils, were determined. Finally, concentrations of Fe, Mn, Cu and Zn were detected in plant and soil.

Results and Discussion: Forms of carbonate, organic, amorphous oxide, crystalline iron oxide in the forms of bounded and residual iron showed 0.0053, 0.0016, 0.44, 21.1 and 78.6% of the total soil iron, respectively. Therefore, the content of carbonate, organically bound iron of soil, represented only a small fraction of total soil iron and was considered unimportant in the total iron.In other words, crystalline iron oxide bound iron and residual iron forms constituted an important part of total iron.

The average contents of chemical forms of iron were classified as follows:

Res-Fe>CFeOX-Fe>AFeOX-Fe>Car-Fe> OM-Fe >Exch-Fe

Applications of Fe had a significant effect on dry matter, concentration, and uptake of Fe, Zn, Cu and Mn, extractable forms via extracting DTPA, EDTA, organic and exchangeable forms in soybean, when compared to the control. Among the chemical forms of iron, organic form had a significant positive correlation with the amount of available iron plant (extraction by DTPA). Moreover, most of the physical and chemical properties of calcareous soils studied were significantly correlated with the chemical forms and amount of iron uptake by plant. DTPA extractable iron had a negative significant correlation with pH (R^2=0.514*) and EDTA extractable iron had a positive significant correlation with organic matter (R^2= 0.428*). The strongest correlation among the different chemical forms was obtained between the total and residual iron forms. Furthermore, the form connected to the amorphous iron oxides (AFeOX-Fe) showed a positive significant correlation with crystalline iron oxide bound iron (CFeOX-Fe). Therefore, there were significant correlations between some chemical forms of Fe, indicating the existence of a dynamic relationship between them in soils.

Conclusions: Application of Fe EDDHA resulted in significant increase in the organic and plant available (DTPA) forms of iron and, then it can be inferred that due to significant regression equation (r=0.435*) between two chemical forms of iron (organic and DTPA extracted), the form of organically bound formed the bulk of available iron in the plant. The positive reaction of plant to the use of Fe EDDHA was attributed to a significant increase in absorbable forms of iron in the studied soils. Furthermore, the highest level of iron (10 mgkg^{-1} as Fe EDDHA) resulted in significant decrease of yield and a sharp drop in the concentration and uptake of other

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nutrients such as Cu, Mn and Zn in plant. Thus, production and appropriate stability of the concentration of the other nutrients and good balance should be achievedthrough using an optimum level of Fe EDDHA in the Soybeancultivation.

Keywords: Iron, EDTA, DTPA, Sequential extraction,Chemical and Physical properties of soil