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Potassium May Have Remarkable Dispersive Effect on Soil Structure

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Editorial

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Abstract

Soil structure is central for ecosystem services included crop productivity and erosion control. Two important characteristics of soil structure are form and stability, which can affect soil functions such as soil fluid transport capability that regulates soil aeration and water infiltration [1]. Clay particles associated with mineral and organic soil components are essential in soil structure stability and for sustaining favourable soil conditions in agricultural soils. Monovalent cations such as sodium (Na) or potassium (K) may create clay dispersion and swelling which result in soil structural degradation [2]. Exchangeable K may disperse soil structure similar to Na, however it has received less attention because amounts of K are typically low in salt-affected soils [3]. Only a few studies have shown that K, which is one of macro-nutrients, can also affect soil structure even when the exchangeable Na concentration is small [4]. The effect of K on soil structure compare with Na directly depended on soil clay mineralogy, it means type of clay and degree of weathering also could affect possible dispersive impact of K on soil structure [1,4].

Keywords: Clay Dispersion; Exchangeable Potassium; Structural Stability

Abbreviations

DDL: Diffuse Double Layer.

Introduction

Highlighted Findings

Potassium is one of the most important nutrients for plant growth and obviously has been added into soils as a fertilizer for decades. The impact of K on soil structure has been reported as being equal or less negative than the impact of Na in the literature. However, K in the exchange complex has been shown to affect clay dispersion as well, even at small amounts of exchangeable Na [5]. Rengasamy P, et al. [3] studied soils in Australia with different soil textures included sandy loam, loamy sand, clay loam and clay, and found strong effect of K (both water soluble and exchangeable K) on clay dispersion.

Farahani E, et al. [4] worked on an Iranian loamy soil applied treatment solutions included two levels of electrical conductivity (EC=3 or 6 dS m^{-1}) and six K:Na ratios per electrical conductivity level. They found dispersible clay increased with increasing K concentration, and with increasing K:Na ratio at both EC levels. Also, a negative linear relationship between percentage of water-stable aggregates and dispersible clay was observed. Higher amounts of exchangeable K than exchangeable Na in all the treated samples demonstrated that the higher exchangeable K on

exchange sites of clay particles led to a stronger dispersive power of K [4]. The role of the amounts of exchangeable K and Na in soils and their dispersive charge/effect on clay particles has been discussed by Rengasamy et al. [2]. As a logical explanation for this finding it was revealed that water molecules in the hydration shell of K were more disordered than those hydrating Na. This effect might increase repulsion forces and, hence, generate a K-induced dispersion of clay particles [6].

Diffuse double layer (DDL) thickness as an index of clay dispersion increased with increasing of K in the treated soils with different K concentrations. It demonstrated that K could affect soil structure because of a change in cation selectivity, with K increasing repulsive forces among clay particles and creating dispersion. Also, a positive relation between net dispersive charge and K concentration can show the degrading effect of K on soil structure [7].

Conclusion

Impact of K application on clay dispersion and soil structural stability could be as important as Na especially if clay particles can keep K ions in exchangeable phase to affect diffuse double layer thickness. However, complex dispersive effect of K on different soil structures needs more studies in the feature.

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