生态学报 2006 26 (2006(12)): 4148～4155 ISSN: 1004-616x CN: 44-1063/R

研究论文

农业土地利用方式对华北平原土壤有机碳组分和团聚体稳定性的影响

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收稿日期 2005-8-28 修回日期 2005-12-10 网络版发布日期: 2006-12-25

摘要 作为土壤质量的重要指标，土壤有机碳及其组分在土壤许多物理、化学和生物特性中发挥着重要作用。以在华北平原具有代表性的禹城市作为研究区域，系统研究和分析了该地区不同农业土地利用对土壤有机碳组分和团聚体稳定性的影响。结果表明：与传统小麦-玉米轮作的粮田相比，果树和苜蓿栽培明显增加了土壤总有机碳（TOC）和总氮（TN）含量，同时也显著提高了土壤易氧化有机碳（EOC）、颗粒有机碳（POC）、轻组有机碳（LFOC）和水溶性有机碳（WSOC）含量和分配比例。果园土壤微生物生物量C（MBC）和可矿化碳（MNC）较传统粮田的土壤分别增加了34.0.5%和66.3%。果树栽培还明显增加了土壤>250μm水稳性团聚体（WSA）的含量，同时减少了土壤粘粒分散率（CDR）。苜蓿栽培也显著提高了土壤MBC和MNC含量以及团聚体稳定性。温室大棚栽培前期（2～3a）的土壤TOC和TN较传统粮田略有增加，但随着耕作历史的增加，土壤TOC和TN呈现逐年下降的趋势。与传统粮田相比，温室大棚内的土壤LOC，POC，LFOC和WSOC含量与比例均有明显下降，这种下降幅度随栽培历史的延长而明显增加。7～10a温室大棚栽培的土壤EOC，POC，LFOC和WSOC含量较传统粮田分别下降了31.3%，41.7%，35.6%和42.1%。 温室大棚栽培的土壤MBC和MNC较传统粮田的土壤平均分别低15.9%和10.1%。温室大棚栽培，特别是长期栽培降低了土壤中>250μm水稳性团聚体的含量和粘粒的稳定性。相关分析表明，土壤>250μm水稳性团聚体的含量与所测定的有机碳组分含量皆成明显的正相关，特别是POC，LFOC和MBC与WSA达到极显著相关，相关系数分别为0.912, 0.893, 0.856。 这表明，土壤POC，LFOC和MBC对维持土壤团聚体稳定性具有更为重要意义。

关键词 华北平原；农业土地利用方式；有机碳组分；微生物生物量碳；团聚体稳定性

分类号 S153.6

Organic carbon fractions and aggregate stability in an aquatic soil as influenced by agricultural land uses in the Northern China Plain

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Abstract As an essential indicator of soil quality, soil organic carbon (SOC) and its fractions play an important role in soil chemical, physical, and biological properties. The effects of agricultural land uses on soil organic carbon fractions and aggregate stability were studied in an Fluvo-aquic soil in Yucheng city, Shangdong Proince of Northern China. Five agricultural land uses were investigated as following: (ⅰ) crop field with wheat-maize rotation, (ⅱ) orchard field, (ⅲ) clover field, (ⅳ)greenhouse vegetable cultivation (23a), and (ⅴ)greenhouse vegetable cultivation (710a). Orchard soils showed highest total organic carbon (TOC) followed by clover field and greenhouse cultivation (23a) soils. By fractionalizing SOC, Orchard and clover soils showed significantly ($p<0.05$) higher soil easily oxidizable C (EOC), particulate organic C (POC), light fraction organic C (LFOC) and water-soluble organic C (WSOC), relative to wheat-maize rotation. For orchard soils, the proportions of EOC, POC, LFOC, and WSOC as a percent of TOC were highes

t among all the agricultural land uses. Fruit cultivation increased soil microbial biomass carbon (MBC) and soil mineralisable organic carbon (MNC) by 34.0% and 66.3%, respectively, as compared to the wheat-maize rotation. Fruit cultivation increased significantly ($p<0.05$) the content of soil water-stable aggregate >250μm (WSA), as well as decreased soil clay dispersion rate (CDR). Conversion of crop field with wheat-maize rotation into clover cultivation also greatly improved soil MBC, MNC, and soil aggregate stability.
Greenhouse vegetable cultivation (23a) had slightly higher TOC, LOC, POC, LFOC and WSOC than the wheat-maize rotation. However, TOC and the investigated soil organic fractions f unchangeably declined with the increase of cultivation period. Soil LOC, POC, LFOC and WSOC for greenhouse vegetable cultivation (710a) decreased by 31.3%, 41.7%, 45.6% and 42.1%, respectively, compared to the wheat-maize rotation. Greenhouse vegetable cultivation showed significantly ($p<0.05$) lower soil MBC and MNC than the wheat-maize rotation. Green-house cultivation (710a) decreased soil WSA, and increased CDR, as compared to the wheat-maize rotation. Correlation analysis showed that soil WAS and CDR was significantly ($p<0.01$ or $p<0.05$) related to SOC and its fractions. More significant ($p<0.01$) correlations between WSA and POC, LFOC, and MBC were found with the coefficients (r) of 0.912, 0.893, 0.856, which suggests that POC, LFOC, and MBC play a vital role in maintaining soil aggregate stability.

Key words Northern China Plain _ agricultural land uses _ organic carbon fractions _ microbial biomass C _ soil aggregate stability

DOI

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