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长期施肥对小麦-玉米作物系统土壤腐殖质组分碳和氮的影响

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Effects of long-term fertilization on soil humus carbon and nitrogen fractions in a wheat-maize cropping system

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摘要 通过对华北平原小麦–玉米轮作农田生态系统18年田间施肥试验，研究了长期不同施肥处理对耕层（0—20 cm）土壤腐殖质及活性腐殖质组分碳和氮的影响。试验设化肥NPK不同组合（NPK、NP、NK、PK），全部施用有机肥（OM），一半有机肥+化肥NPK（1/2OMN）及不施肥（CK）共7个处理。结果表明，各施肥处理均能在不同程度上增加土壤腐殖质（胡敏酸、富里酸和胡敏素）及活性腐殖质（活性胡敏酸和活性富里酸）组分碳和氮含量，提高可浸提腐殖质（胡敏酸和富里酸）及活性腐殖质组分碳和氮分配比例；但施肥对土壤活性腐殖质组分碳和氮含量的增加率均分别高于腐殖质组分碳和氮。各处理土壤腐殖质及活性腐殖质组分碳和氮含量均为OM处理最高，且有机肥与化肥NPK配施高于单施化肥各处理；而化肥处理中NPK均衡施用效果最好。说明施用有机肥、有机肥与化肥NPK配施及化肥NPK均衡施用是增加土壤腐殖质及活性腐殖质组分碳和氮的关键；活性腐殖质组分碳和氮较腐殖质组分碳和氮对施肥措施的响应更灵敏。

关键词： 长期施肥 土壤腐殖质 活性腐殖质 有机碳和氮组分 长期施肥 土壤腐殖质 活性腐殖质 有机碳和氮组分

Abstract:

that applying organic manure or its combination with fertilizer NPK and the balanced application of fertilizer NPK could be the keys for the increase of soil C_{HA}, C_{FA}, C_{HM}, C_{LHA}, C_{LFA}, N_{HA}, N_{FA}, N_{HM}, N_{LHA} and N_{LFA} contents; soil labile humus C and N fractions were more sensitive to fertilization practices than soil humus C and N fractions, respectively. The contents of soil humus (including humic acid, fulvic acid, and humin) and labile humus (including labile humic acid and fulvic acid) carbon and nitrogen fractions in 0–20 cm soil layer were studied on a long-term fertilization field under wheat-maize cropping rotation in North China Plain. The long-term fertilization experiment was designed to include 7 treatments: fertilizer NPK (NPK), organic manure (OM), half organic manure with fertilizer NPK (1/2OMN), fertilizer NP (NP), fertilizer PK (PK), fertilizer NK (NK) and control (CK). After 18 years fertilization, all the manure and fertilizer treatments showed higher contents of humic acid carbon (C_{HA}) and nitrogen (N_{HA}), fulvic acid carbon (C_{FA}) and nitrogen (N_{FA}), humin carbon (C_{HM}) and nitrogen (N_{HM}), labile humic acid carbon (C_{LHA}) and nitrogen (N_{LHA}), and labile fulvic acid carbon (C_{LFA}) and nitrogen (N_{LFA}), and higher proportions of C_{HA}, C_{FA}, C_{LHA} and C_{LFA} in total organic carbon (C_T) and of N_{HA}, N_{FA}, N_{LHA} and N_{LFA} in total organic nitrogen (N_T). The increased rate of contents of soil labile humus C and N fractions were higher than that of soil humus C and N fractions, respectively. Among the fertilization treatments, treatment OM has the highest contents of soil humus and labile humus carbon and nitrogen fractions, followed by treatment 1/2OMN, and the treatments of applying chemical fertilizer alone. Balanced application of fertilizers (treatment NPK) showed higher contents of soil humus and labile humus carbon and nitrogen fractions than imbalanced use of fertilizers (treatments NP, PK, and NK). It was suggested
that applying organic manure or its combination with fertilizer NPK and the balanced application of fertilizer NPK could be the keys for the increase of soil C_{HA}, C_{FA}, C_{HM}, C_{LHA}, C_{LFA}, N_{HA}, N_{FA}, N_{HM}, N_{LHA} and N_{LFA} contents; soil labile humus C and N fractions were more sensitive to fertilization practices than soil humus C and N fractions, respectively.

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