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Effect of Location and Physics-chemical Soil Traits on the Content of Different Iron Fraction in Pseudogleys of Western Serbia

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Abstract— This study was conducted on pseudogley soil having different physico-chemical characteristics. Soil samples were collected from tilled fields and meadows at six different locations in Western Serbia. Soil pH, cation exchange capacity, and the content of the finest soil fractions (powder, clay) had the highest effect on the distribution of different forms of iron in the test pseudogleys. The highest iron content was found in the residual fraction (V) (24,689 mg kg⁻¹ in tilled field soil, and 23,564 mg kg⁻¹ in meadow soil). Reductant releasable Fe occluded in oxides (III) was the second most dominant fraction in the soil (4,425 mg kg⁻¹ in tilled field soil, and 3,665 mg kg⁻¹ in meadow soil). The iron content of the soil organic fraction (IV) was low (270 mg kg⁻¹ in meadow soil, and 194 mg kg⁻¹ in field soil). The content of specifically adsorbed iron and iron bound to carbonates was low (2.18-2.73 mg kg⁻¹), and that of Fe in the exchangeable fraction (I) was negligible, about 0.14 mg kg⁻¹. The content of exchangeable, specifically adsorbed and largely oxidized iron increased with decreasing soil pH, CEC and sand content, and with increasing silt particle size. The iron content in the residual fraction increased with increasing soil pH, CEC, clay content, silt plus clay content, as well as with decreasing sand content. The concentration of residual iron was found to be significantly correlated with the clay content and clay plus silt content. The high positive correlation ($r=0.72^{**}$) between the iron content in HF and HNO₃, and that in the residual fraction (V) suggests a low level of iron available to plants in the test pseudogleys of Western Serbia. Therefore, the sequential extraction procedure provides a reliable estimate of the content and availability of iron in the soil.

Keywords- distribution; forms; iron; location; pseudogley; soil.

I. INTRODUCTION

Pseudogleys cover significant areas of Serbia, accounting for about 285,000 ha or 78.73% of the total land area in Western Serbia [1]. These soils are found in moderately moist to moist climates, and they have disturbed water and air relationships characterized by an occasional decrease in very moist i.e. wet and dry phases. Therefore, this soil is

unfavorable for the cultivation of most plants. The unfavorable soil moisture regime is due to the compact lower Btg horizon which is poorly permeable or impermeable. Under dry conditions, the soil surface horizon undergoes intense desiccation, whereas the deeper impermeable horizon hardens. During the wet phase, reduction conditions occur in the soil, resulting in the reduction of different elements, primarily iron (Fe³⁺ to Fe²⁺), manganese, etc. Since the wet phase is short, only more susceptible substances undergo reduction. During the dry phase, oxygen enters the soil, and oxidizes the substances that were reduced during the wet phase (Fe²⁺ to Fe³⁺).

Pseudogleys are rather poor in alkalis, being medium to strongly acid in reaction. They have a highly unfavorable structure, and a low content of organic matter. The acid reaction of pseudogley, its low humus content, and a low supply with available phosphorus and potassium are limiting factors for higher crop yields [2].

Iron is one of the most common elements in the Earth's crust, ranking fourth in abundance after oxygen, silicon and aluminium. In the soil, iron forms a variety of minerals such as hematite, goethite, limonite, notronite, and pyrite. Iron is also present in the form of grain-coatings in oxidized material, and in many secondary minerals [3]. Iron hydroxides play a key role in the biogeochemical cycle, in the bioavailability of iron itself [4, 5] and in the bioavailability of other elements [6]. The bioavailability, mobility and chemical reactivity of heavy metals in soils are often associated with their distribution among certain soil fractions and the dynamic equilibrium among them [7, 8]. It is well known that main factors affecting the mobility of heavy metals in soil include: pH, content and quality of soil organic matter, content and quality of clay fraction, iron and manganese oxides. Apart from soil pH, which is a key parameter, the content and mainly the quality of soil organic matter can influence the availability of heavy metals in soil [9].