

Profile accumulation of organic carbon and its association with macro-aggregates during 100 years of oasis formation

Chenhua Li, Yan Li, and Yugang Wang

Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, China

Abstract

The maintenance and accumulation of soil organic carbon (SOC) is critical to the agricultural sustainability and the environmental stability in oasis-desert belt. The objective of this study was to determine the dynamics of SOC and aggregate structure, as well as the linkage between them throughout a 0–2 m soil profile during oasis formation. The investigation was conducted in five oases and adjacent deserts, at the northern foot of the Tianshan Mountains in Central Asia. Oasis farmlands reclaimed 3, 5, 10, 20, 50 and >100 years ago were compared with the desert pairs they came from. The SOC content significantly increased throughout the whole profile after 20 years of reclamation, despite a loss in the first 10 years of reclamation, especially in deep soils. The values reached maxima at 50 years of reclamation, which increased by 67–135 % comparing to initial values. The macro-aggregate (diameter >0.25 mm) fraction with high carbon (C) concentration significantly increased throughout the soil profile after reclamation, and showed the greatest variation during oasis formation, compared with the other aggregate fractions (0.25–0.053 mm and <0.053 mm). These changes were significantly correlated with increases in soil nutrients and microbial biomass and decreases in soil pH and salt during oasis formation. In conclusion, the oasis formation enhanced SOC accumulation not only in topsoil but also in deep soil, and soil aggregate structure was improved by increased macro-aggregates. The formation of macro-aggregates and the increase in their associated C had significant correlations with the SOC accumulation. Fertilization, especially nitrogen fertilization, very likely promoted the SOC accumulation and soil aggregation by annual input of crop residues into the originally poor desert soils during oasis formation.