ORIGINAL ARTICLE

Different Cracking Temperature Rice Straw Biological Carbon on SoilCH_4,N_2O Emissions Influence Analysis

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Abstract: Biological carbon can effective reducing greenhouse gas(CH_4,N_2O)EmissionsDifferent cracking temperature under biological carbon of paddy field soilCH_4,N_2OEmissions of influence and mechanism need to further explore.This study use two Raw Material Origin(Harbin,Danyang)Rice Straw biological carbonTo Jiangsu Province Danyang typical rice rotation field for study areaStudy Applied Different cracking temperature rice straw biological carbon on SoilCH_4,N_2OEmissions of influence.Results show that:(1)Compared with conventional fertilizationApplied300,500,700Crack

Solution of Danyang and Harbin rice straw biological carbonCH_4Cumulative emissions respectively reduce10.38%,21.09%,13.28%And42.83%,65.29%,55.44%N_2OCumulative emissions respectively reduce42.77%,53.54%,51.19%And45.34%,48.51%,48.40%;(2)By greenhouse gas emissions strength formula calculatedApplied500 Cracking of Danyang and Harbin rice straw biological carbon respectively300 ,700 Reduce27.09%,25.85%And40.54%,8.09%;(3)Analysis500 Crack

Solution Temperature of biological carbon emission reduction effect is better300 ,700 The main reason is applied three cracking biological carbon afterSoil of methane ancient Bacteria abundance value reduceAnd500

Lower300 ,700 Biological CarbonAverage reduce48.33%,29.35%.At the same time applied500 Biological carbon soil nitrification bacteria abundance lower than applied300 ,700 Students

Keywords: X712 Literature identification code

Extraction four times gasInjection to mark. of aluminum foil sampling bag(0.1 L)In.Gas Production completeRecord Box Gas and Soil TemperatureWill cai ji dai back to laboratory.The gas chromatography Analyzer(GC580)Determination of Gas-likeCH_4AndN_2OThe emission flux.CH_4Determination DetectorFIDColumn temperature40Detector temperature375ToN_2As an carrier gasH_2As an Gas.N_2ODetermination DetectorECDColumn temperature40Detector temperature350To high purityN_2As an carrier gas.By standard gas and to be measured gas of peak area to calculation to be measured gas concentration.

1.4 Analysis Index Determination

1.4.1 Biological Carbon physical and chemical properties to determine the carbon of elements determination the yuanOf Analyzer(EA2400 Ⅱ USA),Respectively DeterminationC,H,O,NElements.Biological Carbon of wai hong spectral analysis is the Fourier Transform Infrared Spectrometer(Nicolet iS50)DeterminationSpecific methods for take a small amount of dry biomass carbon samples andKBRMixedFull grinding uniformPlaced tablet press medium voltage made sheet after determination.The than surface area and aperture distribution instrument

Autosorb-iQ2-MP)Determination of biological carbon of than surface area and aperture points

Than surface area determination selectBETModelAperture analysis selectBJH

Model.Samples in150Vacuum Conditions under degassing2 hTo clear sample surface has adsorption of material99.999% N_2For adsorbateLiquid nitrogen temperature

77 KIn saturated vapor pressure1.0360 bar.P/P_0Take point0.05 ~ 0.35Range.

1.4.2 Microbial abundance and community structure sequencing Based onHiSeq2000

Sequencing PlatformThe16 S rRNAHigh Flux sequencing means on Soil Microbial Genome Sequencing.Extraction kit for Shenzhen acic bissell science and technology the company AmericanMobioOf strong SoilRDNAExtraction kit.Sequencing the company for Wuxi hong zhong gene science and technology limited the company.HiSeqSequencing process main includingDNAExtraction,Primers Design and Synthesis,PCRAmplification and

Product Purification,PCRProduct quantitative and were normalized,HiSeq PELibrary System

By,HiSeq PEHigh Flux sequencing.UseUparseSoftware of effective

According97%The consistencyOTUClusteringAnd useGreengene

Database the species comment.

1.5 Data of processing and statistical

1.51 Calculation Formula Ch_4.AndN_2.OEmission Flux Calculation Formula[11]:

=P× V/A × DC/dt × 273/(273 T)

-InFForCh_4-CEmission Flux(Mg $m^{-2}H^{-1}$)OrN_2O-NEmission Flux(Ug $m^{-2}H^{-1}$);PFor standard state underCh_4-COrN_2O-NOf DensityRespectively0.54G L^{-1}And1.25g L^{-1};VFor sampling box effective volume(M^3),This study0.125 m^3AFor gas production box the cover of paddy field Soil Area(M^2),This study0.25 m^2;DC/dt

Ch_4AndN_2OThe emission rate(Ul $L^{-1}H^{-1}$);TFor sampling process in static box of average temperature().

Greenhouse gas cumulative emissions(Kg hm^{-2})Calculation Formula[12]: InR_CFor greenhouse gas cumulative emissions(Kg hm^{-2});NFor rice growth period number of observations;F_IAnd$F_{I\ 1}$For the firstITimes and the firstI 1Times sampling when Greenhouse Gas Emission Flux(Mg $m^{-2}H^{-1}$OrUg $m^{-2}H^{-1}$),F_1,F_NRespectively for the first time and finally a sampling when Greenhouse Gas Emission Flux;T_I1AndT_IFor the firstI 1Times and the firstITimes Sampling Time Interval

D);AFor transformation coefficientFor rice the whole growth days(Tillage to harvest)In addition to sampling during daysFor135/130.

Of Greenhouse Effect(Global Warming PotentialGWP)More

Used to estimateCh_4,N_2OAnd many kinds of Greenhouse Gas of Climate Change of Comprehensive Effect[13].Calculation Formula:

GWP = 25 × R_{CH4}298 × R_{N2O}

-InGWPSaid comprehensive greenhouse effectUnit isCO_2-EQ kg $hm^{-2}$$R_{Ch4}$Said$Ch_4$Season cumulative emissionsR_{N2O}SaidN_2OSeason cumulative emissions.In100Years scale onSingle MolecularCh_4,N_2OThe cause of global warming potential(GWPKg hm^{-2})RespectivelyCO_2Of

25 Times and298Times[14].

Greenhouse gas emissions strength(Greenhouse gas intensity

GHGI)Used to said food unit yield under greenhouse gas of displacementIs

Will environment benefit and economic benefit phase unified of comprehensive evaluation index[15].Calculation Formula:GHGI = GWP/Output

-InGHGISaid greenhouse gas emissions strengthUnit isCO_2-EQ kg^{-1}.GWPSaid comprehensive greenhouse effectUnit isCO_2-EQ kg hm^{-2}.OutputSaid Rice YieldUnit isKg hm^{-2}.

1.52 Data processing and analysis

Test data usingMic rosoft Excel 2010Software Data FinishingUseOrigin Pro porable 8.5Software doUseSPSS

20.0Statistical analysis software the correlation analysisLSDMethod The significant
Of test($P = 0.05$).

2. Results Analysis

2.1 Different cracking temperature biological carbon of paddy field soilCh_4Of emissions Influence

As shown in figure1Shown inApplied Different cracking temperature rice straw biological carbon ProcessingCh_4Emission flux show general consistent of Change Trend.The whole growth periodCh_4Emissions two times emissions peak(6Month29And7/Month

18 Day),Were there in fertilization afterThis Yan yong hao and[16]Think applied nitrogen fertilizer after promote the soil in ammonium nitrogen and nitrate nitrogen of concentrationEnhance the to nitrate nitrogen,Ammonium nitrogen for life substrate of production methane bacteria of physiological activitiesFromAnd increase the soilCh_4Emissions.Peak appeared in6Month29Day

The highest emissionsBC0Processing101.24 mg $m^{-2}H^{-1}$At this time paddy field FloodingSoil in reduction environmentLead to production methane ancient bacteria of activity increaseAt the same time suppression the methane oxidation bacteria of activityTo produce can increaseCh_4Emissions.In8Month9Day after paddy field into sunningSoil Surface fell rapidly dryDamage the production methane ancient bacteria suitable of reduction environmentCh_4Emissions significantly decreased.Since then Paddy Field Soil flooding and sunning alternatingCh_4Emission Flux keep in stable low-level.

As shown in figure2Applied biological carbon significantly reduce the soilCh_4Cumulative emissionsAndBC0PhaseBC1,BC2,BC3,HBC1,HBC2,HBC3,BC4,BC5The MechanismCH4Tired product emissions points don't reduce

10.38%,21.09%,13.28%,42.83%,65.29%,55.44%,

3.18%,72.92%.This may be because applied biological carbon afterSoil bulk density is reducedSoil Aeration improveEnhance the methane oxidation bacteria of oxidation roleMakesCh_4Emissions reduce.

From cracking temperature to seeApplied500Cracking of biological carbonCh_4Cumulative emissions were than applied300,700Biological carbon lowDanyang rice straw respectively less11.95%And3.34%Harbin rice straw respectively

39.29%And22.10%.On the one handAs shown in figure6This study500Crack

Solution of rice straw biological carbon aromatase degree stronger300Cracking of biological carbonOrganic carbon can't short-term in was soil production methane ancient bacteria decomposition use.On the other handSuch as table2Shown inWith cracking temperature increasedBiological carbon than surface area,Microporous surface area,Total pore volume were was increase trend.Pore Structure the developmentSoil oxygen content increasedThe soil of methane ancient bacteria activity by suppressionSuch as table4Shown in500Cracking of biological carbon methane ancient bacteria

Abundance was significantly lower than that of300,700Cracking of biological carbonCh_4Emissions reduce.In addition500Cracking of biological carbon developed of Pore Structure easy to adsorption soil easy to oxidation organic carbonReduce soil organic carbon of MineralizationCh_4Emissions reduce[17].In additionAnd700Cracking of biological carbon compared500

Cracking of biological carbonPHLowAnd methane oxidation bacteria suitable micro-acid of EnvironmentPHToo high suppression of methane Oxidation Bacteria ActivityTo promoteCh_4Emissions.

Applied Harbin rice straw biological carbon than Danyang rice straw biological

2. Comparison of Pore Structure between Harbin rice straw biochar and Danyang rice straw biochar

Table 2 surface features of two kinds of biochars at different temperaments

After),8Month9Day(Baked field of after),10Month19Day(Field Drying)About.In baked field of after emissions highest peakAt this timeBC0Processing emissions highest126.52 ug $m^{-2}H^{-1}$.The first time fertilization for obvious of emission peak.

As shown in figure4Applied biological carbon significantly reduceN_2OOf cumulative emissions($P < 0.05$)And with biological carbon applied of increasedN_2OEmissions reduceWhich appliedNatural 20 t hm^{-2}Biological carbon emissions minimumFor0.43 kg hm^{-2}.And

BC0PhaseBC1,BC2,BC3,HBC1,HBC2,HBC3,BC4,BC5ProcessingN_2OCumulative emissions respectively reduce42.77%,53.54%,51.19%,45.34%,48.51%,48.40%,32.40%,62.90%.A

AspectsBiological Carbon of low density and multi-pore structure characteristics increase the soil of porosity and AerationSuppression to adapt to anaerobic conditions under nitrogen microbial

Of anti-nitrification roleTo reduceN_2OEmissions.Soil Aeration improveOxygen Content improveCan make soil inNH_4^+-N,NO_3^--N,PO_4^{3-}Plasma was OxidationThe nitrification role and anti-nitrification role made electronic of supply reduceFrom the other hand limit.N_2OEmissions.On the other handSoil Aeration of enhanced also for Microbial Growth Reproduction create the conditions[21]Make

Have to good oxygen microbial of a large number of BreedingTo lead to nitrifying bacteria and anti-nitrificationBacteria available nitrogen source reduceN_2OEmission is limit.Cavigelli[22]Think biological carbon improve the soil of ventilation environmentThis change the soil anti-nitrification bacteria community composition of diversityTo influenceN_2OOf emissions.In additionRice Straw biological carbon of porous structure easy to adsorption soil ammonium nitrogen

To reduce nitrifying bacteria of energy SubstrateSuppression nitrification role[23].

Applied500 Cracking of biological carbon is applied300 ,700

Note:FigureT_1.For the first time,T_2.For the second time,T_3.Express grilled Field

Calculation results show that,Biochar significantly reduces greenhouse gasesEmission Intensity,Which imposes500Pyrolysis Harbin rice straw biochar had the lowest greenhouse gas emission intensity,Lower than no biochar.65.28%.Harbin500Pyrolysis Temperature of biochar

,700Decrease40.54%And8.09%,Danyang500Pyrolysis Temperature of biochar300,700Decrease27.09%And25.85%.Table5.Indicators for each greenhouse gas.

Detection Analysis,Reduction of soil emissions by biochar at different pyrolysis temperatures,Yield Increase Effect is different,The final reason is the differences in physicochemical properties of biochar at different pyrolysis temperatures.Biochar during pyrolysis,Unstable components continue to crack,Functional Groups and molecular structures have also changed..These changes are most

Eventually leading to differences in the nature of biochar.As shown in Fig.6.,Comparison of functional groups of biochar at different pyrolysis temperatures,In300 ~ 500,AliphaticC-HStretching Vibration weakened,In2975 ~ 2845The wave number range is more obvious.AromaticC = C,AromaticC-HStretching Vibration significantly strengthened,Note

This phase Cellulose,Hemicellulose,The components with low stability are constantly changing.Dehydrogenation Reaction,Aromatic structure continues to strengthen.700,AliphaticC-H,AromaticC-H,Open Chain Fatty AnhydrideC-O-CStretching Vibration significantly weakened,It shows that dehydrogenation and deoxidation mainly occurred in this stage.,Degree of graphitization.With300Cracking of biological carbon compared500,700Cracking of biological carbon Cellulose,Semi-cellulose and carbon-containing organic matter significantly reduce

LessAromatase degree enhancedMake for production methane could make use of carbon source reduce

To reduceCh_4Emissions.500Cracking biological carbon of average aperture bigEffective adsorption soil inNH_4-NReduce of methane bacteria required of Nitrogen SourceTo reduceCh_4Of emissions.And700Cracking of biological carbon compared500Cracking of biological carbonPHLowImprove methane Oxidation Bacteria

ActivitySuppressionCH_4Emissions.With the applied of increaseBiological Carbon Change the soil of ventilation conditionsInfluence the function microbial OF ABUNDANCE AND ACTIVITYMake comprehensive

Of greenhouse effect reduce.

Biological Carbon physical and chemical properties of differences lead to the rice yield of difference.Applied500Cracking of Danyang rice straw biological carbon rice yield the highest.On the one hand500Cracking biological carbon developed of pore structure and rich of organic macromoleculesApplication of Soil after has been formation big of aggregateAnd can by improve soil cation exchange capacity to increase the cationic AdsorptionTo can effective control soilNH_4-NOf LeachingImprove Soil of fertilizer Ability[24,25].On the other handBiological carbon containing developed of pore structure and rich of organic macromoleculesApplication of Soil after has been formation big of aggregateAnd can by improve soil cation exchange capacity to increase the cationic AdsorptionAlso may be due to biological carbon input SoilReduce the soil bulk densityTo rice root of deep and extensionTo increase the rice of lodging resistance abilityIncrease the yield;In additionHave researchers think biological carbon input acid soil improve soilPHValueEffective of improve the acidic soil of nutrient content[26].AppliedNatural 20 t hm^{-2}Biological Carbon reduce the rice yieldMay be Because applied high(Natural 20 t hm^{-2})Biological carbon may adsorption is more nitrogen ionMake crop can use nitrogen reduceTo reduce yieldBut also need to further study confirmed that.VisibleBiological Carbon input soil by change soil porosity,

Aggregate Structure,PHValue,NH_4-NContent and other factors influence Rice Yield.500,700Cracking of Biological Carbon Pore Structure DevelopedPHValue is highTo improve rice yield;And applied biological carbon of the increase will increase these factors of role strength.

3. Conclusion

1)CH_4Cumulative emissions performance500Cracking biological carbon<700Cracking biological carbon<300Cracking biological carbon.

Applied biological carbon significantly reduceCH_4Cumulative emissionsApplied500Cracking temperature biological carbon cumulative emissions minimum.Which Harbin500Cracking temperature biological carbon respectively300,700Reduce39.29%And22.10%Danyang500Cracking temperature biological carbon respectively300,

Reduce11.95%And3.34%.Applied500Cracking temperature biological carbonCH_4Emissions low of factors preliminary analysis:The firstApplied

Biological Carbon effective reduce soil production methane ancient Bacteria abundanceThan300,

Biological Carbon average reduce48.33%,29.35%.The secondCompared

500Biological Carbon Pore Structure more developedCan better improve soil aerationSuppressionCH_4Produce;Compared700500Biological CarbonPHLowConducive to methane Oxidation Bacteria Activity improve.

2)N_2OCumulative emissions performance500Cracking biological carbon

<700 Cracking biological carbon<300 Cracking biological carbon.

Applied biological carbon significantly reduceN_2OCumulative emissionsApplied500Cracking temperature biological carbon cumulative emissions minimum.Danyang500Cracking temperature biological carbon respectively300,700Reduce18.82%And4.8%Harbin500Cracking temperature biological carbon respectively300,700Reduction

5.8%And0.2%.Applied500Cracking temperature biological carbonN_2OTired

Product emissions low of factors preliminary analysis:Applied500Biological Carbon after soil nitrification bacteria abundance lower than applied300,700Biological CarbonFrom

And reduceN_2OProduce.

3)Applying three pyrolysis temperatures to rice straw biochar significantly reduced greenhouse gas emission intensity in Soil.

Greenhouse gas emissions from soils after applying biochar at different pyrolysis temperaturesDegree size is500Pyrolysis biocharLess than 700Pyrolysis biochar<

Pyrolysis biochar.At the same pyrolysis temperature,Application of Harbin rice straw biochar than Danyang rice straw biochar greenhouse gas emission intensity

Low.In the case of Stable Production,Exert500Pyrolysis of Harbin rice straw biochar soil has the lowest comprehensive greenhouse effect.

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