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长期施肥对潮土团聚体有机碳分子结构的影响

Effect of long-term fertilization on molecular structure of organic carbon in soil aggregates in fluvo-aquic soil

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中文关键词:团聚体 有机质 ^{13}C -核磁共振 有机肥

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中文摘要:

采取长期施用有机肥（CM）、1/2化肥氮和1/2有机肥氮（HCM）、化肥（NPK）和不施肥对照（CK）的土壤，用湿筛法分为大团聚体（2000~250 μm）、微团聚体（250~53 μm）和粉砂+黏粒组分（<53 μm），利用固态^{13}C-核磁共振技术分析了土壤和团聚体中有机质的分子结构特征。结果表明，随着团聚体粒径减小，烷基碳/烷氧碳比值逐渐提高，并与土壤C/N呈显著负相关（R^2 = 0.421，p = 0.022），表明随着团聚体粒径减小，有机质的分解程度不断增加。与对照土壤相比，长期施用有机肥（HCM和CM处理）提高了土壤中烷氧碳和羰基碳的相对含量，烷氧碳的增加主要是由于大团聚体中甲氧基和含氮烷基碳相对含量的增加，羰基碳则主要在大团聚体和微团聚体中积聚。施用化肥土壤提高了烷氧碳和烷基碳的相对含量，烷氧碳增加主要是由于大团聚体中甲氧基和含氮烷基碳以及微团聚体中含氧烷基碳相对含量的提高，烷基碳增加主要发生在大团聚体。有机肥和化肥处理土壤中芳基碳相对含量降低1.8%~4.6%，主要是大团聚体和微团聚体中芳基碳比例下降引起的。而在粉砂+黏粒组分中芳基碳和酚基碳均增加，烷基碳相对含量降低5.9%~7.1%，表明施肥更利于芳香碳在小粒径组分中积累，减弱烷基碳在小粒径组分中的积累。结果表明长期施用有机肥可通过大团聚体和微团聚体物理保护肥料带入的大量碳水化合物和有机酸从而提高土壤有机碳含量。

英文摘要:

Soil samples were collected from a long-term field experiment which had four treatments, i.e. compost (CM), half N in compost plus half N in fertilizer (HCM), fertilizer (NPK) and control without any fertilizer or compost(CK) and sifted into macroaggregate (2 000~250 μm), microaggregate (250~53 μm) and silt+clay fraction (<53 μm) suing the wet-sieving method for analysis of molecular structure of the organic matter in the soil and the aggregates on the solid-state ^{13}C -nuclear magnetic resonance (^{13}C -NMR) spectroscope. It was found that the ratio of alkyl-C/O-alkyl-C increased with decreasing aggregate size, and was also significantly negatively correlated with the C/N ratio（R^2 = 0.421，p = 0.022）. These findings suggest that the finer the aggregates, the more the organic matter therein decomposed. Compared with CK, treatments HCM and CM increased the ratio of O-alkyl-C or carbonyl-C to total organic C in soil. The increase in the proportion of O-alkyl-C in the soil was mainly attributed to the increase in relative content of methoxyl-C and N-alkyl-C in macroaggregates, and accumulation of carbonyl-C in macroaggregates and microaggregates of the soil. The application of chemical fertilizer increased the ratio of O-alkyl-C and alkyl-C to organic C in the soil. The increase in the proportion of O-alkyl-C was mainly attributed to the increase in methoxyl-C or N-alkyl-C in macroaggregates and O-alkyl-C in microaggregates, whereas that of alkyl-C was mainly observed in macroaggergates. Compared with CK, application of either organic matter or chemical fertilizer reduced the relative content of aryl-C in the soil by 1.8%~4.6%, which was mainly attributed to the decrease in the proportion of aryl-C in macroaggregates and microaggregates; however, in the fraction in the silt+clay the proportion of aryl-C and phenolic-C increased, but that of alkyl-C decreased by 5.9%~7.1%, indicating that fertilization facilitates accumulation of aromatic-C, but weakens that of alkyl-C in fractions small in particle size. All the findings indicate that long-term application of organic manure helps conserve physically the large amount of carbohydrates and organic acids manure carries in in macroaggregates and microaggregates, thus raising the content of organic carbon in soil.

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