秦晓波,李玉娥,万运帆,廖育林,范美蓉,高清竹,刘硕,马欣.耕作方式和稻草还田对双季稻田CH4和N2O排放的影响[J].农业工程学报,2014,30(11):216-224

耕作方式和稻草还田对双季稻田CH4和N2O排放的影响

Effect of tillage and rice residue return on CH4 and N2O emission from double rice field

投稿时间： 2014-01-14 最后修改时间： 2014-03-18

中文关键词: 温室气体 排放控制 秸秆 双季稻田 免耕 高茬还田 交互效应

英文关键词:greenhouse gases emission control straw double rice field no-till high stubble interaction effect

基金项目:公益性行业（农业）科研专项经费（201103039）；国家"973"计划项目（2012CB417106）；中国低碳发展宏观战略研究项目：农田和草地碳汇潜力与扩增战略研究（2013-2014）。

作者	单位
秦晓波	1. 农业部农业环境与气候变化重点实验室，中国农业科学院农业环境与可持续发展研究所，北京 100081
李玉娥	1. 农业部农业环境与气候变化重点实验室，中国农业科学院农业环境与可持续发展研究所，北京 100081
万运帆	1. 农业部农业环境与气候变化重点实验室，中国农业科学院农业环境与可持续发展研究所，北京 100081
廖育林	2. 湖南省土壤肥料研究所，长沙 410125
范美蓉	3. 长沙环境保护职业学院，长沙 410004
高清竹	1. 农业部农业环境与气候变化重点实验室，中国农业科学院农业环境与可持续发展研究所，北京 100081
刘硕	1. 农业部农业环境与气候变化重点实验室，中国农业科学院农业环境与可持续发展研究所，北京 100081
马欣	1. 农业部农业环境与气候变化重点实验室，中国农业科学院农业环境与可持续发展研究所，北京 100081

中文摘要:

稻田温室气体（甲烷和氧化亚氮）排放强度受多种田间管理的影响，以往对各种措施间的交互效应研究较少。为此，该研究利用改进的静态箱－气相色谱法进行了连续4个生长季的湖南典型双季稻田温室气体排放强度观测，旨在分析耕作和稻草还田2种措施的交互效应并探寻多措施联合减缓温室气体排放强度的途径。试验设4个处理：翻耕（CWS，conventional tillage without straw residue）、免耕（NWS，no till without straw residue）、免耕高茬还田（HN，no till with high stubble straw residue）和翻耕高茬还田（HC，conventional tillage with high stubble straw residue）。结果表明，耕作和稻草还田2种措施对稻田甲烷排放有显著的交互效应（P＜0.05），但对氧化亚氮交互效应不显著。2种措施对稻田温室气体排放强度的影响有明显的季节和年际变异。多生长季平均而言，各处理甲烷排放顺序为HC＞HN＞CWS＞NWS（HC显著高于HN，HN和CWS差异不显著），水稻产量顺序为CWS＞HN＞HC＞NWS（HN和CWS差异不显著），而温室气体排放强度（greenhouse gas intensity）顺序为HC＞CWS＞HN＞NWS（HN显著低于HC和CWS，P＜0.05）。可见，"免耕高茬还田"模式能抵消翻耕处理的高温室气体排放，并能比NWS处理提高水稻产量，显著减缓双季稻田温室气体排放强度。在保护性耕作和农田碳库提升的需求下，该模式应被予以高度重视。该研究可为中国双季稻主产区温室气体排放强度减缓措施的选择提供科学支撑。

英文摘要:

Abstract: Greenhouse gas intensity (GHGI) (methane and nitrous oxide) of double rice paddy was controlled by various field managements, tillage, and rice straw return to the field. On one hand, the choice of the tillage mode affects the gas permeability of soil during the crop-growing stage. On the other, the incorporation of rice straw can be a critical way to amend the loss of soil carbon. Both of the two practices have their advantages and disadvantages on rice production and environmental effects. In fact, no tillage causes less methane emissions from double rice fields than the field with conventional tillage. Nevertheless, rice straw return to the field increases tremendous methane production and emission of organic carbon. In spite of its promotion on rice productivity and sequestration of soil organic carbon pool, this practice is still under discussion .Therefore, multi-management mode should be considered simultaneously when regional or national policy is made to reduce GHGI from agriculture. To date, the study of the interaction effect of tillage and the rice residue return on GHGI from double rice fields is lacking. Most of the previous studies focused only on one field management and its influence mechanism. Consequently, we conducted a measurement for 4 rice growing seasons on GHGI of a double rice field in Hunan, China to investigate the interaction effect of tillage and rice straw return on both the social-economical and environmental benefits. The improved static chamber－GC (gas chromatography) method was used to monitor the greenhouse gas emissions from the rice paddy. Major improvements made on the chamber include the adjustable sampling tube and the pores in the base. The former was designed to change with the growth of the rice plant and the latter favored the communication of soil water between the inside and outside of the base. Both of them enhanced the accuracy of the field measurement. Four field practices were included in this research, viz. CWS (Conventional tillage, without straw residue return), NWS (No till, without straw residue return), HN (High stubble residue retain, no till), and HC (High stubble residue retain, conventional tillage). Results showed that there is a significant interaction effect of tillage and rice residue return on methane emissions (P<0.05) instead of nitrous oxide emissions from the double rice field. The interaction effect has pronounced seasonal and inter－annual variation. By the seasonal average value, the sequence of methane flux of each treatment is the following: HC>HN>CWS>NWS (HC significantly greater than HN while no significant difference between HN and CWS). Similarly, the amount of rice grain yield of each treatment of the 4 seasons is the following: CWS>HN>HC>NWS (no significant difference between HN and CWS). For the GHGI, the following order is disclosed: HC>CWS>HN>NWS (HN less than HC and CWS significantly, P<0.05). This indicated that compared to CWS, "no-till plus high stubble residue (HN)" offset the stimulations of conventional tillage on methane production and emission while simultaneously promoting the rice grain yield. Thus the multi－management mode mitigated the GHGI of the double rice field significantly. Under the requirement of organic tillage and the sequestration of agricultural soil carbon pool, HN mode should be considered of great importance. This study can provide scientific support on the measurement choice of greenhouse gases effect reduction from the major rice production region of China.

主办单位：中国农业工程学会 单位地址：北京朝阳区麦子店街41号

服务热线：010－65929451 传真：010－65929451 邮编：100125 Email：tcsae@tcsae.org