

論文 / 著書情報
Article / Book Information

題目(和文)	日本の茶園土壌において蓄積かつ放出される一酸化二窒素の生成および消滅過程に関するアイソトポマー解析
Title(English)	Isotopomeric analysis on the production and consumption processes of nitrous oxide accumulated in and emitted from Japanese tea field soil
著者(和文)	Zou Yun
Author(English)	Yun Zou
出典(和文)	学位:博士(理学), 学位授与機関:東京工業大学, 報告番号:甲第9737号, 授与年月日:2015年3月26日, 学位の種別:課程博士, 審査員:吉田 尚弘,木内 豪,中村 恭志,豊田 栄,大河内 直彦,上野 雄一郎
Citation(English)	Degree:, Conferring organization: Tokyo Institute of Technology, Report number:甲第9737号, Conferred date:2015/3/26, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

(博士課程)
Doctoral Program

論文要旨

THESIS SUMMARY

専攻 :	Environmental Science and Technology	専攻
Department of		
学生氏名 :	Zou Yun	
Student's Name		

申請学位 (専攻分野) :	博士 (Science)
Academic Degree Requested	Doctor of
指導教員 (主) :	Yoshida Naohiro
Academic Advisor(main)	
指導教員 (副) :	Toyoda Sakae
Academic Advisor(sub)	

要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

Nitrous oxide (N_2O) is a greenhouse gas in the troposphere and a potential destroyer of stratospheric ozone layer. N_2O concentration has risen rapidly from 1750 until now, and it will continue increasing in the future. Even atmospheric N_2O concentration is three magnitudes lower than CO_2 concentration; the radiative forcing of N_2O is stronger than that of CO_2 . And the 100-year warming potential (GWP) of N_2O is 265 times higher than CO_2 . Natural soils and agricultural soils are the biggest source of atmospheric N_2O . UV photolysis is the dominant stratospheric sink for N_2O . In the soils, N_2O is produced through microbial processes, nitrification and denitrification, and it is consumed by N_2O reduction through denitrification process. Nitrification is the oxidation of NH_3 into NO_3^- conducted by bacteria and archaea under aerobic condition. In this process, N_2O is produced as a byproduct of NH_2OH oxidation. Denitrification is the reduction of NO_3^- into N_2 conducted mainly by heterotrophic bacteria and fungi under anaerobic condition. N_2O is produced as the intermediate. In the Japanese tea field, the high nitrogenous fertilizer (including organic N and inorganic N) application caused soil acidification and large N_2O emission.

The soil N_2O gas, N_2O flux and soil were collected from Japanese tea field in 2011 and 2012. The concentrations and isotopomer ratios of N_2O and inorganic nitrogen were analyzed to investigate the N sources and sinks of N_2O in Japanese tea field under conventional treatment. Moreover, N_2O mitigation effects by lime nitrogen and dicyandiamide (DCD) treatments were also examined. Furthermore, soil water and rainwater samples were collected from Japanese tea field in 2012. The O isotope ratios of H_2O , N_2O , and NO_3^- were measured to determine the O source of N_2O in the tea field under conventional treatment.

The organic N and inorganic N fertilizers were the major N inputs in the Japanese tea field soil. Relatively smaller amount of N input was wet and dry deposition. Organic N fertilizers were converted to NH_4^+ through mineralization process in the soil. The NH_4^+ could convert to NO_3^- through nitrification process. According to the specific ^{15}N site preference (SP) values of bacterial nitrification, bacterial denitrifier-denitrification, nitrifier-denitrification, and fungal denitrification, it was suggested that bacterial denitrification was the

dominant process of N₂O production on most days in two parallel plots (Plot I and Plot II) under conventional treatment, irrespective of N₂O reduction occurring before or after mixing. However, on 31 May 2011 (after one of fertilizations) during which soil temperatures were 15.8°C to 17.9°C and water-filled pore space (WFPS) was 0.73 to 0.89 in the upper layer of Plot I and deeper layers of Plot II, and on 18 October 2012 during which soil temperatures were 19.7°C to 20.1°C and WFPS was 0.61 to 0.74 in Plot II, bacterial denitrification and bacterial nitrification (or fungal denitrification) contributed nearly equal shares on the produced N₂O. Moreover, on 4 October 2012 (35 cm depth; WFPS was 0.73) and 18 October 2012 (10 cm depth; soil temperature was 19.7°C and WFPS was 0.68) in Plot I, bacterial nitrification (or fungal denitrification) contributed more N₂O than bacterial denitrification.

In situ environment, precipitation was the sole water source. Part of soil water was replaced by precipitation. In nitrification and denitrification processes, H₂O and O₂ are the O sources. Isotopomeric analysis indicated that during the formation of N₂O through denitrifier denitrification process, and N₂O reduction could be negligible. The fractions of O exchange between soil water and N₂O precursors were approximately 80% and 77%, respectively, at 10 cm and 20 cm depths soil. The net ¹⁸O isotope effects for denitrification (NO₃⁻ reduction to N₂O) were estimated as 35‰ and 33‰, respectively, at 10 cm and 20 cm depths soil.

In the Japanese tea field, lime nitrogen and DCD were applied to mitigate N₂O emission. Lime nitrogen effectively suppressed N₂O emission by inhibiting nitrification process. The inhibition effect by lime nitrogen could last for one month or shorter. The inhibition effect decreased with time. However, DCD treatment enhanced N₂O emission. The proportion of N₂O produced through bacterial nitrification process was ascended by DCD. Ineffective inhibition by DCD could be attributed to repeated application year by year. From 18 October to 2 November or to 8 November, N₂O flux decreased. As calculated using Rayleigh distribution equation, on 2 November or 8 November in conventional treatment, 33-35% of N₂O was consumed by N₂O reduction and 58-64% was consumed by diffusion. In lime nitrogen treatment, N₂O reduction consumed 34-82% of N₂O and diffusion consumed 1-57% of N₂O. In DCD treatment, 57-78% of N₂O was lost through N₂O reduction and 7-27% of N₂O was lost through diffusion.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note：Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

注意：論文要旨は、東工大リサーチリポジトリ(T2R2)にてインターネット公表されますので、公表可能な範囲の内容で作成してください。

Attention: Thesis Summary will be published on Tokyo Tech Research Repository Website (T2R2).