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Distribution of soil aggregates and organic carbon in deep soil under long-term conservation tillage with residual retention in dryland

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Abstract: To ascertain the effects of long-term conservation tillage and residue retention on soil organic carbon (SOC) content and aggregate distribution in a deep soil (>20-cm depth) in a dryland environment, this paper analyzed the SOC and aggregate distribution in soil, and the aggregate-associated organic carbon (OC) and SOC physical fractions. Conservation tillage (reduced tillage with residue incorporated (RT) and no-tillage with residue mulch (NT)) significantly increased SOC sequestration and soil aggregation in deep soil compared with conventional tillage with residue removal (CT). Compared with CT, RT significantly increased the proportion of small macroaggregates by 23%–81% in the 10–80 cm layer, and the OC content in small macroaggregates by 1%–58% in the 0–80 cm layer. RT significantly increased (by 24%–90%) the OC content in mineral-SOC within small macroaggregates in the 0–60 cm layer, while there was a 23%–80% increase in the 0–40 cm layer with NT. These results indicated that: (1) conservation tillage treatments are beneficial for soil aggregation and SOC sequestration in a deep soil in a dryland environment; and (2) the SOC in mineral-associated OC plays important roles in soil aggregation and SOC sequestration. In conclusion, RT with NT is recommended as an agricultural management tool in dryland soils because of its role in improving soil aggregation and SOC sequestration.

Keywords: long-term tillage; residue retention; soil aggregates; SOC; deep soil; dryland

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1 Introduction

Soil organic carbon (SOC) is of great importance for soil quality (Plaza-Bonilla et al., 2013; Yang et al., 2014; Yu et al., 2015; Yazdanpanah et al., 2016) and the sustainable development of the environment (Benbi et al., 2016; Ou et al., 2016). It is important to ensure the long-term sustainability of SOC in agro-ecosystems to maintain soil fertility (Liang et al., 2014). Soil aggregates are linked with SOC stabilization and their formation is considered to be crucial for SOC sequestration (Tisdall and Oades, 1982; Balesdent et al., 2000). According to Tisdall and Oades (1982), soil aggregates can be divided into macroaggregates (>250 μm) and microaggregates (<250 μm). Cambardella and Elliot (1993) further classified the aggregates as large

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